VOLUME 3, ISSUE 12

Scientific Journal

ERUS

Educational Research in Universal Sciences

Exact and Natural Sciences

ISSN: 2181-3515

ERUS.UZ

2024/12

ISSN 2181-3515
VOLUME 3 ISSUE 12
DECEMBER 2024

https://erus.uz/

EDUCATIONAL RESEARCH IN UNIVERSAL SCIENCES
VOLUME 3, ISSUE 12, DECEMBER, 2024

DOI: https://doi.org/10.5281/zenodo.14498422

APPLICATION OF FILM TRACK DETECTORS DETECTION OF CHARGED PARTICLES

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ABSTRACT:

This work was carried out within the physical programme of the BECQUEREL experiment [2] at the Nuclotron/NICA accelerator complex located at Veksler and Baldin Laboratory of High Energy Physics. In the BECQUEREL experiment is studied cluster structure of light stable and radioactive isotopes that clearly appears in relativistic dissociation. The ability to form and extract beams of relativistic nuclei is provided by the accelerator complex of the Nuclotron/NICA laboratory. Known and new structural features of the isotopes $_{7,9}Be$, $_{8,10,11}B$, $_{10,11}C$, and $_{12,14}N$ are revealed in the dissociation channel probabilities. The identification of the relativistic decays of $_{8}Be$ and 9B pointed out the possibility to search for triples of α particles in the Hoyle state (HS) in the relativistic dissociation.

Key words: *high energies, emulsion method, alpha fragmentation, alpha-particle tracks, the solid-state nuclear track detectors.*

1. Introduction

The study of nuclear fragmentation is important for both fundamental science and applied problems. There are several ways to study this event, one of them is the nuclear photographic emulsion method. A significant role in the study of interactions at high energies is played by the nuclear track emulsion method, which has unique

capabilities. Due to the best spatial resolution (0.5 μm) in a nuclear emulsion, it is possible to obtain an angular resolution along the tracks of relativistic fragments up to 10^{-5}rad, depending on the primary momentum of the projectile nucleus. This ensures complete observability of all possible decays of relativistic nuclei into charged fragments. In addition, the emulsion method makes it possible to identify the type of particles. Therefore, due to the high resolution of emulsions and the possibility of observing reactions in 4π-geometry, this method seems to be an effective way to study the processes of relativistic fragmentation, and so far no modern electronic detector has been able to replace this remarkable method, which can be used to study the structures and models of different nuclei in a large scale. Knowledge of the characteristics of fragmentation of nuclei is also necessary for solving a number of problems in nuclear astrophysics and cosmic ray physics, as well as medicine. One of the purpose of this work is to accumulate statistics of alpha fragmentation of NTE nuclei induced by relativistic hadrons in nuclear track emulsion and provide measurements of produced alpha-particle tracks in those reactions.

The method of using the solid-state nuclear track detectors (SSNTDs) is one of the methods of ion beam profilometry, which is based on application of solid-state materials able to detect tracks of nuclear fragments passing through them. When ions interact with solid-state material, tracks are formed whose location and shape depend on the energy, type of ions and angle of incidence. By measuring the parameters of the tracks on the surface of a solid-state detector, it is possible to obtain information about the distribution of ion charges in a monoenergetic beam [1[1],2[2]]. The SSNTD method has some advantages over other profilometry methods, such as high spatial resolution, absence of the detector dead time, and low cost. This justifies an opportunity of using SSNTDs to monitor the density, position and total intensity of the heavy relativistic ion beam. This study was carried out in the framework of exposure in the beam of $_{124}Xe^{+(26-28)}$, accelerated for the first time at the JINR linear accelerator complex in December 2022. Thus, It was proposed to analyze exposed CR39 samples using a full scan method on an automated microscope Olympus BX63, followed by image analysis to count the formed Xe tracks (so called “hole”).

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[2] Web-page of BECQUEREL experiment: http://becquerel.jinr.ru

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2. Analysis of alpha fragmentation of nuclei in NTE

Analysis of the alpha fragmentation of nuclei from NTE composition is provided by a set of experimental nuclear track emulsion (NTE) samples have been exposed at a beam of positively charged hadrons (beam composition: π – 60%, p – 35%, kaon – 5%)

[3] G. De Lellis et al., “Measurement of the fragmentation of Carbon nuclei used in hadron-therapy”, Nuclear Physics A Volume 853, Issue 1, 1 March 2011, Pages 124-134

[4] Web-page of BECQUEREL experiment: http://becquerel.jinr.ru

with momentum of 7 GeV/c. The exposure of the NTE was carried out in the area of the Hyperon-M experimental installation, located on channel 18 of the U-70 accelerator complex [3[5]]. The NTE samples were exposed during the spring session in 2018. The total flux of hadrons passing through the NTE stacks was $3 \cdot 10^6$ particles. After exposure the NTE plates were subjected to chemical development. The development procedure mainly depends on the thickness of the NTE layer, so the development process included 2 stages: development of layers of 100 and 200 μm, respectively. During unpacking, most of the records were found to be defective, consisting in the peeling of the emulsion layer from the base - glass. The preliminary reason is non-compliance with the technological process of drying nuclear energy layers at the production stage. The sample of the developed NTE plate is shown in Fig. 1. For this work a plate was taken with more comfortable scanning under a microscope (without big damages of emulsion layer, more or less light due to overexposure).

Fig. 1. NTE plate after chemical development. The typical size of NTE plate is 9x12 cm2 with around 100 mkm thickness of sensitive emulsion layer.

The scanning of the NTE plate was carried out by means of the optical microscope of MBI-9 using a lens with 20x magnification and 15x eyepieces that gives the total optical magnification 300x (Fig. 2). The scanning method of the NTE plate was selected as scanning in strips 1 mm wide. This method allows for a full search for nuclear events over the entire area without loss of information. To fix the vertex position of nuclear events in NTE during the development process a coordinate

[5] Evdokimov S.V., Izucheev V.I., Kondratyuk E.S. and others. // 2021. T. 113. Rel. 5. C. 291.

marking grid is specially applied to the surface of the emulsion layer. The view of the coordinate grid is shown on Fig. 2.

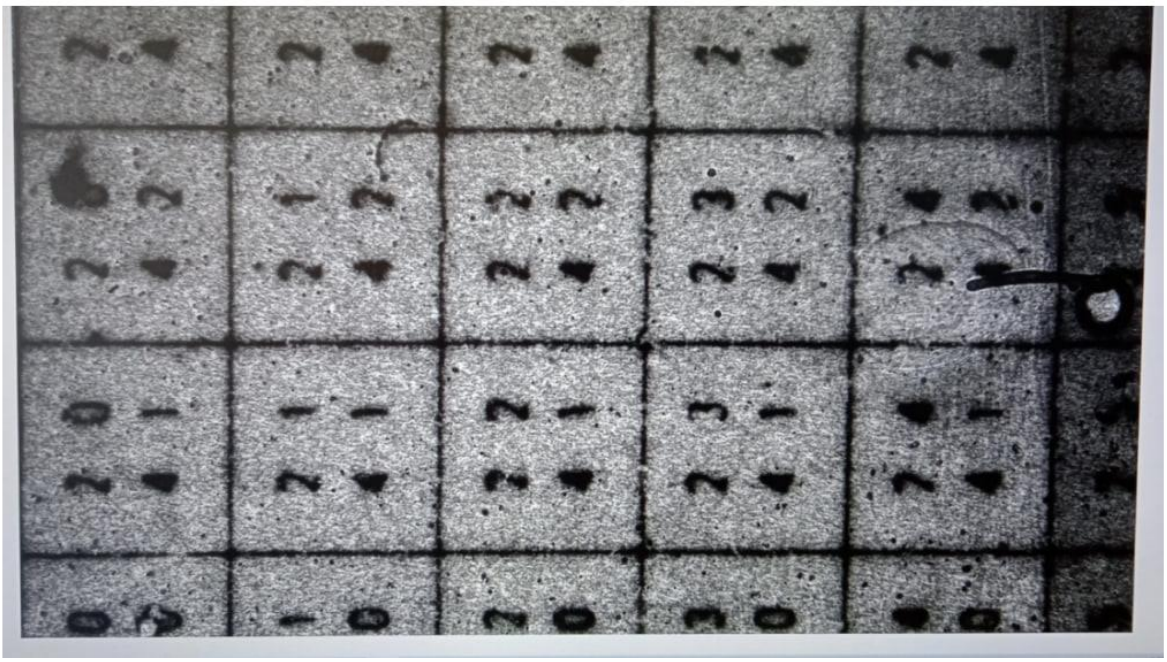

Fig. 2. Coordinate grid applied to the NTE surface. The size of one grid cell is 1x1 cm^2. Each cell has a pair of numbers corresponding to coordinates in the XY plane.

The side width of one square is 1 mm. At the beginning of viewing, the outermost square is selected, spaced from the edges of the plate at a distance of at least 1 cm. This condition is necessary to ensure comfortable viewing and the presence of edge defects on the plate. During my practice, I scanned ten strips
of emulsion plate with a total area of 9 cm^2 with a layer thickness of 100 micrometers. In this area, 10 inelastic interactions of nuclei from the NTE composition with incident relativistic hadrons have been found. The precise identification of the interacting target nucleus in an emulsion experiment is not an easy task, since the medium has a multicomponent atomic composition (H, CNO and AgBr groups of nuclei). However, in the nuclear energy technique the following classification of charged particles is adopted, depending on their relative ionization I/I_0, range L and velocity β [4[6]]:

1. “black” (b-particles) - represent traces of fragments of the target nucleus with relative ionization $I/I0 \geq 7.0$ and $\beta < 0.23$, where I0 is the ionization on the tracks of relativistic particles with charge Z = 1. However, in practical terms, b -particles are

[6] M.I. Adamovich and others., «Multiple particle generation in the interaction of pions and protons with nucleons and nuclei in the energy domain 20-200 GeV» The works of FIAN vol.108 M., «Science» (1979), 65-149.

often conveniently identified by their path length in the nuclear energy volume - L ≤ 3 mm;

2. “gray” (g - particles) - these are mainly protons knocked out from the target nucleus, with relative ionization 6.8 > I/I0 ≥ 1.4 and β < 0.7, with a residual path > 3 mm. This type of particle also includes a small admixture of π-mesons, depending on the initial interaction energy;

In this case, the combination of b and g particles is classified as a group of highly ionizing h particles.

3. “relativistic” (shower or s - particles) - this class of charged particles includes interacting protons of the incident nucleus and singly charged (Z=1) non-interacting fragments of the incident nucleus with relative ionization I/I0 < 1.4 and β > 0.7.

4. “fragments” (f - particles) - multiply charged fragments of an incident nucleus with a charge Z ≥ 2. They are not included in the number of b- and g - particles, which they correspond to by the ionization they produce. Tracks of relativistic singly charged particles and fragments of a projectile nucleus with Z=2 are easily distinguishable under a microscope by the number of developed grains per unit track length.

According to its atomic composition, nuclear energy includes 3 groups: hydrogen H, a group of light nuclei CNO and a group of heavy nuclei AgBr (this group may also include other heavy components, depending on the type of nuclear element, but their relative weight contribution is not significant). Table 1 shows the component composition of standard nuclear energy under normal conditions.

	G5 standart NE		
Relative humidity	0%	58%	84%
Density gram/cm^3	4.033	3.828	3.608
Ag (here and further 10^{22}atoms/cm^3)	1.092	1.013	0.929
Br	1.085	1.007	0.923
J	0.0062	0.0057	0.0052
H	2.83	3.20	3.57
C	1.498	1.390	1.274
N	0.343	0.318	0.291
O	0.705	0.938	1.190
S	0.0146	0.0135	0.0124

Table 1. Elemental composition of nuclear energy [5[7]].

[7] The study of elementary particles by the photographic method: пер. с англ. / Пауэл С., Фаулер П., Перкинс Д.Б - Москва: Издательство иностранной литературы, 1962. - 653 с.

The focus of the search for inelastic interactions was only those events in which tracks of particles with path lengths of less than 100 μm are observed (b-particles). I have found 3 events that can be characterized as alpha fragmentation of the target nucleus (see Fig. 4) and this statistics has enriched the existing one.

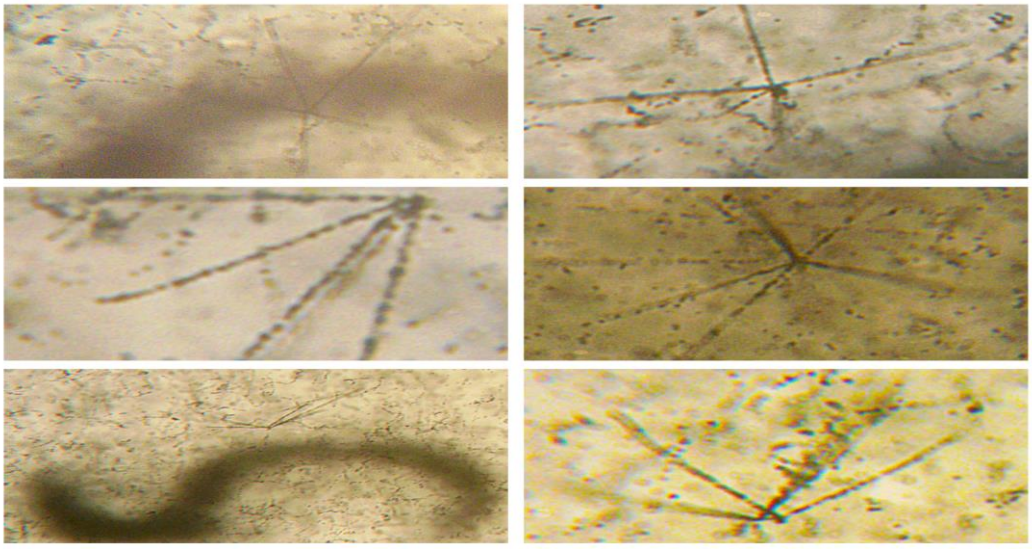

Fig. 3. Images of events with the formation of tracks of b-particles during the interaction of relativistic hadrons with nuclei from the composition of NTE.

After this, the track lengths of particles in the found events were measured using a KSM1 measuring microscope. The measurements were carried out using the standard coordinate method, in which the coordinates (x, y and z) of the vertex interaction and the three-dimensional coordinates of the stopping point of each b-particle track were measured. Then, real lengths of particles in NTE were calculated using the MathCad software package. It is worth noting that after chemical development, the NTE layer has a certain shrinkage coefficient, which must be taken into account when calculating the real particle length. In this way, the distribution of length in the events shown in Fig. 5 was obtained.

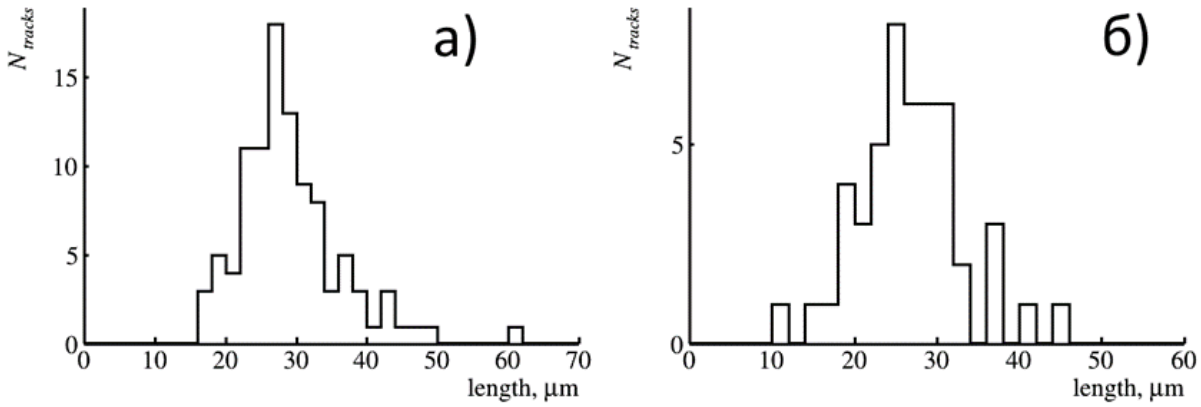

Fig. 4. Distribution over the measured real length in NTE of three (a) and four (b) b-particles in events of interaction of relativistic hadrons.

As you can see the average real length of the measured tracks in events with three b-particles is ⟨L⟩ = 25.9±1.5 μm and σ = 7.8±1.1 μm. And for events with 4b-particles, the average range is ⟨L⟩ = 28.1±3.4 μm at σ = 7.2±2.5.

3. Beam profilometry using SSSD CR39 method.

Irradiation of CR-39 detector was carried out on the experimental installation Baryonic Matter at Nucleotron (BM@N) in the 4th Commissioning Run at the NICA Complex. The energy of the $_{124}$Xe beam was 3.85 A GeV, and the expected loading of the detector was 5 spills of the order of 106 ions. The detector was located between the time-of-flight mRPC system and the zero degree calorimeter (Figure 3), while the surface normal of the CR-39 coincided with the beam direction.The investigated CR-39 detector was a 50x50 mm plate 1 mm thick initially. After irradiation, the CR-39 sample was etched in an aqueous solution of 6M NaOH. The system was in a thermostat maintaining the temperature equal to 85 °C with an accuracy of 0.1 °C. The etching time was 20 minutes. Scanning was carried out by means of a unique motorized microscope Olympus BX63 (Figure 5) using proprietary software Olympus cellSens which fulfills the acquisition of panoramic images while manual scanning or in automatic mode with focus maps

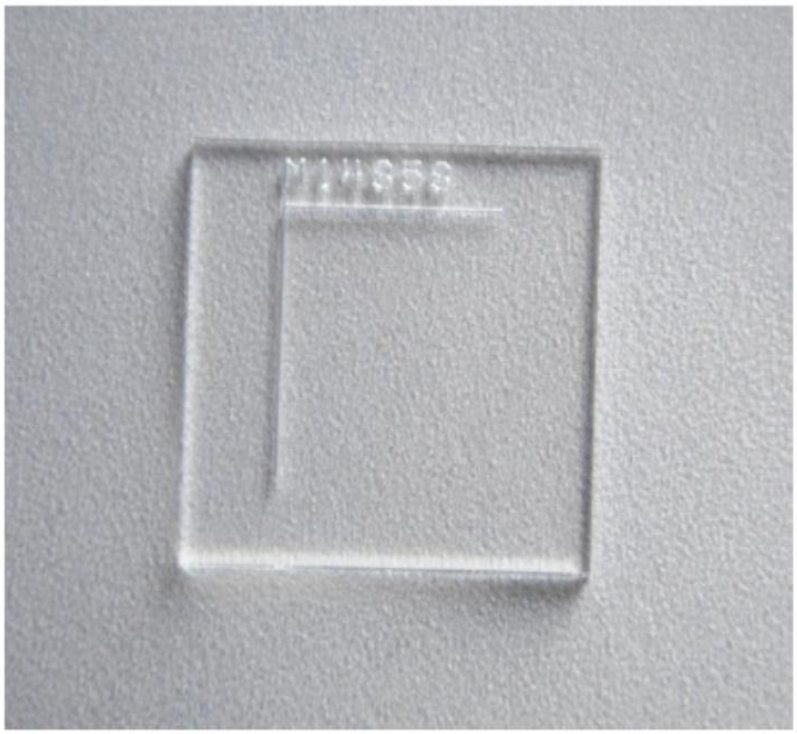

Fig. 5. Sample of solid state solid-state nuclear track detectors CR39 (Columbia Resin #39).

The tracks became visible by a chemical etching (acid or basic solution): during the etching, material is removed at Vt velocity along the track and isotropically at Vb velocity from the bulk material. Principle of the track detector: Vt (track etch rate) >Vb (bulk etch rate) The dimension and shape of the track depend on: • Energy of the impinging particle • Incidence angle • Etching procedure (etchant, temperature, duration). The use of nuclear photographic emulsions in the study of the interaction of high-energy particles with nuclei has played a significant role in the development of existing ideas about the mechanism of these interactions.Operation of the solid-state nuclear track detector is based on the fact that a heavy charged particle will cause extensive ionization of the material when it passes through a medium. For example, an alpha particle with energy of 6 MeV creates about 150,000 of ion pars in cellulose nitrate. Since the range of a 6 MeV alpha particle in this material is only about 40 mm, that means on average 3700 ion pairs are created per micrometer, or 3–4 ion pairs per nanometer. An alpha particle ionizes almost all molecules close to its path. This primary ionizing process triggers a series of new chemical processes that result in the creation of free chemical radicals and other chemical species. Along the path of the alpha particle, a zone enriched with free chemical radicals and other chemical species is then created. This damaged zone is called a latent track. If a piece of material containing latent tracks is exposed to some chemically aggressive solution, chemical reactions would be more intensive along the latent tracks. Aqueous solutions of NaOH or KOH are the most frequently used chemical solutions in this regard. The overall effect is that the chemical solution etches the surface of the detector material, but with a faster rate in the damaged region. In this way, a ‘‘track’’ of the particle is formed, which may be seen under an optical microscope. This procedure is called ‘‘detector etching‘‘ or track visualization, and the effect itself is called the ‘‘track effect’’. The track effect exists in many materials. It is particularly pronounced in materials with long molecules, e.g., cellulose nitrates or different polycarbonates, and such materials are the most convenient ones for application and detector manufacturing.The possibility of visual observation of single acts of nuclear interaction in the form of so-called "stars" in a nuclear emulsion allows us to obtain a large number of direct data on the characteristics of nuclear reactions: on the number and nature of charged particles formed during the splitting of the nucleus, on their angular and energy distributions, on the energy and momentum transmitted to the nucleus during a collision.The average density of the emulsion is about 3.5-4 g / cm^3, with a residual humidity of about 2.5%. Nuclear photographic emulsions are used to register and analyze traces of charged particles of almost any energy. By measuring the characteristics of these traces, it is possible to identify the particle and determine its kinematic characteristics.The effectiveness of the PolyAllyl Diglycol Carbonate

(PADC) etched solid state nuclear track detector (SSNTD), commonly known as CR-39, as a muon detector is assessed. CR-39 is successfully used to detect higher rest mass particles such as neutrons and protons, and is, for example, widely used in neutron dosimetry applications. CR-39 is generally accepted as being less suitable to detect lower rest mass particles such as muons, and especially electrons, due mostly to their reduced momenta and consequently, reduced stopping power. However, there has been some evidence that CR-39 may have application in the detection of cosmic ray muons. Monte Carlo simulations indicate that CR-39 can detect muons with energies up to 2.8 MeV. Experimental data to demonstrate the ability of CR-39 to detect muons was acquired using the MuSR spectrometer station at the ISIS Neutron and Muon Source. Pits deposited in CR-39 generated by positive muons from the beamline have been characterized and compared with pits deposited by protons and neutrons from other sources. The extent to which a CR-39 SSNTD can discriminate muons from particles with different momenta and rest masses is discussed

During irradiation, the angle of incidence of Xe ions was close to perpendicular, which resulted in forming the tracks which approximately had a circular shape. The track images obtained using 4x objective are shown in Figures 7

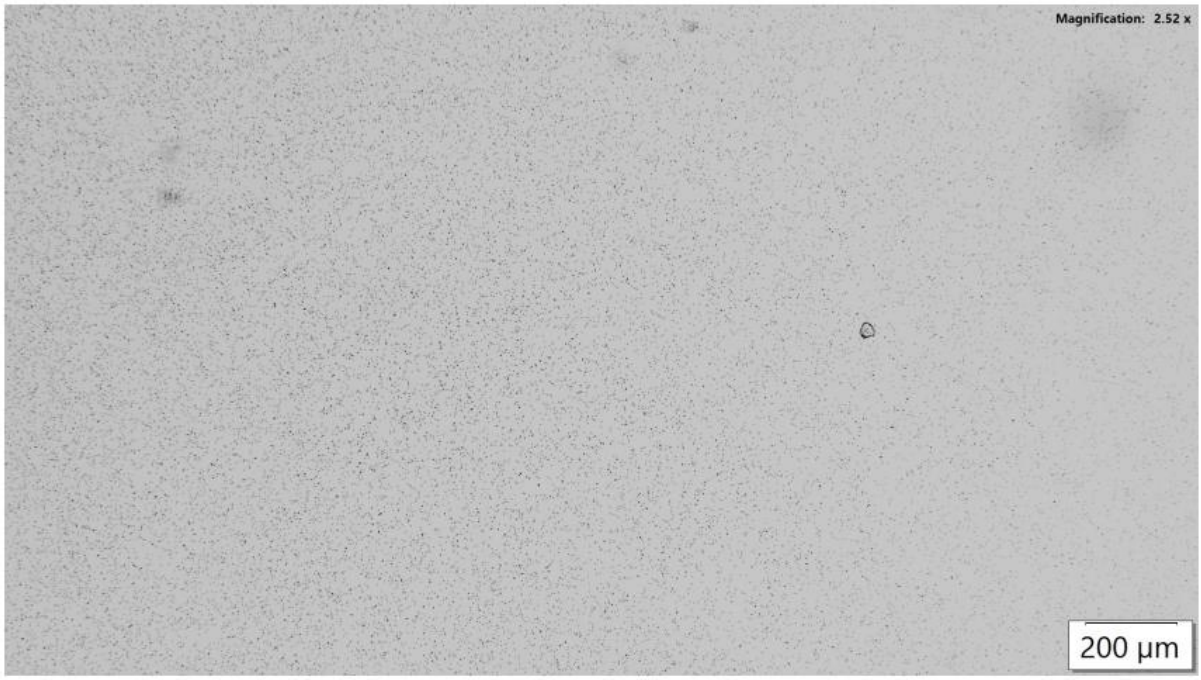

Figure 6: Photo of CR-39 SSNTD at the intermediate beam density, taken with the Olympus BX63 microscope using a 4x objective

Method of tracks analysis .Procedure with the ImageJ

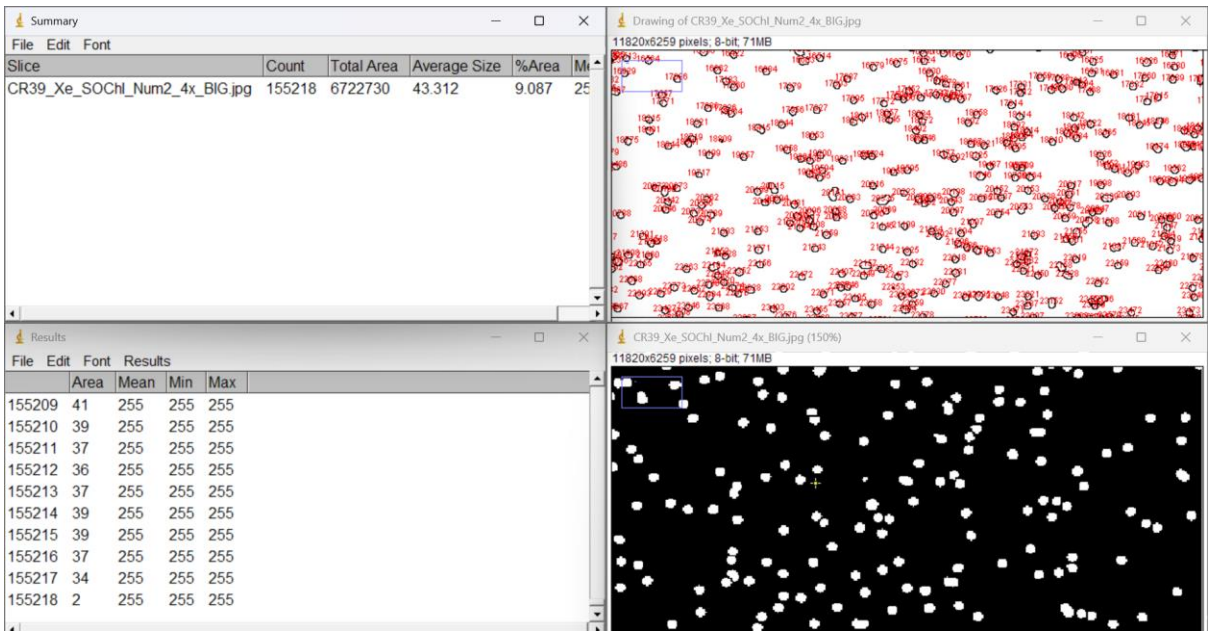

Figure 7. Analysis of some characteristics of tracks using ImageJ software

Results
File Edit Font Results

	Area	Mean	Min	Max	Major	Minor	Angle	Circ.	AR	Round	Solidity
77047	264	255	255	255	20.414	16.466	8.446	0.814	1.240	0.807	0.889
77048	213	255	255	255	21.488	12.621	153.112	0.672	1.703	0.587	0.940
77049	439	255	255	255	35.805	15.611	170.216	0.598	2.294	0.436	0.862
77050	241	255	255	255	20.143	15.233	128.005	0.642	1.322	0.756	0.844
77051	244	255	255	255	26.615	11.673	12.782	0.557	2.280	0.439	0.876
77052	145	255	255	255	15.928	11.591	114.820	0.691	1.374	0.728	0.871
77053	256	255	255	255	19.961	16.329	26.023	0.742	1.222	0.818	0.856
77054	118	255	255	255	13.393	11.218	137.323	0.777	1.194	0.838	0.843
77055	214	255	255	255	20.842	13.073	139.455	0.636	1.594	0.627	0.826
77056	124	255	255	255	15.059	10.484	14.504	0.685	1.436	0.696	0.886
77057	195	255	255	255	18.243	13.610	176.212	0.721	1.340	0.746	0.901
77058	246	255	255	255	21.726	14.417	44.916	0.691	1.507	0.664	0.895
77059	206	255	255	255	20.146	13.019	152.462	0.682	1.547	0.646	0.882
77060	101	255	255	255	11.937	10.773	104.758	0.769	1.108	0.903	0.874
77061	235	255	255	255	28.179	10.618	8.676	0.627	2.654	0.377	0.885
77062	389	255	255	255	33.737	14.681	172.049	0.610	2.298	0.435	0.855
77063	98	255	255	255	12.239	10.195	97.689	0.755	1.201	0.833	0.883
77064	130	255	255	255	13.142	12.595	44.995	0.791	1.043	0.958	0.900
77065	166	255	255	255	19.938	10.601	166.176	0.672	1.881	0.532	0.853
77066	224	255	255	255	19.988	14.269	6.987	0.739	1.401	0.714	0.870
77067	116	255	255	255	14.897	9.914	7.214	0.763	1.503	0.666	0.850
77068	97	255	255	255	13.706	9.011	106.054	0.698	1.521	0.657	0.870
77069	91	255	255	255	12.733	9.100	12.441	0.826	1.399	0.715	0.892
77070	17	255	255	255	5.476	3.953	120.964	1.000	1.385	0.722	0.919
77071	11	255	255	255	4.507	3.107	131.028	1.000	1.450	0.689	0.846

4. Experiments and results

Scanning of exposed layers of nuclear emulsion was carried out in the sector of developing thick-layer nuclear photographic emulsions of the Veksler and Baldin Laboratory of High Energy Physics of JINR. Scanning was carried out on the MBI9 optical microscope (figure 1) using a 20x objective and 15x eyepieces (total magnification 300x). Scanning method selected - scanning by stripes with 1 mm wide side. This method makes it possible to conduct a full-fledged search for nuclear events over the entire area without loss of information. During the internship for the analysis of irradiation in a hadron beam at the Hyperon facility in 2018, 1 plate with a

photosensitive layer area of 9x12 cm2 and a thickness of 100 microns was selected (figure 3). The table 2 shows the scan results. The total viewing area was 70 mm2 with a depth of field of 70 μm. It is worth noting that the effective viewing thickness differs from the original thickness due to shrinkage of the emulsion layer during chemical development. In the examined volume, 36 inelastic interactions of hadrons on nuclei from the composition of the nuclear emulsion were found

The area of the photosensitive part of the nuclear photographic emulsion plates is 9x12 cm2, and the thickness is 100 μm (figure 2). For ease of viewing during development, a coordinate marking grid is applied to the surface of the emulsion in a special way. The side width of one square is 1 mm. At the beginning of viewing, an extreme square is selected, which is at least 1 cm away from the edges of the plate. This condition is necessary to ensure comfortable viewing and the presence of edge defects on the plate (Figure 7)

After studying the obtained results and drawing conclusions from them, a histogram was constructed based on the results for each particle, i.e., black, gray and shower particles

Conclusion

During this 2 month I have mastered the technique of nuclear photographic emulsions and mastered the technique of scanning emulsion layers on optical microscopes MBI-9. Learned to analyze hadron-nucleus interactions. The task of practice included the search for nuclear events, the differentiation of the observed tracks of charged particles. The review material received was added to the existing one. The accumulated statistics of events is a continuation of studies of the Becquerel experiment on the study of hadron-nucleus interaction, in particular, αpartial fragmentation of NTE nuclei. By the end of this practice I have mastered how to measure the true range of a particle. The main one measured the true range of the α-particle, which is the fragmentation of the ^{12}C and ^{16}O nuclei. And I made a histogram based on this data. I concluded from these data that under these conditions the true range of α-particles will turn out to be large with a probability in the range from 10 micrometers to 40 micrometers. At the beginning, the thickness of the emulsions was 100 μm, after chemical treatment and after drying, the thickness of the emulsions decreased. When measuring, it turned out that the thickness of the emulsions became much smaller. Approximately 70-90 microns, and different points changed differently. But this deformation occurs only along the Z axis, and on the XY area the tracks did not change due to the gluing of emulsions onto thin glass. All these factors were taken into account when calculating the true particle range.

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DOI: https://doi.org/10.5281/zenodo.14498438

УДК 628.83

НАДЕЖНАЯ ЭКСПЛУАТАЦИЯ ВОДОХРАНИЛИЩ КАК ВАЖНЫЙ ФАКТОР ЭКОЛОГИЧЕСКОЙ БЕЗОПАСНОСТИ

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Аннотация. *В стране большинство из водохранилищ построено 50-60 лет назад и в настоящее время наблюдается техническое устаревание данных гидротехнических сооружений. В связи с чем, эрозия конструкций и снижение прочности плотины во время эксплуатации водохранилища, является на сегодняшний день серьезной проблемой и влияет на экологическую безопасность страны. В данной статье изучены основные факторы, влияющие на надежную эксплуатацию водохранилищ, в частности Ташкентского водохранилища. В этой связи, посредством пьезометров, как основного инструмента контроля фильтрационного режима водохранилища, была изучена и расчитана фильтрация в плотине, то есть кривая депрессии. Кроме того, исследовано воздействие водной агрессии на техническое состояние водохранилища, что может привести к коррозии бетонных и металлических конструкций плотины. Также, в статье особое отмечены критерии прочности и надежности эксплуатации сооружений водохранилищ.*

Ключевые слова: *экологическая безопасность, пьезометр, водохранилище, кривая депрессии, фильтрация, водная агрессия, эрозия.*

Annotation: *In the country, most of the reservoirs were built 50-60 years ago, and at present there is a technical obsolescence of these hydraulic structures. In this connection, erosion of structures and a decrease in the strength of the dam during the operation of the reservoir is a serious problem today and affects the environmental safety of the country. This article examines the main factors affecting the reliable*

operation of reservoirs, in particular the Tashkent reservoir. In this regard, by means of piezometers, as the main tool for monitoring the filtration regime of the reservoir, the filtration in the dam, that is, the depression curve, was studied and calculated. In addition, the impact of water aggression on the technical state of the reservoir was investigated, which can lead to corrosion of the concrete and metal structures of the dam. Also, the article specifically notes the criteria for the strength and reliability of the operation of reservoir structures.

Key words: *environmental safety, piezometer, reservoir, depression curve, filtration, water aggression, erosion.*

Введение.

В Узбекистане проводятся широкие реформы по охране окружающей среды, рациональному использованию водных ресурсов и обеспечению экологической безопасности страны.

Так, Указом Президента Республики Узбекистан от 30 октября 2019 года № УП–5863 утверждена Концепция охраны окружающей среды Республики Узбекистан до 2030 года, в которой для улучшения качественного состояния окружающей природной среды помимо других мер предусмотрено строительство новых водохранилищ для повышения водообеспеченности орошаемых земель. [10]

Кроме того, Концепцией развития водного хозяйства Республики Узбекистан на 2020 – 2030 годы, утвержденной Указом Президента Республики Узбекистан от 10 июля 2020 года № УП–6024, определено, что приоритетными направлениями Концепции является обеспечение безопасности и надежной эксплуатации водохранилищ, паводковых водохранилищ и других объектов водного хозяйства, в частности защита водохранилищ, селе- и водохранилищ и других объектов водного хозяйства от воздействия антропогенных, техногенных и природных факторов, обеспечение их безопасности и надежной эксплуатации, изучение и внедрение на практике передового опыта зарубежных стран по обеспечению безопасности и надежной эксплуатации водохранилищ и других объектов водного хозяйства.

В контексте обеспечения экологической безопасности неспроста важное значение уделяется водохранилищам и их водным ресурсам, так как они играют существенную роль в развитии промышленности и сельского хозяйства, устраняя дефицит воды, возникающий в период вегетации, в основном на орошаемых землях, и снабжая водой гидромелиоративную отрасль. [1]

В настоящее время в Узбекистане эксплуатируется 70 водохранилищ общим объемом 19,4 млрд $м^3$, в том числе 5,4 млрд $м^3$ в бассейне Сырдарьи и 14,0 млрд $м^3$ в бассейне Амударьи.

Большинство из этих водохранилищ построено 50-60 лет назад и в настоящее время наблюдается техническое устаревание данных гидротехнических сооружений. Кроме того, пренебрежение гидроэкологическими факторами при эксплуатации приводит к снижению надежности работы водохранилищ. [2, 6].

Обе эти проблемы тесно связаны с движением воды в водохранилищах и ее качеством, что тесно связано с эрозией конструкций и снижением прочности плотины во время эксплуатации водохранилища, что является проблемой, требующей серьезного изучения и влияющий на экологическую безопасность.

В целях изучения изменений, возникающих в результате утечки воды разного качества из плотины водохранилищ, оценки прочности плотин под влиянием попадания воды разного качества из дамбы и разработки критериев прочности и эксплуатационной надежности отдельных конструкций водохранилищ было исследовано Ташкентское водохранилище в Ташкентской области. [3]

Оценка режима Ташкентского водохранилища. Пьезометры, расположенные в чаще плотины, являются основным инструментом контроля фильтрационного режима водохранилища. Основными требованиями к пьезометрам (водоприемной части) являются его способность противостоять помутнению и окислению, а для стабильной работы верхняя часть пьезометра должна быть удобна для установки приборов или устройств, позволяющих измерять пьезометрическое давление (уровень), снабжена крышкой от коррозии и должна быть защищена от механических воздействий.

Уровень или давление воды в пьезометрах в чаще плотины следует измерять не реже 2 раз в месяц с помощью манометров и других типов инструментов. Кроме того, требуется химический анализ проб фильтрационной воды в пьезометрах, а ее мутность определяется одновременно с химическим контролем. Когда пробы фильтрационной воды отбираются для химических испытаний и испытаний на мутность, одновременно измеряется их температура. Эта проверка выполняется, чтобы определить, поступает ли вода, поступающая в пьезометр или дренаж, из верхнего дна резервуара, а не из других источников. [4]

При визуальном наблюдении фильтрационного режима плотины и работы дренажа за плотиной особое внимание следует уделять наиболее распространенным участкам фильтрации, таким как:

- нижним откосам (уклонам) плотин и дамб и их нижней стороне;
- стыкам и частям конструкций из различных материалов;
- тектоническим разломам;
- точкам сброса воды, расположенным в непосредственной близости к плотине водохранилища.

К наиболее опасным событиям относятся:

- слив фильтрационной воды на откос (уклон), к месту берега, над дренажными устройствами;
- зарастание грунта под конструкциями за нижним откосом;
- приток мутной фильтрованной воды от основы плотины в нижний бьеф;
- формирование сильных фильтрационных процессов как протечки, мутные ручьи, родники и т. д.
- повышенный расход воды и мутность в фильтрационных точках и образование отложений;
- подъем уровня воды в пьезометре относительно проектирования конструкции.

Длительная и безопасная эксплуатация плотины водохранилища требует изучения и расчета фильтрации, которая будет иметь место в плотине, то есть кривой депрессии. В результате этих расчетов определяется поток фильтрационной воды через тело и основание плотины, положение кривой депрессии, высота выхода и скорость выхода кривой депрессии с нижнего склона плотины.

Свободная поверхность фильтрационного потока называется поверхностью депрессии, а линия, образующаяся в результате пересечения с вертикальной плоскостью, называется кривой депрессии.

Описание фильтрационного потока будет зависеть от типа плотины, схемы дренажных сооружений, рельефа и геологического строения почвы и берегов в месте расположения плотины. Фильтрационные расчеты выполняются для определения тела плотины, фильтрационной прочности ее грунта и берегов, приоритетности откосов плотины и берега, рациональных и экономичных форм размеров и конструкции плотины. [5]

Расчетная кривая депрессии плотины Ташкентского водохранилища

В целях уменьшения процесса фильтрации в плотине Ташкентского водохранилища тело плотины оборудовано ядром. Грунт ядра плотины состоит из уплотненного песка с коэффициентом фильтрации $К_я$ = 0,1 м/сут. Основание тела плотины гравийное, коэффициент фильтрации $К_т$ = 40 м/сут. Результатом расчета является поток фильтрационной воды через тело

и основание плотины, положение кривой депрессии, высота выхода и скорость выхода кривой депрессии от нижнего склона плотины.

Построение кривой депрессии фильтрационной воды в плотине Ташкентского водохранилища было рассчитано для нескольких уровней, результаты которых приведены в таблице 1.

Таблица 1. Расчетные результаты кривой депрессии плотины Ташкентского водохранилища

Точка	Уровень воды, м	Растояние						
		X1	X2	X3	X4	X5	X6	X7
Уровень нормативного наполнения (УНН)	394	33,98	33,98	33,98	3,47	3,21	2,93	2,62
	389	28,99	28,99	28,99	2,74	2,52	2,28	2,01
	384	23,99	23,99	23,98	2,10	1,92	1,72	1,54
	378	17,97	17,97	17,97	1,41	1,28	1,12	0,94
	371,65	11,59	11,59	11,58	0,83	0,74	0,63	0,51

Для проверки состояния кривой депрессии в теле плотины изменение уровня воды в пьезометрах плотины было проанализировано по створам.

Чтобы оценить агрессию, которая возникает в результате движения грунтовых вод от тела плотины водохранилища, необходимо знать закономерности движения воды, вытекающей через тело плотины, и ее влияние на конструкции плотины. Результаты оценки важны для обеспечения устойчивости плотины и сооружений водохранилища. [7]

Вода, вытекающаяся через тело плотины водохранилища, обычно движется ламинарным (линейным) потоком, то есть просачивающаяся вода относится к категории безнапорной. Известно, что безнапорная вода перемещается из места высокого (уровня) гидравлического давления в место низкого давления. В примере с плотиной водохранилища вода движется из чаши водохранилища над плотиной в нижний бьеф плотины.

Из-за того, что Ташкентское водохранилище имеет ядро, скорость утечки воды в участке между 1,2,3 пьезометрами, расположенными на 9-м створе (ПК 22 + 00) большая, перепад напора большой и путь фильтрации короткий. На участке между 3,4,5 пьезометрам, расположенными в 9-м створе (ПК 22 + 00), наоборот, т.е. скорость протекающей воды, перепад напора небольшой, а путь фильтрации длинный. В результате градиент напора на участке между 3,4,5

пьезометрами, расположенными в 9-м створе (ПК 22 + 00), резко уменьшается, и в пьезометрах наблюдается застой воды.

По результатам исследования движение показало непостоянность движения грунтовых вод в ядровых и одинаковых грунтовых плотинах. Эта изменчивость зависит от количества градиентов между пьезометрами, расположенными в плотине, так если градиент находится на уровне нормы, изменение движения грунтовых вод является закономерным, а если градиент напора слишком мал, в пьезомтерах наблюдается застоя воды. Такая ситуация приводит к снижению прочности конструкций и грунтов. [8]

Оценка изменения технического состояния сооружений водохранилища под воздействием водной агрессии.

Техническое состояние водохранилищ претерпевает специфические изменения под воздействием водной агрессии. Эти изменения отражаются в коррозии и эрозии различных горных пород, а также бетонных и металлических конструкций, из которых состоят плотины и дамбы.

Эрозия конструкций и горных пород обычно вызывается содержащими в воде кислотами (угольная кислота), щелочами (ион гидрокарбоната), растворенными солями (сульфатами), активными газами (кислород, хлор).

Металлические конструкции быстрее подвержены коррозии из-за присутствия хлоридов в воде и растрескиваются. В результате срок службы этих объектов будет значительно сокращен. [7]

В таблице 2 приведены результаты оценки агрессивного воздействия проеткания грунтовых вод из тела Ташкентского водохранилища на конструкции тела плотины, т.е. показатели агрессивности грунтовых вод, протекающих из тела плотины водохранилища по отноошению к сооружениям - металлическим пьезометрам.

Таблица 2. Результаты определения агрессивного воздействия протекающих грунтовых вод из тела плотины Ташкентского водохранилища на конструкции (пьезометры), расположенные на теле плотины

Название данных	Результаты лабораторных наблюдений	Безнапорная конструкция		Результаты определения агрессии против бетонных конструкций
		Обычный и сульфатостойкий портландцемент	Обычный и сульфатостойкий путоллан и клинкерный портландцемент	
1. Вид сооружения	безнапорный			
2. Размер сооружения,м	более 2,5			
3. $К_ф$, м/сут	0,1<Кф<10			

4. Ca^{2+}, мг/л	148			
5. pH	7,59	5,2	5,5	*Вода не имеет общей кислотной агрессивности*
6. HCO_3^-, мг·экв/л	3.98	0,4	ненормированно	*Вода не имеет щелочной агрессии*
7. Карбоновая кислота CO_2, мг/л	Не выявлено			*Вода не имеет агрессии карбоновой кислотой*
8. Хлорид, Cl^-,мг	28,7	28,7<1000	28,7<1000	*Ускоряет коррозию металлических конструкций*
9. Сульфат SO_4^{2-}, мг/л	351,3	351,3>350	351,3>350	*Имеет сульфатную агрессию по отношению к обычным цементобетонным сооружениям и металлическим конструкциям*
10. Mg^{2+},мг/л	26	26<1000	26<1000	*Отсуствует магнезиальная агрессия воды*

Результаты исследования воды, которая собирается в чаще Ташкентского водохранилища и протекающей из тела плотины, в части оценки агрессивности на конструкций в теле плотины и верхнем бьефе водохранилища позволили сделать следующий вывод:

Качество грунтовых вод, вытекающих из тела плотины Ташкентского водохранилища является сульфатно-агрессивным в отношении обычных цементобетонных конструкций, серные и хлоридные соли в воде ускоряют коррозию пьезометров, установленных на теле плотины. [8]

Для предотвращения или уменьшения негативного воздействия воды, собираемой в чаше Ташкентского водохранилища, и вытекающей из тела плотины, следующие рекомендации:

1. Бетонные покрытия и конструкции в верхнем бьефе Ташкентского водохранилища не требуют гидроизоляции.

2. Пьезометры, расположенные на плотине Ташкентского водохранилища, следует обработать гидроизоляционными материалами и обеспечить хорошую работу дренажа на нижней части плотины.

Критерии прочности и надежности эксплуатации сооружений водохранилищ

Для повышения прочности и эксплуатационной надежности конструкций водохранилища необходимо соблюдать следующие критерии:

1. Для длительной и безопасной эксплуатации плотины водохранилища необходимо изучить и рассчитать фильтрацию от плотины, т.е. кривую

депрессии. Уменьшение кривой депрессии относительно ее среднего состояния приводит к увеличению расхода воды на фильтрацию и увеличению градиента давления, и наоборот. Таким образом, повышение уровня воды в пьезометрах свидетельствует о снижении сопротивления откоса плотины, а снижение – об уменьшении надежности грунтов по отношению к фильтрациии. Если уровень воды в пьезометрах выше, чем рассчитанная кривая депрессии, это означает, что пьезометры заполнены мусором или что сверху падает дополнительная вода. В данном случае, следует разработать меры по предотвращению таких ситуаций.

2. В плотинах с сердцевиной (ядром) или одним и тем же грунтом движение грунтовых вод непостоянно. Эта изменчивость зависит от количества градиентов между пьезометрами, расположенными в плотине, то есть, если градиент находится на уровне нормы, изменение движения грунтовых вод является регулярным, а если градиент давления слишком мал, застой воды также наблюдается в пьезометрах. В связи с чем, следует предотвратить застой воды в пьезометрах.

3. Для повышения надежности работы водоема следует предотвратить нарушения защитных элементов высокого уклона плотины (повреждение, растрескивание, скольжение, эрозия плит под воздействием природных явлений).

4. Плотина, ее части и сооружения не должны иметь подтоплений, размыва, в определенных случаях, когда эти условия могут допускатся, они не должны превышать уровень заранее установленных норм.

5. Следует недопускать попадания растительных остатков и бытовых отходов на поверхности воды в акватории водохранилища. В случае появления таких веществ в результате оползней следует принять меры по их немедленному удалению.

6. Присутствие кислот (углекислота), щелочей (ион гидрокарбоната), растворенных солей (сульфатов), активных газов (кислород, хлор) в воде, вытекающей из водохранилища и его плотины, должно находится в пределах, предотвращающих эрозию конструкций и грунтов.

7. Снижение кислотного воздействия воды на плотину и ее конструкции для обеспечения надежной работы водохранилища и его конструкций. Для этого, необходимо обеспечить нейтральную кислотность воды в бассейне и теле плотины (6 <pH <9).

8. Снижение щелочного воздействия воды на плотину и ее конструкции для обеспечения надежной работы водохранилища и его конструкций. Это необходимо для предотвращения возникновения щелочной агрессии в воде, т. е. превышения количества углеводородных ионов в воде 0,4–1,5 мг экв.

9. В специфических условиях Узбекистана сульфатная агрессия воды наблюдается во многих водохранилищах, расположенных в регионе, особенно в равнинных (пустынных) регионах западной части. В этом случае необходимо снизить сульфатное агрессивное воздействие воды на плотину и ее конструкции, чтобы водохранилище и его конструкции могли надежно работать. Необходимо обеспечить, чтобы количество сульфат-иона в воде, вытекающей из чаши резервуара и его тела, не превышало 350 мг/л. Для этого, во-первых, необходимо не допустить застоя воды, а во-вторых, принять меры для ускорения процесса водообмена в чаше резервуара.

10. Предотвращение магниевого воздействия воды на плотину и ее конструкции для обеспечения надежной работы водохранилища и его сооружений.

11. Для снижения агрессивного воздействия воды на плотину и ее конструкции в изученных в исследовании Ташкентском водохранилище необходимо, во-первых, обеспечить постоянный водообмен в чаше водохранилища, а во-вторых, предотвратить застоя воды, вытекающей из тела плотины. Необходимо постоянно следить за качеством воды в чаше водоема и за утечкой воды из тела плотины.

12. При контроле качества воды, вытекающей из Ташкентского водохранилища, особое внимание следует обращать на уровень мутности и цвет дренажной воды. Предотвращение слишком мутной воды и красноватого цвета обеспечивает надежную работу плотины и ее конструкций. При возникновении таких случаев, необходимо немедленно выявить причины и принять меры по их устранению.

ВЫВОД

По результатам исследования фильтрационного режима в теле Ташкентского водохранилища изменение количества данных об уровне воды в пьезометрах, определенное на основании натурных наблюдений, относительно расчетной кривой депрессии составило 7 -10%.

По своему качеству грунтовые воды, вытекающие из тела плотины Ташкентского водохранилища, считаются сульфатно-агрессивными к обычными цементобетонными конструкциями, сульфат и хлоридные соли в воде ускоряют коррозию пьезометров, установленных на теле плотины.

Водохранилища имеют важное значение для водоснабжения отраслей экономики, в том числе сельского хозяйства, а также улучшения мелиоративного состояния земель в республике. В связи с этим их надежная эксплуатация является важным фактором обеспечения экологической безопасности в системе водного хозяйства и требует принятия мер по эффективному мониторингу состояния водохранилища и ее водных ресурсов.

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DOI: https://doi.org/10.5281/zenodo.14498444

SIBUTRAMINE USE IN OBESITY PATIENTS WITH ARTERIAL HYPERTENSION

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Relevance. *Obesity is a metabolic disorder that is becoming an epidemic. The World Health Organization (WHO) has declared obesity one of the most common chronic diseases among the adult population, which is no longer just a problem associated with poor nutrition. In 2014, 1.9 billion people over 18 years of age worldwide were overweight, of which 600 million were obese. According to WHO, in Europe in 2015, obesity was detected in 21.5% of men and 24.5% of women. It is expected that the number of obese people by 2030 will be 1.1 billion [1]. According to the ESSE-RF epidemiological study, an increase in the prevalence of obesity, diagnosed both by body mass index (BMI) and waist circumference (WC), is noted in Uzbekistan. It has been established that 26.6% of men and 24.5% of women aged 35–44 years are obese, 31.7% of men and 40.9% of women aged 45–54 years, and 35.7% of men and 52.1% of women aged 55–64 years [2]. Obesity, especially its visceral form, increases the risk of developing arterial hypertension (AH), type 2 diabetes mellitus, dyslipidemia, coronary heart disease (CHD), stroke, cholelithiasis, osteoarthritis, obstructive sleep apnea syndrome, and some oncological diseases. Visceral obesity is also associated with an increased risk of cardiovascular and overall mortality [3]. The results of recent studies show that visceral obesity and its consequences are based on an imbalance of the body's neurohumoral systems, a deficiency of functional forms of natriuretic peptides, and the development of selective insulin, leptin, and adiponectin resistance. Given the heterogeneity of patients with obesity, it is considered appropriate to distinguish phenotypes of the disease, such as metabolically healthy and metabolically active obesity.*

KEYWORDS: *visceral obesity; arterial hypertension; epicardial fat; sibutramine.*

Introduction. The majority of obese patients (60–90%) belong to the metabolically active phenotype. They are characterized by visceral (abdominal) distribution of adipose tissue, the presence of metabolic disorders and associated diseases [4, 5]. The pathogenesis of obesity-associated diseases is based on chronic inflammation, which causes insulin resistance, endothelial dysfunction with increased vascular tone, diastolic dysfunction of the left ventricle (LV) and myocardial fibrosis [6]. The epicardial visceral fat depot has been the most studied in terms of the relationship with cardiovascular diseases. A number of studies have demonstrated an association of epicardial fat (EF) with myocardial hypertrophy and fibrosis, preclinical decrease in diastolic and systolic function of the LV [7]. In this regard, the main goal of obesity treatment is not only weight loss, but also a reduction in the risk of developing concomitant diseases and an increase in life expectancy. Currently, the safest and at the same time most effective method is considered to be gradual (0.5-1.0 kg per week) weight loss for 6 months or more, with 5-10% of the initial body weight lost, mainly due to fat tissue, and not due to the loss of muscle mass or fluid. Drug and non-drug therapy is used for weight loss, including diet, regular exercise and changes in eating behavior. One of the drugs for the treatment of obesity, approved in the Russian Federation, is a serotonin and norepinephrine reuptake inhibitor - sibutramine. Due to this double effect, a feeling of satiety is achieved and the amount of food consumed is reduced, energy expenditure increases as a result of increased thermogenesis [8]. A number of studies, in particular in the PrimaVera program, have shown good efficacy and safety of the drug with long-term use in patients with obesity [9]. According to the instructions for use, sibutramine is prescribed to patients with hypertension with special caution due to a possible increase in blood pressure (BP). Considering that hypertension often develops in patients with visceral obesity, the aim of our study was to evaluate the efficacy and safety of sibutramine in patients with combined pathology during antihypertensive therapy, as well as to study the effect of the drug on epicardial fat depot during long-term use. etdy individuals and study design The study included 57 patients with hypertension and obesity (BMI≥30 kg/m²) aged 35–60 years. All patients initially and after 7 months of observation underwent a comprehensive clinical, instrumental and laboratory examination, including a general examination with anthropometric measurements, electrocardiography (ECG), office blood pressure measurement, 24-hour blood pressure monitoring with aortic stiffness analysis, and echocardiography (EchoCG). The study included patients with controlled hypertension undergoing antihypertensive therapy with office blood pressure <140/90 mm Hg.During the 1st month of observation, all patients were recommended a diet with limited caloric content of food to 1500 kcal/day for women and 1800 kcal/day for men, regular physical activity up to 30 minutes per day, changes in eating behavior

(reducing portion sizes, limiting food consumption in the evening and at night, regularly eating small amounts of food frequently). At the end of the 1st month, sibutramine (Reduxin, manufactured by Promomed, Russia) at a dose of 10 mg per day was added to non-drug therapy. Control visits to assess the efficacy and safety were carried out after 1 and 6 months of taking the drug. Anthropometric measurements Height, weight were measured, body mass index (BMI) was calculated, waist circumference (WC), hip circumference (HC) were determined, the WC/HC and WC/height ratios were calculated. All measurements are necessary for the diagnosis of obesity, identification of the type of distribution of adipose tissue and assessment of the dynamics of weight loss. Measurement methods All patients underwent office blood pressure measurement at each visit. The procedure was performed three times in a sitting position, after a 15-minute rest, the first measurement was excluded from the analysis. The average value of 2 consecutive measurements taken with a 5-minute interval was calculated. Between visits, patients performed self-monitoring of blood pressure in the morning and evening hours using an automatic brachial tonometer. All patients underwent 24-hour blood pressure monitoring using the BPLab system (Russia) before treatment and after 7 months of observation. Average daily, daytime and nighttime values of systolic blood pressure (SBP) and diastolic blood pressure (DBP) were analyzed, the degree of nighttime decrease, variability and morning dynamics of blood pressure were assessed. Echocardiography EchoCG was performed with an S4 transducer in the second harmonic mode with a frequency range of 1.8–3.6 MHz on a VIVID 7 device by General Electric (USA) in accordance with the recommendations of the Nomenclature and Standardization Committee of the American Association of Echocardiography (ASE). All studies were performed in M- and B-modes using standard positions. The LV examination included measurement of end-diastolic (EDS, cm) and end-systolic (ESR, cm) sizes, interventricular septum thickness in systole and diastole (IVST, cm) and posterior wall thickness in systole and diastole (PWS, cm) from the parasternal position along the long axis. The LV myocardial mass was calculated using the formula: LVM = 1.08 × (1.04 × [(EDR + PVD + ISPd)3 - EDR3]) + 0.6 g; where LVM is the LV myocardial mass, ISPd is the interventricular septum thickness in diastole, PVD is the posterior wall thickness in diastole, and LVM is the end-diastolic dimension in diastole. LV hypertrophy was diagnosed if the LVM index (iLVMI) exceeded 95 g/m2 in women and 115 g/m2 in men. Evaluation of epicardial fat depot The thickness of the epicardial fat depot was measured initially and after 7 months of observation during echocardiography.The echo-negative space between the myocardium and the visceral leaflet of the pericardium behind the free wall of the right ventricle in the parasternal position along the long axis was estimated. The measurement was performed at the end of systole,

with the ultrasound beam directed perpendicular to the aortic ring used as an anatomical landmark. The mean value of 3 consecutive measurements was calculated. Ethical review The study was approved by the Local Ethics Committee at A.I. Evdokimov Moscow State Medical University. Upon inclusion in the study, all patients signed an informed consent form in 2 copies. One of the copies was given to the patient. Statistical analysis Statistical processing of the material was performed using the licensed software package Stastica 10.0 Statsoft (USA). When choosing the method for comparing data, the normality of the distribution of the feature in subgroups was taken into account, taking into account the Shapiro-Wilk criterion. With a normal distribution, the mean value and standard deviation were calculated. The null hypothesis when comparing groups was rejected at a significance level of less than 0.05. Delta (Δ) was calculated as the difference between repeated and initial measurements. For multiple comparisons, one-way ANOVA was used. The relationship between two features was assessed using the Pearson correlation coefficient.

Results. The general characteristics of the patients included in the study are presented in Table 1. Women predominated among the study participants. All patients had visceral obesity confirmed by anthropometric data: BMI ≥30 kg/m², WC >102 cm in men and >88 cm in women, WC/HR >0.9 in men and >0.85 in women, WC/height ≥0.5. At inclusion in the study, the patients were on effective antihypertensive therapy, which was confirmed by the results of office BP measurement. According to echocardiography, most patients had impaired LV geometry by the type of concentric remodeling or concentric hypertrophy, which is typical of obesity and hypertension. An increase in one of the main parameters of aortic stiffness, pulse wave velocity (PWV), determined as part of daily BP monitoring, was also revealed. Approximately one third of patients had carbohydrate metabolism disorders, in particular, impaired glucose tolerance or type 2 diabetes mellitus. Almost all patients had dyslipidemia, manifested by an increase in total cholesterol (6.5±1.0 mmol/l), low-density lipoprotein (LDL) (3.7±1.1 mmol/l) and triglyceride (2.4±0.9 mmol/l) concentrations, and a decrease in high-density lipoprotein (HDL) concentrations (1.0±0.09 mmol/l in men, 1.2±0.07 mmol/l in women). During the first month of observation, patients were recommended to follow a diet and general weight loss recommendations. At the end of this period, insignificant dynamics of weight and other anthropometric indicators were revealed (Table 2). On average, patients lost 2 kg, which was less than 2% of the initial weight. With sibutramine intake at a daily dose of 10 mg for 1 month, a more significant weight loss was observed, by an average of 3.7 kg, which was more than 2% of the initial body weight. Subsequently, the rate of weight loss slowed down and by the end of the observation period (6 months of sibutramine intake) it averaged 8.6

kg (6.2% of the initial). With sibutramine intake, a reliable decrease in WC and WC/height was noted, more pronounced in women. No significant dynamics of WC/HC were found, since the hip volume (HV) decreased proportionally to the change in WC. When analyzing the dynamics of echocardiography indicators (Table 3), a tendency towards a decrease in iLVM was revealed, more pronounced in women. According to the latest data, indexing LVM to body surface area (BSA) in obese patients may be inaccurate, especially during weight loss. In this regard, it is recommended to index LVM to height2.7. When analyzing the dynamics of this indicator, a more significant decrease was found, which became reliable in women. The number of patients with impaired LV geometry decreased slightly (from 74 to 63%). Against the background of long-term therapy with sibutramine, a slight decrease in the EF thickness was noted (from 0.79 to 0.71 cm). A more detailed analysis revealed that in women, the dynamics of this indicator was significantly more pronounced than in men.Taking into account more significant dynamics of weight and other anthropometric parameters, it can be said that in our study women lost weight better than men. During the observation period, side effects of sibutramine were detected in 26.3% of the study participants (Table 4). The most common complaints of patients were constipation (12.3%) and dry mouth (10.6%). The severity of symptoms persisted during the first month of sibutramine therapy and then decreased. No drug discontinuation or additional prescriptions were required. Complaints of palpitations occurred in 2 patients (3.5%), while no tachycardia was detected during the general examination or according to ECG data. The average HR according to ECG data was 71.5±8.2 bpm before treatment and 70.5±12.8 bpm after treatment. The study included patients with controlled hypertension. At all scheduled visits, office BP measurements were performed, between visits, patients measured BP at home and filled in a corresponding diary, and 24-hour BP monitoring (ABPM) was performed before and after sibutramine therapy. No episodes of clinically significant BP increase were detected during 6 months of sibutramine therapy. The average daily SBP and DBP in the study group before treatment was 126.3±8.9 mmHg and 81.2±9.1 mmHg, respectively, and after treatment – 127.6±9.3 mmHg and 80.7±7.3 mmHg, respectively. Discussion The rate of obesity spread in all countries is comparable to an epidemic, and the choice of drugs for treating the disease is limited. One of the few drugs approved in Russia for the treatment of obesity is sibutramine. A number of studies have proven the efficacy and safety of the drug during long-term use. Thus, about 70 thousand patients with obesity participated in the All-Russian observational program "PrimaVera". Most of them were prescribed sibutramine in a daily dose of 10-15 mg for a period of 3 months to 1 year. According to the study results, about 65% of patients achieved clinically significant weight loss of 10% or more after 6-12 months

of taking the drug. At the same time, adverse events were registered in only 4.1% of program participants [9]. In our study, the dynamics of weight loss was less pronounced (about 6%), and the frequency of adverse events reached 26.3%, which is possibly due to the more common visceral form of obesity and the presence of metabolic disorders in those included in our study. The PrimaVera program involved 6.5% of patients with controlled hypertension. During the observation period, episodes of clinically significant increases in blood pressure (more than 10 mm Hg over 2 consecutive visits) were recorded in 26% of patients, but this did not lead to discontinuation of sibutramine [10]. In our study, no episodes of clinically significant increases in blood pressure were detected, which was confirmed by self-monitoring data, office and daily blood pressure measurements. Similar results were obtained in the observational program "Vesna", also conducted in Russia. About 35 thousand people participated in it.patients with alimentary obesity aged 18 to 60 years [11]. All patients were prescribed sibutramine (Reduxin) at a daily dose of 10–15 mg. The observation period was 6 months. During sibutramine therapy, there was an average weight loss of 14.3%, WC decreased by an average of 11 cm. In our study, WC decreased more significantly in women – by an average of 7 cm, which was accompanied by a reliable decrease in the thickness of the uterine cavity and could indicate regression of visceral obesity in these patients. Adverse events were recorded in 2.8% of patients. The most common complaints of patients in our study were dry mouth and constipation. Study Limitations The main limitation of this study is the small number of included patients. Also, given the presence of concomitant pathology and metabolic disorders, patients were prescribed sibutramine at a daily dose of 10 mg. Further dose titration was not performed. Conclusion The prevalence of obesity and associated diseases is steadily increasing. Drug therapy for obesity promotes more effective weight loss, affects the nature of the distribution of adipose tissue, and slows down the development of concomitant pathology. The drug sibutramine (reduksin), approved in Russia, in a daily dose of 10 mg is an effective and safe drug that can be used in patients with visceral obesity in combination with controlled hypertension.

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DOI: https://doi.org/10.5281/zenodo.14498464

REDUCING RESISTANCE IN DRUG TREATMENT OF ACROMEGALY

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Relevance. *Acromegaly is a severe disabling neuroendocrine disease caused by long-term excessive production of somatotropic hormone and insulin-like growth factor-1 in individuals with complete physiological growth. The problem of drug resistance in patients with acromegaly is quite common in clinical practice and requires a personalized approach taking into account various clinical, morphological, molecular genetic and laboratory predictors of sensitivity to the choice of treatment method. Today, first-generation somatostatin analogues are in most cases first-line drugs in the drug treatment of acromegaly, but up to 50% of patients do not achieve biochemical remission of the disease. The prognosis of sensitivity to somatostatin analogues is of great importance, and the selection of patients for whom this therapy will obviously be unsuccessful allows us to immediately offer alternative treatment. The presented review summarizes potential predictors of sensitivity and resistance to existing drug treatment of acromegaly, discusses possible ways and means of overcoming the resistance to therapy, offers options for a personalized approach to choosing a treatment strategy in the absence of disease control against the background of monotherapy with somatostatin analogues, including an "off-label" combination. Timely addition of the growth hormone receptor antagonist pegvisomant allows avoiding repeated neurosurgery, radiation therapy or the administration of excessively high doses of somatostatin analogues. Optimal use of mono- or combination therapy helps achieve biochemical remission in most treatment-resistant patients.*

KEYWORDS:*acromegaly; biochemical monitoring; drug therapy; resistance; somatostatin analogues; pegvisomant; combination therapy.*

INTRODUCTION

Acromegaly is a severe neuroendocrine disease caused by long-term excessive production of somatotropic hormone (STH) and its-mediated hypersecretion of insulin-like growth factor-1 (IGF-1) in individuals with completed physiological growth [1]. According to various sources, the prevalence of acromegaly is 28–137 cases per 1 million population, the incidence is 2–11 new cases per 1 million per year [2–4]. In the absence of timely and adequate treatment, acromegaly leads to the development of various complications, progressive disability, and significantly reduces life expectancy [2]. The main causes of early mortality are complications caused by long-term hyperproduction of STH: cardiovascular diseases, diabetes mellitus and its complications (micro- and macroangiopathy), respiratory diseases, malignant neoplasms of the gastrointestinal tract (GIT), and some others [5]. Modern approaches to the treatment of acromegaly are aimed at reducing the severity of symptoms, preventing and correcting complications of the disease, reducing the size of the tumor secreting STH, and normalizing biochemical markers of acromegaly activity. Achieving these goals increases survival and improves the quality of life of patients [6]. MODERN METHODS OF TREATMENT OF ACROMEGALIA Currently, three methods of treatment of acromegaly are available - neurosurgical (endoscopic adenomectomy by transnasal transsphenoidal approach), drug therapy (somatostatin analogs, dopamine agonists and STH receptor antagonists), fractional stereotactic radiation therapy or stereotactic radiosurgery [1, 6, 7]. According to international consensus and Russian clinical guidelines, surgery is a priority treatment method, allowing for rapid normalization of STH and IGF-1 levels [6, 7]. The main factor that largely determines the success of surgical treatment is the qualification of the neurosurgeon, while the radicality of the removal of somatotropinomas primarily depends on the size and degree of tumor invasion into the cavernous sinus [8]. However, long-term biochemical control of the disease after tumor resection is achieved in less than 65% of cases [9, 10]. This is mainly due to the predominance of pituitary macroadenomas, which make up 82% according to the unified Russian registry of tumors of the hypothalamic-pituitary region [1], which does not allow for complete resection of the tumor and is initially considered a predictor of an unfavorable postoperative prognosis. Similar data on the incidence of macroadenomas among patients with acromegaly are presented in the combined national registry of acromegaly (19 countries) [11]. Radiation therapy is usually considered as an additional treatment method when neurosurgical treatment is ineffective and the pituitary tumor is resistant to conservative therapy. Today, radiation therapy in our country, as in a number of other countries,ranks last in importance in the treatment of acromegaly [1, 11]. Negative consequences of radiation therapy include delayed clinical effect and high

percentage of hypopituitarism development (up to 50% of cases), and the frequency of achieving remission of the disease after stereotactic radiosurgery is from 25 to 60% over the next 10-15 years and requires the appointment of drug treatment for a long period [12, 13]. In recent decades, new pharmacological drugs with multidirectional action have entered clinical practice, which have proven their effectiveness in controlling secretory and, in some cases, proliferative tumor activity. In connection with the improvement and spread of neurosurgical treatment, drug therapy is mainly used as a second line, prescribed in case of ineffectiveness of previous transsphenoidal adenomectomy [6]. Today, first-generation somatostatin analogues (octreotide and lanreotide) are considered first-line drugs in the drug treatment of acromegaly in most cases, while dopamine agonists and STH receptor antagonists are usually prescribed when somatostatin analogues are ineffective [7, 14]. When monotherapy is ineffective, combination drug therapy is practiced (Fig. 1). FIRST-GENERATION SOMATOSTATIN ANALOGS USED IN CLINICAL PRACTICE Octreotide is the first somatostatin analogue used in clinical practice since the mid-1980s. Short-acting octreotide drugs are currently not used for the long-term treatment of acromegaly due to the need for frequent injections. They can be prescribed as an adjunct to prolonged-release octreotide in case of severe cephalgic syndrome [6]. Another actively used first-generation synthetic somatostatin analogue is lanreotide, a synthetic peptide containing the amino acids D-alanine and D-tryptophan, which increase the stability of the molecule and enhance the selectivity of binding to somatostatin receptors (SSR) [15]. Indications for therapy with somatostatin analogues are the expectation of the effect of radiation therapy, non-radical nature of transsphenoidal adenomectomy, contraindications to surgical treatment due to the patient's somatic status or tumor growth characteristics, as well as the patient's refusal of surgical intervention [16]. There are reports on the possible use of this group of drugs to relieve cephalgic syndrome in the preoperative period [17]. According to a meta-analysis published in 2005, first-generation somatostatin analogues are effective in normalizing STH and IGF-1 levels in approximately 55% of patients [18].In later studies, the frequency of achieving a safe level of STH and normalization of IGF-1 decreased to 20–30% with octreotide and to 30–50% with lanreotide [19–21]. Such discrepancies in the results of studies are due to the preliminary selection of obviously sensitive patients, which led to a possible overestimation of the effectiveness of long-term treatment with somatostatin analogues in acromegaly. In addition, the use of only one hormonal indicator (STH or IGF-1) as an endpoint may also lead to higher efficacy rates [22]. In addition to the antisecretory effect, somatostatin analogues have a pronounced antiproliferative effect due to the inhibition of proliferation of both normal and tumor cells. It has been shown that activation of CSR subtypes 1, 2, 4 and 5 leads to cell cycle

arrest, while the effect on CSR subtypes 2 and 3 is accompanied by induction of apoptosis [23]. The action of somatostatin analogues is also possible indirectly, due to a decrease in the production of vascular endothelial growth factor and suppression of angiogenesis [24]. According to the literature, a decrease in tumor size is observed in 53–85% of cases, which is an undeniable advantage of somatostatin analogues over other drugs for the treatment of acromegaly [25, 26]. The prognosis of sensitivity to somatostatin analogues is of great importance, and the selection of patients in whom this therapy will be successful provides invaluable assistance in choosing the optimal treatment method. PREDICTORS OF RESISTANCE TO FIRST-GENERATION SOMATOSTATIN ANALOGUES Existing clinical guidelines define the criteria for the effectiveness of acromegaly treatment and disease remission as achieving the IGF-1 level corresponding to the gender and age norm and a decrease in STH by 1.0 ng/ml [6]. There are several approaches to defining the concept of "resistance" in the literature. According to the clinical point of view, resistance to drug treatment is interpreted, on the one hand, as the absence of normalization of biochemical parameters (STH and IGF-1), and on the other hand, as an increase in tumor size or its decrease by less than 20% compared to the initial volume, assessed no earlier than after 12 months of continuous treatment. In the case of a decrease in the IGF-1 level by more than 50% of the initial, but without achieving normalization of this indicator even against the background of maximum doses of somatostatin analogs, resistance can be considered partial [27]. Although most investigators report a close association between biochemical control of acromegaly activity and tumor size reduction [28], in some patients such a relationship is not observed [29]. In recent years, many in vitro and in vivo studies have focused on identifying a number of potential clinical, immunohistochemical, and molecular markers of sensitivity and resistance to somatostatin analog therapy (Table 1) [30, 31].Some of the predictors of the effectiveness of this group of drugs are the features of the receptor phenotype of various STH-secreting pituitary tumors, the study of which is the subject of the largest amount of literature data. Somatostatin receptors are a family of G-protein-coupled receptors, through which somatostatin realizes its biological effects in the body. To date, 5 subtypes of SSR (SSR 1–5) have been identified, which are expressed by different types of cells in neuroendocrine tumors, the gastrointestinal tract, pancreas, lungs, and other localizations, as well as pituitary adenomas, paragangliomas, meningiomas, and some other types of tumors [32]. In vitro studies have demonstrated preferential binding of first-generation somatostatin analogues to subtype 2 SSRs and, to a lesser extent, to subtype 5 SSRs, while the second-generation somatostatin analogue (pasireotide), on the contrary, is highly tropic to subtypes 4 and 5 SSRs [33]. In STH-secreting pituitary tumors, subtype 2 SSRs are also predominantly detected in more

than 95% of adenomas, with subtype 5 SSRs being present somewhat less frequently (85% of cases). Subtypes 1 and 3 SSRs are found in approximately 40% of somatotropinomas, while subtype 4 SSRs are virtually nonexistent [30, 34]. It is assumed that activation of CCP subtypes 2 and 5 is the main mechanism underlying the suppression of STH secretion, blocking the proliferative activity of tumor cells and preventing further development of pathological changes [35]. To date, highly specific rabbit monoclonal antibodies to CCP subtype 2A (clone UMB-1) have been developed, as well as a clear system for assessing their expression, which reliably demonstrates that a high level of CCP 2A expression correlates with the response to treatment with somatostatin analogs [36, 37]. Indeed, tumors with high expression of CCP subtype 2 are more sensitive to therapy with somatostatin analogs, which has been proven in a large number of studies. The response rate to treatment is approximately 50–53%, whereas with low expression of CCP subtype 2, treatment is effective only in 15–20% of cases [37, 38]. However, even with high expression of the 2nd subtype of SSR, up to 50% of patients receiving treatment with first-generation somatostatin analogues are resistant to this drug therapy [39]. One of the reasons may be point gene mutations of SSR, which are capable of changing the species structure of the receptor apparatus of cells and, accordingly, their sensitivity to somatostatin [40]. In addition, in the study of Taboada G. et al. [41], it was suggested that the detection of a low SSR 2/SSR 5 ratio during immunohistochemical examination predicts resistance to therapy with first-generation somatostatin analogues. In addition to SSR, the histological characteristics of somatotropinomas also determines sensitivity to somatostatin analogues. Tumors consisting of densely granulated chromophilic (acidophilic) cells,predominantly express subtype 2 SSR and are characterized by the highest sensitivity to first-generation somatostatin analogues, whereas in sparsely granulated and mixed pituitary tumors, subtype 5 SSR is expressed to a greater extent, which, due to the peculiarity of the receptor phenotype, explains the low sensitivity to treatment [37]. When comparing the frequency of achieving biochemical control of acromegaly in the postoperative period depending on the histological characteristics of the tumor, it was shown that patients with densely granulated tumors responded to treatment with somatostatin analogues in 70–90% of cases and demonstrated a more pronounced decrease in IGF-1 compared to patients with a sparsely granulated tumor type according to immunohistochemical studies [37, 42]. To date, there are conflicting data regarding the prognostic value of the Ki-67 proliferative activity index and the response to therapy with somatostatin analogues. Several studies have shown that high proliferative activity of somatotropin is associated with low sensitivity to first-generation somatostatin analogues [43, 44], but this issue remains a subject of debate and does not allow for an unambiguous recommendation for the use of the Ki-67 index as a

predictive marker. In most studies, the efficacy of somatostatin analogues was assessed in the postoperative period, but there are reports of patients who underwent neurosurgical treatment after long-term therapy with somatostatin analogues. In such studies, the histological type of the resected tumor correlated with the preoperative response to therapy with somatostatin analogues [42, 45]. It is assumed that invasive tumor growth, which prevents the possibility of its complete resection, reduces the frequency of achieving remission both after neurosurgical treatment and in response to therapy with somatostatin analogues. However, previous radiation therapy increases the likelihood of IGF-1 normalization in the late period while taking somatostatin analogs, while the effect on the level of STH is insignificant [46]. Finally, dysfunctions of proteins such as AIP (aryl hydrocarbon receptor-interacting protein), Zac1 (zinc finger protein), RKIP (phosphorylated Raf-kinase inhibitory protein), E-cadherin, β-arrestin, involved in the transmission of intracellular signals after the interaction of somatostatin analogs with CCP, somatic mutations in somatotrophs can also be the causes of variability in response to therapy with somatostatin analogs [47]. WAYS TO OVERCOME RESISTANCE TO SOMATOSTATIN ANALOGUESWhen comparing the frequency of achieving biochemical control of acromegaly in the postoperative period depending on the histological characteristics of the tumor, it was shown that patients with densely granulated tumors responded to treatment with somatostatin analogs in 70–90% of cases and demonstrated a more pronounced decrease in IGF-1 compared to patients with a sparsely granulated tumor type according to immunohistochemical studies [37, 42]. To date, there are conflicting data regarding the prognostic value of the Ki-67 proliferative activity index and the response to somatostatin analog therapy. Several studies have shown that high proliferative activity of somatotropin is associated with low sensitivity to first-generation somatostatin analogs [43, 44], but this issue remains a subject of discussion and does not allow us to unambiguously recommend the use of the Ki-67 index as a predictive marker. Most studies have evaluated the efficacy of somatostatin analogs in the postoperative period, but there are reports of patients who underwent neurosurgical treatment after long-term therapy with somatostatin analogs. In such studies, the histological type of the resected tumor correlated with the preoperative response to somatostatin analog therapy [42, 45]. It is assumed that invasive tumor growth, which prevents the possibility of its complete resection, reduces the frequency of achieving remission both after neurosurgical treatment and in response to somatostatin analog therapy. However, previous radiation therapy increases the likelihood of normalization of IGF-1 in the late period against the background of taking somatostatin analogs, while the effect on the level of STH is insignificant [46]. Finally, dysfunctions of proteins such as AIP (aryl hydrocarbon receptor-interacting protein), Zac1 (zinc finger protein),

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To date, there are several therapeutic options for increasing the effectiveness of therapy with somatostatin analogues (see Fig. 1). The standard starting dose of prolonged-release octreotide preparations is 20 mg once every 28 days, lanreotide - 90 mg monthly with the possibility of reducing the dose to 60 mg or increasing it to 120 mg. If therapy is ineffective after 3-6 months, the octreotide dose can be increased to 3 or 40 mg. In the study by Colao A. et al. [57], an increase in the octreotide dose to 40 mg/28 days contributed to the normalization of IGF-1 levels and the achievement of biochemical control of the disease in 35% of patients with partial resistance to somatostatin analogues. The efficacy and safety of reducing the interval between injections to 21 days or increasing the prolonged-release octreotide dose to 60 mg/28 days was studied in a multicenter, open-label, randomized study. The use of octreotide LAR® in high doses (60 mg/28 days) contributed to a significant decrease in the level of IGF-1 in 90% of cases compared with the group of patients receiving treatment at a dose of 30 mg/21 days. Thus, a reduction in the interval between drug administrations is less effective in achieving biochemical control of the disease compared with an increase in the dose of the drug. A recent study by Giustina A. et al. [59] showed that an increase in the dose of lanreotide Autogel® (180 mg/28 days) and more frequent administration of the drug (120 mg/21 days) normalize IGF-1 levels in approximately 30% of patients with acromegaly whose disease cannot be controlled with standard doses. However, the regimen of increasing the dose was most effective compared with a reduction in the interval between injections. Thus, increasing the dose of extended-release octreotide or decreasing the intervals between injections when treating with extended-release lanreotide may help to achieve biochemical control of the disease. In case of severe resistance, intra-group replacement of octreotide with lanreotide or pasireotide "off-label" is possible [60]. SECOND-GENERATION SOMATOSTATIN ANALOGUES Pasireotide is a long-acting, multiligand analogue of natural somatostatin that affects CSR 1–3 and CSR 5 subtypes. In vitro studies have shown that pasireotide has 40-, 30-, and 5-fold higher binding affinity for CSR 5, CSR 1, and CSR 3 subtypes, respectively, compared to octreotide [61]. Due to this, the use of pasireotide may be effective in patients resistant to first-generation somatostatin analogues, while sensitivity to the drug correlates with the expression of the 5th subtype of SSR in tumor cells, which was demonstrated in the work of Iacovazzo D. et al. [37] (see Table 1).In a prospective, randomized, double-blind study, pasireotide 40 mg/28 days in patients with acromegaly demonstrated significantly greater efficacy than extended-release octreotide (20 mg/28 days) in achieving biochemical disease control (31.3% vs. 19.2%, p=0.007), but both drugs were equally effective in achieving safe GH levels (48.3% in the pasireotide group and 51.6% with octreotide, p=0.002) [62].

CONCLUSION.

The problem of resistance to therapy in patients with acromegaly is quite common in clinical practice and requires a personalized approach taking into account various clinical, morphological, molecular genetic and laboratory predictors of sensitivity to the choice of treatment method. Today, first-generation somatostatin analogues are in most cases first-line drugs in the drug treatment of acromegaly, but up to 50% of patients do not achieve biochemical remission during therapy. One of the possible ways to overcome resistance is to increase the octreotide dose or reduce the inter-injection intervals during treatment with lanreotide, as well as intra-group replacement of octreotide with lanreotide. Thanks to the creation and introduction into clinical practice of new drugs, primarily the growth hormone receptor antagonist pegvisomant, the possibilities and effectiveness of treating patients with acromegaly resistant to somatostatin analogues have significantly expanded. In cases of severe resistance or poor tolerance to somatostatin analogues, the addition of pegvisomant is indicated to achieve normalization of IGF-1 levels. Further study of the possibility of using pegvisomant as first-line therapy and additional prospective studies are needed.

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DOI: https://doi.org/10.5281/zenodo.14498482

A MODERN VIEW OF THE TREATMENT OF CENTRAL DIABETES INSIPIDUS. A REVIEW OF THE NEW ARSENAL.

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Relevance. *Central diabetes insipidus is a severe disease characterized by decreased secretion of arginine vasopressin, resulting in the excretion of an inadequately large amount of hypotonic urine. The main clinical manifestation of the disease is polyuria-polydipsia syndrome, which significantly impairs the quality of life of patients. Currently, desmopressin preparations, a synthetic analogue of arginine vasopressin, are used to treat the disease, available in tablet form and intranasal sprays. Selecting the most convenient form of the drug is a prerequisite for successful treatment of the disease.*

Keywords: *central diabetes insipidus, desmopressin.*

Introduction. Diabetes insipidus is a disease characterized by the inability of the kidneys to reabsorb water and concentrate urine, which is based on a defect in the secretion or action of vasopressin and manifested by severe thirst and excretion of large amounts of dilute urine. Currently, there are 3 main types of diabetes insipidus: central (hypothalamic or pituitary, associated with impaired vasopressin secretion), nephrogenic (renal, vasopressin-resistant, characterized by an inadequate response of the kidneys to vasopressin) and primary polydipsia (a condition associated with excessive fluid intake). In addition to these types, there are also gestagenic (associated with accelerated vasopressin metabolism), functional (caused by rapid deactivation of the vasopressin receptor and a short duration of its action in children under 1 year of

age) and iatrogenic diabetes insipidus [60]. Development of the concept of diabetes insipidus Diabetes insipidus was first described several thousand years ago and was named by analogy with diabetes mellitus, or sugar urination, which was known at that time in ancient Egypt, Greece and Asia. The separation of diabetes mellitus and diabetes insipidus occurred in 1670, when Thomas Willis, an Oxford professor, noticed differences in the taste of urine in patients with polyuria compared to healthy volunteers [7, 12, 13]. He used the term "diabetes", implying polyuria, but it was this observation that led to the separation of diabetes mellitus from the less common diabetes insipidus a century later. The modern description of diabetes insipidus dates back to 1794, when Johann Peter Frank presented a clinical case of a patient "with prolonged abnormal increased excretion of sugar-free urine without concomitant renal pathology" and introduced the term "diabetes insipidus" (from the French word "insipide" - tasteless, colorless) [17]. According to available historical documentation, in 1841 Lacombe described a case of diabetes insipidus symptoms in 8 members of one family, which drew attention to the familial etiology of the disease [29], and subsequently a familial form of diabetes insipidus was described in 1892 [35]. In the following years, the connection of the hypothalamus with the development of diabetes insipidus became apparent, and in 1901 Magnus and Shaffer found that an extract from the posterior pituitary gland had vasopressor and antidiuretic activity [32]. A few years later, in 1913, Farini and van den Velden successfully used an extract from the posterior pituitary gland to treat diabetes insipidus [15, 54]. Subsequently, Bailey and Ranson described the supraoptic-pituitary tract in animals, which made it possible to link the supraoptic nucleus of the hypothalamus and the posterior lobe of the pituitary gland and to prove that damage to this tract in animals provokes the development of diabetes insipidus [4, 43]. In parallel, Camus and Roussy found that hypothalamic puncture promotes the development of polyuria with an intact pituitary gland [6]. As a result, by 1920, the conclusion was made,that diabetes insipidus is one of the variants of pituitary pathology, and this disease began to be called "hypopituitary syndrome" [34, 39]. In 1928, the German scientist De Lange was the first to note that some patients with diabetes insipidus did not respond positively to the administration of posterior pituitary extract, and in families with this pathology there was no transmission of the disease from man to man [31]. These observations were followed by an analysis by Forssman, who established that the kidneys play a leading role in the form of diabetes insipidus resistant to treatment with posterior pituitary extract [16]. Waring described patients with an "unusual syndrome" that manifested itself shortly after birth and was characterized by polyuria, polydipsia, fever, uncontrollable vomiting, high levels of serum sodium and chlorides, rapid dehydration, and the inability to excrete concentrated urine [57]. He concluded that these disorders were caused by a "specific

defect in renal tubular water reabsorption" and were more common in boys. In 1947, Williams and Henry introduced the term "nephrogenic diabetes insipidus" for a congenital syndrome characterized by polyuria and a renal concentration defect with intact vasopressin production [58]. In 1955, du Vigneaud received the Nobel Prize for the synthesis of the polypeptide hormone vasopressin. As part of his scientific work, du Vigneaud isolated both oxytocin and vasopressin, and then synthesized oxytocin in 1953, and vasopressin in 1954 [53]. Etiology, clinical picture and diagnosis of central diabetes insipidus Central diabetes insipidus (CDI) is a rare disease with a prevalence of 1:25,000 [22], which does not differ in men and women. In Russia, the prevalence of CDI is 0.004% [64]. The age of onset of the disease depends on the etiology [48].characterized by polyuria and renal concentration defect against the background of preserved vasopressin production [58]. In 1955, Du Vigneaud received the Nobel Prize for the synthesis of the polypeptide hormone vasopressin. As part of his scientific work, du Vigneaud isolated both oxytocin and vasopressin, and then in 1953 he synthesized oxytocin, and in 1954, vasopressin [53]. Etiology, clinical picture and diagnosis of central diabetes insipidus Central diabetes insipidus (CDI) is a rare disease with a prevalence of 1:25,000 [22], which does not differ in men and women. In Russia, the prevalence of CDI is 0.004% [64]. The age of onset of the disease depends on the etiology [48].characterized by polyuria and renal concentration defect against the background of preserved vasopressin production [58]. In 1955, Du Vigneaud received the Nobel Prize for the synthesis of the polypeptide hormone vasopressin. As part of his scientific work, du Vigneaud isolated both oxytocin and vasopressin, and then in 1953 he synthesized oxytocin, and in 1954, vasopressin [53]. Etiology, clinical picture and diagnosis of central diabetes insipidus Central diabetes insipidus (CDI) is a rare disease with a prevalence of 1:25,000 [22], which does not differ in men and women. In Russia, the prevalence of CDI is 0.004% [64]. The age of onset of the disease depends on the etiology [48].

Etiology of CDI

1. Congenital.
2. Family:

• autosomal dominant;
• DIDMOAD syndrome.

3. Due to developmental disorders of the brain (septo-optic dysplasia).
4. Acquired:

• traumatic (after surgical interventions and traumatic brain injuries);
• tumor (craniopharyngioma, germinoma, glioma, etc.);
• metastatic;
• due to hypoxic or ischemic brain damage;

• as a result of lymphocytic neurohypophysitis;
• granulomatous (tuberculosis, sarcoidosis, histiocytosis);
• infectious (congenital cytomegalovirus infection, toxoplasmosis, encephalitis, meningitis); • due to vascular pathology (aneurysm, vascular malformation);
• idiopathic.

The pathogenesis of diabetes insipidus is associated with impaired secretion or action of arginine vasopressin (AVP), a neurohypophyseal nonapeptide that regulates water-electrolyte balance [22, 23]. AVP is encoded by the AVP-neurophysin II gene, synthesized in the supraoptic and paraventricular nuclei of the hypothalamus as part of a complex of AVP precursors, neurophysin II, and the glycopeptide copeptin, and then secreted as AVP from neurons into the posterior pituitary gland. AVP is released by calcium-dependent exocytosis in response to stimuli such as orthostatic hypotension or the gag reflex [23]. Regulation of water-electrolyte balance by AVP is based on serum osmolality and circulating blood volume and is mediated by vasopressin type 2 receptors (V2 receptor) [18, 22, 23]. AVP binds to V2 receptors located on the basolateral membrane of the principal cells of the collecting ducts, which leads to the activation of protein kinase A, which phosphorylates aquaporins 2 - vasopressin-sensitive channels "embedded" in the apical cell membrane for water reabsorption (Fig. 1) [18, 22]. If this mechanism is disrupted, water is lost in large quantities with urine, causing dehydration and thirst [60]. The clinical picture is associated primarily with polyuria-polydipsia syndrome: patients excrete and consume from 3 to 20 liters of fluid, feel severe thirst, which can lead to a significant decrease in the quality of life. Other characteristic symptoms are weakness, fatigue, nocturia and associated sleep disorders, signs of dehydration (dry skin and mucous membranes, weight loss, low skin turgor). Arterial hypotension and tachycardia, decreased pressure in the right ventricle and pulmonary artery, and impaired consciousness are observed with severe dehydration and hypernatremia [11, 22]. Diagnosis is based on the presence and persistence of polyuria-polydipsia syndrome, confirmation of dehydration during a clinical examination of the patient, and laboratory data (hypernatremia and increased blood osmolality, decreased urine osmolality). Differential diagnosis of various forms of diabetes insipidus is performed in several stages [22, 33, 51, 60]. 1. The first stage confirms the presence of hypotonic polyuria. 2. The second stage includes a dry-eating test and a desmopressin test: the patient is asked to limit fluid intake for as long as possible; blood and urine samples are taken before, during, and after the test, the patient’s weight and blood pressure are measured, and the general condition is monitored. When urine osmolality decreases to 30 mOsm/kg, with a loss of 5% of body weight, an objectively serious condition, or at the patient’s request (unbearable thirst), the test is stopped. After stopping the test, desmopressin is administered, the patient is

allowed to eat and drink, and urine is collected again after 2 hours and 4 hours to determine osmolality. 3. At the third stage, the causes of the disease are sought.

Treatment. The main goal of treatment is to reduce the severity of thirst and polyuria to such an extent that the patient would be able to lead a normal life. Treatment should be easily tolerated and not significantly limit the patient's life, and the doses and time of taking the drugs should be selected individually [50, 63]. Water can also be considered as a means of treating diabetes insipidus, since its consumption in sufficient quantities allows for the relief of metabolic disorders [61], provided that the disease is not severe [50, 60, 61, 64].

Drugs for the treatment of central diabetes insipidus

1. Water.

2. Vasopressin analogues (desmopressin); - chlorpropamide; - carbamazepine; - clofibrate.

3. Natriuretic drugs: - thiazide diuretics; - indapamide. Desmopressin is the preferred drug for the treatment of central insipidus and the only one recommended in the Republic of Uzbekistan. Other drugs are effective only in cases where a slight decrease in diuresis can eliminate the symptoms of diabetes insipidus, which is possible with the preservation of residual secretion of vasopressin, but their administration increases the effect of desmopressin. [8, 61]. Desmopressin in the treatment of central insipidus The first attempts to use vasopressin to treat central insipidus were made as early as 1913, after obtaining an extract of the posterior pituitary gland containing vasopressin and oxytocin. The most effective was considered to be vasopressin tannate (pitressin), an oil solution, which became available for clinical use in the 1930s and was the drug of choice for the treatment of diabetes insipidus until the 1970s, i.e. before the advent of desmopressin. Pitressin had a longer action (5-6 days), but required intramuscular administration, which was painful and often accompanied by purulent complications [52]. Substitution of the 8th radical of vasopressin with the D-isomer of arginine reduced the vasopressor effect of vasopressin and provided greater (approximately 2000 times) antidiuretic activity of desmopressin than natural L-arginine vasopressin [45], which made desmopressin the most preferred drug for the treatment of diabetes insipidus [46, 47]. This synthetic analogue of vasopressin has a prolonged antidiuretic effect, a lesser vasoconstrictor and rhinostimulating effect, and resistance to vasopressinase. The ability to use smaller doses of the drug reduces the risk of developing such severe conditions as hyponatremia and convulsive syndrome. All this makes desmopressin the drug of choice for the treatment of central and gestational diabetes insipidus [25, 42, 55]. The first synthetic vasopressin preparations were created back in 1954, were mainly used intranasally and had lower efficacy and duration of action compared to pitressin [10], but given the lack of need for parenteral

administration were often more preferable [49]. Before the creation of the tablet form, the most commonly used desmopressin preparation was adiuretin (intranasal drops), but their use was accompanied by such unpleasant side effects as vasoconstriction and irritation of the nasal mucosa [52], and also created some difficulties for accurate dosing of drugs, sometimes requiring the use of nasal catheters [19]. In 1987, a tablet form of desmopressin, Minirin, was created, which has become widespread since the 1990s. in Europe [63]. Minirin (manufactured by Ferring AG) currently exists in two forms: for oral administration and for sublingual use. When taken orally, desmopressin is characterized by low bioavailability (from 1 to 5%), and taking it with food reduces bioavailability by another 40%,Therefore, it must be taken on an empty stomach, maintaining an interval of 30–40 minutes before meals, or 2 hours after meals, which is not always convenient for patients. Failure to comply with the rules for taking the drug may lead to a decrease in its effectiveness and the need to replace the drug [66]. After oral administration, the antidiuretic effect of the drug occurs within 15 minutes and lasts from 7 to 9 hours. The onset of action of the drug, determined by a decrease in the volume of urine and an increase in its osmolality, occurs 1 hour after administration [37]. The initial dose is 0.1 mg 2–3 times a day, then the dose is selected depending on the patient's needs for the drug and is on average 0.1–0.2 mg 2–3 times a day [60, 64]. Minirin is also an effective drug for the treatment of nocturnal enuresis in both children and adults [2, 9]. The sublingual form of the drug is used by dissolving under the tongue; the drug does not need to be washed down with water. The bioavailability of this form is 60% higher, and the clinical effect occurs within 15–45 minutes from the start of administration. The initial dose is 60 mcg in 2–3 doses, the average dose can range from 60 to 960 mcg/day [64]. A relatively recent form of intranasal administration of desmopressin has appeared in the form of a spray (Vazomirin manufactured by GENFA MEDICA, SA). The initial dose is 10 mcg (1 dose) 1–2 times a day, on average, patients require 10–40 mcg/day. The drug combines the accuracy of dosing and ease of use of the tablet form and the speed of onset of the clinical effect with intranasal use: the effect occurs within 15–30 minutes after administration. The duration of action of the drug is 8–24 h, and in some patients with high sensitivity to desmopressin, it is possible to use intranasal sprays only once a day [60, 61, 65], which can significantly affect patient compliance. In addition, the possibility of using the spray in high doses makes this form of drug administration the most convenient for patients with severe forms of CDI [61]. No special conditions are required for storing the drug, patients can take it with them [62, 68]. A limitation to the use of this form are diseases accompanied by swelling of the nasal mucosa, due to reduced absorption of the drug [50, 60, 64]. Like the tablet form, the intranasal spray is successfully used in urological practice for the treatment of nocturia: the use of the

drug allows to reduce the number of night awakenings by more than 50% against the background of good tolerability and the need for low doses [14, 26]. In addition, intranasal desmopressin has proven its effectiveness in renal colic, significantly reducing the intensity of pain [28]. Thus, desmopressin is currently available in the Russian Federation as an intranasal spray, in tablet form and as sublingual tablets. Parenteral administration of desmopressin is also possible (this form of the drug is not registered in the Russian Federation) 0.5–2,0 mcg subcutaneously, including in outpatients with concomitant pathology or allergies, with the therapeutic response being 5–20 times more pronounced than with intranasal administration [44]. When the dose of the drug is sufficient to maintain a stable therapeutic effect, a further increase in the dose only causes an increase in the duration of action by several hours [30, 44]. Due to individual pharmacokinetic characteristics and different sensitivity to the drug in patients, it is extremely important to determine the individual duration of action and the need for the drug based on the severity of polyuria symptoms in each patient [30, 44, 67]. To do this, after the effects of taking previous drugs have faded, the time of each urination and the volume of urine excreted are noted in the patient against the background of a free drinking regimen after taking the minimum dose of desmopressin. Usually, the volume of diuresis decreases 1-2 hours after taking the drug, and the total duration of action does not exceed 16-18 hours. As a rule, the maximum required dose rarely exceeds 0.2 mcg when taken orally or 10 mcg when administered intranasally in 2-3 doses [30, 44]. The most dangerous adverse effect during use is fluid retention and hyponatremia, in which case you should skip taking desmopressin and wait for the release of light urine, as well as a moderate feeling of thirst [50, 60, 64]. According to research, the use of an intranasal spray can more often provoke the development of hyponatremia in patients compared to the sublingual form, which, however, may also be associated with the heterogeneity of the studied patient groups by age [59]. Other drugs in the treatment of CDI Chlorpropamide, an antidiuretic drug that is not currently used. The antidiuretic effect is associated with the effect on the renal tubules and a decrease in water clearance, which made it possible to enhance the hydroosmotic effect of vasopressin, provided that its secretion was at least partially preserved [21, 41]. Despite the decrease in diuresis from 5.4–10.7 l/day to less than 2 l/day, there were no official recommendations for the use of this drug in CDI; in addition, severe adverse reactions such as severe hypoglycemia were noted [8, 50, 61]. Carbamazepine is an anticonvulsant and psychotropic drug used to treat epilepsy and mental disorders. This drug can stimulate the release of vasopressin from the posterior pituitary gland and also directly affects the renal tubules, increasing water reabsorption even in the absence of arginine vasopressin in vitro. This effect is associated with the effect on cAMP: in laboratory animals, carbamazepine promoted reabsorption and greater permeability for

water in the collecting ducts through a direct effect on the G-complex of the V2 receptor protein (vasopressin receptor type 2) and an increase in the expression of aquaporin 2 [5]. When studying the effect of carbamazepine on 6 patients with CDI who received 200–800 mg/day of the drug,All of them had a decrease in diuresis from 8–16 l/day to 1.9–6 l/day and an increase in urine osmolality from 60–120 mOsm/kg to 150–532 mOsm/kg. At the same time, the level of AVP remained undetectable, which confirms the absence of stimulation of its release or obstacle to deactivation by carbamazepine [36]. The development of hyponatremia was noted in up to 40% of cases in patients receiving carbamazepine for neurological disorders or pain syndrome [3, 5, 20, 24]. Clofibrate is a lipid-lowering agent that stimulates AVP production in patients with partial CDI [33, 38]. Treatment with clofibrate at a dose of 500 mg every 6 hours significantly decreased urea clearance from 280 ml/h to 141 ml/h and water clearance from 158 ml/h to 10 ml/h, while urine osmolality increased from 152 mOsm/kg to 317 mOsm/kg against the background of a concomitant decrease in AVP excretion in 2/3 of patients. A significant antidiuretic effect was observed even in patients with hypervolemia [38]. Thiazide diuretics can be used to treat both central and nephrogenic diabetes insipidus [1, 33]. This group of drugs affects the distal convoluted tubules, inhibiting the cotransport of sodium and chlorides. With prolonged exposure, the volume of extracellular fluid decreases, which leads to reabsorption of sodium and water in the proximal tubules of the kidneys, and ultimately decreases the amount of urine excreted [1]. Treatment of diabetes insipidus with chlorothiazide at 5-10 mg/kg/day or hydrochlorothiazide (1-2 mg/kg/day) in children with CDI was effective and safe, hospitalization for hypernatremia was required in 1/13 patients [40]. Indapamide is an antihypertensive diuretic agent, similar in molecular structure to hydrochlorothiazide and chlorpropamide and, like thiazide diuretics, affecting water reabsorption in the proximal renal tubules [48]. The use of indapamide 2.5 mg/day in CDI in one study allowed to reduce daily diuresis from 5–16 l/day to 2.3–9.2 l/day, but no significant effect was observed in patients who had not previously received treatment for CDI [27]. Conclusion The ability to choose the most convenient form of drug administration seems to be a very important condition for successful treatment and improving the quality of life of patients with CDI. Currently, desmopressin preparations are available in various forms, and one of the most convenient, effective and safe for patients is an intranasal spray.Treatment with clofibrate at a dose of 500 mg every 6 hours significantly decreased urea clearance from 280 ml/h to 141 ml/h and water clearance from 158 ml/h to 10 ml/h, while urine osmolality increased from 152 mOsm/kg to 317 mOsm/kg against the background of a concomitant decrease in AVP excretion in 2/3 of patients. A significant antidiuretic effect was observed even in patients with hypervolemia [38]. Thiazide diuretics can be used to treat both central

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DOI: https://doi.org/10.5281/zenodo.14498516

PROS AND CONS OF A HIGH-PROTEIN DIET

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Relevance. *In recent years, the nature of human nutrition as an important element of prevention and therapy of many pathological conditions, primarily obesity, type 2 diabetes mellitus (T2DM) and cardiovascular diseases (CVD), has become increasingly relevant. Some of the most popular nutrition models are high-protein diets, among which the Dukan diet has received the greatest recognition. Increasing the proportion of protein in the diet has shown an effective reduction in body weight, primarily due to the loss of adipose tissue, without a significant effect on muscle mass. Another advantage of a high-protein diet is the formation of an earlier and longer-lasting feeling of satiety compared to other diets, which makes it comfortable to use. In addition to obesity, a high-protein diet is presumably effective in the treatment of diseases such as non-alcoholic fatty liver disease, T2DM and CVD. However, despite the important advantages, this nutrition model is not universal and is contraindicated in a number of liver diseases, kidneys, and osteoporosis. In addition, long-term adherence to a high-protein diet, even by healthy individuals, can become a risk factor for developing urolithiasis and reducing bone mineral density. Thus, increasing the proportion of protein in the diet should only occur under the supervision of a physician.*

KEYWORDS: *high protein diet; protein, kidneys; muscles; diabetes; cardiovascular disease.*

INTRODUCTION. The nature of human nutrition as part of the prevention and treatment of obesity, as well as associated diseases, primarily type 2 diabetes mellitus (T2DM) and cardiovascular diseases (CVD), is becoming increasingly important every year [1]. The benefits and possible negative consequences of some diets, such as the

Mediterranean or Dukan diets, have been relatively well studied. Others, on the contrary, have a weak evidence base and an ambiguous prognosis, since they are largely based only on hypotheses and assumptions about their impact on human health, although they are actively used by the population, including for the purpose of weight loss. Literally 10-15 years ago, the main recommendation for weight loss was to reduce fat intake in the diet. However, at present, on the contrary, high-protein diets are among the most popular dietary models [2]. The question of what amount of protein should be considered optimal and what is increased remains open. Physiological factors that determine the daily protein requirement are: the rate of absorption of amino acids in the gastrointestinal tract (varies from 1.3 to 10 g/h depending on the protein source), the ability of the liver to form urea, and the rate of excretion of urea by the kidneys.

There are three ways to measure your daily protein intake:•

share of total daily caloric intake (%);

• absolute (g/day);

• calculated based on body weight (g/kg/day).

Each of the proposed options has its pros and cons. The share of protein in the total daily energy value can be easily calculated independently. However, this method is not universal, and in some situations, for example, when following a hypo- or hypercaloric diet, its use is controversial. In the first case, the daily dose of protein may be insufficient to meet the physiological needs of the body, and in the second - excessive and have a toxic effect. A similar problem arises when the amount of protein is measured in grams and equals a specific figure. People with different weights, especially if this is due mainly to muscle mass, will have different protein needs. Thus, the most optimal method is an individual calculation in grams per kilogram of body weight per day under the supervision of a nutritionist [3]. In addition to quantity, the origin of the protein is important. There are various classifications of protein quality [4]. DIAAS (Digestible Indispensable Amino Acid Score) is a method for assessing the nutritional value of food proteins, taking into account their source and the content of essential amino acids. It is calculated as the ratio between the amount (mg) of digestible essential amino acid in 1 g of the test protein and the amount (mg) of the same amino acid in 1 g of the control protein. DIAAS may have values below or, under certain circumstances, above 100% [5]. Animal protein, rich in essential amino acids, is of the highest quality, while plant proteins (except soy) are characterized by moderately low quality [6]. According to the US National Institutes of Health, the protein dose for a person without significant muscle loads is 0.8 g / kg / day [7]. However, the norm may differ for certain categories. For example, people with well-developed muscles need more protein. Due to age-related loss of muscle mass, the daily protein dose in the elderly should be at least 1.0-1.3 g / kg / day. At the age over 50 years and in the presence of acute or chronic diseases (except for kidney and liver

pathology), the need for protein increases to 1.2–1.5 g/kg/day [8, 9]. On the other hand, it is important to remember that excessive protein intake – up to 5 g/kg/day, typical for athletes and bodybuilders, may exceed the liver's ability to convert excess nitrogen into urea and be potentially dangerous for the body at any age [3]. Some authors believe that the daily protein requirement for a person with normal body weight should be revised upwards. Bilsborough S. et al. suggest considering the protein intake of 2.0–2.5 g/kg/day as normal, which, in their opinion, will not only satisfy the body's needs, but will also contribute to weight control without undesirable toxic effects. Morales FE et al. It is believed that the optimal amount of protein is 1.5–2.0 g/kg/day, which is almost 2 times more than Russian recommendations [3].Similar figures are cited by Canadian nutritionists and the American College of Sports Medicine (1.2–2.0 g/kg/day) [10, 11]. Since the opinions of researchers regarding the daily protein intake differ, the concept of a "high-protein diet" has not yet been defined. Various sources define a high-protein diet as one in which 27 to 68% of daily calories come from protein or protein intake ranges from 90.5 to 284 g/day, or from 1.2 to 4.4 g/kg/day [12, 13]. The most popular model of a high-protein diet over the past 10 years has been the Dukan diet, which includes 4 phases. During the first two, weight loss occurs, and the next two stabilize the result. A prerequisite before starting to eat according to the Dukan system is to determine your true weight. The calculation is based on gender, age, maximum and minimum weight throughout life, desired weight, family history of obesity, bone mineral density and the number of pregnancies in women. The resulting figure, according to Dukan, is the true weight that can be maintained for a long time without any restrictions, physical and emotional discomfort. The cornerstone of the Dukan diet is 100 permitted products. This list includes: 68 protein products (lean meat, fish, seafood, vegetable proteins, low-fat dairy products), 32 types of vegetables and oat bran. Physical exercise is included in each phase of the method and should be individually adapted. The minimum requirement is daily walking plus the type of activity chosen by the patient (aerobics, cycling, swimming, dancing, fitness, etc.). Below - more details about each of the stages of the Dukan diet. • Phase I - attack. Rapid weight loss is achieved by consuming 68 animal protein products in unlimited quantities. It is also recommended to drink 6 to 8 glasses of water per day, since digesting large amounts of protein leads to an increase in the level of ketones, which are excreted from the body in the urine. In addition, oat bran as a source of fiber and carbohydrates should be a mandatory component of the diet. Walking at an individual comfortable level is recommended as physical activity. The factors that determine the duration of the first phase are age and the weight to be lost. If the goal is to reduce body weight by less than 5 kg, the attack phase will take 1-2 days, 6-13 kg - from 3 to 5 days, more than 14 kg - up to 7 days, respectively. • Phase II - alternation. The goal of the

second stage is a gradual decrease in body weight until the desired weight is achieved. The second phase is based on alternating NP days (Natural Proteins), when only protein foods are allowed, with PV days (Proteins and Vegetables), during which 32 types of non-starchy vegetables can be added. NP days alternate with PV days in equal proportions. For example,1/1 means 1 day of pure protein, then 1 day of protein and vegetables, etc. Weight loss is gradual - on average 500 g every 3 days, mainly due to fat tissue. Physical activity is also an important part of the alternation phase, preference should be given to brisk walking for at least 30 minutes a day. • Phase III - consolidation. In the third stage, the main task is to maintain the weight achieved during the alternation phase. The basis of the diet remains 100 permitted proteins and vegetables, while high-calorie foods are gradually added. During the week, it is recommended to introduce a new group of products daily, which allows you to maintain motivation for a long time. One of the days remains purely protein, due to which, if necessary, you can adjust your weight. The duration of the third phase depends on how much body weight has decreased: for every 450 g - 10 days.

A rough outline of the consolidation phase might look like this.

• Monday: protein day.
• Tuesday: + unlimited vegetables.
• Wednesday: + fruits.
• Thursday: + wheat bread.
• Friday: + cheese.
• Saturday: + starchy foods (pasta, etc.).
• Sunday: Festive meal (aperitif (wine, etc.), appetizer, main course and cheese OR dessert; each course can only be eaten once).

As for physical activity, brisk walking for at least 30 minutes a day is still recommended. • Phase IV - stabilization. You are allowed to eat whatever you want, observing 3 simple rules: • one day of pure proteins each week; • 20 minutes of walking each day and refraining from using elevators and escalators; • 3 tablespoons of oat bran daily. This is the high-protein diet model proposed by Pierre Dukan [14]. The Stillman diet is also high-protein: proteins provide 64% of the daily caloric value (4.3 g / kg / day), and only 2% are carbohydrates. Given the strict restrictions in the diet - only lean meat (lamb, veal, etc.), fish (haddock, cod, etc.), eggs and cheese made from skim milk are allowed - the Stillman diet is recommended to be followed for a short period of time and only under the supervision of a doctor. The diet proposed by Arthur Agatston (or the South Beach Diet) is based on foods with a low glycemic index (GI), which are digested more slowly by the body and cause smaller fluctuations in blood glucose and insulin levels. Proteins make up about 39% of daily calories. It is recommended to mainly consume natural foods. The diet consists of 3 phases: Phase I - strict restriction of carbohydrates - lean meat, seafood, cheese, eggs, nuts are allowed; Phase II - a small

amount of low GI foods is introduced into the diet (some types of vegetables and fruits, whole grain bread and pasta, low-fat liquid dairy products); Phase III - almost all foods are included in the diet, with the exception of easily digestible carbohydrates. In the Zone Diet, the protein/fats/carbohydrates ratio is 30/30/40, preference is given to low GI foods and monounsaturated fats. Products are grouped into blocks based on macronutrient content. Each main meal consists of 3–5 blocks, snacks – one block. The limitations of this diet are the need to constantly count proportions and daily consumption of large amounts of vegetables [15]. Thus, despite the wide range of high-protein diets and their great popularity among those wishing to lose weight, it is important to remember that increasing the proportion of protein in the diet can lead to negative health consequences. Use in obesity An advantage of a high-protein diet may be that it results in weight loss mainly due to the loss of adipose tissue, without a significant effect on muscle mass [16]. In two studies, the first lasting 12 weeks and the second 6 months, participants followed a diet with a protein content of 0.8 g/kg/day and 1.2–1.4 g/kg/day, respectively. A decrease in body mass index (BMI) was observed in both groups, with muscle mass being higher in the second group [13, 17]. Longland TM et al. analyzed the combined effect of a high-protein diet and exercise on changes in body composition. Participants consumed 2.4 g/kg/day of protein for 4 weeks,while the control group followed a diet with a protein level of 1.2 g/kg/day. Both groups performed high-intensity training three times a week and walked 10,000 steps per day. At the end of the study, the BMI of all participants was significantly reduced. However, after analyzing the body composition, differences were revealed: against the background of increased protein intake, loss of fat tissue was predominant [18]. Another supposed advantage of a high-protein diet is an earlier and longer-lasting satiety compared to other diets, which not only contributes to weight loss, but also makes it comfortable for a person [19]. Based on the visual analog scale (VAS), which is a standard tool for measuring the subjective feeling of hunger and satiety, it was shown that the feeling of satiety is significantly higher with a diet with 60% protein than after a meal with 19% protein [20]. It is known that the feeling of hunger is formed as a result of the interaction of two groups of substances: anorexigens, which suppress appetite, and orexigens, which have the opposite effect. The main anorexigens are cholecystokinin (CCK), glucagon-like peptide 1 (GLP-1), peptide YY (PYY) and leptin; among the orexigens, ghrelin plays an important role [19, 21]. It is assumed that protein consumption controls appetite by influencing the production of an- and orexigens. Amino acids have been shown to stimulate the secretion of CCK, GLP-1 and PYY in the small intestine [21]. CCK causes contraction of the gallbladder and the release of pancreatic enzymes. In addition, it enhances the feeling of satiety by influencing the transmission of vagus nerve signals to the brainstem [22]. In an

experiment, intravenous administration of physiological doses of CCK was accompanied by a decrease in the portion of food eaten and faster satiety [23]. GLP-1 and PYY act similarly through the vagus nerve [22, 3]. A number of studies have shown that intravenous administration of PYY in doses corresponding to postprandial concentrations significantly reduces appetite [23]. In addition, PYY blocks the expression of orexigenic neuropeptide Y (NPY) and agouti-related peptide (AgRP) mRNA in the hypothalamus; improves glucose tolerance, accelerates thermogenesis and reduces the amount of white adipose tissue [21, 24]. It is noteworthy that PYY deficiency is observed in obese individuals [23]. GLP-1 slows down gastric emptying, which contributes to the formation of a longer feeling of satiety [25]. A similar effect of GLP-1 could be used to create a drug for weight loss, if not for the rapid half-life (1–3 min) due to destruction by the enzyme dipeptidyl peptidase IV, which greatly limits the clinical use of this molecule [26]. Unlike anorexigenic hormones, ghrelin levels decrease in response to protein consumption [27]. Ghrelin activates NPY and AgRP neurons in the arcuate nucleus, thereby causing a signal to increase food intake and decrease energy expenditure [28]. Leptin has the opposite effect, acting through PI3K (from the Englishphosphoinositide 3-kinases) and STAT3 (signal transducer and activator of transcription 3) [3]. Carbohydrates have the strongest, albeit short-term, suppressive effect on ghrelin production, while fat and protein cause a small but stable decrease. Blom et al. showed that after a high-protein meal, the feeling of satiety is significantly stronger, and the postprandial concentration of ghrelin decreases compared to an isocaloric meal rich in refined carbohydrates [29]. Interestingly, the specific response of ghrelin to macronutrient intake is observed only in people with normal weight, while in the presence of obesity it almost completely disappears [30, 31]. High-protein, low-carbohydrate diets promote gluconeogenesis in the liver in order to maintain normal plasma glucose levels, which, presumably, can also influence the formation of a more pronounced feeling of satiety. It is known that lowering blood glucose levels increases appetite, while amino acid-induced gluconeogenesis prevents hypoglycemia and has the opposite effect. In addition, the formation of ketone bodies (especially beta-hydroxybutyrate) increases in response to protein consumption, which also contributes to appetite suppression [32]. Another possible mechanism for weight loss during a high-protein diet is diet-induced thermogenesis (DIT). Food intake results in a temporary increase in energy expenditure, which is associated with nutrient processing (digestion, absorption, transport, and storage). DIT values are highest for protein (~15–30%), followed by carbohydrates (~5–10%) and fat (~0–3%) [33]. Whitehead et al. showed that energy expenditure was 297 kJ/day higher in individuals consuming a high-protein diet (36% of daily calories) compared to those consuming a diet rich in carbohydrates and fats. Mikkelsen et al. obtained similar results [32]. The

effects depend not only on the amount of protein, but also on its qualitative composition. Among amino acids, leucine has the greatest suppressive effect on food intake and stimulating effect on muscle protein synthesis [22, 34]. Leucine acts by inactivating AMP-activated protein kinase (AMPK) and activating the mammalian target of rapamycin (mTOR) in the hypothalamus. Activation of mTOR and deactivation of AMPK decreases the expression of NPY and AgRP, while increasing the release of the anorexigenic peptide proopiomelanocortin, which together create a feeling of satiety [22, 35]. An equally important effect of leucine is its participation in the regulation of mTOR activity in skeletal muscles, which increases muscle protein synthesis through insulin-dependent and insulin-independent mechanisms. This leads to better weight control in the long term [36]. Use in type 2 diabetes According to a meta-analysis of 18 studies,An increase in the proportion of protein in the diet in type 2 diabetes is associated with a significant decrease in the level of glycated hemoglobin [37]. As for the effects on the cardiovascular system, the data are ambiguous. Sargrad KR et al. compared blood pressure (BP) in two groups of patients: the first group followed a diet with a high protein content, the second - a normal diet. After 8 weeks, individuals in the first group showed a decrease in both diastolic (-18 mm Hg) and systolic (-10.5 mm Hg) BP compared with baseline values, while BP numbers in the second group remained unchanged [38]. Von Bibra et al. obtained similar results [39]. At the same time, other authors did not note any change in BP with an increase in the proportion of protein in the diet [40]. It is assumed that not only the amount, but also the origin of the protein are important. According to some data, red meat consumption is associated with adverse cardiovascular outcomes [41]. Sucher S. et al. showed that a diet with a higher protein content (30% of daily calories) reduces the severity of chronic inflammation and increases insulin sensitivity, which is accompanied by improved glycemic control. However, such positive effects were observed only against the background of a diet with a predominance of plant protein, but not animal protein [42]. The results of studies that examined the effect of diets with different protein content on lipid profile parameters (total cholesterol, high- and low-density lipoprotein cholesterol, triglycerides) are heterogeneous, and therefore further research is needed [40]. Data on the effects of a high-protein diet on renal function in type 2 diabetes are insufficient and contradictory. One study compared the effects of two diets (22 and 10% of daily calories from protein, respectively) in patients with type 2 diabetes and microalbuminuria on the glomerular filtration rate (GFR) and the severity of albuminuria. After 3 weeks, the parameters in patients in the first group remained unchanged, while the low-protein diet led to a significant decrease in GFR and albuminuria. Other studies, on the contrary, did not show significant changes in GFR, microalbuminuria, creatinine clearance, creatinine and urea levels in the blood against

the background of diets with different protein content [40]. There is also no clear opinion on whether the origin of protein affects renal function in patients with type 2 diabetes. Thus, Sucher et al. showed that the GFR remained stable regardless of which protein predominated in the diet - plant or animal [42]. Of interest are the results of a meta-analysis of Food4me data, according to which the consumption of plant proteins is associated with a reduced risk of developing T2DM, while the predominance of animal proteins in the diet, on the contrary, is a risk factor for its development [43]. Effect on the cardiovascular system The question of what type of nutrition is optimal for CVD remains open. Studies of the effects of high-protein diets on blood lipid levels,as the main risk factors for the development of atherosclerosis, show mixed results [37, 44]. In addition, there is no consensus on which protein - animal or plant origin - is preferable. It has been shown that with the consumption of predominantly plant protein (primarily soy), a more pronounced decrease in low-density lipoproteins, triglycerides, visceral fat volume and systolic BP is noted, while high consumption of red meat increases the risk of coronary heart disease and stroke [45–48]. Teunissen-Beekman et al. compared BP levels after consumption of pea, milk and egg protein, respectively. In response to egg protein, BP values were the highest [49]. Fekete AA et al., on the contrary, showed that cow's milk proteins have a lowering effect on BP and improve the arterial stiffness index [50]. In addition to the protein source, according to Tielemans et al., age is also important: increased intake of plant protein was inversely associated with BP only in elderly men [51]. Thus, further studies are needed to assess the benefit/risk ratio of high-protein diets in CVD. Use in non-alcoholic fatty liver disease The effect of a high-protein diet on patients with non-alcoholic fatty liver disease (NAFLD) remains controversial. According to some authors, a high-protein diet may have a therapeutic effect in NAFLD [52, 53]. Protein catabolism requires a large amount of energy, one of the sources of which may be ketogenesis in the liver [54, 55]. Glucagon, produced in response to protein intake, also stimulates ketogenesis and suppresses de novo lipogenesis [56]. In addition, a high-protein diet increases the synthesis of bile acids from cholesterol in hepatocytes [57]. All this leads to a decrease in fat infiltration and, as a consequence, the severity of NAFLD [58]. Zelber-Sagi S. et al., on the contrary, believe that animal protein increases the risk of developing NAFLD, in contrast to plant proteins [59]. Effect on bone mineral density Data on the effects of an increased proportion of protein in the diet on bone mineral density (BMD) are contradictory. Today, the problem of osteoporosis has become global - 1 in 4 women over 70 years of age experiences at least one fracture during their lifetime. In this regard, such available preventive measures as dietary modification are of paramount importance [60]. The supposed positive effect of a high-protein diet on BMD is realized due to the effect on calcium

absorption, bone metabolism and the production of insulin-like growth factor 1 (IGF-1). One of the important criteria increasing calcium absorption may be the stimulation of gastric juice secretion in response to protein food. Low pH of the stomach promotes calcium ionization and its subsequent absorption [61]. It has been shown thatthat patients with achlorhydria absorb less calcium than individuals with normal gastric pH. Another confirmation of this hypothesis is a significant decrease in calcium absorption after taking a proton pump inhibitor. In turn, the more calcium enters the body, the lower the response level of parathyroid hormone, which leads to a slowdown in bone resorption [23]. Isotope studies have shown greater calcium absorption in individuals whose diet contains an increased amount of protein [23]. During the study, participants adhered to a diet with a moderate (1.0 g / kg / day) and high (2.1 g / kg / day) protein level for 2 weeks. The results showed significantly greater intestinal calcium absorption and an increase in urinary calcium concentration in those who consumed more protein. At the same time, a significantly lower content of calcium in urine from bone tissue was found against the background of a high-protein diet. Therefore, hypercalciuria with an increase in protein intake is apparently associated with increased intestinal calcium absorption. It is known that the concentration of IGF-1 in the blood serum depends not only on the quantity but also on the quality of the consumed protein. It was found that higher levels of IGF-1 are observed in those who prefer animal proteins. The positive effect of IGF-1 on bone health has been confirmed by the results of a number of studies. IGF-1 increases the activity of osteoblasts, slows down the decline in BMD of the proximal femur in the elderly, and stimulates the growth of BMD in the spine and radius. A study involving 41,837 women aged 55–69 years revealed an inverse relationship between protein intake and the risk of hip fracture, confirming the important role of protein in nutrition [23]. Effect on the urinary system High-protein diets can be potentially dangerous for people with concomitant liver and kidney diseases, since they lead to excessive nitrogen intake into the body [3, 63]. In healthy individuals, increased protein intake is accompanied by an increase in the level of enzymes in the liver that break down amino acids, which compensates for the nitrogen load, while in liver diseases, an increase in the levels of amino acids, ammonia and urea in the blood may occur [3]. The removal of elevated, compared to a normal diet, concentrations of protein breakdown products necessitates an increase in the volume of fluid consumed. First of all, this is relevant for individuals with normal kidney function; in the presence of any diseases, the volume of fluid consumed is strictly individual. Martin WF et al. analyzed the relationship between the amount of protein consumed, the concentration of urea in the blood, plasma osmolality and the specific gravity of urine. During the study, the participants were divided into 3 groups: diet I contained 3.6 (high consumption), II - 1.8 (average) and III - 0.8 (low) g / kg /

day of protein, respectively. The participants adhered to their usual level of fluid consumption. According to the results,In group I, blood urea levels, plasma osmolality, and urine specific gravity were the highest [64]. An increase in SCF after consuming large amounts of protein is another indicator of increasing stress on the kidneys. In the long term, this can lead to kidney damage and a decrease in SCF, primarily in predisposed individuals. Huang MC et al. studied the effect of diet on SCF in a study of 599 adult patients diagnosed with stage 3–5 chronic kidney disease. It was found that individuals consuming a high-protein diet had a significant decrease in SCF compared to those consuming normal or low amounts of protein [65]. A high-protein diet may negatively affect the risk of kidney stones [66]. A link between high protein intake and the risk of developing or recurring urolithiasis (UB) was demonstrated in a study of healthy men on their usual diet with a four-year follow-up. Men consuming >77 g/day of animal protein showed a higher risk of developing urolithiasis than those whose diet contained 50 g of protein per day (1.33 vs. 1.00, respectively). It has been proven that limiting the consumption of animal protein, on the contrary, is one of the ways to prevent recurrent kidney stones [62]. It is assumed that the lithogenic effect is realized through several mechanisms. For example, by reducing the level of citrate in the urine. In addition, it has been shown that high consumption of animal protein is accompanied by an increase in the excretion of oxalates in the urine in about 30% of patients with idiopathic calcium nephrolithiasis, while in others such an effect is not observed. This susceptibility is apparently associated with genetic factors [62]. Thus, patients with an increased risk of kidney pathology (including diabetes, arterial hypertension and CVD) should be prescribed a high-protein diet with caution and exclusively under the supervision of a physician. In addition, it is important to remember that nephrolithiasis is a potential side effect of a high-protein diet, and therefore such dietary patterns are contraindicated in patients with a history of ICD. There is also insufficient data on the long-term impact of increased protein intake in older people, since SCF decreases with age. There is currently no evidence that a high-protein diet can negatively affect liver and kidney function in healthy individuals [67]. However, further research is needed to study this issue in more detail.In a study of 599 adult patients diagnosed with stage 3–5 chronic kidney disease, the effect of diet on SCF was studied. It was found that individuals consuming a high-protein diet had a significant decrease in SCF compared to those consuming normal or reduced amounts of protein [65]. A high-protein diet may negatively affect the risk of kidney stones [66]. An association between high protein intake and the risk of developing or recurring urolithiasis was demonstrated in a study of healthy men on their usual diet with subsequent observation for four years. Men consuming >77 g/day of animal protein showed a higher risk of developing urolithiasis than those whose diet contained 50 g

of protein per day (1.33 versus 1.00, respectively). On the contrary, limiting animal protein intake has been proven to be one of the ways to prevent recurrent kidney stones [62]. The lithogenic effect is believed to be mediated by several mechanisms. For example, by reducing urinary citrate levels. In addition, high animal protein intake has been shown to be associated with increased urinary oxalate excretion in approximately 30% of patients with idiopathic calcium nephrolithiasis, while no such effect is observed in others. This susceptibility appears to be associated with genetic factors [62]. Thus, patients at increased risk of renal pathology (including diabetes, hypertension, and CVD) should be prescribed a high-protein diet with caution and only under medical supervision. In addition, it should be remembered that nephrolithiasis is a potential side effect of a high-protein diet, and therefore such dietary patterns are contraindicated in those with a history of impaired ICD. There is also insufficient data on the long-term effects of increased protein intake in the elderly, since SCF decreases with age. There is currently no evidence that a high-protein diet can negatively affect liver and kidney function in healthy individuals [67]. However, further research is needed to study this issue in more detail.In a study of 599 adult patients diagnosed with stage 3–5 chronic kidney disease, the effect of diet on SCF was studied. It was found that individuals consuming a high-protein diet had a significant decrease in SCF compared to those consuming normal or reduced amounts of protein [65]. A high-protein diet may negatively affect the risk of kidney stones [66]. An association between high protein intake and the risk of developing or recurring urolithiasis was demonstrated in a study of healthy men on their usual diet with subsequent observation for four years. Men consuming >77 g/day of animal protein showed a higher risk of developing urolithiasis than those whose diet contained 50 g of protein per day (1.33 versus 1.00, respectively). On the contrary, limiting animal protein intake has been proven to be one of the ways to prevent recurrent kidney stones [62]. The lithogenic effect is believed to be mediated by several mechanisms. For example, by reducing urinary citrate levels. In addition, high animal protein intake has been shown to be associated with increased urinary oxalate excretion in approximately 30% of patients with idiopathic calcium nephrolithiasis, while no such effect is observed in others. This susceptibility appears to be associated with genetic factors [62]. Thus, patients at increased risk of renal pathology (including diabetes, hypertension, and CVD) should be prescribed a high-protein diet with caution and only under medical supervision. In addition, it should be remembered that nephrolithiasis is a potential side effect of a high-protein diet, and therefore such dietary patterns are contraindicated in those with a history of impaired ICD. There is also insufficient data on the long-term effects of increased protein intake in the elderly, since SCF decreases with age. There is currently no evidence that a high-protein diet can negatively affect liver and kidney function in

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CONCLUSION. To sum up, we can conclude that a high-protein diet is very effective and comfortable for weight loss in the short term. However, given the significant load on the kidney and liver function, a protein diet can only be recommended for certain categories of patients. An extensive list of contraindications necessitates switching to a high-protein diet exclusively under the supervision of a doctor and after undergoing an examination with monitoring of the condition in dynamics.

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DOI: https://doi.org/10.5281/zenodo.14498527

HOW SPECT (SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY) WORKS

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Annotation: *Single-photon emission computed tomography (SPECT) is a diagnostic imaging technique in which radionuclide distribution tomograms are obtained using gamma photons detected at multiple label distribution sites. Emission computed tomography (ECT) allows obtaining a layer-by-layer distribution of functional properties from the upper and lower layers of the studied organ in biological tissues that do not take into account the contribution of radioactivity, and ECT images describing physiological and metabolic processes in the body and physiological and metabolic processes in the body are approximately 15 in SPECT systems With a spatial resolution of -20mm this is worse than TKT systems (1mm).*

Keywords: *SPECT, Single photon emission computed tomography, radioisotopes, Gantry motion, CT, TKT, Emission computed tomography.*

The goal: The principle of single-photon emission computed tomography is to obtain a series of scintigrams by software-controlled rotation of one or more tomograph directors along the longitudinal axis of the body of patients receiving radiopharmaceuticals necessary for research. A chest X-ray is an example of a planar transmission image. An abdominal computed tomography (CT) is an example of a transmission tomography (TT). Single Photon Emission Computed Tomography (SPECT) is similar to PET and uses radioisotopes and gamma radiation emitted by a gamma camera, SPECT is a rapid so It requires injection of a traceable U-radioactive marker, but is not redistributed by the brain. Its consumption is approximately 100%

within 30-60 seconds, which reflects the blood supply of the brain at the time of injection. These properties of SPECT make it particularly suitable for epilepsy, which is usually difficult due to patient movements and various types of seizures. The image projections obtained during the full rotation of the detector system are processed on a computer and special algorithms are used to reconstruct the axial, coronal, sagittal and oblique sections. The detector head includes: a collimator, a 3/8" (9.3 cm) thick NaI (Tl) scintillation detector, a light guide, a photomultiplier unit, and a coordinate and energy signal generation circuit. The detector head includes : a lead shield protecting against the impact of the gamma-ray detector, excluding the collimator apertures. In modern tomographs, signals are digitized at the level of preamplifiers of photomultipliers, and all subsequent data processing is carried out on a digital scale (fully). Digital one-photon emission computed tomography - in such tomographs, the number of analog-to-digital converters is equal to the number of photomultipliers. SPECTRUM forms. Planar. A planar image shows only one projection of the distribution of a radiotracer in the patient's body. Tomographic. A tomographic image is a slice or volume representation of the radiotracer distribution calculated from multiple images taken at different camera positions. There are two types of images in SPECT: emission images (they show the distribution of the radiotracer in the body) and transmission images (they show the distribution of the extinction coefficient) . In SPECT, transmission tomography can be used to more accurately reconstruct emission tomograms. This could be by building more accurate models of the emission data collection process and providing the data needed for more accurate inversion software. Examining bones using SPECT is an example of emission tomography (ET). Planar transmission emission images are projections of the scanned object. Through the interior of the gray object at each point, the information transmits the sum of the information received from all points along a single path. The goal of image reconstruction is to interpret this mixed information to determine the features of the object at each individual point of the body. A major advantage of SPECT is ET imaging—images of a radiotracer inside the body are used to evaluate the attenuation effects of gamma rays within the patient, and TT imaging is performed to correct the ET images. These non-attenuation-corrected images are non-quantitative and are only suitable for qualitative assessment of the marker distribution.

Single photon emission computed tomography systems. The advantage of acquiring data in SPEKT is that it is enough projection data to reconstruct the tomographic image. To do this, gamma cameras rotate around the object, and data is collected for several sections at the same time. Standard protocols take 64 or 128 measurements (using 64 or 128 detector elements) of the object at each angle during

camera rotation. That is, at each stop in the data corner, a 64x64 or 128x128 image or projection is created according to the scanning protocol.

System configurations. SPEKT systems differ in the number of gamma cameras. (Jaszczak, Chang, Stein, et al., 1979; Lim et al., 1980, 1985; Chang et al., 1992; Rowe et al., 1993; Milster et al., 1990). In principle, as the number of cameras increases, the sensitivity of the system increases, because gamma-ray photons that do not propagate perpendicular to the surface of any camera head are simply not counted.

Gantry movement. There are two common forms of data collection, which are reflected in the way the portal operates. In continuous scanning, data is collected by continuously rotating the Gntry ring with the camera around the patient. The data obtained for each scanning angle form an equivalent array. In step scanning, the rotating gantry ring stops at various positions until data collection is complete and then moves on to the next position.

Summary: Because SPECT images have relatively low spatial resolution, doctors often compare them to X-ray CT images. This allows to better determine the exact position of the anomaly in relation to the surrounding anatomical structures.
For this purpose, imaging support systems have been developed that perform SPECT and CT using the same cameras on a rotating gantry. These imaging devices, called SPECTT systems, produce well-aligned SPECT and CT images with precise anatomic localization of pathology. In addition, CT images can be used to correct for attenuation in SPECT images.

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DOI: https://doi.org/10.5281/zenodo.14498563

LAZERLAR VA ULARDAN TIBBIYOTDA FOYDALANISH

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ANNOTATSIYA

Ushbu maqolada lazer texnologiyasining tibbiyotdagi qo‘llanilishiga bag‘ishlangan tahlil keltirilgan. Lazerlarning asosiy turlari (CO_2, Nd:YAG, diod va ekzaimer lazerlar) va ularning xususiyatlari bayon etilgan. Tibbiyot sohasida lazerlarning qo‘llanilish yo‘nalishlari, jumladan jarrohlik amaliyotlari, oftalmologiya, dermatologiya, stomatologiya, urologiya va ginekologiyadagi afzalliklari va imkoniyatlari ko‘rib chiqilgan. Shuningdek, lazer terapiyasining afzalliklari (aniqlik, kam invazivlik, tez tiklanish) va cheklovlari (yuqori narx, mutaxassis talab etilishi) tahlil qilingan. Maqola lazer texnologiyasining tibbiyotda kelajakda yanada rivojlanishi va keng qo‘llanilishi mumkinligiga ishora qiladi.

Kalit so‘zlar: *Lazer texnologiyasi, tibbiyotda lazer qo‘llanilishi, jarrohlik lazerlari, oftalmologiya, dermatologiya, Nd:YAG lazer, CO_2 lazer, stomatologiya, estetik tibbiyot, lazer terapiyasi, invaziv bo‘lmagan davolash, ko‘z operatsiyalari, teri yoshartirish, ginekologiya, lazer ablatsiyasi, buyrak toshlarini maydalash.*

Kirish: Lazer texnologiyasi oxirgi o‘n yilliklarda tibbiyot sohasida inqilobiy o‘zgarishlar kiritdi. Bu texnologiya o‘zining yuqori aniqligi, invaziv emasligi va kam asoratlar bilan ajralib turishi sababli keng qo‘llanilmoqda. Lazer nurlari muayyan

to‘qimalarni nishonga olishda katta samaradorlikni ta’minlab, turli xil kasalliklar davosida ishlatiladi. Ushbu maqolada lazerlarning asosiy turlari, ularning xususiyatlari va tibbiyotda qo‘llanilishiga e’tibor qaratamiz.

Lazer texnologiyasi va asosiy tushunchalar: “Lazer” atamasi inglizcha “Light Amplification by Stimulated Emission of Radiation” so‘zlarining qisqartmasidir, ya’ni “nurlanishning stimulyatsiyalangan emissiyasi orqali yorug‘likni kuchaytirish”. Lazerlar quyidagi asosiy xususiyatlarga ega:

Monoxromatiklik: Lazer nuri 1ta to‘lqin uzunligida bo‘ladi, u bir xil rangga ega.

Kogerentlik: Lazer nurlari fazoda va vaqtda muvofiqlikda bo‘ladi.

Lazerlarning turlari: Lazerlar har xil xususiyatlariga ko‘ra tasniflanadi, jumladan, ularning to‘lqin uzunligi, energiyasi va ishlash usuli. Quyida tibbiyotda keng qo‘llaniladigan asosiy lazer turlari bilan tanishamiz:

1. Gaz lazerlari: CO_2 (Karbonat angidrid) lazeri: To‘qimalarni kesish, bug‘latish va koagulyatsiya qilish uchun ishlatiladi. Juda chuqur kesish qobiliyatiga ega bo‘lgani uchun, teri jarrohliklari, oftalmologiya va onkologiyada keng qo‘llaniladi.

Argon lazeri: Qon tomirlarini davolashda, jumladan, retinal yallig‘lanishlarni davolash va qon tomirlarining koagulyatsiyasi uchun oftalmologiyada qo‘llaniladi.

2. Qattiq jism lazerlari: Nd:YAG (Neodimiyum doplangan ittriyum-aluminiy granat) lazeri: Ushbu lazer yuqori penetratsiya qobiliyatiga ega bo‘lib, qon tomirlarni yopish, qorin bo‘shlig‘I jarrohligi, teri kasalliklarini davolash va onkologiyada qo‘llaniladi.

3. Diod lazerlari: Ular turli xil to‘lqin uzunliklarida mavjud bo‘lib, epilyatsiya, teri yoshartirish va tish kasalliklarini davolashda ishlatiladi.

4. Ekzaimer lazeri: 193 nm ultrabinafsha nurlanishi yordamida ishlaydi. Ushbu lazer asosan oftalmologiyada, ayniqsa LASIK va PRK kabi ko‘z operatsiyalarida keng qo‘llaniladi, chunki u korneani shakllantirish va ko‘zning qiyoslash qobiliyatini oshirish uchun aniqroq ishlatiladi.

Lazerlarning tibbiyotda qo‘llanilishi: Tibbiyotda lazer texnologiyasi turli sohalarda keng qo‘llaniladi. Quyida ularning eng muhim yo‘nalishlari bilan tanishamiz:

1. Jarrohlik amaliyotlarida: Lazerlar tibbiyotda invaziv jarrohlik amaliyotlarini ancha soddalashtirdi. Ular orqali bemorlarda qon yo‘qotish darajasi kamayadi, jarohat tezroq bitadi va infeksiya xavfi past bo‘ladi. Masalan:Laparoskopik jarrohlik: Lazerlar orqali qorin bo‘shlig‘I jarrohliklarida aniq va minimal invaziv kesishlar amalga oshiriladi.Onkologiya: O‘smalarni lazer yordamida yo‘q qilish mumkin, bu esa sog‘lom to‘qimalarga minimal zarar yetkazadi.

2. Oftalmologiya: Oftalmologiya lazerlardan foydalanishning eng mashhur sohalaridan biridir.LASIK operatsiyasi: Ko‘rish qobiliyatini tiklash uchun korneani

shakllantirish orqali miyopiya, gipermetropiya va astigmatizmni davolash uchun ishlatiladi.Retinopatiya: Lazerlar diabetik retinopatiya va boshqa retinal kasalliklarni davolash uchun qon tomirlarini koagulyatsiya qiladi.

3. Dermatologiya va estetik tibbiyot: Teri yoshartirish: Lazerlar terining kollagen ishlab chiqarishini rag‘batlantiradi, shuningdek, ajinlar va pigmentatsiya bilan kurashishga yordam beradi.Lazer epilyatsiyasi: Soch follikulalarini yo‘q qilish orqali doimiy soch o‘sishini to‘xtatadi.Tatuirovka olib tashlash: Lazerlar tatuirovka pigmentini parchalab, teridan olib tashlaydi.

4. Stomatologiya: Stomatologiyada lazerlar tish plombalari, to‘qimalarni kesish, periodontal kasalliklarni davolash va hatto tishlarni oqartirishda qo‘llaniladi. Bu jarayonlar bemorlar uchun kamroq og‘riqli bo‘lib, an’anaviy usullarga qaraganda tezroq tiklanish imkoniyatini beradi.

5. Urologiya: Lazerlar buyrak toshlarini maydalashda (litotripsiya) keng qo‘llaniladi. Bu lazerlar katta toshlarni mayda zarrachalarga parchalab, ularni tabiiy ravishda siydik orqali chiqarib yuboradi.

6. Ginekologiya: Lazer ablatsiyasi: Endometrioz va servikal displaziya kabi kasalliklarni davolashda ishlatiladi.Lazer vaginal yoshartirish: Vaginal to‘qimalarni siqish va kollagen ishlab chiqarishni rag‘batlantirish orqali ayollarning reproduktiv salomatligini yaxshilashga qaratilgan.

Lazer terapiyasining afzalliklari va cheklovlari: Afzalliklari:

Aniq nishon olish va qo‘shni to‘qimalarga zarar yetkazmaslik.

Minimal qon ketish va infeksiya xavfi.

Tiklanish davrining qisqarishi va bemorlar uchun kamroq noqulaylik.

Jarrohlik kesmalari minimal invaziv bo‘lgani sababli kamroq iz qoldiradi.

Cheklovlari:

Lazer uskunalarining yuqori narxi.

Malakali shifokorlar tomonidan boshqarilishi kerakligi sababli o‘qitish va tayyorgarlik talab etiladi.

Ba’zi hollarda to‘qimalarning kuyish xavfi.

Ba’zi bemorlar lazer nuriga sezuvchan bo‘lishi mumkin.

Xulosa: Lazer texnologiyasi tibbiyotda haqiqiy inqilob bo‘lib, turli xil kasalliklar va patologiyalarni davolashda keng imkoniyatlar ochib berdi. Ular nafaqat jarrohlik amaliyotlarini yengillashtirdi, balki kosmetik tibbiyot, stomatologiya va oftalmologiyada ham ko‘plab innovatsiyalar olib keldi. Biroq, lazer texnologiyasidan foydalanish tibbiyot mutaxassislari tomonidan ehtiyotkorlik bilan amalga oshirilishi kerak, chunki noto‘g‘ri foydalanish salbiy oqibatlarga olib kelishi mumkin. Foydalanish imkoniyatlarining kengayishi bilan lazer texnologiyasi kelajakda yanada rivojlanib, tibbiyotning turli sohalarida yangi davolash usullarini taqdim etishi kutilmoqda.

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DOI: https://doi.org/10.5281/zenodo.14498580

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Annotatsiya: *Ushbu maqolada yurak porogi – bu yurak mushaklariga qon oqimi to‘satdan to‘xtashi natijasida yuzaga keladigan jiddiy holatlar bo‘lib jarayonning mohiyati, yurak mushaklariga qon yetkazib beruvchi koronar arteriyalar torayishi yoki tiqilishi natijasida miokard infarkti rivojlanadidan iboratdir.*

Kalit so‘zlar: *Yurak porogi, Koronar arteriya, Arteriya va vena, Modifikatsiya, Elektrokardiogramma, Koronar angioplastika. Asosiy sababi: Koronar arteriyaning ateroskleroz (xolesterin blyashkalari) tufayli torayish yoki tromb hosil bo‘lishi.*

Yurakning anatomik tuzilishidagi turg‘un nuqson, kamchilik va o‘zgarishlar; normal qon oqimiga xalaqit beradi. Tug‘ma va orttirilgan Yurak poroklari farq qilinadi. Tug‘ma Yurak poroklari homila yuragi va yurak yirik tomirlarining embrional rivojlanish davrida noto‘g‘ri shakllanishi natijasida ro‘y beradi. Homiladorlikning ilk davrida ona organizmining zaharlanishilar asosan, ba’zi kasalliklar bilan og‘rishi mumkun chunki ionlovchi nurlarning biologik ta’sirilari asosan irsiy kasalliklar va hokazo sabab bo‘ladilar. Go‘daklik davrida (1 yoshgacha) yuraktomir sistemasining to‘la rivojlanmay qolishi (mas, ochiq arterial yo‘llar yoki oval teshikning bitmay qolishi) Yurak poroklariga kiradi. Tug‘ma Yurak poroklari ning ko‘p uchraydigan turlari: katta va kichik qon aylanish doiralari o‘rtasida har xil kombinatsiyadagi anormal yo‘l shuningdek, yurakning yirik tomirlari (mas, o‘pka arteriyasi va aorta)da toraygan yoki bitib qolgan joylar bo‘lishi yoki shu tomirlarning noto‘g‘ri joylashuvlari aralash poroklari yurak bo‘lmachalar soni va tuzilishiga oid nuqsonlardir.

Arteriya va vena qonining qay daraja aralashib turishiga qarab ba’zi tug‘ma Yurak poroklari sianoz bilan (ko‘k xildagi poroklar), ba’zilari sianozsiz (oq xildagi poroklar) bo‘ladi. Bu qonning katta va kichik qon aylanish doiralarini tutashtiruvchi

noo‘rin teshiklar orqali qaysi tomonga oqib o‘tishiga (shunt yo‘nalishiga), o‘pka arteriyasidagi bosimning ko‘tarilishi darajasi va yurak muskullari holatiga bog‘liqdir. Bolaning jismonan tuzuk rivojlanmasligi, rangparlik yoki ko‘karib ketish, nafas siqishi, yurak hajmi va holatining o‘zgarishi, yurakda shovqin eshitilishi va boshqalar tug‘ma Yurak poroklariga xos belgilardir.

Sabablari va xavf omillari

1. Modifikatsiyalanadigan omillar:

1 Chekish.

2 Noto‘g‘ri ovqatlanish (yuqori xolesterin).

3 Semizlik va kam harakatlilik. 4 Gipertoniya (qon bosimining balandligi)

Yurak porogining belgilari; Yurak porogi belgilari odatda to‘satdan yuzaga keladi va darhol tibbiy yordam talab qiladi:

• Asosiy simptomlar:

• Ko‘krak sohasida qattiq og‘riq, bosim yoki siqilish hissi.

• Og‘riqning chap qo‘l, elka yoki jag‘ga tarqalishi.

• Nafas qisishi va o‘pka yetishmovchiligi.

• Qo‘shimcha belgilari:

• Terlash, bosh aylanishi.

• Ko‘ngil aynishi va qusish.

• Xiralashgan ong yoki zaiflik.Kasallik belgilari

Diagnostika: • Elektrokardiogramma (EKG): Yurakning elektr faolligini o‘lchash orqali miokard infarkti aniqlanadi.

• Qon tahlillari: Yurak fermentlari (troponin va kreatinkinaza) darajasini aniqlash.

• Angiografiya: Koronar arteriyalar holatini aniqlash uchun kontrast modda yordamida o‘tkaziladigan rentgen tekshiruvi.

Davolash: 1. Favqulodda yordam:

• Qon tomirlarni kengaytiruvchi dori vositalari (nitroglitserin).

• Tromblarni erituvchi preparatlar (trombolitiklar).

2. Jarrohlik usullari: Koronar angioplastika: Arteriyani kengaytirish va stent qo‘yish.

• Koronar bypass: Bloklangan arteriyani chetlab o‘tish uchun yangi qon yo‘lini yaratish.

Profilaktika: Yurak porogining oldini olish. Yurak porogining oldini olish uchun quyidagi chora-tadbirlar tavsiya etiladi:

• Sog‘lom turmush tarzi:

• Muntazam jismoniy faollik (haftasiga kamida 150 daqiqa o‘rtacha harakat).

• Noto‘g‘ri ovqatlanishdan voz kechish, xolesterin va tuz iste’molini kamaytirish.

• Yomon odatlardan voz kechish:

• Chekishni tashlash.

• Me’yordan ortiq spirtli ichimliklarni iste’mol qilmaslik.
• Tibbiy nazorat: Qon bosimini va xolesterin darajasini muntazam nazorat qilish.
• Yoshi katta odamlarga profilaktik tekshiruvlar tavsiya etiladi.

Xulosa qilib aytganda: Yurak porogi – hayot uchun xavfli bo‘lgan jiddiy sog‘liq muammosi. Uning oldini olish uchun sog‘lom turmush tarzi, muntazam tibbiy nazorat va xavf omillarini boshqarish muhimdir. Har bir inson yurak sog‘lig‘ini asrash bo‘yicha mas’uliyatli bo‘lishi va sog‘lom odatlarni hayotga tatbiq etishi zarur.

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DOI: https://doi.org/10.5281/zenodo.14498594

KO‘P O‘LCHAMLI KUB ELEMENTLARI SONINI HISOBLASH

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Annotatsiya: *Ushbu maqolada ko‘p o‘lchamli kub tushunchasi, uni hosil qilish jarayoni, n o‘lchamli kublarning uchlari, qirralari, yoqlari sonini hisoblashning umumiy ifodasi va analitik ko‘rinishi berilib, n o‘lchamli kub elementlarini aniqlovchi ko‘phadlari keltirilgan.*

Kalit so‘zlar: *kesma, kvadrat, kub, n o‘lchamli kublar, n o‘lchamli kubning ko‘phadi.*

Abstract: *This article presents the concept of a multidimensional cube, the process of its creation, a general expression and analytical view of calculating the number of vertices, edges, sides of n-dimensional cubes, and polynomials defining the elements of n-dimensional cubes.*

Key words: *cross section, square, cube, n-dimensional cubes, n-dimensional cube polynomial.*

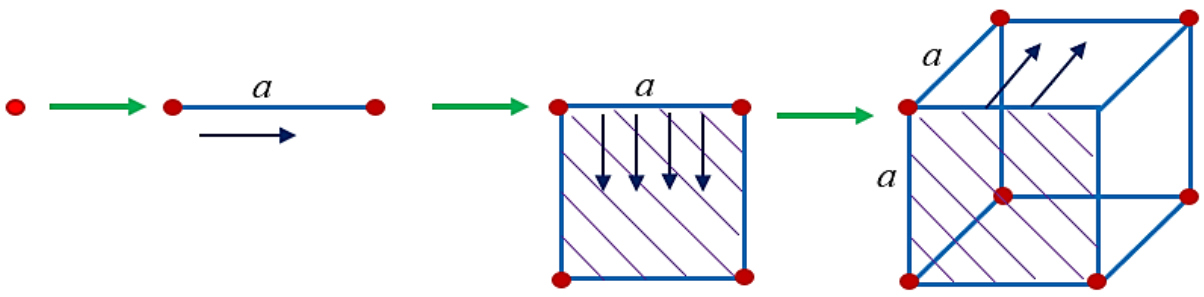
Kirish. O‘quvchilar tomonidan doimiy ravishda geometrik masalalar yechib borish nazariyani ongli va puxta o‘zlashtirishga yordam beradi, uning amaliy qiymatini ko‘rsatadi, shu bilan birga masala yechish o‘quvchining mantiqiy tafakkurini, ijodiy tashabbuskorliklarini, fazoviy tasavvurlarini rivojlantirishda hamda ularga bir qancha zarur amaliy mahorat va malakalar beradi. Jumladan tekislikda kvadrat va uning xossalarini puxta o‘zlashtirga o‘quvchi, kubning yoqlari kvadratlardan iborat ekanligini tasavvur qilgan holda uning elementlarini topishga doir masalalarni qiynalmay hal qila oladi. O‘quvchilarga ko‘p o‘lchamli fazolar to‘g‘risida tushuncha berganimizda o‘z-o‘zidan ular tomonidan bu fazolarda ko‘pyoqlarning asosan kubning ko‘rinishi va uning elementlari soni qanday o‘zgarishi bo‘yicha savollar tug‘ilib,

qiziqishlari ortib boradi. Ko‘p o‘lchamli ko‘pyoqlarni o‘rganish fazoviy tasavvurlarni, mantiqiy fikrlashlarni rivojlantirishda muhim o‘rin tutadi.

Mavzuga oid adabiyotlarning tahlili. Ko‘p o‘lchovli kublar yoki giperkublar mavzusi geometriya, grafiklar nazariyasi, toifalar nazariyasi va informatika va fizikadagi ilovalarni o‘z ichiga olgan keng doiradagi sohalarni qamrab oladi. Ushbu mavzu bo‘yicha adabiyotlar xilma-xil bo‘lib, ko‘p o‘lchovli ob’ektlarning nazariy jihatlarini ham, amaliy qo‘llanilishini ham qamrab oladi. Ko‘p o‘lchamli kublar nazariyasi o‘rganilgan ba’zi ishlarni keltiramiz: "Geometrical Foundations of the Theory of n-Dimensional Space" (V. Klee, 1961) – giperkublarning geometrik xossalari, ularning simmetriyasi va topologik xarakteristikalari batafsil o‘rganilgan, "Higher-Dimensional Geometry" (P. McMullen, 1989) — ko‘p o‘lchovli ob’ektlarni, shu jumladan giperkublarni ko‘p o‘lchovli geometriya nuqtai nazaridan tasvirlaydi, "The Theory of Polytopes" (Branko Grünbaum, 2003) — ko‘pburchaklar, shu jumladan giperkublar, ularning topologik va kombinatorik xususiyatlari muhokama qilingan holda batafsil tavsiflangan, “Многомерный куб” (Г. А. Гальперин, 2015)-ko‘p o‘lchamli kub tushunchasi, uni hosil qilish jarayoni, n o‘lchamli kublarning uchlari, qirralari, yoqlari sonini hisoblashning umumiy ifodasi va analitik ko‘rinishi berilib, n o‘lchamli kub, tetraedr, oktaedrlarning elementlarini aniqlovchi ko‘phadlari keltirilgan.

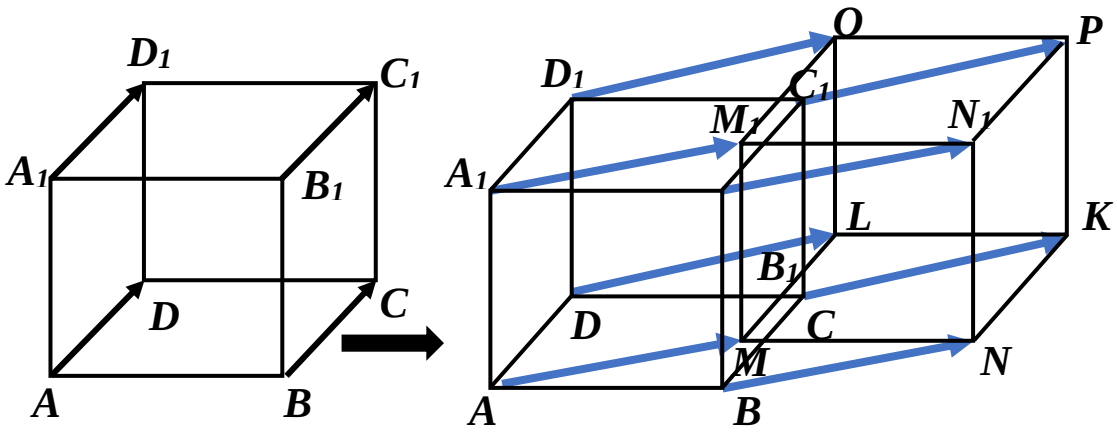
Tadqiqot metodologiyasi. Ma’lumki, uch o‘lchamli kubning uchta o‘lchami bo‘lib, ular: bo‘yi, eni va balandligi. Tekislikda kubning analogi kvadrat bo‘lib, u ikki o‘lchamga ega: bo‘yi va eni. Shuning uchun uni ikki o‘lchamli kub deb qarash mumkin. Xuddi shunday mulohaza yuritsak demak to‘g‘ri chiziqdagi kesmani bir o‘lchamli kub deyish mumkin.

To‘rt o‘lchamli kubni qurishimiz uchun biz kichik o‘lchamli kublarni induktiv fikr yuritib qurishdan boshlaymiz. Nuqtani olib uni to‘g‘ri chiziq bo‘ylab harakatlantirsak, biz ma’lum uzunlikdagi a kesmaga ega bo‘lamiz, demak bizda bir o‘lchamli $(n=1)$ kub hosil bo‘ldi. Ushbu kesmani unga perpendikulyar yo‘nalishda a miqdorga parallel ko‘chirsak biz tomonlari a ga teng bo‘lgan kvadratga ega bo‘lamiz, ikki o‘lchamli $(n=2)$ kub hosil bo‘ladi. Nihoyat, kvadratni uchinchi o‘lcham bo‘ylab siljitib, biz qirrasi a ga teng bo‘lgan, $n=3$ o‘lchamli kubga ega bo‘lamiz.



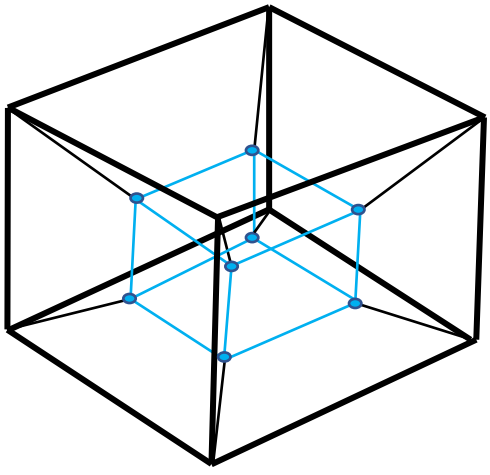
Endi yuqoridagilarga o‘xshash holda harakat qilib, oldingi uchta yo‘nalishga perpendikulyar bo‘lgan yo‘nalishda uch o‘lchamli kubni harakatlantirib to‘rt o‘lchamli kubni (giperkub) hosil qilamiz.

Giperkub (to‘rt o‘lchamli kub) tasvirini ikki o‘lchamli tekislikda tasvirlayotganimiz uchun biz uning tekislikdagi proyeksiyasini tasvirini keltiramiz.



Odatda to‘rt o‘lchamli gubning (to‘rt o‘lchamli gub tesserakt ham deyiladi) ko‘rgazmali tasvirini hosil qilish ushun ikkinchi kubni kattalashtirib dastlabki kubni uning ichiga joylab, tasvirni tekislikka proyeksiyalasak quyidagi ko‘rinishga ega bo‘lamiz:

Tahlil va natijalar. Endi ikki o‘lchamli kub, ya’ni kvadratdan uch o‘lchamli kub va uch o‘lchamli kubdan to‘rt o‘lchamli kub hosil qilish jarayonida uchlari, qirralari va yoqlari soni qanday o‘zgarishini ko‘rib chiqamiz.



Dastlab kvadratdan uch o‘lchamli kubni qurishni qaraymiz:

1. Barcha uchlari ikki barobar ortadi (qo‘shgandan keyin siljitilgan kvadratning uchlari) va ularning qiymati 2·4=8 aylanadi;

2. Barcha qirralar ikki barobar o‘zgaradi (qirralar qo‘shiladi). O‘zgartirilgan kvadrat, yangi *ABCD* kvadratining uchlaridan chiqayotgan qirralar, ularning qiymati 2·4+4 = 12 ga teng;

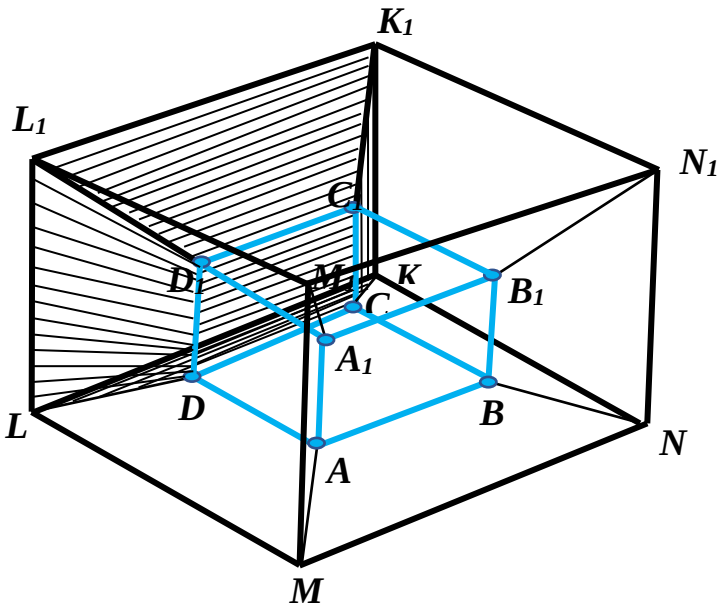
3. *ABCD* yoqqa unga parallel bo‘lgan yana bitta *A’B’C’D’* yoq, hamda to‘rtta yon yoq qo‘shiladi va jami yoqlari soni 2+4=6 bo‘ladi.

Endi kubidan to‘rt o‘lchamli kub qurishni ko‘rib chiqamiz:

1. $ABCDA_1B_1C_1D_1$ kubning uchlari soni ikki barobar ortadi, yani ular soni $2 \cdot 8 = 16$ ta bo‘ladi.

2. $AB, BC, \ldots, D_1A_1$ qirralari soni ikki barobar ortadi, ularga tashqi kubning $MN, NK, \ldots, L_1M_1$ qirralari mos keladi, shuningdek, $A, B, C, D, A_1, B_1, C_1, D_1$ uchlardan “o‘sib” chiqqan yangi qirralarni qo‘shiladi: $2 \cdot 12 + 8 = 32$

3. Barcha $ABCD, \ldots, A_1B_1C_1D$ yoqlar soni ikki barobar ortib ularga tashqi kubning $MNKL, \ldots, M_1N_1K_1L_1$ yoqlar mos keladi. Shuningdek $ABCDA_1B_1C_1D_1$ kubning barcha qirralaridan “o‘sib chiquvchi” yangi yoqlar qo‘shiladi: $2 \cdot 6 + 12 = 24$. Demak to‘rt o‘lchamli kubning ikki o‘lchamli yoqlari soni 24 ta.



4) Ikkita $ABCDA_1B_1C_1D_1$ kub va undan parallel ko‘chirish bilan hosil qilingan $MNKLM_1N_1K_1L_1$ uch o‘lchamli kublardan tashqari $ABCDA_1B_1C_1D_1$ kubning yoqlaridan “o‘sib chiquvchi” oltita kesik piramidalarni ham qo‘shish kerak. Natijada to‘rt o‘lchamli kubning $2+6 = 8$ ta uch o‘lchamli yoqlari hosil bo‘ladi.

Yuqoridagilarga asosan hosil bo‘layotgan kublarning uchlari, qirralari va yoqlari sonini topishni analitik ifodasini ko‘rib chiqamiz.

n o‘lchamli kublarning k o‘lchamli yoqlari sonini $F_n{}^k$ orqali belgilaymiz.

Nuqta no‘l o‘lchamli kub bo‘lgani uchun faqat bitta no‘l o‘lchamli yoq mavjud. Kesma yani bir o‘lchmli kub ($n=1$) uchun ikkita no‘l o‘lchamli ($k=0$) yoq (uchlari) va bitta ($n=1$) bir o‘lchamli kub (kesmaning o‘zi) mavjud. Ikki o‘lchamli kub ($n=2$) - kvadratda 4 ta no‘l o‘lchamli yoqlar - uchlari ($k=0$), 4 ta bir o‘lchamli ($k=1$) yoqlar – tomonlari mavjud. Shu jarayonni davom qildiradigan bo‘lsak quyidagi munosabatlarga ega bo‘lamiz:

$n=0$ (nuqta) da $F_0^0 = 1$, $n=1$ (kesma, 1 o‘lchamli kub) da $F_1^0 = 2$, $F_1^1 = 1$, $n=2$ (kvadrat, 2 o‘lchamli kub)da $F_2^0 = 2 \cdot F_1^0 = 4$, $F_2^1 = 2 \cdot F_1^1 + F_1^0 = 4$, $F_2^2 = 1$, $n=3$ (3 o‘chamli kub)da $F_3^0 = 2 \cdot F_2^0 = 8$, $F_3^1 = 2 \cdot F_2^1 + F_2^0 = 12$, $F_3^2 = 2 \cdot F_2^2 + F_2^1 = 6$, $F_3^3 = 1$, $n=4$ da

$F_4^0 = 2 \cdot F_3^0 = 16,\ \ F_4^1 = 2 \cdot F_3^1 + F_3^0 = 32,\ \ F_4^2 = 2 \cdot F_3^2 + F_3^1 = 24,\ \ F_4^3 = 2 \cdot F_3^3 + F_3^2 = 8,\ \ F_4^4 = 1.$

Yuqoridagilarga asosan kublarning uchlari, qirralari va yoqlari sonini topishni ifodasi $F_{n+1}^0 = 2 \cdot F_n^0$, $F_{n+1}^k = 2 \cdot F_n^k + F_n^{k-1}$, *(* bunda $1 \le k \le n$*)* ko‘rinishda bo‘ladi.

Soddalik uchun F_n^k ni F_k orqali belgilaymiz va quyidagi jadvalni hosil qilamiz:

n	F_0	F_1	F_2	F_3	...	F_{n-1}	$F_n = 1$	-
$n+1$	$2F_0$	$2F_1 + F_0$	$2F_2 + F_1$	$2F_3 + F_2$		$2F_{n-1} + F_{n-2}$	$2F_n + F_{n-1}$	$F_{n+1} = 1$

F_k *-k* o‘lchamli yoqlar soni.

Koeffisiyentlari $F_0,\ F_1,\ \ldots..\ ,\ F_{n-1},\ F_n$ bo‘lgan x o‘zgaruvchining quyidagi ko‘phadini qaraymiz:

$$P_n(x) = F_0 x^n + F_1 x^{n-1} + F_2 x^{n-2} + \ldots + F_{n-1} x + F_n$$

Endi yuqoridagi jadval asosida quyidagi ko‘phadni tuzamiz

$$P_{n+1}(x) = (2F_0)x^{n+1} + (2F_1 + F_0)x^n + (2F_2 + F_1)x^{n-1} + \ldots + (2F_{n-1} + F_{n-2})x^2 + \\ + (2F_n + F_{n-1})x + (2F_{n+1} + F_n).$$

Agar yuqoridagi $P_n(x)$ ko‘phadni *2x+1* ga ko‘paytirsak $P_{n+1}(x)$ ko‘phad hosil bo‘ladi. Demak $P_{n+1}(x) = (2x+1)P_n(x)$.

Teorema. $P_n(x) = (2x + 1)^n$ [1]

Isbotlash induksiya orqali olib boriladi: *n=0* (nuqta) uchun $P_n(x) = 1 = (2x+1)^0$ o‘rinli deb qabul qilamiz. $P_{n+1}(x)$ uchun isbotlaymiz:

$$P_{n+1}(x) = P_1(x)(2x+1) = (2x+1)^n(2x+1) = (2x+1)^{(n+1)}.$$

Demak, *n* o‘lchamli kubning ko‘phadi: $P_n(x) = (2x + 1)^n$ ga teng.

Endi *n=1,2,3, 4* ni tekshirib ko‘raylik, $(2x + 1)^n$ ko‘phadning koeffitsientlari turli o‘lchamdagi yoqlari sonini ifodalaydi.

1. $P_1(x) = (2x + 1)^1 = 2x + 1;$

bir o‘lchamli kub (kesma) 2 ta uchi va 1 ta kesma (bir o‘lchamli yoq).

2. $P_2(x) = (2x + 1)^2 = 4x^2 + 4x + 1;$

kvadratning 4 ta uchi (no‘l o‘lchamli yoq), 4 ta tomoni (bir o‘lchamlin yoq) va 1 ta ikki o‘lchamli yoq.

3. $P_3(x) = (2x+1)^3 = 8x^3 + 12x^2 + 6x + 1;$

uch o‘lchamli kubning 8 ta uchi (no‘l o‘lchamli yoq), 12 ta qirrasi (bir o‘lchamli yoq), 6 ta yoq (ikki o‘lchamli yoq) va 1 ta uch o‘lchamli yoq.

4. $P_4(x) = (2x+1)^4 = 16x^4 + 32x^3 + 24x^2 + 8x + 1;$

giperkub (to‘rt o‘lchamli kub)da 16 ta uch (no‘l o‘lchamli yoq), 32 ta qirralar (bir o‘lchamli yoq), 24 ta ikki o‘lchamli yoq, 8 ta uch o‘lchamli yoq va 1 ta to‘rt o‘lchamli yoq mavjud.

F_n^k uchun analitik ifoda $F_n^k = C_n^k \cdot 2^{n-k}$ ko‘rinishda bo‘lib , bunda $C_n^k = \frac{n!}{k!(n-k)!}$

Masalan:

Uch o‘lchamli kub ($n = 3$)da $2^{3-0} \cdot C_3^0 = 8 \times 1 = 8$ ta burchak ($k=0$), $2^{3-1} \cdot C_3^1 = 4 \times 3 = 12$ ta qirra ($k=1$), $2^{3-2} \cdot C_3^2 = 2 \times 3 = 6$ ta yoq ($k=2$), $2^{3-3} \cdot C_3^3 = 1 \times 1 = 1$ ta 3 o‘lchamli yoq ($k=3$).

Agar $P_n(x) = (2x + 1)^n$ dagi $2x+1$ ifodada 2 va 1 koeffisiyentlarni o‘rinlarini almashtirsak hosil bo‘lgan $(x+2)^n$ ifodaning yoyilmasi $P_n(x) = (2x + 1)^n$ ko‘phadning F_n^k koeffisiyentlari teskari tartibda yozilgani hosil bo‘ladi [1]:

$$Q_n(x) = (x+2)^n = F_n^n x^n + F_n^{n-1} x^{n-1} + F_n^{n-2} x^{n-2} + \ldots + F_n^1 x^1 + F_n^0$$

$Q_n(x)$ ko‘phad ham n o‘lchamli kubning ko‘phadi bo‘ladi. Bu ko‘phad $P_n(x)$ dan ko‘ra foydalanishga qulay, chunki $Q_n(x)$ ko‘phadning x^k oldidagi F_n^k koeffisiyentlari k o‘lchamli yoqlari sonini beradi. Masalan:

1. *$n=1$ da $Q_1(x) = (x+2)^1 = 1 \cdot x + 2 \cdot x^0$, ya’ni kesma (bir o‘lchamli kub)da bitta bir o‘lchamli yoq va ikkita no‘l o‘lchamli yoq mavjud;*
2. *$n=2$ da $Q_2(x) = (x+2)^2 = 1 \cdot x^2 + 4 \cdot x + 4 \cdot x^0$, ya’ni kvadrat (ikki o‘lchamli kub)da bitta ikki o‘lchamli yoq, to‘rtta bir o‘lchamli yoq va to‘rtta no‘l o‘lchamli yoq mavjud;*
3. *$n=3$ da $Q_3(x) = (x+2)^3 = 1 \cdot x^3 + 6 \cdot x^2 + 12 \cdot x^1 + 8 \cdot x^0$, ya’ni uch o‘lchamli kubda bitta uch o‘lchamli yoq, oltita ikki o‘lchamli yoq , o‘n ikkita bir o‘lchamli yoq va 8 ta no‘l o‘lchamli yoq mavjud;*

4. *n=4 da* $Q_4(x)=(x+2)^4=1\cdot x^4+8\cdot x^3+24\cdot x^2+32\cdot x^1+16\cdot x^0$, *ya'ni to'rt o'lchamli kubda bitta to'rt o'lchamli yoq, sakkizta uch o'lchamli yoq , 24 ta ikki o'lchamli yoq, 32 ta bir o'lchamli yoq va 16 ta no'l o'lchamli yoq mavjud va x.k.*

Xulosa va takliflar. Ma'lumki geometriyani o'rganishda fazoviy tasavvurlarni rivojlanganlik darajasining ahamiyati kattadir. Geometrik masalalarni yechishning turli usullarini bilish turli qiyinliklardagi masalalarni yechishning maqbul usullarini tanlash imkonini kengaytiradi. Biz ushbu maqolada ko'p o'lchamli fazolarda n o'lchamli kub va uning elementlarini aniqlash usullari o'quvchilarning fazoviy tasavvurlarini rivojlantirib geometriya masalalarini yechish malakalarini oshiradi.

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DOI: https://doi.org/10.5281/zenodo.14498602

TEMIR YO‘LLAR QURILISHIDA QO‘LLANILADIGAN ZAMONAVIY GEODEZIK ASBOBLAR

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ANNOTATSIYA

Ushbu maqolada temir yo‘l izlari va obyektlari hamda ularni qurishda foydalaniladigan geodezik asboblar haqida ma’lumotlar berilgan.

Kalit so‘zlar: *temir yo‘l, inshoot, elektron taxeometr, aniqlik diapazoni, avtomatlashtirish, elektron teodolit, lazerli nivelir.*

ANNOTATION

This article provides information about railroad tracks and objects, as well as geodetic tools used in their construction.

Key words: *railway, structure, electronic total station, accuracy range, automation, electronic theodolite, laser level.*

KIRISH. Temir yo‘llar bu – murakkab texnik tizim hisoblanib, katta sondagi inshootlar va qurilmalardan, mexanizm va mashinalardan, avtomatlashgan jihozlardan tashkil topgan bo‘ladi hamda yo‘lovchi va yuklarni tashiydigan, texnika inshootlari majmui bilan jihozlangan transport korxonasidir. Temir yo‘l obyektlari tarkibiga ko‘priklar, tunnellar, yer osti va yer usti hajmli inshootlari va temir yo‘l qatnovi uchun xizmat qiladigan barcha bino va inshootlar kiradi. Akveduk, viaduk va ko‘priklar asosan avtomobil yo‘llari bilan kesishgan joylarda, jarlik mavjud bo‘lgan yerlarda quriladi.

ADABIYOTLAR TAHLILI VA METODOLOGIYA: Hozirgi davrdagi geodezik asbobsozlikning ajralib turadigan jihatlaridan asosiysi ilg‘or zamonaviy texnologiyalarni qo‘llash bilan bog‘liq bo‘lgan texnologik o‘sish bo‘ldi. Zamonaviy geodezik asboblar faqat optik asboblar bo‘la qolmay, balki kompyuterlashgan optik elektron sistemalar yo‘nalishida rivojlanmoqda va geodezik asboblar ishlab chiqaruvchilar an’anaviy optik asboblar bilan birgalikda zamonaviy optik elektron asboblar – elektron teodolitlar, taxeometrik stansiyalar, elektron (raqamli), lazerli nivelirlar va boshqa asboblar ishlab chiqilmoqda. Bunday asboblarning ko‘pchiligi

mexanik blok, optik blok va tarkibida o‘lchash moduli va interfeysli modul bo‘lgan elektron blokdan iborat.[1] Temir yo‘l qurilishida ko‘pgina geodezik asboblar, shular jumlasidan elektron taxeometrning o‘rni beqiyosdir.

1-rasm. “STONEX R3+350

Elektron taxeometr eng ommaviy bo‘lib, ko‘p firmalar tomonidan chiqarilmoqda. Har bir firma o‘z asboblarini kodlash sistemasiga ega. Ular odatda ma’lum aniqlik diapazonini qamrab oladigan bir avlod asboblarining 3-sinf (seriyasi) chiqariladi.

Har bir seriyada o‘rnatilgan diapazon doirasida aniqligi, avtomatlashtirish darajasi va qo‘shimcha funksiyalarning har-xil to‘plami bo‘yicha farqlanadigan bir necha modifikatsiyasi bo‘ladi shulardan biri (1-rasm).

Natijalar va munozaralar. Taxeometrik stansiyalar masofalarni va burchaklarni bevosita o‘lchash - qutubli syomka, rejalash ishlari, masofani vositali aniqlash, balandlikni aniqlash, maxsus ishlarni – doiraviy qabullar usulida, doiraviy egrilarni rejalash, foydali syomka, poligonometriyani o‘rnatish va boshqa maxsus ishlarni bajarishda qo‘llaniladi[1].

Zamonaviy elektron taxeometrik stansiyalar avtomatlashtirish darajasiga ko‘ra mexanik, motorlashtirilgan, robotlashtirilgan (dioaloqa orqali olisdan motorlashtirilib boshqariladigan) turlarga bo‘linadi.

Burchakli va chiziqli o‘lchash aniqligi bo‘yicha ular tegishlicha

o‘rtacha aniqlikda: **-m_β=3-5″; m_D=5+[5-3] mm/km**;

aniq: **m_β=2-3″, m_D=3+[3-2] mm/km**;

yuqori aniqlikda: **m_β=1″, m_D=1+[2-1] mm/km**;

o‘rta kvadratik xatoliklar bilan o‘lchaydiganlarga bo‘linadi. [1]

1-jadval

Burchak o‘lchash aniqligi	5"
Burchak o‘lchash uslublari	Mutloq, doimiy va diametrik
O‘lchash aniqligi	2 mm + 2 ppm
Prizma aniqligi	1.5 mm + 2 ppm

Nurqaytargichsiz o‘lchash masofasi	500 m
Nurqaytargich bilan o‘lchash masofasi	3 500 m
Yaqinlashtirish	30x
Tasvir turi	“STONEX R3+350” *elektron taxeometrining tarkibiy qismlari*
Ko‘rish maydoni	1° 30’ (1.66 daraja) / 2.7 m ga 100 m masofa
Kompensator aniqligi	1.5
Ishchi xaroratlar	- 20° .. +50° C
Og‘irligi	5.1 kg
Quvvatlagich	Li-Ion (GEB211)
Operatsion tizim	Windows CE 5.0
Xotira	100 mingta nuqta.
Ekran	CH/B (oq/qora) yuqori aniqlik

Elektron taxeometrlarning paydo bo‘lishi taxeometrik syomkani to‘la va qisman avtomatlashtirish imkonini tug‘dirdi. Bunda asbob syomkali nuqtalarda o‘rnatiladi va piketli nuqtalarga taxeometr komplektiga kiradigan qaytargichli nishon tayoqchalar qo‘yiladi. Bu hamda yondosh va syomkali nuqtalardagi nishon tayoqchalarga asbob trubasi yo‘naltirilganda ufqiy va tik burchaklar hamda bu burchaklargacha masofa avtomatik rejimda aniqlanadi. Taxeometrning mikro EHMi o‘lchash natijalariga avtomatik tarzda ishlov beradi va Δx va Δy miqdor orttirmalarni, yondosh syomkali hamda piketli nuqtalargacha nisbiy balandliklarni aniqlaydi.

Bunda o‘lchanadigan masofalarga va o‘lchanadigan burchaklarga asbob tik o‘qini qiyaligi ta’siri uchun ham tuzatmalar avtomatik tarzda hisobga olinadi.

*2-rasm. “***STONEX R3+350 elektron taxeometrini ishchi holatga keltirish**

O‘lchashlar natijalari maxsus xotira (informatsiya yig‘uvchi) moslamalariga kiritilishi yoki magnitli kassetaga yozilishi mumkin. Keyinchalik informatsiya magnitli kasseta – yig‘uvchidan EHMga kiradi, u maxsus dastur bo‘yicha o‘lchashlar natijalarini yakuniy ishlovini bajaradi, syomkali va piketli nuqtalarning koordinatalarini hisoblashni, joy topografik rejasini grafikli yasash va joyning raqamli modelini tuzish uchun zarur bo‘lgan xisoblashlarni o‘z ichiga oladigan o‘lchashlar natijalarini topografik rejasini yasashni EHM bilan ulangan grafo-yasovchida amalga oshiriladi.

Xulosa. Temir yo‘llar iqtisodiyotning qon tomiri hisoblanadi. Chunki, uzoq masofalar uchun yirik qatnovlar temir yo‘l transporti orqali amalga oshiriladi. Yuk va yo‘lovchi tashishda respublikamizda temir yo‘l transporti yetakchi o‘rinni egallaydi. Shuning sababli temir yo‘l izlarini mustahkam qurish, noqulay ob-havo sharoitida ham xavfsiz tashishlarni amalga oshirish muhim sanaladi. Respublikamizda bu kabi ishlarni nazorat qiluvchi vakolatli organ “O‘zbekiston temir yo‘llari AJ” va uning hududiy bo‘linmalaridir.

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ZAMONAVIY TEXNOLOGIYALAR ASOSIDA SUR'ATGA OLISH JARAYONLARI

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ANNOTATSIYA

Kosmik apparatlarning orbitalari ularning oldiga qo'ygan vazifasiga bog'liq bo'lib, oldindan belgilanadi. Yer yuzasidagi tabiiy resurslarni o'rganishda va meteorologik kuzatishlar olib borishda kosmik apparatlar uchun doiraviy orbita tanlanadi. Doiraviy orbita bo'yicha harakatlanayotgan kosmik apparatlarda surat olish balandligi asosida masshtab aniqlanadi.

Kalit so'zlar: *Aero-kosmiksurat, sun'iy yo'ldosh, kosmik kema, doiraviy orbita, elliptik orbita.*

ACCELERATION PROCESSES BASED ON MODERN TECHNOLOGIES

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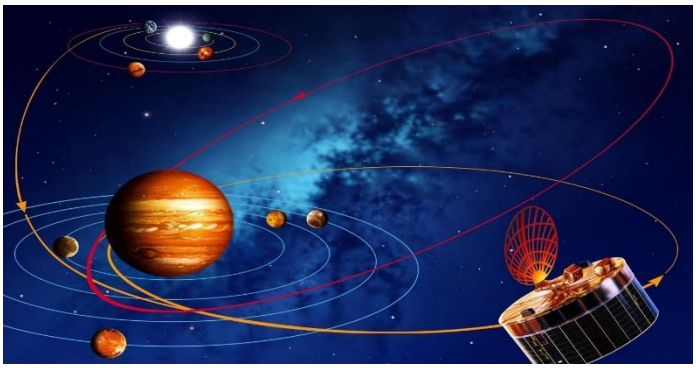
ABSTRACT

The orbits of space vehicles depend on the task set before them and are determined in advance. A circular orbit is chosen for spacecraft in the study of natural resources on the Earth's surface and conducting meteorological observations. Scale is determined based on the height of taking pictures in space vehicles moving in a circular orbit.

Keywords: *Aero-space photography, satellite, spacecraft, circular orbit, elliptical orbit.*

KIRISH. Yer yuzasida va atmosferadagi bo'layotgan global jarayonlarni uzoq vaqt kuzatib turish uchun doiraviy orbita tanlanadi. «Molniya» sun'iy yo'ldoshi doiraviy orbitaga uchirilgan. Meteorologik sun'iy yo'ldoshlar, kosmik kemalar, orbital stansiyalar yer atrofi orbitasida harakatlanib 200-400 km balandlikda uchiriladi.

ADABIYOTLAR TAHLILI VA METODOLOGIYA: Agar orbita balandligi bir necha ming km bo‘lsa kosmik apparatlar Yerning sun’iy yo‘ldoshiga aylanib qoladi. Odatda, orbitaning ekvator tekisligiga nisbatan qiyaligi uchirilayotgan kosmik apparatni maqsadiga mos qilib tanlanadi. Lekin ularning salmog‘iga ham bog‘liq. Meteorologik kuzatishlar olib boriladigan sun’iy yo‘ldoshlar birmuncha yengil bo‘lib atrofidagi orbitaga chiqariladi. Og‘irligi katta bo‘lgan kosmik va orbital kemalar uchun (masalan, Rossiya hududlarini o‘rganish uchun) uchiriladigan kosmik kemalar ekvatorga nisbatan qiyaligi 50^0 atrofida bo‘ladi.

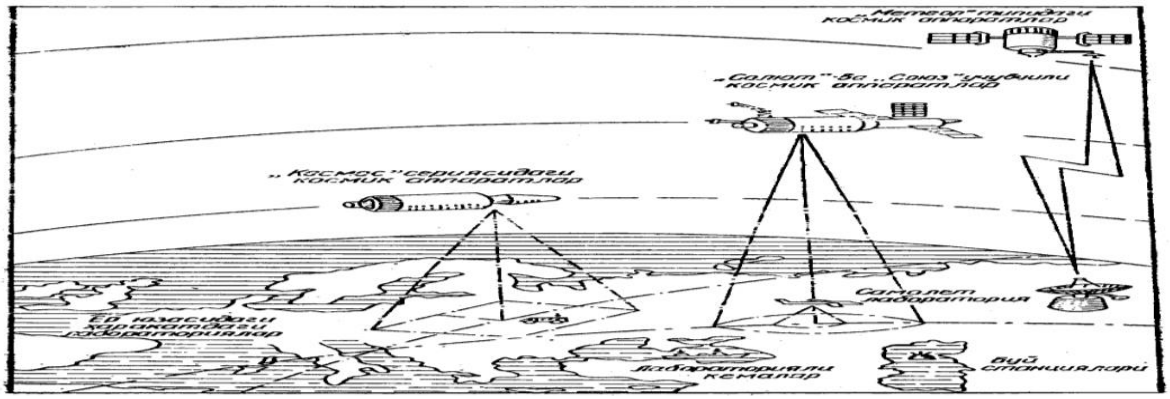


1-rasm. Orbita turlari

ADABIYOTLAR TAHLILI VA METODOLOGIYA: Agar orbita balandligi bir necha ming km bo‘lsa kosmik apparatlar Yerning sun’iy yo‘ldoshiga aylanib qoladi. Odatda, orbitaning ekvator tekisligiga nisbatan qiyaligi uchirilayotgan kosmik apparatni maqsadiga mos qilib tanlanadi. Lekin ularning salmog‘iga ham bog‘liq. Meteorologik kuzatishlar olib boriladigan sun’iy yo‘ldoshlar birmuncha yengil bo‘lib atrofidagi orbitaga chiqariladi. Og‘irligi katta bo‘lgan kosmik va orbital kemalar uchun (masalan, Rossiya hududlarini o‘rganish uchun) uchiriladigan kosmik kemalar ekvatorga nisbatan qiyaligi 50^0 atrofida bo‘ladi. Masalan, «Soyuz», «Salyut», «Mir» kemalarini shu orbita atrofida bo‘lsa AQSH da uchiriladigan kosmik kemalar esa 30^0 qiyalikda bo‘ladi. Chunki AQSH da uchirilgan kosmik kemalar «Jemini», «Appalon», «Chelenjer», «Shattl», «Kolumbiya» va boshqalar ekvator va ekvator atrofi rayonlarini o‘rganishga mo‘ljallangan. 1976 yilda uchirilgan kosmik kema «Soyuz-22» ning orbitasi esa 65^0 kenglikda bo‘lib, Yevropa materigini o‘z ichiga olishga mo‘ljallangan. Orbita qiyaligiga qarab kosmik apparatlarni qaysi kengliklar bo‘yicha harakatlanishi belgilanadi. Yo‘ldosh orbitada harakatlanayotganda, uning qoldirgan iziga yer yo‘ldoshini trassasi deyiladi. Agar orbita ekvator tik bo‘lib doira shaklida bo‘lsa uning balandligi 360000 km ga teng. Yo‘ldoshning aylanish davri 1 sutkaga ya’ni 24 soatga teng bo‘lsa geostatsionar orbita deb yuritilib yer tabiiy resurslarini global masshtabda aniq syomka qilish uchun doiraviy qutbiy quyoshli sinxronli orbita tanlanib, trassa

bo‘ylab suratga olish vaqtida quyosh yerni doimo yoritib turishi hisobga olingan. Masalan, AQSH da shunday orbitada resursli ERTS yo‘ldoshi uchirilgan.

NATIJALAR. Dastlabki kosmosga uchgan inson Rossiya fuqarosi Y.A.Gagarin edi. U 1961 yilda «Vostok» kemasida kosmosga parvoz qilgan. Shundan buyon 20 tadan ortiq mamlakat fuqarolaridan 500 dan ortiq kosmonovtlar kosmosda bo‘lib qaytgan. AQSH da 60-70-yillarda «Appalon» programmasi asosida shu mamlakat fuqarolaridan 10 kishi 6 marta Oyga qo‘ndirilgan. Kosmosga o‘nlab tonna og‘irlikdagi kosmik apparatlar: «Salyut», «Mir», «Skayleb», «Kolumbiya» singarilar uchirilgan, ba’zilari esa hozir ham harakatda. Kosmik apparatlar Oy, Mars, Venera kabi planetalarni tadqiq qilmoqda. Shu bilan birga kosmonavtlarni fazodagi ish davri ham oshib bormoqda.



2-rasm. Tabiiy resurslarni tadqiq qiluvchi kosmik sistemalarning strukturasi.

Kosmik apparatlardan olingan suratlarning masshtablari bir xil bo‘lmasdan, u uchish balandligiga va aparatlarning tiplariga bog‘liq. Umuman, kosmik aparatlardan olingan suratlar 1:1 000 000 dan 1:10 000 000 masshtabda va undan ham kichik bo‘lishi mumkin. Masalan, «Zond-5» va «Zond-7» planetalararo kosmik avtomatik kemalardan olingan suratlarning masshtablari 1:200 000 000 ga teng bo‘lib, 70 va 90 ming kilometrlardan olingan.Kosmik suratlarning masshtabi olinayotgan suratning maqsadiga bog‘liq. Yerni topografik kartasini tushirish uchun 1:1 000 000 masshtabli surat olinsa, tabiiy resurslarni o‘rganish uchun 1:2 000 000 atrofidagi masshtabli suratdan foydalaniladi. Tabiiy resurslarni suratga olishda balandligi 600 va 900 km li orbita tanlanib, yer atrofini bir sutkada 14-15 marta aylanib chiqadi. Masalan, AQSH ning «Landsat» resursli yo‘ldoshi 916 km balandlikda harakatlanib bir sutkada yer atrofini 14 marta aylanadi. 1967 yildan boshlab meteorologik tadqiqotlarga mo‘ljallangan «Meteor» seriyasidagi sun’iy yo‘ldosh uchirilgan edi. Uning orbita balandligi 600 km ga yaqin, unda surat olish uchun ko‘p zonali skanerli qurilma o‘rnatilgan. Yo‘ldosh bir sutkada Yer atrofini 15 marta aylanib chiqadi. Olingan suratlar maydoniga, masshtabiga, obzorligiga qarab har xil bo‘ladi. Mayda masshtabli

suratlar, uchish balandligi 1000 kilometrdan yuqori bo‘lib planetalararo orbitalarda uchirilgan «Molniya» va «Appalon» tipidagi kosmik apparatlardan olinadi.

Regional suratlar materik yoki okeanlarni ayrim katta qismlarining tasviridir. Ularning qamrov maydoni 100 ming km^2 dan ziyod bo‘ladi. Suratlarning masshtablari 1:5 mln, 1:10 mln. ga teng.

Televizion suratlar tabiiy geografik rayonlarning katta qismlarini o‘z ichiga oladi. Ularning maydoni o‘n minglab km^2 joylarni qamrab olib, masshtabi 1:1 mln dan 1:5 mln. gacha bo‘lib, «Soyuz» va «Skayleb» orbital stansiyalari orqali minglab suratlar olingan. Mukammal suratlarda bir necha metrli obyektlar ham aks etadi. Masshtabi 1:100 000 – 1:1 000 000 gacha bo‘lgan surat uchun orbita balandligi 200 km.li apparatlardan olinadi.

MUHOKAMA. Kosmosdan olingan suratlarni tasnif qilishda ularning spektral diapazonlari ham e’tiborga olinadi. Bunday suratlar asosan uch diapazonli bo‘ladi:

1. Ko‘rinadigan va yaqin infraqizil diapazonli suratlar;
2. Issiq infraqizil diapazonli suratlar;
3. Radiodiapazonli suratlar.

Kosmik suratlarni guruhlarga bo‘lib o‘rganish ulardan foydalanish imkoniyatini oshiradi va maqsadga muvofiq tarzda ishlash imkoniyatini beradi.

Kosmik suratlar har xil aniqlikda tasvirlanadi. Masalan, ba’zi bir suratlarda alohida turgan binolarni ham ko‘rish mumkin bo‘lsa, ba’zi suratlarda kichik aholi yashaydigan joylarni ham ko‘rish qiyin. Kosmik suratlarda obyektlarni minglab yoki millionlab kichraytirib tasvirlanishi suratga olish sistemasida ishlatiladigan asosiy ko‘rsatkichlaridan biri yechimlilik (razreshayemaya sposobnost) xususiyatiga bog‘liq.

Kosmik suratlarni yechimi bo‘yicha V.I.Kravsova quyidagi to‘rtta guruhga bo‘lgan:

1. Juda katta o‘nlab kilometrli obyektlarnigina o‘qish mumkin bo‘lgan suratlar. Bu suratlarning ravshanligi juda kam bo‘lganidan o‘lchami 100 м^2 dan kam bo‘lsa mahalliy obyektlarni tasvirlay olmaydi. Bunday suratlar infraqizil nurlar orqali olinadi.

2. 1 km^2 kattalikdagi obyektlarni o‘qish va ko‘rish mumkin bo‘lgan suratlar. Ularda o‘rtacha kattalikka ega bo‘lgan mahalliy obyektlarni ham o‘qish mumkin. Bunday ravshanlikdagi televizion suratlar ko‘proq meteorologik sun’iy yo‘ldoshlardan olinadi.

3.100 м^2 kattalikdagi obyektlarni o‘qish mumkin bo‘lgan suratlar. Ularda deyarlik hamma tabiiy obyektlarni o‘qish mumkin.

4. O‘nlab metr (10 м^2 dan 100 м^2 gacha) kattalikdagi obyektlarni o‘qish mumkin bo‘lgan suratlar. Bunday suratlarda faqat tabiiy obyektlargina emas balki xo‘jalik obyektlarini ham o‘qish imkoniyati bor. Shunday ravshanlikda yuqori sifatli fotografik usulda olingan fotosuratlargina bo‘ladi.

Kosmik suratlarni mukammalliligi (kichik narsalarni ham ko‘rsatuvchanligi) bo‘yicha ham 3 guruhga bo‘lgan:

1. Kam mukammallilikdagi suratlar, ularda informatsiya (ma’lumotlar) kam. Bunday suratlarni kosmosdan olingan masshtabda o‘qish qiyin bo‘lgani uchun bir necha (2-5) marta kattalashtirib foydalaniladi.
2. O‘rtacha mukammallikdagi suratlar-ulardan juda ko‘p informatsiya olish mumkin. Bunday suratlarni 5-15 marotaba kattalashtirilgandan keyin foydalanish mumkin.

O‘ta mukammal suratlar – ulardan juda ko‘p informatsiya olish mumkin. Bunday suratlardan 15-30 marotaba kattalashtirib foydalaniladi.

Xulosa:

Turli mamlakatlardan uchirilgan kosmik apparatlar maqsadiga ko‘ra ikki sinfga bo‘linadi:

1. Ilmiy tadqiqot ishlari uchun uchirilgan kosmik apparatlar bo‘lib, ular atmosferaning yuqori qatlamlarini va yer yuzasini o‘rganishga mo‘ljallangan.
2. Amaliy ahamiyatga ega bo‘lgan kosmik apparatlar xalq xo‘jaligining ehtiyojlarini qondirishga va maxsus harbiy maqsadlar uchun ham mo‘ljallangan bo‘lishi mumkin.

Ilmiy tadqiqot ishlari uchun uchirilgan kosmik apparatlar ham har xil bo‘ladi, ularning ko‘pchiligi maxsus sohalar bo‘yicha geofizik, astronomik, geodezik, yadroviy fizika, biologik hamda universal tadqiqot ishlarda foydalaniladi.

Meteorologik aloqa navigatsiya, harbiy va boshqa maqsadlar uchun uchirilgan kosmik apparatlardan hayotning xilma-xil jabhalarida foydalanilmoqda. Kosmik apparatlar uchuvchili va uchuvchisiz bo‘lib, uchuvchili kemalar atmosferani yuqori qatlamlaridan 200-500 km balandlikda uchib yuradi.

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DOI: https://doi.org/10.5281/zenodo.14498683

BIOSIGNALLARNING TIBBIYOTDAGI AHAMIYATI

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Annotatsiya: *Maqolada Biosignallarning tibbiyotdagi ahamiyati ochib berilgan. Biosignallarning asosiy turlari va usullari hamda ishonchli Biosignalni olish shartlari ko‘rib chiqiladi. Tibbiyotda Biosignallashdan foydalanishga ba’zi misollar keltirilgan.*

Kalit so‘zlar: *Biosignal; Tibbiy Biosignal; Tashxislash, Davolash.*

Biosignallar - bu tirik organizmlarning turli xil faoliyatlarini aks ettiruvchi elektr, kimyoviy yoki mexanik signallardir. Ular tananing ichki muhitini nazorat qilish, turli organlar va tizimlar o‘rtasidagi aloqani ta’minlash, shuningdek, tashqi muhit bilan o‘zaro ta’sirni amalga oshirishda muhim rol o‘ynaydi.

Biosignallar turlari:

* Elektr biosignallari: Nerv impulslarini, yurak urishini, miya faoliyatini va mushaklarning qisqarishini aks ettiruvchi elektr signallari.

* Kimyoviy biosignallar: Gormonlar, neyrotransmitterlar va boshqa kimyoviy moddalar tomonidan uzatiladigan signallar.

* Mexanik biosignallar: Tovush, teginish, bosim va harakatlar kabi mexanik o‘zgarishlarni aks ettiruvchi signallar.

Biosignallarni o‘lchash va tahlil qilish:

Biosignallarni o‘lchash va tahlil qilish uchun turli xil texnologiyalar mavjud:

* Elektrokardiogramma (EKG): Yurak urishini o‘lchash uchun ishlatiladi.

* Elektroensefalogramma (EEG): Miya faoliyatini o‘lchash uchun ishlatiladi.
* Elektromiyogramma (EMG): Mushaklarning faoliyatini o‘lchash uchun ishlatiladi.
* Magnit-ensefalogramma (MEG): Miya faoliyatini o‘lchash uchun ishlatiladi.
* Funksional magnit-rezonans tomografiya (fMRI): Miya faoliyatini o‘lchash uchun ishlatiladi.

Biosignallarni qo‘llash sohalari:

* Tibbiyot: Kasalliklarni tashxislash, davolash va monitoring qilishda.
* Fiziologiya: Tananing faoliyatini o‘rganishda.
* Psixologiya: Miya faoliyatini va xulq-atvorni o‘rganishda.
* Sport: Sportchilarning ishlashi va sog‘lig‘ini kuzatishda.
* Xavfsizlik: Biometrik identifikatsiya tizimlarida.

Kelajakda biosignallar:

Biosignallarni o‘lchash va tahlil qilish texnologiyalari rivojlanishi bilan kelajakda ularning qo‘llanilish sohalari yanada kengayadi. Masalan, sun’iy intellekt va mashina o‘rganish texnologiyalari biosignallarni tahlil qilishda yangi imkoniyatlar yaratadi.

XULOSA:

Biosignallar tirik organizmlarning sirli tilidir. Ular tananing ichki muhitini nazorat qilish, turli organlar va tizimlar o‘rtasidagi aloqani ta’minlashda muhim rol o‘ynaydi. Biosignallarni o‘lchash va tahlil qilish texnologiyalari rivojlanishi bilan kelajakda ularning qo‘llanilish sohalari yanada kengayadi.

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DOI: https://doi.org/10.5281/zenodo.14498687

SMART INTERFEYSLAR VA ULARNI ISHLAB CHIQISH USULLARI

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Annotatsiya: *Maqolada web ilovalarda smart interfeyslarni loyihalash va ularni axborot tizimlari resurslari bilan integratsiyalashuvini ta'minlaydigan muloqotni tashkil etish jarayonlari keltirilgan. Ushbu jarayon foydalanuvchilarning o'z fikrlari va talablarini aniqlab, ushbu talablar bo'yicha tizim bilan muloqatga kirishish imkoniyatlarini kengaytiradi. Bunday jarayonlarni tashkil qilish ma'lumotlarni tahlil qilish, tasavvur qilish, tizimni optimallashtirish va ma'lumotlarni tasvirlashning o'zgarmas qatiy usullaridan farqli ravishda smart interfeys tuzishga imkon beradi.*

Kalit so'zlar: *Interfeys, smart interfeys, web ilovalar, bilimlar banki, ma'lumotlar bazasi, HCI.*

SMART INTERFACES AND METHODS OF DEVELOPING THEM

Abstract: *The article presents the processes of designing smart interfaces in web applications and organizing communication that ensures their integration with the resources of information systems. This process expands the possibilities of users to identify their opinions and requirements and communicate with the system in accordance with these requirements. The organization of such processes allows you to create a smart interface, unlike the fixed methods of analyzing, visualizing, optimizing the system and describing information.*

Keywords: *Interface, smart interface, web applications, knowledge bank, database, HCI.*

KIRISH

Smart interfeyslar yaratish uchun mashhur kompaniyalar tomonidan juda ko‘plab ilmiy ishlar olib borilmoqda. Insonning his-tuyg‘ulari asosida interfeyslar yaratish buyicha juda ko‘p maqolalar chop etilmoqda[1, 2]. Bundan tashqari bu yo‘nalishda “Inson va kompyuterning o‘zaro ta’siri (HCI)” deb nomlangan fan joriy etilgan. Interfeyz o‘zi nima va va uning xozirgi kunda qanday turlari mavjud?

Kompyuterning qanday ishlashi haqida ko‘plab kitoblar yozilgan: uning "miyasi" va "yuragi" (xotira va protsessor), "asab tolalari", "sezgi organlari" (boshqa qurilmalar) haqida. Biroq, biz kompyuter bu biologik mavjudot emas, balki mashina ekanligini unutmasligimiz kerak. Har qanday texnik qurilmalar singari, kompyuter inson bilan chegaralangan, majburiy bo‘lgan muayyan qoidalar to‘plami orqali aloqa o‘rnatadi. Ushbu qoidalar kompyuter adabiyotida **interfeys** deb ataladi [3, 4].

SMART INTERFEYS VA UNI ISHLAB CHIQISH USULLARI

Maqolada web ilovalar uchun smart interfeyslar yaratish g‘oyasi ilgari surilgan. Nima uchun aynan web ilovalarda chunki web ilovalarda son-sanoqsiz yangiliklar, reklamalar va kontentlarning ichidan foydalanuvchilar o‘zlariga tegishlisini ajratib olishda qiyinchiliklarga duch kelmoqda yoki ajratib olish uchun ko‘p vaqt sarflanmoqda. Bu esa muhim ma’lumotlarni o‘z vaqtida o‘qilmasligiga va foydalanuvchilarning web saytga bo‘lgan ishonchlarini so‘nishiga olib kelmoqda.

Bunday muammolarni oldini olish uchun web ilovalarda foydalnuvchining kasbi, yo‘nalishlari va hattoki his-tuyg‘ularini ham inobatga olgan holda hamda insonlarning yana boshqa turli xil shaxsiy xarakterlaridan foydalangan holda smart interfeyslar yaratish kerak [5, 6]. **Hissiy dizayn** - bu foydalanuvchilarning ijobiy taassurotlarini va his –tuyg‘ularni keltirib chiqaradigan dizaynlarni yaratish kontseptsiyasi hisoblanadi. "Hamma narsaning o‘ziga xos xususiyati bor: hamma narsa hissiy signal beradi. Dizaynerning maqsadi bo‘lmagan taqdirda ham, web -saytni ko‘radigan odamlar shaxsiyati haqida xulosa chiqaradilar va hissiyotlarga beriladi”. **Smart interfeys** – aqlli vazifalarni bajaradigan va qarorlar chiqaradigan proseduralarga ega bo‘lgan dizayndir. Turli xil ranglar yordamida inson hissiyotlari o‘rganiladi, qisqa va mazmunli so‘rovnomalar asosida foydalanuvchilarning toifalari aniqlanadi. Ushbu toifalar uchun dizayn stillari va imkoniyatlari shakillanatiriladi [7]. Masalan, biznesmanlar uchun web sayt dizaynida raqamlardan iborat statistikalar, siyosatchilar uchun yangi chiqarilayotgan qonunlar va ularnig muhokamasi, oqituvchilar uchun esa ta’lim sohasida va ilmiy faoliyatdagi so‘nggi yangiliklar muhum hisoblanadi. Web sayt foydalanuvchilarini toifalarga bo‘lishning yanada ko‘proq parametrlari topilsa, ushbu toifadagi insonlar uchun samarali, zerikarsiz va muhum ma’lumotlarni o‘z vaqtida yetkazish imkoniyatlari yartiladi. Web ilovalarning turlarini inobatga olgan holda

smart interfeyslar yaratish uchun foydalnuvchilarning kasbi boyicha toifalalariga quyidagi ketma-ketlikda smart interfeys parametrlari ishlab chiqilgan.

1- jadval.

Web foydalanuvchilari uchun smart interfeys parametrlari

№	Foydalanuvchi toifalari	Smart interfeys parametrlari				
		Ranglar	**Bo‘limlar**	**Stillar**	**Harakatdagi obyektlar**	**Qayta aloqa**
1	Biznesmenlar	To‘q sariq	Raqamli statistika	Raqamlar alohida ko‘rinishda	Ramlardan iborat reklama, yangiliklar	Tezkor savol javob (tel)
2	O‘qituvchilar	Och ko‘k	Fanlardan ilmiy ma’lumotlar	Aval va o‘tmas burchakli figuralar ko‘rinishida	Grafik ko‘rinishdagi, ilmiy sohadagi reklama va yangiliklar	Yozma shakilda savol javob
3	Siyosatchilar	Och va to‘q yashil	Qonunlar haqida ma’lumotlar	Ma’lumotlarni o‘qish qulay figuralar ko‘rinishida	Jadvallar ko‘rinishidagi siyosiy jarayonlar yangiliklar	Yozma shakilda savol javob

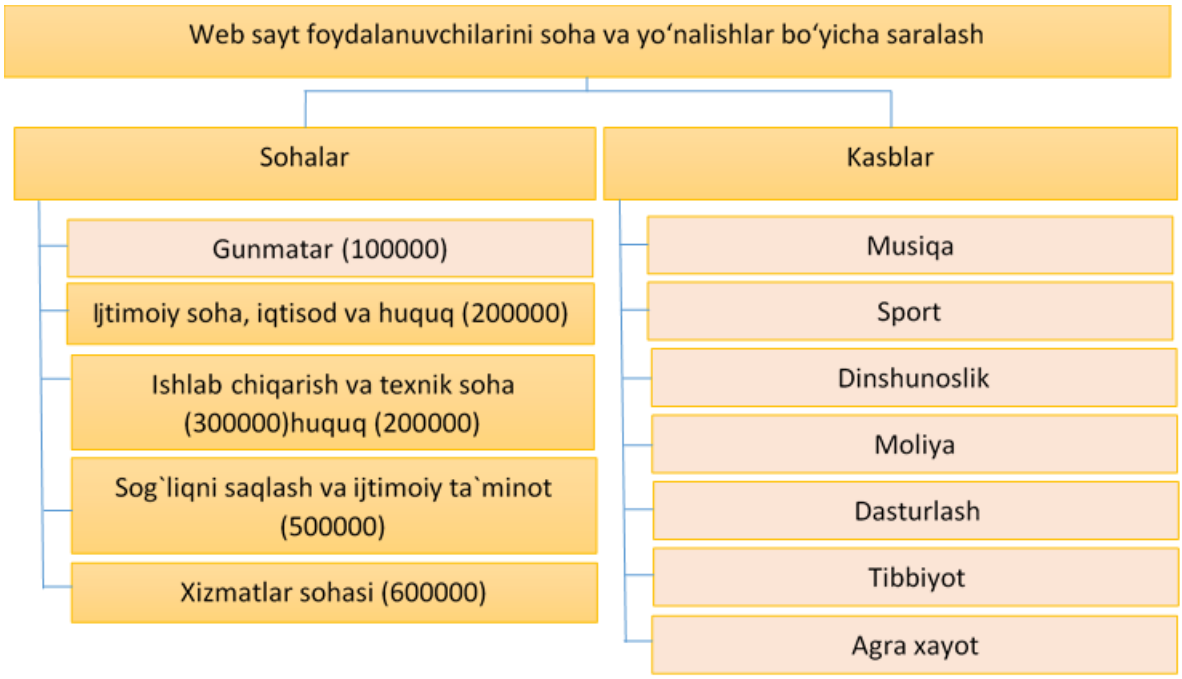
Tajriba 10 dan ortiq toifadagi foydalanuvchilar uchun web ilova dizaynida zarur komponentlar ro‘yhati aniqlangan. Maqolada Biznesmen va o‘qituvchi toifasidagi foydalanuvchilar uchun Smart interfeys parametrlari keltirilgan. Masalan, binesmen foydalanuvchilar uchun web ilova dizaynida to‘q sariq ranglardan ko‘proq foydalanish, biznesga doir statistik ma’lumotlarni aniq raqmlarda matn fonidan ajralib turadigan stilda namoyon etish, xarakatlanayotgan obyektlarda reklama va yangiliklarni ko‘rsatish hamda qisqa savol javoblar uchun qayta aloqa uchun ishonchli telefon raqamlarini qulay holda joylashtirish zarur.

O‘qituvchi toifasidagi foydalanuvchilar uchun web ilova dizaynida och ko‘k ranglardan ko‘proq foydalanish, fanlardan ilmiy ma’lumotlarni aval va o‘tmas burchakli figuralar ko‘rinishidagi stilda namoyon etish, xarakatlanayotgan obyektlarda grafik ko‘rinishdagi, ilmiy sohadagi yangiliklarni ko‘rsatish hamda yozma shakilda savol va javob o‘tkazish uchun ishonchli bo‘limini joylashtirish zarur.

Amaliyotga joriy etish uchun web interfeyslar haqida ma’lumotlar o‘rganib chiqildi. Web interfeyslar, veb-saytlar yoki ilovalarning iste’molchilari bilan aloqa qilish uchun xizmat qiladigan interfeysidir. Foydalanuvchilar web-interfeyslar orqali veb-sayt yoki ilovadagi turli xizmatlarni amalga oshirishlari mumkin, Jumaladan, yangiliklarni o‘qish, xaridlarni amalga oshirish, ma’lumotlarni qidirish, yuklab olish

va boshqalar. Hozirda web interfeyslar ko‘plab sohalarda qo‘llaniladi, masalan, onlayn do‘konlar, banklar, ijtimoiy tarmoqlar, tibbiyot va boshqa sohalarda. Web interfeyslarning aqilli qarorlar asosida ishlashi millionlab foydalanuvchilar uchun muhimdir, chunki foydalanuvchilar smart interfeysni ko‘rsatuvchi web-sayt yoki ilovalarda ishlashni yoqtiradi.

Web sahifalarda turli xil sohalardagi insonlar bo‘lishi mumkin. Ularning soha va kasbi haqida ma’lumotlar olinadi. Bu ma’lumotlar orqali sahifaga tashrif buyuruvchining kasbiga qarab aynan ma’lumotlarni chop etish ko‘zda tutilgan. Masalan ta’lim sohasida faoliyat yurituvchi xodim, o‘qituvchi unga aynan qanday ma’lumotlarni chop etish to‘g‘risida smart interfeys algoritm orqali o‘ylab topiladi va kerakli ma’lumotlarni asosiy interfeysda aks ettiradi. Bu esa foydalanuvchi kasbiga, sohasiga taalluqli bo‘lgan ma’lumotlarni ortiqcha vaqt sarflanmagan holda o‘zlashtirish hamda sohasiga oid eng ishonchli va eng so‘nggi ma’lumotlarni taqdim etadi[3].



1- rasm. Web foydalanuvchi turlari.

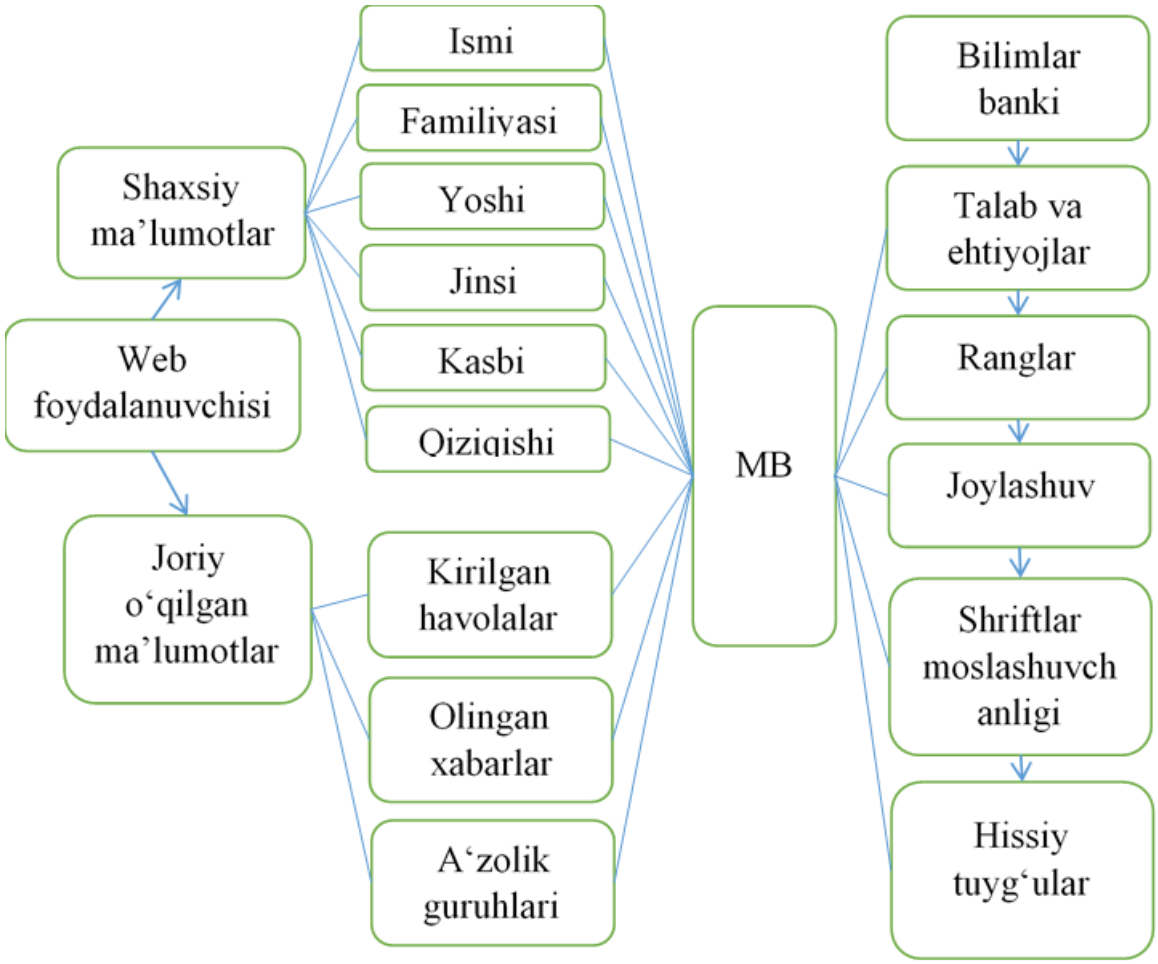
Samrt interfeyslarni loyihalash jarayonlarida soniyalardagi o‘zgarishlarni inobatga olib web foydalanuvchiga mos kelishuvlarni topadi. Smart interfeys foydalanuvchilar bilan o‘zaro muloqotda bo‘lib, vazifalarni osonlashtirish va sayt foydalanuvchisiga qulay interfeysni ta’minlashda katta ahamiyatga ega[4].

2-rasmda keltirilgan web foydalanuvchilarni klassifikatsiyalash sxemasi orqali smart interfey imkoniyatlari yanada ortadi. Natijada foydalanuvchi shaxsiyati o‘rganib boriladi. Masalan, web-sayt foydalanuvchilari orasida katta yoshlilar, o‘rta yoshlilar,

kichik yoshlilar va keksalar bo‘lishi mumkin. Interfeysni bir bo‘lagi bo‘lgan shriftlar o‘lchami har xil yoshdagi foydalanuvchilar uchun turli xil o‘lchamdagi yozuvlarda bo‘ladi. O‘rta yoshdagilar 11 shriftdagi yozuvlarni xohlashsa, keksalarga yozuvlar 17 shrifdan kam bo‘lmaslik tavsiya etiladi. Smart interfeyslarni loyihalash foydalanuvchining kreaktivligiga mos ravishda yaratilishi, kerakli ma’lumotlar bilan ta’minlash doimiy ravishda yangilanib borishi kerak. Bular smart interfeysni yaratishda muhim omil hisoblanadi.

Bilimlar banki web interfeysga yordam berish uchun tasdiqlangan, ma’lumotlarni informativligiga qarab tanlov qilinadiganlarini jamlanadigan axborotni o‘z ichiga oladi.

Smart interfeyslarni loyihalovchi usul va algoritmlar, web foydalanuvchilarning shaxsiy ma’lumotlariga asoslangan holda yaratiladi hamda foydalanuvchilarga xizmatlardan foydalanish tarixi, qulayliklari, xizmatlar va mahsulotlar to‘g‘risidagi sharhlar va boshqa ma’lumotlarni taklif qilish uchun ma’lumotlar bazasini ishlatadi.



2- rasm. Bilimlar banki.

XULOSA

Xulosa sifatida shuni aytish mumkinki, web ilovalar foydalanuvchilarining turli xil toifalari doimiy o‘rganib borilsa, web ilova foydalanuvchilari uchun chiroyli, interaktiv, smart va hissiy dizaynlarni yaratish usullari Respublikamizda yanada takomillashadi. Bu esa web sahifa sifatini va unga tashrif buyuruvchilarini sonini tinimsiz oshiradi va foydalanuvchi etikasini yanada rivojlantiradi. Ushbu maqolada smart interfeys yartish turlari va uning sxemalari keltirildi. Kelasi maqolalarimizda samart interfey va uning bilimlar bankini ishlab chiqish usullari va algoritmlarini yaratishga bag‘ishlanadi.

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DOI: https://doi.org/10.5281/zenodo.14498345

KIMYO FANI DARS JARAYONLARIDA ZAMONAVIY METODLARNING QO‘LLASH ORQALI SAMARALI TA’LIMGA ERISHISH USULLARI

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ANNOTATSIYA

Ushbu maqolada umumta’lim maktabi kimyo fani darslarida zamonaviy interfaol metodlarning qo‘llanishi orqali sifatli va samarali darslarga erishish mumkinligi izohlab o‘tilgan. Amaliy mashg‘ulotlarda, loyiha ishlari va laboratoriya ishlarida didaktik materiallar hamda interfaol metodlardan foydalanish usullari ko‘rsatib o‘tilgan. O‘quvchilar bilan individual shug‘ullanish usullaridan namunalar keltirilgan.Ushbu maqola metodik tavsiya xarakteriga ega bo‘lib, bu maqoladan kimyo fani va tabiiy fan o‘qituvchilari ham foydalanishi mumkin.

Kalit so‘zlar: *“Raqamlar so‘zlaganda”, “Reaksiyani tugallang”, “Venn diagrammasi”, “Rangli chizmalar bilan ishlash” usuli.*

ANNOTATION

This article explains the possibility of achieving quality and effective classes through the use of modern interactive techniques in chemistry classes of the secondary school. In practical training, project work and laboratory work, the methods of using didactic materials and interactive methods are indicated. Examples of individual methods of dealing with students are given. This article has a methodological recommendation nature, which can also be used by teachers of chemistry and Natural Science.

Keywords: ***“****When the numbers speak”, “Complete the reaction”, “Venn diagram", “Working with color drawings” method.*

KIRISH

Har qanday fanni o‘qitishning ta’limiy masalalari bilan birgalikda jamiyatni rivojlantirishda muhim ahamiyatga ega bo‘lgan tarbiyaviy masalalari ham mavjud.Kimyo fanini o‘qitishda tarbiya va ta’limning ijobiy turlarini o‘quvchilar ongida shakllantirish mumkin.

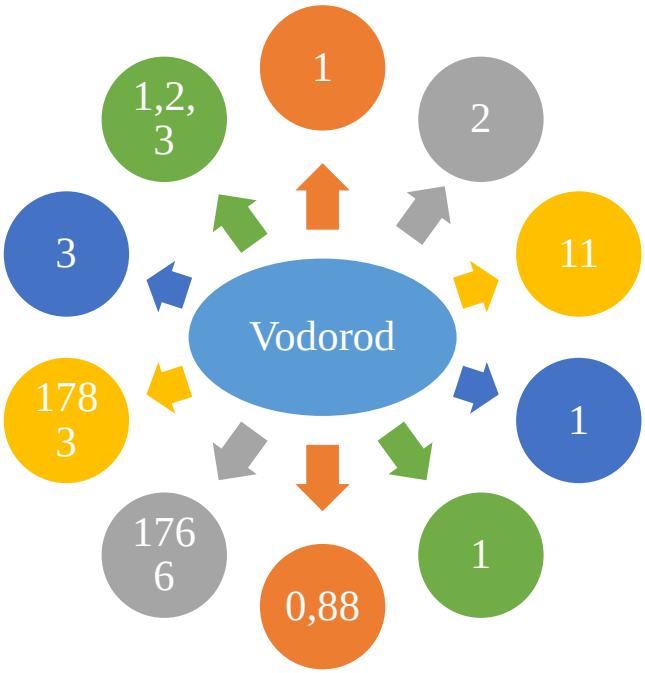
Umumta’lim maktablarida dars jarayonlari 45 daqiqaga mo‘ljallangan. Har bir sinflar o‘rtacha 25-35 tagacha o‘quvchilardan iborat bo‘ladi. Sinfda tahsil olayotgan o‘quvchilarning bilim darajalari turli xil bo‘lishi mumkin. Kimyo fani murakkab fanlardan biri bo‘lganligi tufayli fanni o‘zlashtirish o‘quvchilarga qiyinchilik tug‘dirishi mumkin. Shuning uchun zamonaviy interfaol metodlaning dars jarayonlarida qo‘llanilishi yaxshi natijalarga erishishga yordam beradi. Tabiiy fanlarni o‘zlashtirishda eng muhim tavsiya bu o‘quvchilarni fanga jalb etish, ularning qiziqishlarini ortirish va fanni o‘zlashtirish usullarini soddalashtirish deb o‘ylaymiz. Bu uchun har bir pedagog izlanuvchan, talabchan hamda kreativ fikrlovchi bo‘lishi kerak.

Ushbu maqolada keltirilgan interfaol metodlardan foydalanish orqali samarali darslarni, ochiq darslarni va to‘garak mashg‘ulotlarini tashkil etish mumkin. Maqolada yosh pedagoglar hamda amaliyotchi pedagoglar uchun kerakli metodik tavsiyalar keltirilgan.

ADABIYOTLAR TAHLILI VA METODOLOGIYA

Pedagogika va kimyo fanini o‘qitish bo‘yicha mavjud bo‘ldan adabiyotlarni tahlil qilganimizda eng samarali metodlar bu o‘quvchi uchun sodda va jozibali metodlar hisoblanishiga guvoh bo‘ldik. Amaliyotda umumta’lim maktabi o‘quvchilariga sinab ko‘rilgan zamonaviy metodlarni namunalar asosida tahlil qilib o‘tamiz.

“Raqamlar so‘zlagand ”metodi yordamida vodorod mavzusiga doir bilimlarni umumlashtirish mumkin.

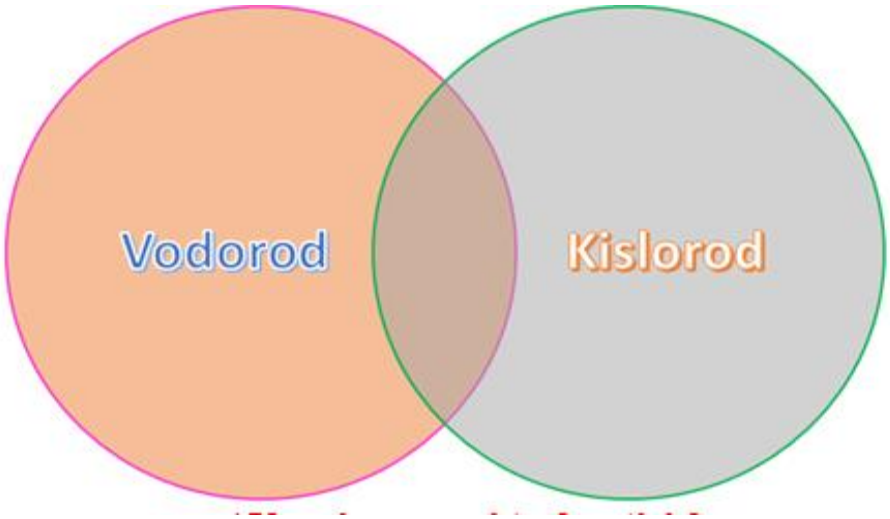


Ushbu metod yordamida vodorodga oid dastlabki tushunchalar tahlil qilib o‘tiladi. Barcha ilmiy ma’lumotlarni shu metod yordamida o‘rganish mumkin.

“Reaksiyani tugallang” metodi yordamida har bir sinfga oid kimyoviy reaksiya tenglamalarini takrorlash mumkin. So‘roq belgisi qo‘yilgan joyga tushib qolgan kimyoviy moddani formulasi yoziladi.

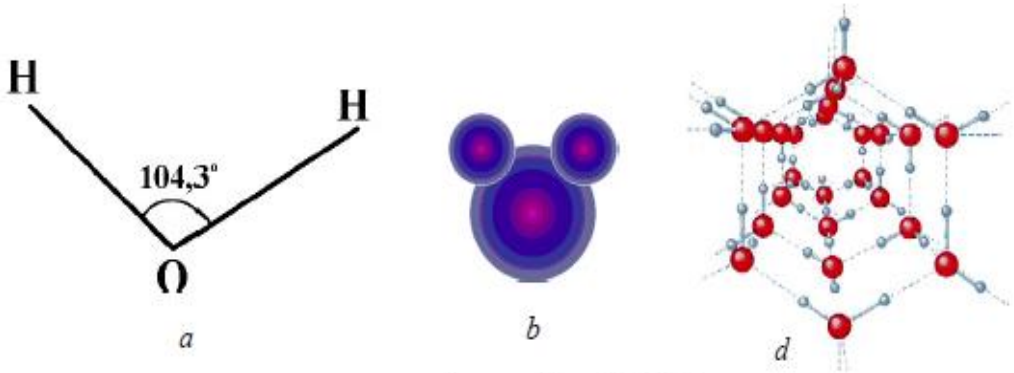
а) $HCl + ? \rightarrow H_2\uparrow + FeCl_2$;
б) $? + H_2SO_4 \rightarrow ? + H_2\uparrow$;
в) $? + Al \rightarrow H_2\uparrow + Al_2(SO_4)_3$;
г) $? + ? \rightarrow ZnCl_2 + H_2\uparrow$;
д) $Mg + ? \rightarrow MgCl_2 + ?\uparrow$;
е) $H_2SO_4 + Zn \rightarrow ? + H_2\uparrow$.

“Venn diagrammasi” (kislorod va vodorodning o‘xshahshlik va farqlarini topish.) Yoki bu metod yordamida metallar, metallmaslarni,oksid va kislotalarni farqlashni o‘rganish mumkin.



Ushbu metod yordamida o‘quvchilarni kreativ fikrlashga, kimyoviy moddalarni bir-biridan farqlashga o‘rgatish va juda ko‘p mavzularda bu metodni qo‘llash orqali samarali dars maqsadiga erishish mumkin.

“Rangli chizmalar bilan ishlash” usuli yordamida bo‘sh o‘zlashtiruvchi o‘quvchilarni fanga bo‘lgan qiziqishini ortirish mumkin.
Masalan: “Suv” mavzusiga oid ilmiy ma’lumotlarni rangli didaktik tarqatma material yordamida o‘quvchilarga tarqatiladi.



31-rasm. Suvning grafik tuzilishi *(a)*,
hajmiy tuzilishi *(b)* va assotsiyatsiy holati *(d)*.

O‘quvchilar ushbu chizmada suvning grafik tuzilishini osonroq o‘rganib tahlil qiladilar.

1)“Ha” yoki “Yo‘q” o‘yini

1) Suv o‘z tarkibida ikki atom vodorod va bir atom kislorod tutadi?

2) 1 mol suvning massasi 20 g ga teng

3) Suvga hid bilan ta’mni uning tarkibidagi faqat tuzlar beradi?

4) Suv eng yaxshi erituvchi

5) Suv 0° da muzlaydi va 1000°C da qaynaydi?

2)Kimyoviy reaksiyalardan tushirib qoldirilgan moddalarni toping

1) $2Na + \ldots\ldots = 2NaOH + H_2\uparrow$ 2) $\ldots\ldots + H_2O = Ca(OH)_2$

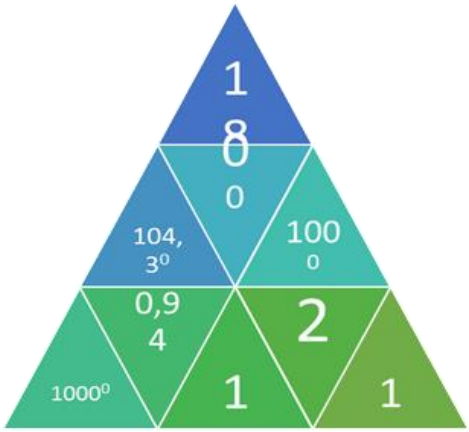
3) $\ldots\ldots + H_2O = H_2SO_4$ 4) $CuSO_4 + 5H_2O = \ldots\ldots$

5) $\ldots\ldots + 4H_2O = Fe_3O_4 + 4H_2\uparrow$

Javoblar: 1) $2H_2O$ 2) CaO 3) SO_3 4) $CuSO_4 \cdot 5H_2O$ 5) $3Fe$

Bu metod yordamida o‘quvchilarni tezkor fikrlashga o‘rgatish mumkin.Ularning faolligini oshirish mumkin.

“Raqamli piramida” metodi yordamida o‘quvchilarni diqqatini darsga to‘liq jalb qilish mumkin. Masalan: Doskaga rangli plakat yoki elektron doskaga slayd tarzida **“Piramida”** metodi namoyish etiladi.



O‘quvchilar slaydda keltirilgan raqamlarni tahlil qilib qaysi modda haqida fikr yuritilayotganini bilib olishadi.

NATIJALAR: Maqolada keltirilgan metodlarni umumta’lim maktablari dars jarayonlarida, to‘garak mashg‘ulotlarida foydalanish orqali darslarni sifatli va samarali tashkil etish mumkin. Bu metodlar bo‘sh va iqtidorli o‘quvchilar bilan 45 daqiqa davomida individual shug‘ullanishga katta yordam beradi.

MUHOKAMA: Hozirda umumta’lim maktablaridagi asosiy muammolardan biri bu o‘quvchilarning fanga bo‘lgan qiziqishlarini ortirishdir.Umumta’lim maktablaridagi asosiy muammo bu darsning 45 daqiqa bo‘lishi va sinfdagi o‘quvchilarning 25-35 tagacha bo‘lishidir. Kimyo fanini o‘qitishda bu muammolar har bir o‘qituvhilarni qiynab kelishi mumkin. Shuning uchun bunday muammolarning eng yaxshi samarali usuli bu zamonaviy interfaol metodlarni qo‘llash deb bilaman. Bu orqali 45 daqiqa davomida bemalol 25-35 tagacha o‘quvchilar bilan shug‘ullanib dars o‘z maqsadiga erisha oladi. Faqat metodlarni to‘g‘ri va kerakli joyda qo‘llay olish ko‘nikmasiga ega bo‘lishimiz lozim.

XULOSA: Xulosa qilib aytadigan bo‘lsak fanlarni o‘qitishda zamonaviy metodlarning o‘rni juda ham katta.Bu metodlarni to‘g‘ri va samarali qo‘llash har pedagogning mahoratiga bog‘liq.Maqsadimiz o‘quvchilar chiroyli, sifatli ta’lim berib, ularni kelajakda yaxshi kasb va hunar egallashlariga yordam berishdir. Hayotda har bir inson o‘z o‘rnini topishda ta’lim katta ahamiyatga egadir.

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DOI: https://doi.org/10.5281/zenodo.14498695

JIZZAX SHAHRIDA INTRODUKSIYA QILINGAN OCHIQ URUG‘LI O‘SIMLIKLARNING O‘SISHI VA RIVOJLANISHI

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Tabiiy fanlar fakulteti o‘qituvchisi.

Annotatsiya: *Daraxt va butalarning o‘sish xususiyatlari ularning introduksiya sharoitida istiqboliligini belgilab beruvchi asosiy ko‘rsatkich bo‘lib hisoblanadi. Daraxt va butalarning vegetatsiya davrida o‘sish xususiyatlarini o‘rganish, ularni turli sharoitlarga moslashishini aniqlash va keng miqiyosda ko‘paytirishga tavsiya etish imkonini beradi.*

Kalit so‘zlar: *Daraxt, butalar, ko‘paytirish, ontogenez, ochiq urug‘li o‘simliklar, Picea pungens, P. Excelsa, P.schrenkiana.*

Аннотация: *Особенности роста деревьев и кустарников являются основными показателями, определяющими их перспективность в условиях интродукции. Это позволяет изучить особенности роста деревьев и кустарников в течение вегетационного периода, определить их адаптацию к различным условиям и рекомендовать их широкомасштабное размножение.*

Ключевые слова: *Дерево, кустарники, размножение, онтогенез, открытосеменные растения, Picea pungens, P. excelsa, P. schrenkiana.*

Abstract: *The growth characteristics of trees and shrubs are the main indicators determining their prospects in the conditions of introduction. Studying the growth characteristics of trees and shrubs during the growing season allows us to determine their adaptability to different conditions and recommend them for large-scale propagation.*

Keywords: *Trees, shrubs, propagation, ontogenesis, gymnosperms, Picea pungens, P. Excelsa, P. schrenkiana.*

Daraxt va butalarning o‘sish xususiyatlari ularning introduksiya sharoitida istiqboliligini belgilab beruvchi asosiy ko‘rsatkich bo‘lib hisoblanadi. O‘sish, o‘simliklar hayotidagi boshqa ko‘plab hodisalar kabi, atrof-muhit omillariga, shuningdek, organizmning antropogen, fiziologik va boshqa holatlariga uzviy bog‘liq bo‘ladi [4;168c].

Daraxt va butalarning vegetatsiya davrida o‘sish xususiyatlarini o‘rganish, ularni turli sharoitlarga moslashishini aniqlash va keng miqiyosda ko‘paytirishga tavsiya etish imkonini beradi.

Daraxt va butalarning o‘ziga xos xususiyatlaridan biri, ular ontogenezining uzoq yillar davom etishidir. Yog‘ochlanuvchi o‘simliklarning yer ustki qismi qisman yoki to‘liq vegetatsiya nihoyasida ham saqlanib qoladi. Ularning yangi o‘sish kurtaklari yer sathidan balandda joylashgan bo‘ladi va shu holatda ular har yili o‘sadi. Ayrim hollarda butalarda bu holat istisno bo‘lib, qishda ularning yer ustki qismlari qurib qolish holatlari kuzatiladi [1;368c].

Ochiq urug‘li o‘simliklar. Ma’lumki, shaharlarning manzarali xususiyatlariga e’tibor berish hamda ularni dizaynini yaratishda ochiq urug‘li daraxtlardan keng ravishda foydalaniladi. Bu esa o‘z navbatida mazkur xildagi o‘simliklarni introduksiya qilish va ularning biologik xususiyatlarini o‘rganish muhim ahamiyatga ega. Quyida dastlab Jizzax shahridagi ochiq urug‘li o‘simliklarning ayrimlari xususida so‘z yuritamiz.

Jizzax shahrining markaziy ko‘chalarida *Picea* A.Dietr. (qoraqarag‘ay) turkumining 3 ta turi: *Picea pungens* Engelm. (tikanli qoraqarag‘ay), *P. excelsa* (Lam.) Peterm. (oddiy qoraqarag‘ay) va *P.schrenkiana* Fisch. & C.A.Mey. (Tyanshan qoraqarag‘ayi) ekilgan. Ushbu turkum Qarag‘aydoshlar oilasiga mansub bo‘lib, asosan Shimoliy yarimsharda tarqalgan 45 turni qamraydi. Turkum vakillari qadimiy, muhit sharoitiga tez moslanuvchi daraxtlar hisoblanadi. Ular bir uyli, monopodial o‘suvchi, uzoq umr ko‘ruvchi daraxt o‘simliklari hisoblanadi [6;122-125c].

Picea pungens Engelm. – tikanli qoraqarag‘ay tabiiy holda Shimoliy Amerikaning qoyali tog‘laridagi o‘rmon mintaqasida tarqalgan bo‘lib, tog‘ning shimoliy yonbag‘irlaridagi daryolar bo‘yida yakka-yakka yoki guruh bo‘lib o‘sadi [7;46-59c]. Toshkent sharoitida bahor ob-havosining qanday kelganligiga bog‘liq holda yillik o‘sish o‘rtacha 24,8 sm gacha yetishi qayd etilgan. Bahor oylarida yog‘ingarchilik ko‘p bo‘lsa va havo harorati me’yorga nisbatan yuqori bo‘lmasa tikanli qoraqarag‘ayning tez o‘sishi aniqlangan [2;82-90c: 5;329-331c]. Janubiy O‘zbekistonda uning aprelning uchinchi o‘n kunligidan may oyining oxirigacha o‘sishi, yillik o‘sishi 10 sm ni tashkil qilishi aniqlangan[3;210c].

Tadqiqotlar davomida turning o‘sish xususiyatlari aniqlandi. Kuzatuvlar asosan 3-7 yillik daraxtlarda olib borildi. Havo haroratining ortib borishi hamda yillik yog‘in miqdorining ko‘pligi bevosita o‘simliklarning rivojlanishiga o‘z ta’sirini ko‘rsatadi. 3-4 yoshli tikanli qoraqarag‘ay (*P.pungens*) dastlabki 2 yilda 8-13 sm (umumiy 16-25 sm)dan o‘sishi kuzatildi. Mazkur turning o‘ziga xos jihatlaridan biri, sovuqqa chidamliligi hisoblanadi. Shahar sharoitida yuqori tomondan soya bo‘lishi yoki boshqa yirik daraxtlar ta’sirida, o‘simlikning bo‘yiga o‘sishi birmuncha sekinlashib boradi. 5-yoshli o‘simlikning bir yilda 7-12 sm atrofida o‘sishi kuzatildi. 10-12 yoshdagi o‘simliklar yiliga nisbatan kamroq, ya’ni 6-9 sm atrofida o‘sishi kuzatildi. Tur haqida qisqcha xulosa tarzida shuni ta’kidlashimiz mumkinki, mazkur tur dastlabki 5 yilda nisbatan tez, keyinroq esa nisbatan sekin o‘sishi qayd etildi.

P. excelsa (Lam.) Peterm. – oddiy qoraqrag‘ay tabiiy holda Yevropaning deyarli barcha hududlarida tarqalgan. Shimolda tekisliklarda, O‘rta va Janubiy Yevropada tog‘larda, dengiz sathidan 2000 m gacha bo‘lgan joylarda o‘sadi. Toshkentda uning boshqa turlarga nisbatan tez o‘sishi, yillik o‘sish ko‘rsatkichi o‘rtacha 29,8 sm gacha yetishi qayd qilingan [2;82-90c]. Janubiy O‘zbekiston sharoitida esa bu ko‘rsatkich atigi 12 sm ni tashkil qilgan [3;210c]. Jizzax shahrida o‘sgan o‘simlikningtanasining quyi qismigacha doira shaklida shoxlanib, keng piramidasimon va qalin shox-shabba hosil qiladi. Ildiz tizimi yuzaki, shu tufayli o‘simlik shamolga chidamsiz. Po‘stlog‘i kulrang, ingichka plastinka bo‘lib ajralib tushadi. To‘rtqirrali ignabarglari spiral hosil qilib joylashgan, barg yostiqchalarida bittadan joylashgan. Ignabarglarining uzunligi 10-12 sm. Har bir ignabarg olti va undan ham ko‘p yil yashaydi. Jizzax shahri sharoitida o‘sishi yiliga 17-24 sm atrofida bo‘lishi kuzatildi. Tadqiqotlar davomida 10 yoshgacha bo‘lgan tuplar o‘rganildi. O‘simlik dastlabki yillarda tezroq o‘sishi kuzatildi. 3 yoshli o‘simlikning yiliga 17-20 sm atrofida o‘sishi kuzatildi. Olib borilgan tadqiqotlar shuni ko‘rsatadiki, *P. excelsa* tuplari yosh vaqtida sovuqqa chidamsiz bo‘ladi. Ular yiriklashgan sari sovuqqa chidamliligi ortib boradi. Zax yerlarda ekilgan o‘simlikning yer ostki qismi jiddiy zararlanib, nobud bo‘lganligi kuzatildi. 4 yoshli o‘simlikning 45-60 sm gacha o‘sishi kuzatildi. O‘simlikning yetilgan qubbalari 9-14 sm uzunlikda bo‘lib, avval yashil, yetilishi oldidan qo‘ng‘ir rangga kiradi. O‘simlik urug‘idan yaxshi ko‘payadi.

Mikrostrobilalar (erkak qubbalar) barg qo‘ltig‘ida joylashgan bo‘lib o‘tgan yilgi novdaning uchki qismida shakllanadi va asos qismi tangachalar bilan o‘ralgan bo‘ladi. Megastrobilalar (urg‘ochi qubbalar) ikki yillik shoxlarning uchki qismida shakllanadi. Jizzax shahri sharoitida ular avval vertikal o‘sadi, so‘ng asta sekin uchki qismi pastga egiladi va osilib turadi, so‘ngra kuz oylarida yetiladi. Yetilgan qubbalar cho‘zinchoqsimon, bo‘yi 15 sm, eni 4 sm. Urug‘lari tuxumsimon-o‘tkirlashgan,

uzunligi 4 mm gacha yetadi; qanotchasi qizg‘ish- jigarrang. Urug‘lari qishning o‘rtasigacha qubbalarda qoladi va yanvar-mart oylarida to‘kila boshlaydi.

P.schrenkiana – Tyanshan qoraqarag‘ayi tabiiy holda Tyanshan tog‘ining Jung‘or Olatog‘ va Kungey Olatog‘ tizmalari, Xitoyning Tibet qismida dengiz sathidan 1500-2500 m gacha bo‘lgan balandliklarda o‘sadi. T.V.Yesipova ma’lumotlariga ko‘ra, Toshkent sharoitida yillik o‘sishi bahorda namgarchilik yuqori bo‘lganda o‘rtacha 24,0 sm bo‘lgan. Bahor quruq kelganda esa bu ko‘rsatkich atigi 4 sm ni tashkil qilgan [2;82-90c].

2019-2022 yillarda Jizzax shahri sharoitida turning vegetatsiya davridagi o‘sish xususiyatlari o‘rganildi. O‘simlik novdalari tukli yoki tuksiz, och sarg‘ish rangda bo‘lishi kuzatildi. O‘simlik bir uyli bo‘lib, erkak qubbalari qo‘ng‘ir rangdagi silindr shaklda bo‘ladi. Yetilgan payti sariq rangga kirishi kuzatildi. Urg‘ochi qubbalari ham silindir shaklda bo‘lib, ularning tiniq rangli tangachalari yaqqol ko‘rinadi. Jizzax shahri sharoitida turning changlanishi aprel oyiga to‘g‘ri keldi.

P.schrenkiana havoning va tuproqning quruqligiga ham biroz chidamli ekanligi kuzatildi. Tadqiqotlar davomida 3 dan 10 yoshgacha bo‘lgan tuplarning o‘sishi o‘rganildi. Unga ko‘ra o‘simlik dastlabki yillarda o‘rtacha tezlikda o‘sishi kuzatildi. Yillik yog‘in miqdori va harorat ortib borgan yillarda yiliga 11-29 sm atrofida o‘sishi kuzatildi. Mazkur yillarda o‘simlik jami 45-50 sm atrofida o‘sganligi kuzatildi. 2018 yilda olib borilgan fenologik kuzatuvlar natijasida hamda tashqi ekologik omillarga bog‘liq tarzda 45-50 sm, 2019 yilda 38-42 sm, 2020 yilda 40-45sm, 2021 yilda esa 40-46 sm o‘sganligi kuzatildi.

Mazkur yillarda asosan o‘simlik mart oyining oxiridan may oyining 3-dekadasigacha jadallik bilan o‘sganligi kuzatildi. 9 va 10 yoshli o‘simliklar o‘sish nisbatan sekinlashib, yiliga 7-13 sm ni tashkil qilishi kuzatildi.

Shuni alohida ta’kidlash lozimki, yuqorida keltirilgan ko‘rsatkichlar bir qancha abiotik omillar ta’sirida o‘zgarib turishi qayd etildi. Mazkur turlarni o‘rtacha o‘suvchi turlar qatoriga kiritiladi.

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DOI: https://doi.org/10.5281/zenodo.14498710

КЎКДУМАЛОҚ МАЙДОНИ ҚУЙИ ВА ЎРТА ЮРА ЁТҚИЗИҚЛАРИНИНГ ЛИТОЛОГИК ТАВСИФИ

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Аннотация: *Мақолада Кўкдумалоқ майдонининг қуйи ва ўрта юра даври ётқизиқларини геологик ва литологик стратиграфик тузилиши келтирилган. Кўкдумалоқ майдонининг стратиграфик тузилиши келтирилган. Кўкдумалоқ майдонининг юра даври ётқизиқлар нефт ва газга истиқболли ҳисобланади.*

Калит сўзлар: *палеозой, мезазой ва кайнозой, Зекри, Дивалкак, Кушаб, юра, карбонат формацияси, туз ангидрит формацияси, неоком, альб.*

Annotation: *The geological and lithological stratigraphic structure of the Lower and Middle Jurassic deposits of the Kokdumolok area is presented in the article. The stratigraphic structure of the Kokdumaloq area is shown. The Jurassic deposits of the Kokdumaloq area are promising for oil and gas.*

Keywords: *Paleozoic, Mesozoic and Cenozoic, Zekri, Divalkak, Kushab, Jurassic, carbonate formation, salt anhydride formation, neocom, alb.*

Ўрганилаётган ҳудуднинг геологик тузилишида палеозой, мезозой, кайнозой ёшидаги ётқизиқлар иштирок этади. Буларнинг ичида меза-кайназой даври ётқизиқлари кўпроқ ўрганилган. Чунки бу давр ётқизиқлари нефт ва газга истиқболли ҳисобланади.

Палеозой эротемаси - PZ

Чоржов тектоник поғонаси марказий қисмида олиб борилган чуқур бурғулаш ишлари натижасида палеозой ётқизиқлари асосан чўкинди ва метаморфик тоғ жинсларидан (оҳактошлар, рифли оҳактошлар шунингдек туфлар) иборат эканлиги аниқланган. Палеозой ётқизиқлари 2907-3027м (Зекри майдони 4,5,6,7-қудуқларида), 2935м (Дивалкак, 1-қудуқ), 2675м (Чандир 4-

қудуқ), 3195м (Уртабулак 102-қудуқ), 3707м (Кушаб 1-қудуқ), 3934м Памук 1-қудуқ) чуқурликларида очилган.

Мезозой эротемаси - MZ

Мезозой ётқизиқлари палеозой ётқизиқлари устида бурчакли номувофиқлик билан ётади ва улардан метоморфизмга учрамаганлиги, алохида горизонтлар мустаҳкамланганлиги билан фарқланади. Уларнинг қалинлиги жанубдан шимолга қараб қисқариб боради. Юра кесмасининг қисқариши, асосан, туз-гипс ётқизиқлари қалинлиги камайиши ҳисобига юз беради.

Юра системаси – J

Ўрганилаётган майдон юра ётқизиқлари барча қудуқларда очилган ва терриген, карбонат ва туз-ангидритли ётқизиқлардан ташкил топган. Терриген ётқизиқлари ҳосил бўлиши, айнан, қуйи-ўрта юра комплекси, фундамент блокининг бир йўналишида нотекис ҳаракатланиши билан боғлик.

Юра ётқизиқлари кесмасининг пастки қисми терриген континентал ва юқори қисмида денгиз-лагуна ҳосилаларидан ташкил топган. Континентал ётқизиқлар қумтошлар, алевролитлар ва гиллар билан алмашиб ётувчи юпқа қатламли аргиллитлардан такиб топган.Терриген юра ётқизиқлари Испанли-Чандир кўтарилмасида 435 м дан (2 қудуқ, Дивалкак) 683 м гача (1 қудуқ, Крук), Денгизкул кўтарилмасида 565 м (102 қудуқ, Ўртабулак), Култак кўтарилмасида -741 м гача (3 қудуқ, Кўкдумолақ) ўзгаради.

Юра терриген жинслари қалинлиги қисқарган зоналарида ётқизиқларнинг қумлиги ортади.

Қудуқдаги геофизик тадқиқотлари (ГИС) маълумотларига кўра терриген юра ётқизиқларида XVII, XVIII, XIX ва XX коллектор горизонтлар ажратилган бўлиб, улар бир неча майдонларда (Дивалкак, Ўртабулак, Помуқ, Шимолий Алан, Кўкдумолақ ва бошкалар) маҳсулдор эканлиги кузатилган.

Карбонат формацияси ётқизиқлари терриген формацияси ётқизиқларига мувофиқ ётади ва қалинлиги 84м дан 352м гача ўзгарадиган фациал ўзаро боғланган карбонатли жинсларнинг турли хил комплексларидан иборат.

Карбонатли юра кўпинча оҳактошлардан, унинг фациал ўзгариши туфайли вужудга келган оолитли, уюшиқли, пелитоморф оҳактошлари ва уларнинг оралиқ турларидан ташкил топган. Коллектор жинслари уюшиқли, оолитли, уюшиқли-сувўтли оҳактошлар ҳисобланади.Оҳактошлар қисман ёки кучли доломитлашган.

Т6 қайтарувчи горизонти шу ётқизиқлар юзасига тегишли (К+О). Карбонатли ётқизиқлар қалинлиги 84 м дан 352 м гача боради. Келловей-оксфорднинг карбонатли ётқизиқлари устида кимеридж-титоннинг туз-ангидритли ётқизиқлари ётади, бу қатламлар XV-1 (Т6) горизонтининг газ учун

тутқич вазифасини ўтайди. Киммериж-титон ётқизиқлари ангидрит, оч қизғиш рангдаги гиллар, алевролит ва доломитлашган оҳактош линзалари ҳамда мергеллар бўлган қумтошларидан ташкил топган. Ўрганилаётган майдонда кимеридж -титон ётқизиқларининг қалинлиги 160м дан 402м гача ўзгаради.

Бўр системаси - К

Бўр ётқизиқлари карбонатлар ёки ангидритларнинг ювилган юзаси ётади, қуйи ва юқори бўлимларга ажралади.

Қуйи бўр - $К_1$

Қуйи бўр неокомнинг қизил рангли континентал терриген ётқизиклари ҳамда апт ва альбнинг кулранг денгиз чўкинди терриген ётқизиқларидан ташкил топган. Ўтказувчан қумтошлар XII, XIII, XIV горизонтларга ажратилган. Қуйи бўр ётқизиқлари қалинлиги ўрганаётган майдонда 350 метрдан 700 метргача ўзгаради.

Юқори бўр - $К_2$

Юқори бўр сенон-турон яруслари ва юқори сеноман яруси ётқизиқларидан ташкил топган бўлиб, кам миқдорда оҳактош ва мергел қатламчаларига эга бўлган кулранг терриген чўкинди жинслардан ташкил топган. Юқори бўр қалинлиги 800 метрдан 1100 метргача ўзгаради.

Кайнозой эратемаси - KZ

Кайнозой ётқизиқлари палеоген, неоген ва антропоген ётқизиқларидан ташкил топган.

Палеоген системаси – P

Палеогеннинг қуйи қисми палеоценнинг бухоро қатлалари кулранг оҳактошларидан, сарғиш-кулранг зич, баъзан дарзлашган ва ғовакли қумтошлардан иборат. Бу ётқизиқлар ўрганилаётган майдоннинг барча қисмида мавжуд ва ишончли сейсмик таянч вазифасини ўтайди. Уларнинг қалинлиги 75м дан 230 м гача ўзгаради.

Палеоген оҳактошларида эоценнинг органик моддаларига бой қора кулранг ва яшил-кулранг гиллари ривожланган (40м чамаси).

Неоген – N

Палеоген ётқизиқларининг ювилган юзасига қумтош, гил, алевролитлардан ташкил топган неоген (0-110м) ётқизиқлари ётади.

Тўртламчи давр ётқизиқлари – Q

Тўртламчи давр ётқизиқлари гил, соз тупроқ, қумтошлар ва суглинкалардан ташкил топган бўлиб, уларнинг қалинлиги 30-40 м дан ошмайди.

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DOI: https://doi.org/10.5281/zenodo.14498726

ОПРЕДЕЛЕНИЕ ИСПАРЕНИЯ НА ПОВЕРХНОСТИ ТОДАКОЛЬСКОГО ВОДОХРАНИЛИЩА (НА ОСНОВЕ ГИДРОМЕТЕОРОЛОГИЧЕСКИХ ДАННЫХ)

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Аннотация. *Данная работа ориентирована на определение среднемесячной суммы испарения с уровня воды по гидрометеорологическим данным в виде слоев (мм) на примере Тодакульского водохранилища. Для проведения работы была проанализирована литература по данной теме, подобраны формулы, использованы данные метеостанции Навои. В результате определялась годовая сумма испарения, влияющая на выходной баланс водохранилища, в виде слоев по месяцам. Построены графики количества испарения с поверхности водоема в виде сезонного и месячного слоев.*

Ключевые слова. *Тодакул, водохранилище, испарение, гидрометеорология, метеостанция, выходной баланс, годовой объемю*

DETERMINATION OF EVAPORATION ON THE SURFACE OF THE "TODAKOL" RESERVOIR (BASED ON HYDROMETEOROLOGICAL DATA)

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Annotation. *This work is focused on determining the average monthly amount of evaporation from the water level according to hydrometeorological data in the form of layers (mm) using the example of the Todakol reservoir. To carry out the work, the literature on this topic was analyzed, formulas were selected, data from the Navoi meteorological station were used. As a result, the annual amount of evaporation, which affects the output balance of the reservoir, was determined in the form of layers by months. Graphs of the amount of evaporation from the surface of the reservoir are plotted in the form of seasonal and monthly layers.*

Key words. *Todakol, reservoir, evaporation, hydrometeorology, weather station, output balance, annual amount.*

ВЕДЕНИЕ. Если говорить точнее, большая часть территории нашей республики состоит из 78,8% равнин (пустынная и полупустынная зоны), а возможная испаряемость в несколько раз больше, чем выпавший дождь. В водохранилищах, расположенных в аридных зонах, расход воды на испарение больше, чем в других регионах. Такая ситуация требует определения количества испарения, которое имеет важное значение в расходном балансе озер и водохранилищ. С этой целью в данной работе была предпринята попытка определения испарения с поверхности Тудакульского водохранилища с помощью гидрометеорологических данных. Водохранилище расположено в Кызылтепинском районе Навоийской области и построено в 1965-1968 годах на средства областных водохозяйственных организаций на основе материалов проектной группы Управления ирригационных систем Бухарской области. Водохранилище расположено на открытой равнине, не окруженной горами.

Проведен ряд научных исследований по изучению и определению ежегодных потерь потока испарения с поверхности водохранилища. Испарение с поверхности воды изучали Б.К.Давыдов, С.Н.Крицкий, М.Ф.Менкель, К.И.Российский, Б.Д.Зайков, А.П.Браславский и другие. В Средней Азии этим вопросом занимались такие ученые, как А.М.Никитин, Н.Э.Горелкин, В.Н.Рейзвих.

Основная часть. На водохранилищах нашей республики были проведены наблюдения, изучены их специфические факторы и с учетом географического расположения водохранилища были разделены на группы предгорных и равнинных водохранилищ. Для определения испарения с поверхности водохранилищ, расположенных на равнине, рекомендована следующая формула.

$$Z=0{,}15n(\ell_0-\ell_{200})\ (1+0{,}72V_{200})\ (1)$$

Для водохранилищ, расположенных в горных районах, рекомендуется следующая формула.

$$Z=0,19n(\ell_0-\ell_{200})\ (1+0,51\ V_{200})\ (2)$$

Приведенные выше формулы используются для определения испарения с поверхности водохранилища в зависимости от температуры воды. Для выполнения вышеуказанной работы мы использовали выражение Б.Д.Зайкова. При отсутствии наблюдений за температурой поверхности воды в водохранилище мы используем следующее уравнение для определения количества испарения поверхности воды:

$$e_0\text{-}e_{200}=C\cdot d_{200}^{0,78} \qquad 3)$$

где: d_{200}-2 метров недостаток влаги в воздухе, С-географический параметр, зависящий от соотношения поверхности воды и температуры воздуха, его значение определяется на специальной карте, составленной Б.Д.Зайковым по координатам метеостанции. Для границ пустынно-полупустынных районов Средней Азии можно принять С=1,2. Известно, что недостаток влаги в воздухе (d_{200}) определяется следующим образом:

$$d_{200}=e_0\text{-}e_{200} \qquad (4)$$

где значение e_0 определяется из таблицы упругости насыщенного водяного пара по температуре воздуха, зафиксированной на метеорологической станции. Учитывая приведенные выше уравнения, выражение Б.Д.Зайкова можно записать в следующем виде:

$$Z=0,15\cdot n\cdot C\cdot d_{200}^{0,78}\cdot(1+0,72\cdot v_{200}),\quad \text{мм/м} \qquad (5)$$

Составим расчетную таблицу в соответствии с этим выражением. Точнее говоря, эта таблица должна отражать количество дней в каждом месяце (n), эластичность насыщенного водяного пара (e_0), зафиксированную эластичность водяного пара (e_{200}), их разницу (e_0 - e_{200}), скорость ветра ($_{200}$) и, наконец, месячную величину испарения (Z).

Переход от скорости ветра, определяемой на высоте флюгера, к скорости на высоте 2 м над земной поверхностью. Скорость ветра, определяемая на метеорологической станции на высоте флюгера, на высоте 2 метров от поверхности земли, осуществляется с помощью следующего выражения:

$$v_{200}=\frac{lg\frac{z_1}{z_0}}{lg\frac{z_2}{z_0}}\cdot v_{1000} \qquad (6)$$

С помощью приведенного выше выражения скорость ветра на высоте флюгера переходит от скорости, определенной за январь, к скорости на высоте 2 м над земной поверхностью следующим образом (формула 5). Скорость ветра на высоте 2 м над земной поверхностью определяется в таком же порядке для остальных месяцев.

$$v_{200} = \frac{lg\frac{200}{0,3}}{lg\frac{1000}{0,3}} \cdot 3,8 = \frac{lg\ 666,7}{lg\ 3333,3} \cdot 3,8 = \frac{2,8240}{3,5228} \cdot 3,8 = 0,80 \cdot 3,8 = 3,0\frac{m}{s} \quad (5)$$

Среднемесячные значения метеоэлементов, наблюдаемые на метеорологической станции Навои

1- таблица

Метеоэлементы	Месяцы											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
$t_{h,}\,°C$	4,7	6,8	8,7	20,4	22,7	28,5	30,5	26,9	23,8	19,6	11,2	2
$e_{0,\,mb}$	8,5	9,9	11,2	23,8	27,6	38,7	42,2	35,5	29,5	22,8	13,2	7
$v_{1000,\,m\backslash s}$	3,8	4,2	4,3	3,8	4,3	3,8	5,1	4,5	3,6	3,2	3,8	2,9
e_{200}	6,5	6	7,6	11,1	11,6	9,3	8,4	7,1	6,1	8,9	9	4,3

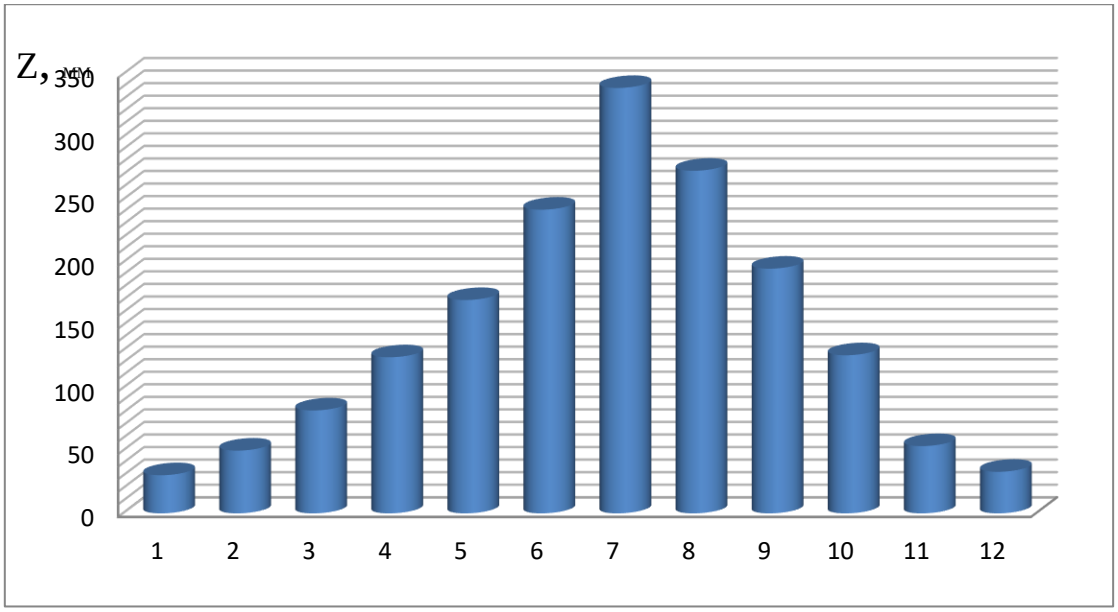
На следующем этапе нашей работы, используя среднемесячные значения метеоэлементов, наблюдаемые на Навоийской метеорологической станции, зная, что Тудакульское водохранилище расположено на равнине, мы попытались отобразить количество испарения в виде слоя в таблице на основе среднемесячной температуры воздуха. При выполнении работы из приведенных выше формул за основу были взяты 5 и подготовлена таблица 2.

Расчет испарения Тудакульского водохранилища в зависимости от температуры воздуха

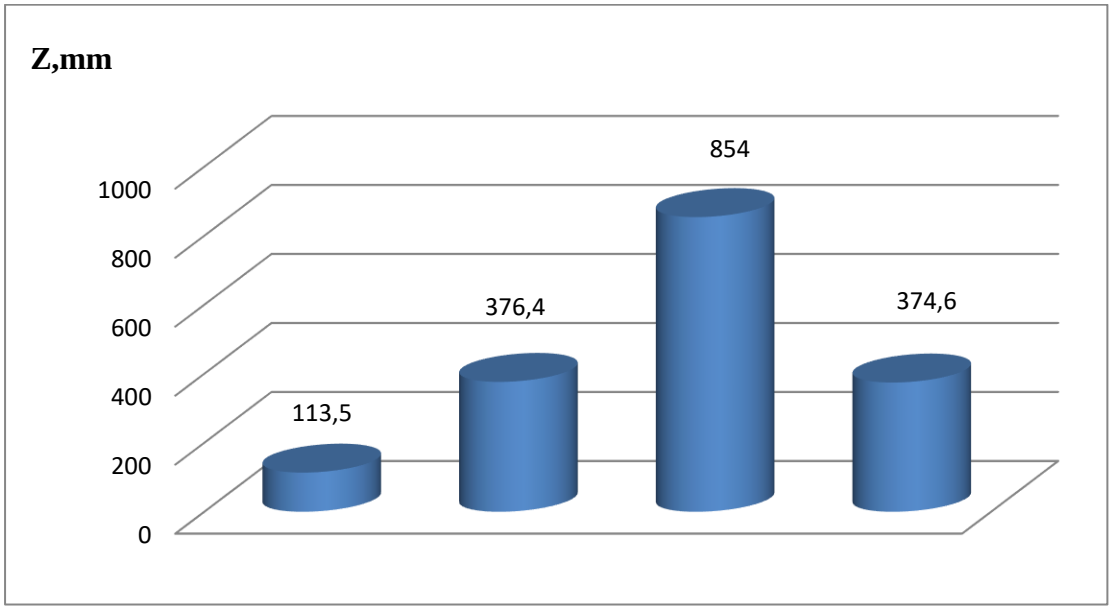
2- таблица

Расчетные элементы	Месяцы											
	I	II	III	IV	V	VI	VII	VII	IX	X	XI	XII
-n	31	28	31	30	31	30	31	31	30	31	30	31
$0,15\cdot n$	4,65	4,2	4,65	4,5	4,65	4,5	4,65	4,65	4,5	4,65	4,5	4,65
$0,15\cdot n\cdot C$	5,58	5,04	5,58	5,4	5,58	5,4	5,58	5,58	5,4	5,58	5,4	5,58
e_0	8,5	9,9	11,2	23,8	27,6	38,7	42,2	35,5	29,5	22,8	13,2	7
e_{200}	6,5	6	7,6	11,1	11,6	9,3	8,4	7,1	6,1	8,9	9	4,3
$d_{200} = e_0 - e_{200}$	2	3,9	3,6	12,7	16	29,4	33,8	28,4	23,4	13,9	4,2	2,7
$d_{200}^{0,78}$	1,7	2,9	4,2	7,2	8,7	14	15,6	13,6	11,7	7,8	3,1	2,2
$-v_{200}$	3,04	3,36	3,44	3,04	3,44	3,04	4,08	3,6	2,9	2,6	3,04	2,32
$0,72\cdot v_{200}$	2,2	2,4	2,5	2,2	2,5	2,2	2,9	2,6	2,08	1,9	2,2	1,7
$1+0,72\cdot v_{200}$	3,2	3,4	3,5	3,2	3,5	3,2	3,9	3,6	3,08	2,9	3,2	2,7
Z,mm	30,4	50	82	124,4	170	242	339	273	195	126	53,6	33,1

Определяя испарение с поверхности водохранилища в виде слоя, мы хотим отдельно остановиться на следующих мыслях: количество испарения с поверхности воды водохранилища напрямую зависит от температуры, повышение температуры увеличивает интенсивность испарения. Кроме того, уровень воды в водохранилище и в зависимости от него площадь поверхности воды водохранилища также будет различной. Большая площадь воды в равнинных районах приводит к увеличению объема испарения.



1- график. Распределение количества испарения с поверхности Тудакульского водохранилища по месяцам в течение года



РЕЗУЛЬТАТ. На основании приведенных выше данных можно сделать следующие выводы.

- Тудакульское водохранилище расположено в пустынной и полупустынной зоне, в балансе отходов значительное количество испарения.
- Среднегодовая температура воздуха на Навоийской метеостанции, расположенной недалеко от водохранилища, составляет 17,1 °C.
- Среднегодовая скорость ветра составит 3,9 м/с, в основном с севера и северо-запада.

В зависимости от состояния воздуха слой испарения с поверхности воды составляет 1720 мм, основная испаряемость продолжается с апреля по октябрь.

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DOI: https://doi.org/10.5281/zenodo.14498738

ADMINISTERING A SPECIFIC IMMUNOTHERAPY FOR ALLERGENS USING THE "ANTI POLLIN" PRODUCT, A BLEND OF WEEDS AND GRASSES, FOR SEASONAL CASES OF ALLERGIC RHINITIS (HAY FEVER)

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Over the past 30 years, meteorologists have observed an increase in the average temperature of the planet by 1 degree. This has led to large-scale changes in the growth patterns of allergenic plants, their pollen production, and even the levels of allergenic pollen proteins.

Keywords: *allergic rhinitis, Pollinosis, Antipollin, ASIT, Weeds, Meadow grasses, Trees.*

Over the past 30 years, according to meteorologists, the average temperature on the planet has increased by 1 degree. This, in turn, caused large-scale changes in the areoles of allergenic plants, their dusting activity and even the level of allergenic pollen proteins. [1, p. 3]. The increase in the number of allergic diseases in recent decades has become a global problem around the world, requiring the joining of efforts not only from health systems, but also politicians, ecologists and other specialists whose work is associated with the formation of the human environment. [3, 4, 6 c. 6, 11.14]. The processes of global warming, widespread climate change, changes in construction technologies and other factors contribute to the change in human living conditions. [2.11.6 s 8, 12.16]. The increase in CO2 in the atmospheric air in recent decades has caused changes in the growth rate of plants with earlier flowering and the release of large amounts of pollen. Cyclones, which have become more frequent in recent years, facilitate the transfer of allergenic pollen over long distances, which predisposes to the appearance of clinical manifestations in persons with latentsensitization. A number of authors note an increase in the prevalence of allergic diseases (AD) ofthe respiratory tract, including pollen etiology. With this pathology, which is based on a chronic inflammatory process that develops mainly on the mucous membrane of the respiratory organs, the goal of therapeutic measures is to achieve a good level of control over the symptoms of the disease, reduce the risk

of subsequent exacerbations and prevent aggravation AD.

In our country, 2 methods of introducing allergens are most often used - subcutaneous (SCIT) and sublingual (SLIT). As shown in many studies, these methods have common mechanisms of action in relation to the switching of the Th-cell response and the induction of blocking antibodiesof the IgGisotype. However, the effect of large doses of the allergen, which occurs in SLIT, on the oral mucosa, which has a common lymphatic drainage from the nasal mucosa and cervical lymph nodes, causes additional local mechanisms and thus resembles the natural processes of tolerance formation. By its mechanism of action, ASIT is the only method capable of modifying the natural course of the disease, and its use is a unique opportunity to prevent the emergence of new sensitization in a patient. ASIT most fully meets the principles of personalized medicine. [10,9,7 c 12,3.5]. This means that the patient receives only the therapy intended for him according to the spectrum of sensitization and after proving the causal role of a particular allergen. In this article, we present our own data on the analysis of the effectiveness of Antipollin treatment of patients with various forms of hay fever with sensitization to pollen from wormwood, quinoa, and ragweed.

Purpose of the study: to evaluate the effectiveness of one course of SLIT in patients with allergy to pollen of meadow and weed grasses.

Materials and research methods. The patients were examined at the Republican Scientific Specialized Allergological Center of the Republic of Uzbekistan. One course pack contains 9blisters of 6 tablets, 54 tablets in total. The active substance of the preparation "ANTIPOLLIN" a mixture of weeds and meadow grasses is an allergen of plant pollen from 0.0001 PNU to 1000 PNU. Blister No. 1- 0.0001 PNU, blister No. 2- 0.001 PNU, blister No. 3- 0.01 PNU, blister No. 4-

0.1 PNU, blister No. 5-1 PNU, blister No. 6-10 PNU, blister No. 7- 100 PNU, blister No. 8- 1000 PNU, blister No. 9- 1000 PNU. The drug "ANTIPOLLIN" was prescribed no later than 2 - 2.5 months before the beginning of the flowering season of the "guilty" plant (weeds). The patientsused the drug "ANTIPOLLIN" before meals, one tablet a day, sublingually (under the tongue) until completely absorbed, without drinking water.

In the presence of colds, taking pills is contraindicated, therefore, patients were allowed to continue ASIT only after complete recovery. Patients strictly adhered to a hypoallergenic dietduring treatment with ANTIPOLLIN. The diet was prescribed

individually for each patient, depending on the course of the disease. During treatment, patients were also advised to limit contactwith possible allergens. During the menstrual cycle, women were advised to take a short break. On the days of taking ANTIPOLLIN tablets, a mixture of weeds and meadow grasses is also not advisable to consume alcohol.

To assess the dynamics in the future, before the start of treatment, questionnaires were filled in,reflecting the quality of life, the number and severity of symptoms. The effectiveness of therapy was assessed in points, taking into account the severity of clinical manifestations before flowering and during pollination, the need to take symptomatic drugs.

Research results. 43 people received “ANTIPOLLIN” a mixture of weeds and meadow grasses, including 24 adults: 13 women aged 19-50 years and 11 men aged 20-55 years. And also 19 children from 7 to 18 years old: 13 boys and 6 girls. All patients had not previously received ASIT. A carefully collected anamnesis made it possible to exclude patients who had contraindications. In the blood of patients, specific IgE to pollen allergens, an increase in total IgE were detected, positive results were obtained during skin testing with pollen allergens. All patientsat the start of treatment with "ANTIPOLLIN" were in remission for the underlying disease. Termsof treatment start: December - meadow grasses, from March - weeds. The course of treatment consisted of daily sublingual use of the tablets for 70 days. The so-called pre-season ASIT. Side effects in the form of itching of the oropharynx, moderate nasal congestion was observed in 17-12%of patients and only when taking the first 2-3 blisters. Symptoms were mild and resolved on their own, therefore drug withdrawal was not required in any case.

An excellent result was considered the absence of all manifestations of the disease; good - the clinical manifestations of the disease are insignificant, do not affect the quality of life and can be completely stopped by taking a minimum amount of symptomatic drugs; satisfactory - the manifestations of the disease have become less frequent and less pronounced, but at the same time the quality of life is reduced, in order to achieve partial remission, it is required to take symptomatic drugs; unsatisfactory - no clinical improvement.

The results of the study noted that in the subsequent ASIT season of exacerbation, clinical symptoms were noted by 72.4% of patients - after slASIT. In patients with hay fever after a course of ASIT, a follow-up was found to decrease the frequency and severity of nasal symptoms to 66.7%, conjunctival - to 33.3% and 30%, in

patients with hay fever it was accompanied by a significant decrease in both indicators of eosinophils in the peripheral blood.

After the ASIT course, a decrease in the degree of sensitization to weed allergens was noted in 55.0% of individuals, absence - in 40.0%, a "new" episode of sensitization - in 5.0% of individuals, the persisting degree of sensitization was not observed in 1 patient. 65.0% of patients had one or another sensitization to meadow fescue. The persisting degree of sensitization was noted in 27.8% - after slASIT, a decrease in the degree of sensitization was noted in 55.6%; lack of sensitization to this allergen -16.7%.

76.7% of patients had one or another sensitization to wormwood. The persisting degree of sensitization was noted in 4.2% - after slASIT; a decrease in the degree of sensitization was noted in39.1%; lack of sensitization to this allergen - in 34.8%,

54.2% of patients had some type of sensitization to swan. The persisting degree of sensitization was noted in 16.7%; a decrease in the degree of sensitization was noted in 16.7; lack of sensitizationto this allergen - 58.3%.After the first course of treatment, a decrease in the level of general and specific Ig E was noted in 88% of patients.

Conclusion. Based on the results reviewed by us, it can be concluded that ASIT with the use of the drug "ANTIPOLLIN" a mixture of weeds and meadow grasses allows to achieve a high clinical and immunological effect, since it affects almost all significant links in the pathogenesis of an allergic reaction, and serves as the basis for use in general practice treatment of pollinosis.

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DOI: https://doi.org/10.5281/zenodo.14498748

INNOVATIVE METHODS IN SYNTHESIZING ORGANOMETAL HALIDE PEROVSKITES FOR ENHANCED SOLAR CELL EFFICIENCY

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ABSTRACT

The pursuit of efficient and stable perovskite solar cells (PSCs) has led to the development of several innovative synthesis methods for organometal halide perovskites. This study reviews seven key techniques that have significantly enhanced the performance and stability of PSCs. These methods include Hybrid Chemical Vapor Deposition (HCVD), Hydrochloric Acid Vapor Annealing (HAVA), interface functionalization, cryo-controlled nucleation, the incorporation of core-shell metal nanoparticles, tantalum-doped TiO_2 nanorods, and sequential vacuum deposition. HCVD allows for precise control of deposition parameters, achieving efficiencies up to 11.8%. HAVA enhances structural and electronic properties by converting CH3NH3PbI3 to phase-pure CH3NH3PbCl3, increasing efficiency to 17.40%. Interface functionalization with organometallic compounds such as ferrocenyl-bis-thiophene-2-carboxylate has achieved efficiencies of 25.0% and maintained stability over long-term operation. Cryo-controlled nucleation creates highly uniform films, reaching a PCE of 21.4%. The integration of core-shell metal nanoparticles reduces exciton binding energy, achieving efficiencies of up to 11.4%. Tantalum doping in TiO2 nanorods enhances electron transport and band alignment, resulting in a record efficiency of 19.11%. Sequential vacuum deposition produces uniform, highly crystalline perovskite films, achieving efficiencies up to 15.4%. These advancements address key challenges in the scalability, stability, and efficiency of PSCs, paving the way for the commercial viability of high-performance perovskite-based photovoltaics. Continued research and optimization of these methods will drive further progress in the field.

Keywords: *Perovskite Solar Cells (PSCs) ,Organo- metal halide perovskites, Interface functionalization, Cryo-controlled nucleation, Core-shell metal nanoparticles,Power conversion efficiency (PCE), Photovoltaics, Scalability, Stability, Efficiency, Solar Energy.*

INTRODUCTION

Organometal halide perovskites are a class of materials with significant potential in various applications, particularly in photovoltaics and optoelectronics. Their development has seen rapid advancements, focusing on synthesis techniques and understanding their structural and optical properties. Research has expanded to include various dimensional structures (3D, 2D, 1D, 0D), with low-dimensional perovskites showing unique properties due to strong quantum confinement **(Lin et al., 2018).** A novel organometal halide perovskite ($CH_3NH_3PbI_3$) was synthesized for hybrid solar cells, achieving higher efficiency and voltage compared to its analogues **(Qiu et al., 2013).** Development of inorganic halide perovskite nanocrystals has been significant due to their stability and high photoluminescence, making them suitable for next-generation lighting and display applications **(Li et al., 2017).** The synthesis of dual-functional molecularly imprinted polymers-modified organometal lead halide perovskite shows potential in photoelectrochemical sensing applications **(Yang et al., 2019).** Research has focused on controlling the synthesis of organometal halide perovskite nanocrystals to improve their photoluminescence and stability, essential for applications in solar cells and light-emitting devices **(Zhu et al., 2015).** Organometal halide perovskites have been used as light harvesters and hole conductors in hybrid heterojunction solar cells, achieving efficiencies up to 15% **(Singh & Nagarjuna, 2014**). Two-dimensional organometal halide perovskite nanorods have tunable optical properties, making them promising for various optoelectronic applications **(Aharon & Etgar, 2016).** The innovative methods discussed in this review, including HCVD, HAVA, interface functionalization, cryo-controlled nucleation, core-shell metal nanoparticles, Ta-doped TiO2 nanorods, and sequential vacuum deposition, represent significant advancements in the field of perovskite solar cells. Each technique offers unique advantages and addresses specific challenges, contributing to the overall progress in the development of efficient, stable, and scalable PSCs. Continued research and optimization of these methods will be essential for realizing the commercial potential of perovskite-based photovoltaics, ultimately paving the way for more sustainable and cost-effective solar energy solutions..

METHODS AND RESULTS

Several advanced techniques for synthesizing organometal halide perovskites were investigated, focusing on their ability to improve power conversion efficiency (PCE) and device stability. The methods include hybrid chemical vapor deposition (hcvd), hydrochloric acid vapor annealing (hava), cryo-controlled nucleation, interface

functionalization, incorporation of core-shell metal nanoparticles, and tantalum-doping of TiO_2 nanorods.

Hybrid chemical vapor deposition (HCVD): integrated strategies lead to improved efficiency and stability of hybrid chemical vapor deposition based perovskite solar cells and modules. This study presents integrated strategies for hybrid chemical vapor deposition (HCVD) to fabricate perovskite solar cells/modules. By mitigating the oxygen loss in the electron transport layer and optimizing the PbI_2 solvent with N-methylpyrrolidone (NMP), the power conversion efficiency (PCE) reached 21.98% with remarkable stability ***(Tong et al., 2023).*** The HCVD method demonstrated the ability to achieve efficiencies of up to 11.8% and demonstrated its industrial scale potential with precise control of the synthesis conditions. This method maintained almost the same efficiency after about 1100 hours of storage in dry N_2 gas ***(Leyden et al., 2014).*** Crystal engineering grown perovskite solar cells for low defect density and high efficiency hybrid chemical vapor deposition. The HCWD technique provided high versatility and reproducibility in growing perovskite films with low defect density Slow cooling after deposition significantly reduced the trap density and increased the PCE by 17.6% ***(Ng et al., 2016)*** . Uniform, stable, and efficient planar-heterojunction perovskite solar cells by facile low-pressure chemical vapor deposition under fully open-air conditions. The research developed a low-pressure chemical vapor deposition (LPCVD) method that produces perovskite films with good crystallization and long carrier diffusion lengths. This method achieved a PCE of 12.73% under open-air conditions, indicating its suitability for low-cost fabrication (***Luo et al., 2015).*** Investigation of high-efficiency perovskite-based solar cells grown by hybrid chemical vapor deposition technique. This study investigated perovskite-based solar cells with an inverted structure grown by HCVD. Enhanced device performance is associated with bandgap states, achieving higher efficiency through optimized low-frequency noise characteristics ***(Gokkaya et al., 2017).*** High efficiency perovskite solar cells fabricated by hybrid physicochemical vapor deposition. A hybrid physicochemical vapor deposition (HPCVD) method was used to fabricate perovskite solar cells with mixed perovskite films. The highest PCE achieved was 18.1%, which demonstrated the potential of fine-tuning the composition of the perovskite material ***(Wei et al., 2020).*** These citations highlight advances in hybrid chemical vapor deposition and various approaches to improve the efficiency and stability of perovskite solar cells.

Power conversion efficiency of various hcvd techniques

Power conversion efficiency (PCE) %

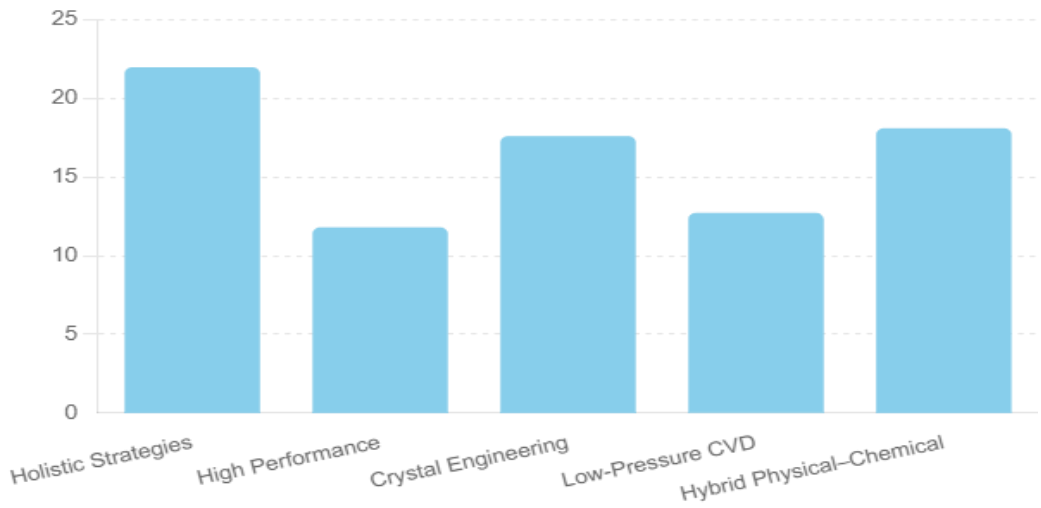

Figure 1. Here is the updated bar chart summarizing the power conversion efficiency (PCE) of various HCVD techniques in perovskite solar cells without the references in the labels:

Interface functionalization plays a critical role in enhancing the performance and stability of perovskite solar cells (PSCs). Various strategies have been developed to optimize the interfaces between perovskite layers and charge transport layers to reduce defects, improve charge transfer, and enhance overall device efficiency. Combining hybrid perovskites with Lewis base molecules and graphene improves surface trap passivation and alters band alignment, resulting in enhanced performance. Thiocarbamide and thioacetamide, as S-donors, demonstrate higher binding strength and effectiveness in eliminating deep trap states, enhancing stability and efficiency ***(Yu et al., 2019)***. MoS_2 quantum dots (QDs) and reduced graphene oxide (RGO) hybrids, used as hole transport and active buffer layers, provide hole-extraction and electron-blocking properties, achieving efficiencies over 20%. This combination enhances the uniformity of the layers and reduces pinholes, significantly improving device performance ***(Najafi et al., 2018)***.A multifunctional agent, histidine, is employed to modify the SnO_2/perovskite interface. This agent reduces interfacial trap state density and nonradiative recombination losses, enhancing electron extraction and the quality of the perovskite film. The resultant devices achieve a PCE of 22.91% with improved humidity and thermal stability **(Li et al., 2022)**. Introducing functional molecules such as fluorene-based conjugated polyelectrolyte (CPE) and organic halide salt (OHS) reduces interfacial recombination losses, achieving a high VOC of 1.18 V and a PCE of 21.33%. This method highlights the synergistic effect of these molecules in improving device performance **(Li et al., 2020)**. Functionalizing multication and halide perovskite interfaces with ferrocenyl-bis-thiophene-2-carboxylate enhances efficiency and stability, achieving a PCE of 25.0% and maintaining over 98% of initial

efficiency after 1500 hours of continuous operation under simulated conditions **(Li et al., 2022)**.

Power conversion efficiency of interface functionalization techniques

Power Conversion Efficiency (PCE) %

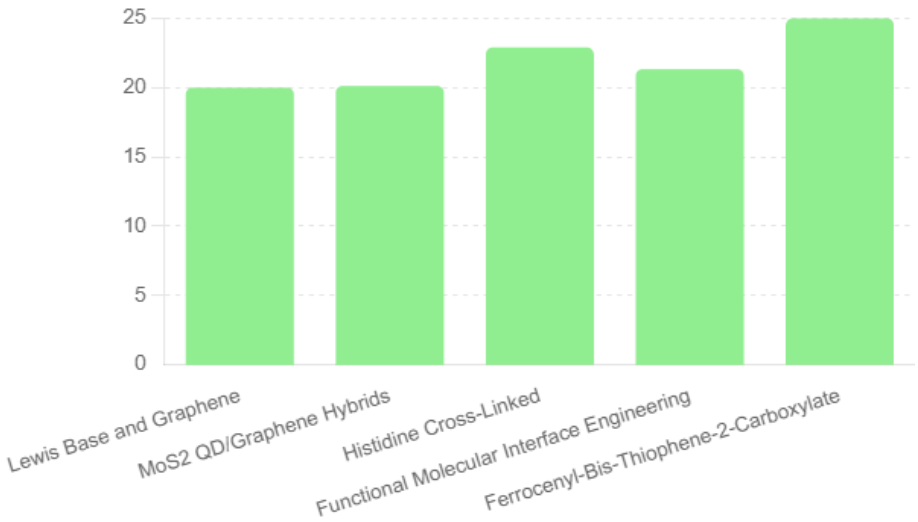

Figure 2. Here is the bar chart summarizing the power conversion efficiency (PCE) of various interface functionalization techniques in perovskite solar cells:

Interface functionalization significantly enhances the efficiency and stability of perovskite solar cells. Strategies such as Lewis base and graphene functionalization, MoS_2 QD/graphene hybrids, and various molecular interface engineering techniques have demonstrated substantial improvements in device performance and longevity. These advancements are pivotal for the commercial viability of PSCs.

Hydrochloric acid vapor annealing (HAVA) is an innovative post-treatment method used to enhance the performance of perovskite solar cells by improving the quality and characteristics of the perovskite films. The HAVA method is a low-cost and facile approach that converts CH3NH3PbI3 to phase-pure CH3NH3PbCl3. This conversion increases the average grain size, reduces trap states, and enhances crystallinity. As a result, the power conversion efficiency (PCE) of the perovskite solar cell was significantly improved from 14.02% to 17.40%, with the highest PCE reaching 18.45%. The method also effectively suppresses hysteresis in the current-voltage response **(Zhou et al., 2018)**. Although not specifically HAVA, the room-temperature water-vapor annealing (WVA) method shares similarities with HAVA in terms of improving perovskite film quality. WVA treatment results in high crystallinity and void-free perovskite films, achieving a PCE of 16.4% with a high open-circuit voltage (Voc) of 1 V. This method highlights the effectiveness of vapor annealing treatments in enhancing the photovoltaic performance of perovskite solar cells **(Wang et al., 2016)**. This study introduces a mixed-solvent-vapor annealing (MSVA) method,

which, although not identical to HAVA, similarly aims to improve perovskite film quality. The MSVA method enhances the PCE of perovskite solar cells from 12.2% to 15.1%. Further improvements are achieved through compositional engineering and interface treatments, with efficiencies reaching up to 18.9% **(Sun et al., 2016).** Similar to HAVA, this method involves room-temperature annealing with mixed-solvent vapors. It produces ultra-smooth perovskite films with high crystallinity, resulting in a PCE of 16.4% and excellent reproducibility among different devices. This technique demonstrates the potential of vapor annealing in fabricating large-area perovskite solar cells with high efficiency **(Yu et al., 2016).**

Power Conversion Efficiency Of Various Vapor Annealing Techniques

Power Conversion Efficiency (PCE) %

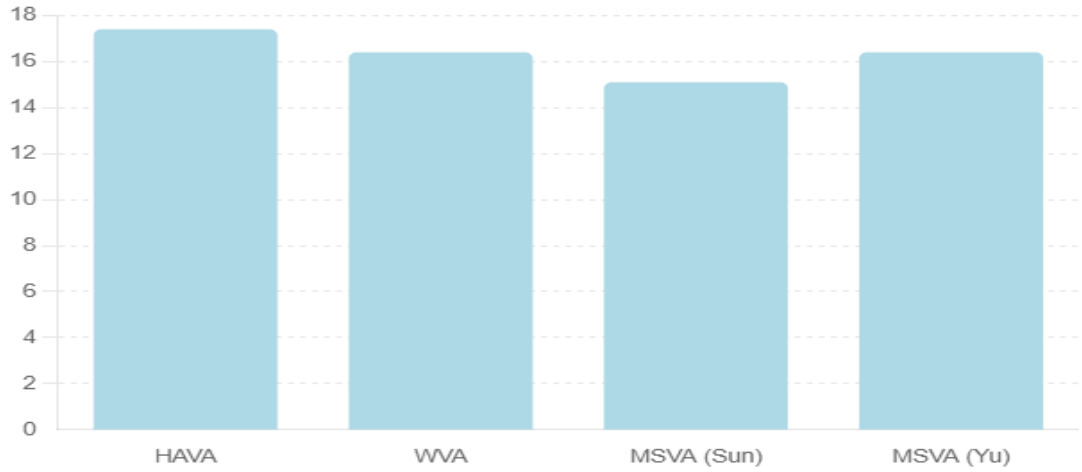

Figure 3. Here is the updated bar chart summarizing the power conversion efficiency (PCE) of various vapor annealing techniques in perovskite solar cells:

Hydrochloric acid vapor annealing (HAVA) and similar vapor annealing techniques significantly enhance the efficiency and stability of perovskite solar cells by improving the crystallinity, reducing trap states, and enlarging grain sizes of the perovskite films. These methods are crucial for the commercial viability and scalability of perovskite-based photovoltaics.

Cryo-controlled nucleation is a novel technique used to improve the efficiency and quality of perovskite solar cells by precisely controlling the nucleation and crystallization phases during film formation. This method involves a rapid temperature reduction, causing supersaturation in the precursor layer, leading to uniform nucleation sites. This results in highly uniform perovskite films with excellent quality, achieving a power conversion efficiency (PCE) of 21.4% **(Ng et al., 2018).** The technique involves an abrupt decrease in ambient temperature, leading to supersaturation and uniform nucleation, preventing premature crystallization. This results in high-quality perovskite films and a PCE of 21.4% **(Ng et al., 2018).** This process eliminates the need for environmentally harmful antisolvents by using rapid cooling with liquid

nitrogen, followed by nitrogen gas blow-drying. It results in uniform precursor precipitation and high-quality films, achieving a PCE of 21.4% (Ng et al., 2018). Using poly(methyl methacrylate) (PMMA) as a template for nucleation control leads to perovskite films with high electronic quality and a PCE of up to 21.6% **(Bi et al., 2016)**. Spin-coating perovskite films on frozen substrates allows control over nuclei position and crystal growth direction, resulting in high-quality films and a PCE of 17.14% **(Wang et al., 2019).** Cryo-controlled nucleation significantly improves the efficiency and quality of perovskite solar cells by providing precise control over nucleation and crystallization processes. These methods have achieved PCEs of up to 21.6%, demonstrating their potential for high-performance solar cell applications.

Core-shell metal nanoparticles have been integrated into perovskite solar cells to enhance their efficiency by leveraging plasmonic effects and improving charge transport properties. Here are some significant findings from recent research: Incorporating Au@SiO2 nanoparticles into meso-superstructured perovskite solar cells resulted in a device efficiency of up to 11.4%. The enhancement was attributed to the reduced exciton binding energy rather than increased light absorption **(Zhang et al., 2013)**. Integrating Au@TiO2 core-shell nanoparticles into porous TiO2 and perovskite layers increased PCE from 12.59% to 18.24%. This improvement was due to enhanced exciton generation, charge separation, and reduced recombination **(Luo et al., 2017)**. Introducing Ag.TiO_2.Pa nanoparticles improved light absorption and carrier extraction, resulting in a PCE increase from 18.4% to 20.2%. The bishell structure activated efficient plasmon-exciton coupling and reduced charge recombination **(Yao et al., 2019)**. Incorporating Ag@TiO2 nanoparticles through a low-temperature process boosted device efficiencies up to 16.3% by enhancing radiative decay of excitons and reabsorption of emitted radiation, representing a novel photon recycling scheme (Saliba et al., 2015). Simulations showed that embedding dielectric-metal-dielectric nanoparticles in perovskite layers increased short-circuit current density by approximately 25% (gold) and 29% (silver), leading to a maximum PCE of 23.00% **(Jangjoy & Matloub, 2023).** Incorporating these nanoparticles into the TiO2 mesoporous layer increased efficiency to 16.27%, leveraging upconversion and light scattering effects (Liang et al., 2018).

Power conversion efficiency of core-shell metal nanoparticles techniques

Power conversion efficiency (PCE) %

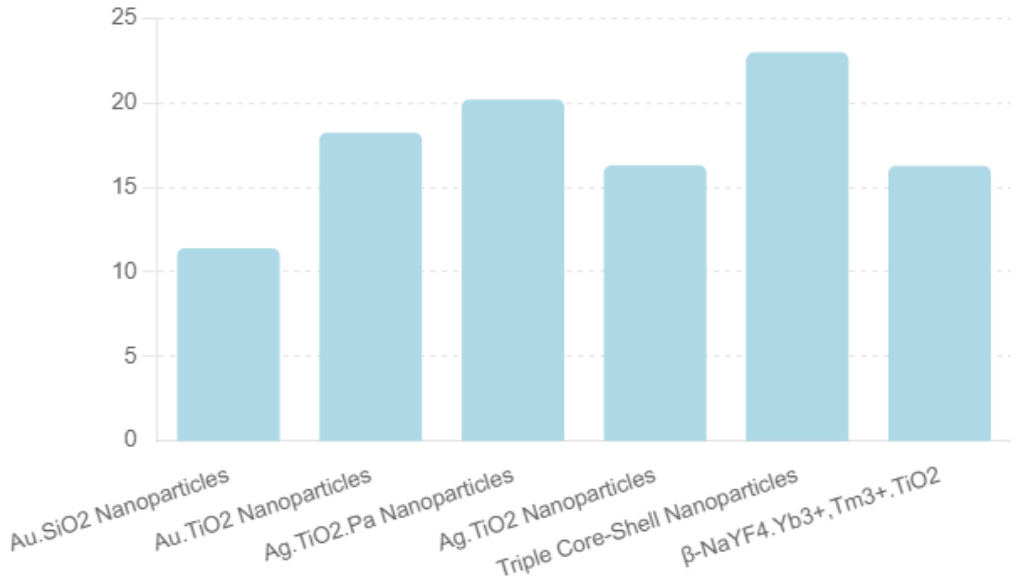

Figure 4. Here is the bar chart summarizing the power conversion efficiency (PCE) of various core-shell metal nanoparticles techniques in perovskite solar cells:

Core-shell metal nanoparticles significantly enhance the efficiency of perovskite solar cells through various mechanisms, including plasmonic effects, improved charge separation, and reduced recombination. These advancements demonstrate the potential of core-shell nanoparticles to boost the performance of perovskite solar cells, making them more viable for commercial applications.

Tantalum (Ta) doping in TiO_2 nanorods is an effective strategy to enhance the performance of perovskite solar cells (PSCs). Here are some significant findings from recent research: This study describes a one-step solvothermal method for preparing Ta-doped TiO2 nanorod arrays. Ta doping tunes the electronic structure of TiO2 NRs by leveraging the lower 5d orbitals of Ta5+ ions and reducing oxygen vacancies. This synergistic tuning improves the band alignment at the TiO2 NR/perovskite interface, boosting short-circuit current and fill factor. Using this optimized doped TiO2 NR array as the electron transport layer (ETL), a record efficiency of 19.11% was achieved **(Cui et al., 2017).** Ta-doped TiO2 thin films were grown using plasma-enhanced atomic layer deposition (PEALD). This method showed that Ta incorporation introduces oxygen vacancies, reducing crystallinity and optical band gap. The Ta-doped films exhibited resistivity three orders of magnitude lower than undoped TiO2, enhancing the fill factor and conversion efficiency of PSCs **(Hsu et al., 2021)**. A low-temperature chemical bath method was used to prepare a TiO2 ETL co-doped with tantalum (Ta) and niobium (Nb). This co-doping increased the conduction band level of TiO2, reduced trap-state density, and boosted electron injection efficiency. The resulting planar PSCs achieved a superior PCE of 19.44%, significantly higher than pristine TiO2 **(Duan et al., 2021).** Ta doping in the TiO2 compact layer of PSCs improved device performance by enhancing electrical conductivity and reducing series

resistance (Rs). Kelvin probe force microscopy (KPFM) indicated that Ta doping shifts the Fermi level of TiO_2 downward, providing a driving force for electron transfer, resulting in a 40% improvement in overall **efficiency (Ranjan et al., 2018).**

This study developed a sequential layer-by-layer sub-100°C vacuum-sublimation method to fabricate planar-type organometal halide perovskite solar cells. The process produced very uniform and highly crystalline perovskite thin films with 100% surface coverage, achieving maximum efficiencies up to 15.4% (Chen et al., 2014). This study demonstrated the fabrication of high-efficiency perovskite solar cells with vacuum deposition, yielding devices with better stability. The vacuum-deposited perovskite films were denser with complete surface coverage, resulting in improved stability and efficiency. Devices exhibited only a 7% efficiency degradation after 1488 hours in ambient conditions **(Zhang et al., 2016).** This research focused on the use of vacuum deposition to create thermally stable perovskite solar cells. Using organometallic copper phthalocyanine (CuPc) and zinc phthalocyanine (ZnPc) as hole transport layers, the study achieved a PCE of up to 13.9% and demonstrated excellent long-term stability, with no observable degradation after more than 5000 hours in storage and 3700 hours under thermal stress **(Yuan et al., 2022).** This seminal paper introduced a sequential deposition method where PbI2 is first deposited onto a nanoporous titanium dioxide film and then converted into perovskite by exposing it to a solution of CH_3NH_3I. This method allowed for better control over perovskite morphology, achieving a PCE of approximately 15% **(Burschka et al., 2013).** Utilizing a Cl-containing alloy-mediated sequential vacuum evaporation approach, this study produced homogeneous, pinhole-free perovskite films. The resulting solar cells achieved a PCE of 24.42%, demonstrating the potential for high-throughput fabrication of perovskite solar cells **(Li et al., 2022).**

Sequential vacuum deposition is a powerful technique for enhancing the efficiency and stability of perovskite solar cells. By enabling precise control over film quality and morphology, this method has led to significant advancements in device performance, demonstrating its potential for scalable and high-efficiency perovskite solar cell production.

DISCUSSION

The innovative methods discussed for synthesizing organometal halide perovskites offer significant improvements in the efficiency and stability of solar cells. Each technique addresses specific challenges and provides unique advantages, making them valuable for advancing the field of photovoltaic research. Here we delve deeper into the implications and potential of each method.

Hybrid chemical vapor deposition (HCVD)

Implications: HCVD allows for precise control over the deposition process, making it suitable for large-scale industrial applications. The method's ability to produce stable and reproducible films over extended periods is crucial for the commercial viability of perovskite solar cells.

Future Potential: Further optimization of HCVD parameters could lead to even higher efficiencies and greater scalability, positioning it as a key technique for mass production.

Hydrochloric acid vapor annealing (HAVA)

Implications: HAVA post-treatment significantly enhances the structural and electronic properties of perovskite films by converting CH3NH3PbI3 to phase-pure $CH_3NH_3PbCl_3$. This process leads to larger grain sizes and fewer trap states, which are critical for improving solar cell performance.

Future Potential: The simplicity and low cost of HAVA make it an attractive option for widespread adoption. Further research could explore the effects of varying annealing times and temperatures to optimize efficiency further.

Interface functionalization

Implications: Functionalizing interfaces with organometallic compounds like ferrocenyl-bis-thiophene-2-carboxylate significantly improves both efficiency and stability. This method addresses the common issue of interface instability in perovskite solar cells, which is a major barrier to commercialization.

Future Potential: Expanding the range of functional materials and exploring different combinations could yield even more robust and efficient devices. Long-term studies are needed to confirm the durability of these enhancements.

Cryo-controlled nucleation

Implications: Cryo-controlled nucleation provides a novel approach to film formation by decoupling nucleation and crystallization phases. This results in highly uniform films with excellent electronic properties, which are essential for high-efficiency solar cells.

Future Potential: This technique could be refined to further enhance uniformity and reduce defects. Integrating cryo-controlled nucleation with other advanced deposition methods may lead to synergistic improvements in performance.

Core-shell metal nanoparticles

Implications: The integration of core-shell metal nanoparticles, such as Au@SiO2, into perovskite films reduces exciton binding energy and enhances photocurrent. This approach leverages plasmonic effects to boost solar cell efficiency without complicating the device architecture.

Future Potential: Further exploration of different core-shell materials and configurations could optimize light absorption and charge transport. This method shows promise for enhancing performance in various photovoltaic applications.

Tantalum-doped TiO_2 nanorods

Implications: Ta doping in TiO_2 nanorods improves electron transport and band alignment, resulting in higher short-circuit currents and overall efficiency. This method addresses the need for better electron transport layers in perovskite solar cells.

Future Potential: Investigating other dopants and optimizing doping concentrations could further enhance the performance of TiO_2-based ETLs. This method could be combined with other interface engineering techniques for maximum effect.

Sequential vacuum deposition

Implications: Sequential vacuum deposition allows for the precise control of film thickness and composition, leading to highly uniform and crystalline perovskite layers. This technique is versatile and can be applied to both rigid and flexible substrates.

Future Potential: The development of low-temperature and high-vacuum processes could make this method more accessible for various applications. Integrating sequential vacuum deposition with other advanced fabrication techniques could lead to next-generation solar cells with superior performance.

Perovskite nanocrystals have demonstrated impressive PCEs in solar cells, with record efficiencies exceeding 25%. The ability to tune the bandgap through compositional engineering allows for the design of multi-junction solar cells with enhanced efficiency . For example,**(Saliba et al. (2016))** achieved a PCE of 25.2% using a multi-junction approach with perovskite nanocrystals .

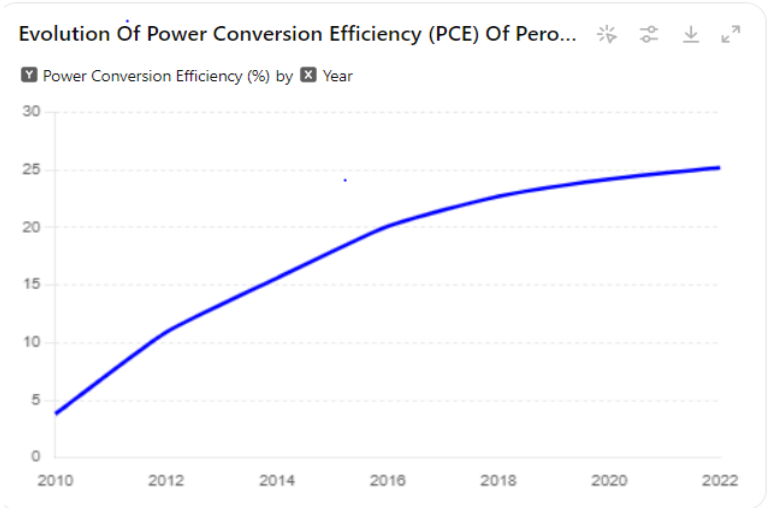

Figure 5: Evolution of power conversion efficiency (PCE) of perovskite solar cells over the years.

Here is the graph illustrating the evolution of power conversion efficiency (PCE) of perovskite solar cells over the years. The plot shows the increase in PCE from 2010 to 2022, with key milestones annotated.

CONCLUSION

The development of innovative methods for synthesizing organometal halide perovskites has led to significant advancements in the efficiency and stability of perovskite solar cells. These methods address various challenges in the fabrication process, resulting in high-performance photovoltaic devices. Here is a detailed conclusion based on the discussed methods:

Future prospects

The discussed methods represent significant advancements in the synthesis of organometal halide perovskites. Each technique offers unique benefits and addresses specific challenges, contributing to the overall progress in the field of perovskite solar cells. The future of perovskite photovoltaics lies in the continuous improvement and optimization of these methods to achieve even higher efficiencies and greater stability.

Scalability and commercialization: Techniques like HCVD and sequential vacuum deposition show promise for large-scale production, making them key players in the commercialization of perovskite solar cells.

Stability enhancements: Methods such as HAVA and interface functionalization focus on improving long-term stability, addressing one of the main barriers to widespread adoption.

Efficiency optimization: Innovative approaches like cryo-controlled nucleation and core-shell metal nanoparticles aim to push the efficiency limits of perovskite solar cells, making them competitive with traditional photovoltaic technologies.

Final thoughts

Innovative synthesis methods are crucial for the continued advancement of perovskite solar cell technology. By addressing the key challenges of scalability, stability, and efficiency, these methods pave the way for the commercial viability of high-performance perovskite-based photovoltaics. Continued research and development in this area will undoubtedly lead to even greater breakthroughs, bringing us closer to realizing the full potential of perovskite solar cells in the global energy landscape.

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DOI: https://doi.org/10.5281/zenodo.14498764

TUPROQ FAZALARI

Nosirov Yosin Soyibjon o‘g‘li

Farg‘ona Davlat Universiteti, magistr

Annotatsiya. *Tuproqning barcha fazalari ya’ni qattiq, suyuq, gaz va tirik fazalarining uzviy bog‘liqligi, shuningdek, tuproq fazalarining o‘rganishning ahamiyatini hamda ularning mineral va organik qismlari, tuproq eritmasi, tuproq havosi va tuproqdagi tirik organizmar haqida batafsil ma’lumotlar keltirilgan.*

Kalit so‘zlar: *Profil, struktura, qattiq faza, suyuq faza, tirik faza, gaz faza, mega, mikro, makrofauna, tuproq eritmasi, minerallar, biokos, tabiiy tana.*

Tuproq fazalari va tuproqning to‘laqonli strukturasini ifodalashda uning morfologik ko‘rsatkichlari bo‘yicha alohida analiz qilish bu boradagi ilmiy tasavurrlarni yanada boyitib, mavjud ilmiy ma’lumotlar to‘ldira olmagan bo‘shliqlarni to‘ldiradi. Tuproq, bu qattiq, suyuq, gaz va tirik moddali fazalardan tarkib topgan ko‘p fazali tabiiy tana hisoblanadi.

Tuproqning qattiq fazasi – bu tuproqning asosi, sinchi bo‘lib, tuproq ona tog‘ jinsidan tuproq paydo bo‘lish jarayoni davomida shakllanadi va u tog‘ jinsining tarkibi va xossalarini to‘la qonli darajada meros qilib olgan. Tuproqning bu sinchi o‘z navbatida ko‘p dispersli va ko‘p komponentli organo-mineral sistemadir. U qoldiq minerallar yoki tog‘ jinsi uvoqchalaridan va tuproq paydo bo‘lish jarayonining ikkilamchi mahsulotlaridan – o‘simlik qoldiqlari, ularning qisman parchalanish mahsulotlari, gumus, ikkilamchi gil minerallari, jinslarning nurashi natijasida ozod bo‘lgan va geokimyoviy oqim agentlari tomonidan qayta yotqizilgan oddiy tuzlar va elementlar oksidlari, yangi yaralmalar va boshqalardan tarkib topgan.Tuproqning qattiq fazasi o‘ziga xos mexanikaviy, mineralogik va kimyoviy tarkibga ega bo‘lib, muayyan qovushma, struktura va g‘ovaklik kabi hossalar bilan tavsiflanadi.

Tuproqlarning mexanik tarkibga ko‘ra tasnifi

O‘zPITI	Tasnifi	Kachinskiy	Tasnifi
Mexanik tarkibiga ko‘ra tuproqlarning nomlanishi	Fizik loy miqdori (<0,01mm,)%	Mexanik tarkibiga ko‘ra tuproqlarning nomlanishi	Fizik loy miqdori (<0,01mm,)%
So‘z (loy)	50% dan ko‘p	Og‘ir soz loy	85% dan ko‘p
Og‘ir qumoq	40-50	O‘rta soz loy	75-85
O‘rta qumoq	32-40	Yengil soz (loy)	60-75
Yengil qumoq	25-32	Og‘ir qumoq	45-60
Qumloq	14-25	O‘rta qumoq	30-45
Qum	14% dan kam	Yengil qumoq	20-30

Tuproqning suyuq fazasi – bu tuproqdagi bo‘sh g‘ovaklarni to‘ldirgan suv, tuproq eritmasidir. Bu eritma tarkibi va hajmiga ko‘ra o‘ta harakatchandir. Tuproq eritmasining tarkibi va xossalari tuproqning suv-fizik xossalariga, kimyoviy tarkibi, yer ostidan (sizot) va atmosferadan namlanish sharoitiga, va umuman, obhavo holatiga bog‘liq. Bundan tashqari qo‘riq va voha tuproqlarining (bir tuproq tipi doirasida) eritma tarkibi ham o‘zaro farq qiladi. Ya’ni bunda sug‘orish suvlarining kimyoviy tarkibi ham ahamiyat kasb etadi. Suyuq faza qishning past haroratli kunlarida muzlab, qattiq holatga, yozda esa tuproq suvining bir qismi bug‘lanib, gazli fazaga o‘tishi mumkin. Suyuq faza, go‘yo tuproq tanasining «qoni» bo‘lib, tuproq kesmasi tabaqalanishining asosiy omili hisoblanadi. Chunki suvning tuproqdagi tik va yonlama harakatlari tufayli suspenziya yoki chin yo kolloid eritma holidagi turli moddalarning siljishi ro‘y beradi.

Tuproqda suv quyidagi holatlarda bo‘ladi: kimyoviy birikkan suv, kristallizatsion suv, bug‘simon suv, gigroskopik suv, pardali suv, kapillyar suv, gravitatsion suv, grunt suvi. Tuproqning suyuq qismi (fazasi) yoki boshqacha qilib aytganda, tuproq eritmasi uning eng muhim tarkibiy qismidir. Yog‘in-sochinlar va uncha chuqur bo‘lmagan grunt suvlari tuproqdagi suv manbai hisoblanadi. Yog‘in-sochinlardan hosil bo‘lgan suv kimyoviy jihatdan toza bo‘lmaydi, bu suv atmosfera orqali o‘tib kelar ekan, CO2, O2, N2 gazlariga va qisman nitrat oksidi hamda ammiakka boyiydi. Bu gazlar yoqilg‘ilarning yonishidan va momaqaldiroq natijasida paydo bo‘ladi. Tuproq eritmasining tarkibi asosan tuproq paydo qiluvchi ona jins tarkibiga bog‘liq holda shakllanib, mos ravishda turli tuproq iqlim mintaqalarida turlicha tarkibga ega. Quyida tuproq eritmasini o‘rganishning suvli so‘rim usuli bo‘yicha aniqlangan eritma tarkibi ma’lumotlari bilan tanishamiz.

Boshqa tuproq-iqlim mintaqalarida esa eritma tarkibi tuproq paydo qiluvchi omillar ta’sirida u yoki bu ionlarning bor-yo‘qligi, ko‘p yoki ozligi bilan o‘zaro farq qiladi.

Markaziy Farg‘ona o‘tloqi saz tuproqlarining suvli so‘rim tahlili natijalariga ko‘ra eritma tarkibi, % (U.Mirzayev.)

Kesma №	Chuqurlik, sm	Quruq qoliq	HCO_3^-	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+
Sug‘oriladigan arziqli o‘tloqi saz tuproqlar								
1	0-33	1,057	0,012	0,010	0,715	0,187	0,047	0,046
	33-67	1,252	0,012	0,012	0,864	0,250	0,047	0,046
	67-96	1,390	0,016	0,012	0,920	0,261	0,035	0,090
	96-127	1,314	0,016	0,010	0,920	0,253	0,049	0,070
	127-138	1,252	0,016	0,014	0,870	0,230	0,056	0,046
	138-159	1,228	0,014	0,014	0,840	0,230	0,051	0,067
Sug‘oriladigan o‘tloqi saz tuproqlar								
2	0-31	0,210	0,009	0,008	0,126	0,028	0,012	0,014
	31-46	0,226	0,010	0,010	0,134	0,031	0,013	0,014
	46-66	0,243	0,010	0,010	0,153	0,037	0,013	0,016
	66-103	0,270	0,012	0,014	0,167	0,044	0,018	0,011
	103-134	0,278	0,015	0,014	0,174	0,045	0,018	0,011
	134-173	0,370	0,018	0,012	0,234	0,048	0,031	0,012

Tuproqning gaz fazasi – bu tuproqdagi suvdan bo‘sh bo‘lgan g‘ovakliklarni to‘ldirgan havo bo‘lib, uning tarkibi atmosfera havosi tarkibidan ancha farq qiladi. Gaz faza o‘ta harakatchan hisoblanadi. Tuproq havosining manbasi bo‘lib atmosfera havosi va tuproq tirik organizmlari va biokimyoviy jarayonlarda ajralib chiqadigan gazlar xizmat qiladi. Tuproqdagi barcha bo‘shliqlarning umumiy hajmida suv bilan havo o‘zaro antogonist bo‘lib, bir birining o‘rnini olishga intiladi. Quruq tuproqda, odatda, havo miqdori ko‘p bo‘ladi, namli tuproqda esa, aksincha – oz.

Tuproqdagi havo shakllari quyidagicha ajratiladi:

1. Erkin tuproq havosi – tuproqdagi erkin harakat qiluvchi gazlar aralashmasi.
2. Berk tuproq havosi – bu tuproqning atrofi suv bilan o‘rab olingan kovakliklaridagi havodir. Uning miqdori tuproqning mexanik tarkibiga ham bog‘liq. Qumoq mexanik tarkibli tuproqlarda uning miqdori 12% gacha yetishi mumkin.
3. Adsorbsilangan tuproq havosi – tuproq kolloid va zarrachalari yuzasiga adsorbsilangan gazlar.
4. Erigan tuproq havosi – tuproqning suyuq qismi tarkibidagi gazlar aralashmasi yoki havo.

Tuproq havosining miqdori tuproqning g‘ovakligi va namligiga bog‘liqdir. Strukturali va qo‘zilagan tuproqlar strukturasiz va zich tuproqlarga nisbatan o‘zida ko‘p havo saqlaydi. Namlik ortgan sari tuproqdagi havoning kamayishi tabiiydir. A.Shmuk ma’lumotlariga ko‘ra, qora tuproqlarda gaz miqdori 8% dan 31% gacha bo‘ladi. Chopiq qilinadigan ekinlar tagidagi yerda chopiq qilinmaydigan ekinlar ostidagiga qaraganda havo ko‘proqdir. Shudgor qilingan tuproqlarda havo eng ko‘p bo‘ladi.

Havo	N	O_2	CO_2	Noyob gazlar
Atmosferaning havosi	78,1	20,9	0,03	0,97
Tuproqning havosi	78,1	19-21	0,1-1,0	-

Tuproq havosi atmosfera havosidan tarkibida CO2 ning ko‘pligi va ko‘pincha kislorodning kamligi bilan farq qiladi. Bu esa o‘simliklarning nafas olishi va organik moddalarning parchalanishi natijasida CO2 ning to‘planishi bilan bog‘liqdir. O‘simlik ildizlari va mikroblarning kislorod yutishi va tuproqdagi moddalar oksidlanganda kislorod shu moddalar tarkibiga o‘tib qolishi tufayli u kam miqdorda bo‘ladi. Tuproqning tirik fazasi – bu tuproqqa joylashib, uning paydo bo‘lish jarayonida qatnashadigan organizmlardir. Ularga ko‘p sonli mikroorganizmlar –bakteriyalar, aktinomitsetlar, zamburug‘lar, suv o‘tlari va tuproqning mikromezofaunasi vakillari – bir hujayralilar, qurt-qumursqalar, chuvalchanglar, shuningdek, o‘simliklarning ildiz sistemalari kiradi.Tuproq tirik fazasi undagi organizmlar o‘lchamlari va yashash joylariga ko‘ra quyidagilarga bo‘linadi:

1. Mikrofauna – o‘lchamlari 0,2 mm dan kichik bo‘lgan sodda organizmlar (nematoda va boshqalar) bo‘lib, ular tuproqning mikrokovak va agregatlarning ichki bo‘shliqlarida tarqalgan.

2. Mezafauna – o‘lchamlari 02-0,4 mm atrofida bo‘lgan mayda hashorot va qurtlar bo‘lib, ichki agregat va agregatlararo bo‘shliqlarda tarqalgan.

3. Makrofauna – o‘lchamlari 4 mm dan 80 mm gacha bo‘lgan tuproq organizmlari. Ularga mollyuska, qurt-chuvalchang va chumolilar misol bo‘la oladi.

4. Megafauna – o‘lchamlari 80 mm dan katta bo‘lgan organizmlardan tashkil topib, yerqazar, mayda va yirik kemiruvchilar, shuningdek, mayda ildizchalar ularga misol bo‘la oladi.

Tuproqning barcha fazalari o‘zaro uzviy bog‘langan va doimiy o‘zaro ta’sirda bo‘ladi. Tabiiy tuproq barcha fazalarning yaxlit fizik tana sifatidagi birligi holatidagina mavjud bo‘lib, o‘z vazifalarini ado etadi.

Chuvalchang (loyxo‘rak) tuproqda juda ko‘p (masalan, O‘rta Osiyoning bir gektar bo‘z tuproqlarida 600-700 ming, sug‘oriladigan tuproqlarda 1000-1300 ming va eski bedapoyada 5000 ming chamasida). Ular tuproqning 1,5 m chuqurligigacha (O‘rta Osiyoda, ko‘pdan beri sug‘orib kelinayotgan tuproqlarda 1,5 m dan ham chuqur) bo‘lgan qatlamni ilma-teshik qilish bilan birga, juda ko‘p miqdorda tuproqni o‘z tanalari ichidan o‘tkazadilar. Bu esa tuproqdagi suv, havo va oziq miqdoriga juda katta ta’sir etadi. Yumronqoziq, ko‘rsichqon va tog‘ sichqonlari yerni ancha chuqur qatlamigacha kavlashlari natijasida tuproqning suv va havo o‘tkazish qobiliyati kuchayadi.

Xulosa

Xulosa qilib aytganda, tuproq fazalari uning o‘zaro bir-biri bilan bog‘liq holda rivojlanuvchi tarkibiy qismi bo‘lib, ular doimo o‘zaro uzviy aloqadorlikda bo‘ladi. Boshqa tarafdan, tuproq morfologik tuzilishini yuqorida ko‘rsatib o‘tilgan turli bosqichli sistemalar kabi alohida ko‘rinishi sifatida ham tasvirlaydi. Ikkinchi tarafdan esa, har bir faza uning tashkil etgan morfologik belgi va elementlar holatidan kelib chiqib o‘zining tavsifiy tuzilishiga ega bo‘ladi. Shuningdek, o‘z o‘rnida tuproq morfologik tuzilishini ifodalashda uning bir bo‘lagi bo‘lib xizmat qiladi.

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DORIVOR O‘SIMLIKLARNING BIOEKOLOGIK VA MORFOLOGIK XUSUSIYATLARI

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ANNOTATSIYA. *Bugungi kunga kelib inson organizmi turli xildagi kasalliklar bilan kurashib kelmoqda. Masalan bu turdagi kasalliklarni davolash uchun tabobatimizda har xil turdagi dorivor o‘simliklardan foydalanib kelinmoqda. Shu bilan birga, hozirgi paytda dorivor o‘simliklarning bir qancha turlari mavjud va bulardan xalq tabobatida eng ko‘p foydalaniladigan o‘simliklar: dorivor gulxayri, namatak, rastaropsha, xolmon, shirach, sallagul. Bu mavzu yoritib berish mobaynida dorivor o‘simliklarning morfologik va bioekologik xususiyatlarini o‘rganib chiqamiz. Ishni amalga oshirishda shu mavzuga oida adabiyotlar tahlil qilindi. Morfologik xususiyat bu dorivor o‘simliklarning tashqi tuzilishini belgilab beradi. O‘simliklar morfologiyasi juda qadimdan o‘rganila boshlangan.*

Kalit so‘zlar: *morfologik, bioekologik, dorivor gulxayri, organogenez, O‘zbekiston bog‘lari, madaniy o‘simliklar, fitoterapiya, flavonoid.*

БИОЭКОЛОГИЧЕСКИЕ И МОРФОЛОГИЧЕСКИЕ ОСОБЕННОСТИ ЛЕКАРСТВЕННЫХ РАСТЕНИЙ

АННОТАЦИЯ. *На сегодняшний день организм человека борется с различными заболеваниями. Например, для лечения этого вида заболеваний в нашей медицине используются различные лекарственные растения. Наряду с этим в настоящее время существует несколько видов лекарственных растений. Из них наиболее широко используемые в народной медицине растения: алтей лекарственный, шиповник, расторопша, солодка, тмин, тюльпан. В ходе освещения этой темы мы изучим морфологические и биоэкологические особенности лекарственных растений. Морфологические особенности определяют внешнее строение этих лекарственных растений. Морфология растений изучалась с древнейших времен.*

Ключевые слова: *морфологический, биоэкологический, лекарственный алтей, органогенез, сады Узбекистана, культурные растения, фитотерапия, флавоноид.*

Kirish. Respublikamizda so‘nggi yillarda dorivor va ziravor o‘simliklarni rivojlantirishga, xususan tabiiy boyliklardan samarali va unumli foydalanishga katta ahamiyat berilmoqda. Jumladan, O‘zbekiston Respublikasi Prezidentining 2020-yil 10-apreldagi “Yovvoyi holda o‘suvchi dorivori o‘simliklarni muxofaza qilish, madaniy holda yetishtirish, qayta ishlash va mavjud resurslardan oqilona foydalanish chora-tadbirlari to‘g‘risida”gi PQ-4670-son qarori sohani tubdan rivojlanishining huquqiy asoslarini yaratib berdi. Ushbu qarordagi vazifalarni amalga oshirish natijasida dorivor o‘simliklarni nafaqat tabiatda yovvoyi holda terib olish, balki madaniy holda plantatsiya usulida ko‘paytirish va qayta ishlashni tashkil etish bilan shug‘ullanuvchi fermerlar va tadbirkorlar soni ham sezilarli darajada ortib bormoqda. O‘tgan davr mobaynida 9 ta dorivor o‘simliklar yetishtirish klasterlari tashkil etilib, ular tomonidan moychechak, kovrak, limono‘t, qalampir yalpiz, qizilmiya, za’faron (*Crocus sativus* L.) va boshqa dorivor o‘simliklar yetishtirilmoqda. Dorivor o‘simliklarni 2 xil tasniflash qabul qilingan: 1) ta’sir qiluvchi moddalarning tarkibiga qarab — alkaloidli, glikozidli, efir moyli, vitaminli va boshqa 2) farmakologik ko‘rsatkichlariga qarab tinchlantiruvchi, og‘riq qoldiruvchi, uxlatuvchi, yurak-tomir tizimiga tasirqiluvchi, markaziy nerv sistemasini qozg‘atuvchi, qon bosimini pasaytiruvchi va boshqalar.U o‘simlik organlarining fiziologik funksiyalari va tashqi muhit ta’sirini forma hosil bo‘lishida muhim omil deb hisobladi.

Hozirgi vaqtda Dorivor o‘simliklarning turi ko‘payib, xalq tabobati shifobaxsh osimliklar bilan boyigan. Dorivor o‘simliklardan ko‘proq, anor, achchiqmiya, bodom, dorivor gulxayri, yongoq, jag-jag, zubturum, isiriq, itburun, omonqora, pista daraxti, sachratqi, choyot, shirinmiya, shuvoq, yantoq, yalpiz, kiyikot, tog‘rayhon, qizilcha, qoqio‘t va boshqalari tarqalgan. Oddiy isiriq, Turkiston arslonquyrug‘i, Turkistonadonisi, teshik (oddiy) dalachoy, dag‘al dalachoy, Regel qo‘ziqulog‘i, gulbandli kiyiko‘t, gangituvchi buzulbang, maydagul tog‘rayhon va soxta yantoq o‘simliklarining o‘ti (er usti qismi), dorivor tirnoqgul, sertuk xandeliya va Samarqand bo‘znochi gullari, do‘lana va itburun.

Dorivor o‘simliklar (lotincha: *plantae medicinalis*) yovvoyi va madaniy o‘simliklar bo‘lib, profilaktika va davolash uchun ishlatiladi. Odamlar va hayvonlar kasalliklari dorivor o‘simliklar bilan davolash tizimi **fitoterapiya** deb ataladi. O‘simliklardan dorivor maqsadlarda foydalanish imkoniyati ular qo‘llanadigan dori turiga bog‘liq. Misol uchun, Rossiya sog‘liqni saqlash tizimida faqat dori vositalarining davlat reestriga kiritilgan dorivor o‘simliklardan foydalanish mumkin. O‘zbekiston tabiiy va geografik jihatdan dorivor o‘simliklarga boy hudud hisoblanib, respublikada tabiiy holda mavjud 4500 turga yaqin yuksak o‘simliklarning, shundan dorivor o‘simliklardan 700 ortiq turi mavjud. Shulardan tabiiy sharoitda o‘sadigan va

madaniylashtirilgan 120 ga yaqin o‘simlik turlaridan ilmiy va xalq tabobatida foydalaniladi.

MDH mamlakatlari florasida uchraydigan 17500 tur yuksak sporali va gulli o‘simliklarning tibbiyotda 70 oilaga mansub bo‘lgan 247 turi qo‘llanilmoqda. Hozirgi paytda tashlandiq, bo‘z va cho‘l yerlarning o‘zlashtirilishi sababli, yovvoyi dorivor o‘simliklarning turlari va boyliklari kamayib ketmoqda. Bundan tashqari, shifobaxsh o‘simliklarning tabiiy boyliklarining hosildorligi har yilgi ob-havo sharoitiga bog‘liq bo‘lib ko‘pincha barqaror emas. Shu tufayli, shifobaxsh o‘simliklarning 50 turi madaniylashtirilgan holda ekilmoqda. S.S. Sahobiddinov ma’lumotlariga Qaraganda, O‘rta Osiyo o‘simliklar olamida dorivor o‘simliklarning 413 turi xalq tabobatida turli kasalliklarni davolashda foydalanilmoqda.

Dorivor o‘simliklardan tayyorlanadigan dori-darmonlar organizmga ta’sir etish harakteriga qarab, tinchlantiradigan, uxlatadigan, og‘riq qoldiradigan, qon ketishni to‘xtatadigan, karaxt qiladigan, qo‘zg‘atadigan, darmonsizlantiradigan, quvvatlantiradigan, qayd qildiradigan, yaralarni bitiradigan va antibiotiksingari grupparga bo‘linadi. Flavonoidlar sariq rang degan so‘zni anglatadi. Ular tabiiy murakkab birikmalardan bo‘lib, benzo-U piron mahsuli xisoblanib, uning asosini fenil-propan tashki| etadi. Flavonoidlar, o‘z navbatida, flavon, flavonoid, flavonol, katexin, antonian kabi gruppalarga bo‘linadi. Antosianlar binafsha rangdan qizil ranggacha bo‘lgan bo‘yoq ko‘rinishini beradi. Antosianlar flavonli glyukozidlar hisoblanib, gidrolizlanib, qand hamda aglikon-antosianidinga parchalanadi. Ular o‘z navbatida, kerasianin, enin va betaninlarga bo‘linadi. Antosianlar suvda yaxshi eriydi. Qizdirilsa yoki qaynatilsa tez buziladi, ya’ni rangi hamda xususiyatini yo‘qotadi. Antosianlar o‘simliklarning guli, mevasi hamda urug‘larida ko‘proq bo‘ladi. Tibbiyotda kvarsetin va rutin moddalaridan tayyorlanadigan dori-darmonlar ko‘proq qo‘llaniladi. Ular yurak-tomir, qon ketish, oshqozon yarasi, qon bosimi oshishi kabi xastaliklarga qarshi ishlatiladi. Tanid ayrim o‘simliklarning bargi, mevasi, po‘stlog‘i, ildiz hamda tugunaklarida to‘planadi. Bu modda o‘simlik hujayra shirasida erigan holda uchraydi. U boshqa moddalar bilan birikkan yoki ayrim holda bo‘ladi. O‘simlik to‘qimalari o‘lgandan so‘ng, hujayra devorchalariga shimiladi. Tanid teri sanoati uchun asosiy xom ashyo hisoblanadi. Bu modda tibbiyotda oshoqon-ichak kasalliklari oldini oluvchi bakteriosid modda tariqasida ishlatiladi. Alkaloidlar o‘simliklarning turli organlarida to‘planadigan azot saqlovchi va ishqor xususiyatiga ega bo‘lgan juda murakkab organik birikmalardan tashkil topgan moddalardir. Bu moddalar o‘ziga xos fiziologik ta’sirchanlik xususiyatiga ega. Alkaloidlardan morfin, papaverin, kofein, kodein kabi turli xil dori-darmonlar ishlab chiqariladi. Ular tibbiyotda turli xastaliklarni davolashda keng ko‘lamda qo‘llaniladi. Furokumarinlar teri xastaliklarini davolashda keng qo‘llaniladigan dorilarni ishlab chiqarishda asosiy xomashyo manbalaridan

xisoblanadi. Organik kislotalar o‘simlik hujayra shirasida uchraydi. O‘simlikning barcha organlarida, ayniqsa mevalarida olma, limon, vino, shovil, chumoli, askorbin, ba’zan xin va linolen kislotalari holida bo‘ladi. Organizmda organik kislotalar moddalar almashinuvida aktiv ishtirok etadi. Shira ishlab chiqariladigan bezlarning ish qobiliyatini oshiradi. O‘t suyuqligi va pankreatik shiraning ajralishiga ta’sir ko‘rsatadi. Organik kislotalar bakterisidlik xususiyatiga ega. Shu sababli ham turli mikroblarni qirib tashlaydi. Natijada inson organizmiga xastaliklar yuqishi oldini oladi. Organik kislotalar ishtahani ochadi, ovqat hazm bo‘lishini yaxshilaydi. Fermentlar o‘simlik to‘qimalarida hosil bo‘ladi. Ular mevalarda ko‘proq to‘planadi hamda moddalar almashinuvi jarayonida faol ishtirok etadi. Fermentlar deyarli oqsil moddalardan xosil bo‘ladi. Organizmda sodir bo‘ladigan kimyoviy reaksiyalar fermentlar ishtirokida o‘tadi. Shuningdek fermentlar ma’lum moddalarning reaksiyaga kirishini tezlashtirishda katalizatorlik rolini ham o‘taydi. Fermentlarga ta’sir ko‘rsatadigan harorat 40°C dan yuqori bo‘lmasligi lozim. Agar harorat bu ko‘rsatkichdan yuqori bo‘lsa, farmentlardagi oqsillar koagulyasiya holiga tushadi, natijada fermentlar katalizatolik xususiyatini yo‘qotadi.

Fitonsidlar o‘simlik organlarida to‘planib, mikroorganizmlarni qirib tashlash xususiyatiga ega bo‘lgan murakkab tuzilishdagi organik moddalardan hisoblanadi. Bu moddalarni o‘simlik antibiotigi yoki fitonsidi deyiladi. Fitonsidlar alkaloid, efir moyi, antosian ko‘rinishlarida bo‘lishi mumkin. O‘simliklardan ayrim fitonsidlar toza holda ajratib olingan. Masalan, allisin fitonsidi sarimsoqdan ajratib olingan bo‘lib, allin aminokislotalaridan tashkil topgan. U bakterisidlik xususiyatiga ega. Fitonsidlar bakteriyalarni qirib tashlaydi va o‘sishi hamda ko‘payishi oldini oladi. Kraxmal polisaxaridlarga mansub bo‘lib, murakkab tuzilishga ega. U organizmni tetiklashtiradi hamda quvvatini oshiradi. Tirik organizmda undan glyukoza hosil bo‘ladi. Kraxmaldan tibbiyotda oshqozon-ichak hamda teri kasalliklarini davolashda qo‘llaniladigan dori-darmonlar tayyorlanadi. Shuningdek kraxmal sanoatda, uy-ro‘zg‘or ishlarida keng ko‘lamda ishlatiladi.

Polisaharidlar o‘simliklarning barcha organlarida, ayniqsa meva, tugunak ildiz hamda piyozlarida ko‘p bo‘ladi. Polisaharidlar murakkab tuzilishga ega bo‘lib, uglevodlar yg‘indisidan tashkil topadi. Ular kundalik ehtiyoj uchun zarur bo‘lgan moddalardan biri hisoblanadi.

Azotli moddalar murakkab birikmalardan tashkil topgan bo‘lib, ularning asosini oqsilli moddalar hosil qiladi. Ular o‘z navbatida, aminokislotalar hamda amidlardan iborat. Shuningdek oqsilsiz azotli moddalar o‘z tarkibida nuklein kislota, ammiak tuzlari, nitratlar, ba’zi vitamin va glyukozidlarni saqlaydi. Insoniyat rivojlanishining dastlabki bosqichlarida o‘simliklar nafaqat odamlar uchun oziq-ovqat manbai bo‘lgan, balki odamlarga kasalliklardan xalos bo‘lishga yordam bergan. Dorivor

o‘simliklarning organizmga ta’siri uning tarkibidagi kimyoviy birikmalarning miqdoriga bog‘liq. Bu birikmalar o‘simlikning qismlarida turli miqdorda to‘planadi. Dorining ta’sirchanlik quvvati hamda sifati yuqori bo‘lish davri ularning gullash hamda urug‘lash davrining boshlanishi vaqtiga to‘g‘ri keladi. Dorivor moddalar ba’zi o‘simliklarning kurtagi, bargi yoki poyasida, ba’zi o‘simliklarning guli yoki mevasida, ba’zilarida ildizi yoki po‘stlog‘ida to‘planadi. Shuning uchun o‘simliklarning asosan biologik aktiv moddalari ko‘p bo‘lgan qismi yig‘ib olinadi. O‘simliklarning ildizi, ildizpoyasi, piyozi va tuganagi, odatda, o‘simlik uyquga kirgan davrda kech kuzda yoki o‘simlik uyg‘onmasdan oldin erta bahorda tayyorlanadi. O‘simlikning meva va urug‘lari pishib yetilganda yig‘iladi, chunki ular bu paytda dori moddalariga boy bo‘ladi. Yangi yig‘ib olingan dorivor o‘simlik mahsuloti tarkibida (yer ustki a’zolarida 85% gacha, ildizida 45% gacha) nam bo‘ladi. Bu nam yo‘qotilmasa (quritish yo‘li bilan), o‘simlik chirib, dori moddalari parchalanib, yaroqsiz bo‘lib qoladi. Dorivor o‘tlar tarkibida dorivor xususiyatga ega bo‘lgan kamida bitta faol modda mavjud. Ushbu modda yoki moddalar ko‘pincha o‘simlikning to‘qimalari va qismlari bo‘ylab notekis taqsimlanadi. Shuning uchun, dorivor o‘tlarni yig‘ishda siz foydali elementlarning qayerda to‘planganligini va o‘simlik rivojlanishining qaysi davrida ularning konsentratsiyasi maksimal ekanligini bilishingiz kerak. O‘simliklar morfologiyasining tarixiy taraqqiyoti davomida undan o‘simliklar anatomiyasi, o‘simliklar embriologiyasi, sitologiya mustaqil fan sifatidaajralib chiqdi. Tabiatdagi o‘simliklarning morfologik jihatdan turli tumanligini aniqlash; tuzilishi, organlar va organlar sistemasining o‘zaro joylashuvi qonuniyatlarini o‘rganish; o‘simliklarning umumiy tuzulishi va ayrim organlarining individual rivojlanishida (ontomorfogenez) o‘zgarishini tadqiq etish; o‘simlik dunyosining evolyutsion rivojlanishida organlarning paydo bo‘lishini izohlash (filomorfogenez); forma hosil bo‘lishida turli xil tashqi va ichki omillar ta’sirini o‘rganish- o‘simliklar morfologiyasining asosiy muammolaridan hisoblanadi.

O‘zbekistonda anatomik metod keng qo‘llanishi asosida morfogenez sohasida muhim ishlar olib borildi; qiyin ekologik sharoitda yashovchi ob’yektlarda organogenez etaplar va ularning tashqi muhitga bog‘liqligi to‘g‘risidagi ta’limot shular jumlasidandir. Chog‘ishtirma ekologik o‘simliklar morfologiyasi sohasidagi ma ‘lumotlar faqat forma hosil bo‘lish qonuniyatini tushuntirish bilan birga ulardan amaliyotda foydalanishga imkon berdi. Ontomorfogenez, ekologik va eksperimental O‘simliklar morfologiyasi sohasidagi tadqiqotlar o‘rmonchilik va o‘tloqchilikning biologik asoslarini yaratishda hamda manzarali o‘simliklar yetishtirish usullarini ishlab chiqishda ahamiyatga ega. Botanika bog‘laridagi introduksiyalash ishlarida ontogenetik va ekologik o‘simliklar morfologiyasi ma’lumotlariga asoslaniladi va ayni vaqtda bu ishlar yangi nazariy xulosalar uchun material beradi. O‘zbekistonda

"Botanika" ilmiy ishlab chiqarish markazida ham o‘simliklar morfologiyasining turli sohalarida tadqiqot ishlari olib boriladi. O‘simliklar organlari tuzilishining yana bir muhim xususiyati ularning simmetirik bo‘lishidir, ya’ni keng ma’noda olganda, bir xil qismlarning guruhda munosib joylashuvi yoki qismlarning bir xilligidir.

U har xil tipda bo‘lishi mumkin. Ko‘pincha radial simmetriya uchraydi. O‘zida ustinsimon poya yoki sharsimon meva aylanasini bir necha graduslarga bo‘lib, tekislik o‘tkazilgan deb faraz qilinsa, bu tekisliklar ularni teng qismlarga bo‘ladi. Boshqa holda o‘simlik organi bo‘ylab faqat ikkita o‘zaro perpendikulyar tekislik o‘tkazish mumkin. Bu tekisliklar organni simmetirik teng bo‘laklarga ajratadi. Masalan: yong‘oq yoki bodomni chaqsak, ana shunday simmetirik bo‘laklar hosil

bo‘ladi. Bu bilateral simmetriya deyiladi. Bir o‘simlik yoki uning organidan faqat bitta simmetirik tekislik o‘tkazish mumkin bo‘lsa,monosimmetriya deyiladi. Ba’zi o‘simliklar tanasidan ularni simetirik qismlarga ajratadigan birorta ham tekislik o‘tkazib bo‘lmaydi, ular assimmetirik tuzilgan bo‘ladi. Morfologik tadqiqotlarning asosiy metodlari - tasvirlash, chog‘ishtirma va eksperimental metodlardir. Birinchisi o‘simlik organlari va organlar sistemasini tasvirlaydi (organografiya), ikkinchi metodda tasvirlangan material tavsiflanadi. Eksperimental metodda nazorat etiladigan tashqi muhit kompleksi sun’iy hosil qilinadi hamda bu sharoitda o‘simliklarning morfologik reaksiyasi va boshqalar o‘rganiladi. O‘simliklar morfologiyasi botanikaning boshqa bo‘limlari: o‘simliklar paleobotanikasi, o‘simliklar sistematikasi va filogeniyasi, o‘simliklar fiziologiyasi, o‘simliklar ekologiyasi, o‘simliklar geografiyasi va geobotanika, genetika va o‘simlikshunoslik bilan chambarchas bog‘liq.

Xulosa. Bugungi kunga kelib ko‘plab dorivor o‘simliklar yo‘qolib borayotganligi va turi juda kamayib borayotganligi tufayli O‘zbekiston Respublikasi Qizil Kitobiga kiritilib bormoqda. Bunga asosiy sabab insonlarning shavqatsizlarcha dorivor o‘simliklardan foydalanganligi sabablidir. Oddiygina misol qilib keltiradigan bo‘lsak, piyozdoshlar oilasiga mansub piyozlarning xalq xo‘jaligidagi ahamiyati juda katta. Bosh piyoz bakteriyalarni o‘ldiradigan modda -fitonsidlarga juda boy shu sababli undan o‘simlik sifatida foydalaniladi. Fitonsidlarga boyligi, dorivorlik xususiyatiga ko‘ra sarimsoq piyoz bosh piyoz bilan yonma-yon turadi.Va ularning 10 ta turi O‘zbekiston Respublikasi Qizil Kitobiga kiritilgan.Va bulardan tashqari dorivorlik xususiyatiga ko‘ra Gulxayridoshlar oilasiga mansub yerbag‘ir tugmachagul dorivorlik xususiyatiga ko‘ra yetakchi o‘rinlarda turadi. Masalan uning quritilgan bargi, guli va urug‘i tabobatda ichni yumshatuvchi dori sifatida foydalaniladi. Shu bilan birga bu oilaga kiruvchi yana bitta tur ya’ni dorivor gulxayri. Bo‘yi 70-150 sm keladigan ko‘p yillik o‘t. Ildizidan tayyorlangan qaynatma tabobatda yo‘talga qarshi vosita sifatida foydalaniladi. Agarda biz barcha dorivor o‘simliklardan oqilona foydalansak, ularning ko‘plab turlarini saqlab qolgan bo‘lamiz.

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DOI: https://doi.org/10.5281/zenodo.14498781

THE IMPORTANCE OF SAVING WATER AND PRACTICAL TIPS TO DO IT

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ABSTRACT

Water is one of the most essential natural resources on Earth. It sustains life, supports ecosystems, and drives economic development. Despite covering 71% of the planet's surface, only 2.5% of Earth's water is freshwater, and even less is readily available for human consumption. With growing populations, climate change, and increased demand, saving water has become a global priority. This article explores the importance of conserving water and offers practical strategies for individuals and communities to contribute to this vital cause.

Key words: *water, essential natural resources, water conservation, increased demand, human consumption, water scarcity, innovative solutions, irrigation systems.*

2. Why Is Water Conservation Important?

Preserving Ecosystems

Rivers, lakes, wetlands, and groundwater sources support diverse ecosystems. Reducing water usage ensures that these natural habitats remain intact, protecting plants, animals, and microorganisms. Over-extraction of water can lead to the drying up of rivers and lakes, endangering wildlife and biodiversity.

Mitigating Water Scarcity

Many regions of the world face water shortages due to overuse, droughts, and poor water management. Conserving water helps maintain a stable supply, ensuring access to clean water for drinking, agriculture, and sanitation. For communities in arid and semi-arid regions, water conservation is a matter of survival.

Reducing Energy Usage

Pumping, treating, and transporting water consumes large amounts of energy. By using less water, we reduce the energy required to process and deliver it, thereby

lowering greenhouse gas emissions. This directly supports global efforts to combat climate change.

Cost Savings

Conserving water leads to lower utility bills for households and businesses. Small changes in daily habits, such as fixing leaks and using water-efficient appliances, can significantly reduce water bills over time. On a larger scale, governments can also reduce infrastructure costs for water treatment and distribution.

Sustainable Agriculture and Food Security

Agriculture accounts for about 70% of global freshwater usage. Efficient irrigation methods like drip irrigation can reduce water waste, helping to produce more food with less water. Water conservation in agriculture ensures food security and reduces the impact of water shortages on farming communities.

3. How Can We Save Water?

At Home

- Fix Leaks Promptly
- Install Water-Efficient Appliances
- Turn Off Taps While Brushing or Washing
- Use Rainwater Harvesting
- Limit Lawn Watering
- Use Dishwashers and Washing Machines Efficiently

At School

- Educate Students on Water Conservation
- Install Water-Saving Fixtures
- Check for Leaks and Report Them
- Use Rainwater for School Gardens

At Workplaces and Offices

- Encourage Employee Participation
- Install Water-Efficient Fixtures
- Maintain Plumbing Systems
- Limit Use of Water-Cooled Equipment
- Water-Saving Campaigns

4. Innovative Solutions for Water Conservation

Smart Irrigation Systems

Smart irrigation systems use sensors and weather data to determine when and how much to water crops. This technology significantly reduces water wastage in agriculture.

Water Recycling Systems

Greywater recycling systems treat used water from sinks, showers, and washing machines, making it suitable for non-drinking purposes like flushing toilets or irrigating gardens.

Desalination Technologies

Desalination plants convert seawater into fresh, drinkable water. While energy-intensive, advances in technology are making desalination more affordable and eco-friendly.

Leak Detection Sensors

Smart water meters and leak detection sensors alert users to leaks in their plumbing systems, preventing unnecessary water loss. These systems can be installed in homes, schools, and offices.

5. What Can Governments Do?

Water-Saving Policies

Governments can introduce laws requiring water-efficient appliances in new buildings and offer rebates for households that install water-saving devices.

Investment in Infrastructure

Aging water infrastructure often leads to leaks and water loss. Governments can invest in modern, efficient water distribution systems to reduce waste.

Public Awareness Campaigns

Large-scale media campaigns highlighting the importance of water conservation can inspire individuals and businesses to take action.

Pricing and Tariffs

Water pricing models that reward lower consumption can motivate people to use water wisely. Tiered pricing, where higher usage leads to higher costs, encourages conservation.

6. Conclusion

Water conservation is a shared responsibility that affects people, wildlife, and the planet as a whole. While technological solutions and government policies are essential, individual actions also play a vital role. By adopting simple, everyday habits and using water-saving technologies, each of us can contribute to preserving this precious resource. Saving water is not just about cutting costs — it’s about ensuring a sustainable future for generations to come.

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DOI: https://doi.org/10.5281/zenodo.14498790

THE ROLE OF CHEMISTRY IN HUMAN DEVELOPMENT

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ABSTRACT

Chemistry, often referred to as the "central science," forms the backbone of many of the innovations and advancements that have propelled human civilization forward. From the earliest discoveries of fire and metalworking to the cutting-edge technologies of today, chemistry has consistently been at the core of human progress. Its influence permeates every aspect of life, playing a vital role not only in scientific research but also in practical applications that touch daily living, industry, healthcare, environmental protection, and much more.

Key words: *chemistry, core of human progress, sustainable solutions, herbicides, chemical analysis, chemical innovations, fertilizers.*

As the world continues to evolve and confront new challenges, chemistry remains a key driver of sustainable solutions. It provides the scientific understanding needed to address some of the most pressing issues of our time, such as combating diseases, mitigating environmental impacts, and ensuring the sustainable production of food and energy. By bridging gaps between biology, physics, environmental science, and engineering, chemistry is essential to enhancing quality of life and fostering economic growth on a global scale.

This article delves into the pivotal role chemistry plays in shaping human development across various sectors, highlighting its contributions to medicine, agriculture, environmental sustainability, industrial innovation, and even space exploration. Understanding the breadth and depth of chemistry's impact offers insight into how future discoveries in this field will continue to drive progress and improve the well-being of people worldwide.

1. Healthcare and Medicine

One of the most significant contributions of chemistry is in the field of healthcare and medicine. The development of life-saving drugs, vaccines, and antibiotics are all results of chemical research and innovation. Pharmaceuticals have transformed the way diseases are treated, increasing life expectancy and improving the quality of life worldwide. Chemistry also plays a role in diagnostic technologies, such as blood tests and imaging methods, which allow for early disease detection and effective treatment plans.

2. Agriculture and Food Production

Chemistry has had a profound influence on agriculture, improving crop yields and food security. The development of fertilizers, pesticides, and herbicides has allowed farmers to grow crops more efficiently, leading to more abundant and nutritious food. Additionally, food chemistry helps in the preservation and enhancement of food products, allowing for longer storage times and improved taste. Chemistry's role in understanding soil composition and nutrient cycling also helps farmers manage resources sustainably, ensuring food security for future generations.

3. Environmental Protection

As humanity strives for sustainable development, chemistry is pivotal in addressing environmental challenges. Environmental chemistry focuses on understanding pollutants, their effects on ecosystems, and how to mitigate their impact. Chemistry has been integral to the development of green technologies, such as renewable energy sources (solar, wind, and biofuels) and biodegradable materials. Furthermore, chemists are working on innovations like water purification methods, waste recycling processes, and carbon capture technologies to combat climate change and reduce the ecological footprint of industrial activities.

4. Industrial and Technological Advancements

The industrial revolution, powered largely by chemical advancements, marked a turning point in human development. From the production of steel and plastics to the invention of synthetic materials, chemistry has been at the heart of technological progress. Today, chemistry continues to drive innovation in sectors like energy, transportation, electronics, and manufacturing. Batteries, semiconductors, and nanotechnology, which all stem from chemical research, are central to modern technologies such as smartphones, electric vehicles, and renewable energy storage systems.

5. Cosmetics and Personal Care

The chemistry behind personal care products has improved daily human life in significant ways. From skincare formulations that promote health and vitality to makeup products, sunscreens, and haircare items, chemistry helps create products that

enhance well-being and personal appearance. These innovations also reflect advancements in safety and efficacy, as chemical analysis ensures products meet regulatory standards and protect consumer health.

6. Space Exploration and Scientific Discovery

Chemistry's role in space exploration is another critical contribution to human development. From the fuels used to launch spacecraft to the materials that withstand the harsh conditions of space, chemical sciences have enabled humanity to explore beyond Earth. Additionally, chemical analysis of planets, stars, and other celestial bodies helps scientists understand the universe's composition and the potential for life beyond Earth. This knowledge expands human horizons and may one day lead to breakthroughs that revolutionize life on Earth.

7. Everyday Applications

In our daily lives, chemistry is present in almost everything we use. Cleaning products, textiles, paints, and even the food we consume are all products of chemical processes. This constant application of chemistry simplifies life, improves health standards, and enhances comfort. Household products, like detergents and disinfectants, owe their effectiveness to chemical innovations that have made homes and workplaces safer and cleaner.

CONCLUSION

The role of chemistry in human development is vast and multifaceted. Its contributions span across critical areas of life, driving advances that improve health, extend life expectancy, increase food security, protect the environment, and power technological innovation. As the world faces new challenges, from climate change to global health issues, chemistry will continue to play a vital role in shaping the future of human progress.

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DOI: https://doi.org/10.5281/zenodo.14498798

TALABALARGA TA-LAB ANALIZATORIDAN FOYDALANISHNING PEDAGOGIK MOHIYATI

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ANNOTATSIYA

Voltamperometriya turli sohalarda, jumladan kimyo, biologiya va atrof-muhit fanlarida keng qo'llaniladigan kuchli tahliliy texnikadir. Bu eritmadagi elektroaktiv turlarni miqdoriy va sifat jihatidan tahlil qilish imkonini beradi. Voltamperometriyani talabalarga o'rgatish biroz qiyinroq, chunki u nazariy tamoyillarni va amaliy ko'nikmalarni chuqur tushunishni talab qiladi. Shuning uchun o'qituvchilar o'rganishni osonlashtirish uchun samarali pedagogik strategiyalardan foydalanish tavsiya etilgan. Ushbu maqola talabalarga voltamperometriyani o'rgatishning pedagogik parametrlarini o'rganadi, o'rganish tajribasini oshirish uchun ilmiy innovatsiyalar va tadqiqotlarni integratsiyalashga qaratilgan. Shuningdek, maqola mavzuga doir ilmiy izlanishlarni taqqoslash asosida yurtimizda yaxshilanishi mumkin bo'lgan tamoyillar o'rganib chiqilgan.

Kalit so'zlar: *Voltamperometriya, pedagogik strategiyalar, analitik kimyo, virtual labaratoriya, elektrokimyo, raqamli simulyatsiya, keys study, BPL.*

THE PEDAGOGICAL ESSENCE OF USING THE TA-LAB ANALYZER FOR STUDENTS

ABSTRACT

Voltammetry is a powerful analytical technique widely used in various fields, including chemistry, biology, and environmental sciences. It allows for the quantitative and qualitative analysis of electroactive species in solutions. Teaching voltammetry to students is somewhat more challenging because it requires a deep understanding of theoretical principles and practical skills. Therefore, teachers are advised to use effective pedagogical strategies to facilitate learning. This article explores the pedagogical parameters of teaching voltammetry to students, focusing on integrating scientific innovation and research to enhance the learning experience. The article also examines the principles that can be improved in our country based on a comparison of scientific research on the topic.

Keywords: *Voltammetry, pedagogical strategies, analytical chemistry, virtual laboratory, electrochemistry, numerical simulation, case study, BPL.*

KIRISH

Voltametriyani samarali o‘rgatish uchun o‘qituvchilar birinchi navbatda o‘quvchilarning elektrod jarayonlari, tok-potentsial munosabatlari va Nernst tenglamasi kabi asosiy tushunchalarni mustahkam o‘zlashtirib olishlarini ta’minlashi kerak. Ushbu asoslar siklik voltametriya, kvadrat to‘lqinli voltametriya va differensial impulsli voltametriya kabi murakkab voltametrik usullarni tushunish uchun asos bo‘lib xizmat qiladi.

Maqolada voltamperometriyani o‘rgatishning pedagogik strategiyalari sifatida quyidagi tamoyillar tanlab oldik:

Amaliy laboratoriya mashg‘ulotlari orqali faol o‘rganish. Voltamperometriya eksperimental fan bo‘lib, amaliy laboratoriya mashg‘ulotlarini samarali o‘rganish uchun muhim ahamiyatga ega. Talabalar laboratoriya ishlarida faol qatnashib, nazariy tushunchalarni chuqurroq o‘zlashtirib, amaliy ko‘nikmalarga ega bo‘ladilar. Zamonaviy elektrokimyodan foydalanib, talabalar turli voltamperometrik usullar bilan tajriba o‘tkazishlari va suvdagi yoki biologik suyuqliklardagi og‘ir metallarni tahlil qilishlari mumkin. Raqamli simulyatsiyalar va virtual laboratoriyalardan foydalanish - fan ta’limida tom ma’noda inqilob yasadi. Virtual laboratoriyalar talabalarga murakkab elektrokimyoviy jarayonlarni tasavvur qilish va xavf-xatarsiz muhitda tajribalar o‘tkazish imkonini beradi. Shuningdek ular jarayonni modellashtirishi masalan, tahlil qiluvchi moddalar kontsentratsiyasini o‘zgartirish yoki skanerlash tezligini o‘zgartirish bilan o‘quvchilarga asosiy tamoyillarni chuqurroq tushunishga yordam beradi. Ilmiy tadqiqotlar va innovatsiyalarni integratsiyalash. O‘qituvchilar voltamperometrik texnikadagi so‘nggi yutuqlarni, masalan, ultra sezgir aniqlash uchun nanoelektrod massivlarini yoki kengaytirilgan selektivlik uchun massa spektrometriyasi bilan birgalikda voltamperometriyani joriy qilishlari mumkin. Talabalarni so‘nggi tadqiqot ishlarini o‘qish va tanqid qilishga undash ham tanqidiy fikrlash va tahliliy ko‘nikmalarni rivojlantirishi mumkin. Muammoli ta’lim (PBL) va Case Studi pedagogik texnologiyalari. PBL - bu talabalar murakkab, haqiqiy muammolarni hal qilish orqali o‘rganadigan ta’lim usuli. Voltametriya uchun PBL suvdagi ifloslantiruvchi kontsentratsiyasini aniqlash uchun tajribalarni loyihalashni yoki qondagi glyukozani aniqlash uchun voltametrik sensorni ishlab chiqishni o‘z ichiga olishi mumkin. Atrof-muhit monitoringi yoki oziq-ovqat xavfsizligi uchun voltammetriyadan foydalanish kabi amaliy tadqiqotlar o‘rganishni kontekstuallashtirishi mumkin, bu esa uni yanada dolzarb va qiziqarli qiladi. Hamkorlikdagi ta’lim talabalarni muammolarni hal qilish va bilim almashish. Talabalar o‘qituvchi nazorati ostida bir-birlarini o‘rgatadigan tengdoshlar bilan o‘qitish ularning tushunishini mustahkamlashi va muloqot qilish qobiliyatini rivojlantirishi mumkin. Voltamperometriya bo‘yicha guruh loyihalari, masalan, yangi

sensorni loyihalash yoki ma’lum bir dastur bo‘yicha adabiyotlarni ko‘rib chiqish jamoaviy ishlashni rivojlantirishi va tushunishni chuqurlashtirishi mumkin.

NATIJA VA MUHOKAMALAR

Sanoat va ilmiy-tadqiqot institutlari bilan hamkorlik - talabalarga voltametriyaning real dunyo ilovalari bilan tanishish imkonini beradi. Sanoat mutaxassislari va tadqiqotchilar voltammetriya farmatsevtika, atrof-muhit monitoringi yoki oziq-ovqat xavfsizligi kabi turli sohalarda qanday qo‘llanilishini ko‘rsatuvchi mehmon ma’ruzalari yoki seminarlari o‘tkazishlari mumkin. Ushbu o‘zaro ta’sirlar talabalarni ilhomlantirishi va ularga voltametriyaning haqiqiy muammolarni hal qilishda ahamiyatini tushunishga yordam berishi mumkin.

1-jadval.

Voltametriyani o‘qitishda erishilgan yutuqlarni miqdoriy baholash uchun innovatsion pedagogik usullar va tadqiqot integratsiyasi orqali qiyosiy baholash.

Tr	Ko‘zlangan maqsad	Taqqoslash xulosalari	Kutilayotgan natija (% da)
1	Talabalarning faolligi va o‘zlashtirishning ortishi	Dunyodagi tadqiqotlar shuni ko‘rsatadiki, elektrokimyo kurslarida amaliy laboratoriya mashg‘ulotlari va raqamli simulyatsiyalar, shu jumladan voltamperometriya an’anaviy ma’ruzaga asoslangan o‘qitish bilan solishtirganda talabalarning ish faoliyatini taxminan 30-40% ga yaxshilashi mumkin.	30-40%
2	Talabalarni jalb qilish	Faol ta’lim va tadqiqotga asoslangan loyihalarni amalga oshirish, analitik kimyo kurslarida talabalarni jalb qilish ko‘rsatkichlarining 20-25% ga oshishi bilan ilmiy salohiyatni oshirish mumkin.	20-25%
3	Virtual laboratoriyalardan foydalanish	Dunyodagi universitetlar va oliy ta’lim muassasalarining taxminan 60-70% da virtual laboratoriyalar va simulyatsiyalar o‘zlarining kimyo o‘quv dasturlariga integratsiyalashgan bo‘lib, bu masofadan o‘qitish va elektrokimyoviy jarayonlarni yaxshilangan vizuallashtirish imkonini beradi.	30-40%
4	Laboratoriya xarajatlarini kamaytirish	Raqamli simulyatsiyalarni o‘z ichiga olgan holda, o‘quv muassasalari laboratoriya materiallari va jihozlariga texnik xizmat ko‘rsatish bilan bog‘liq xarajatlar 15-25% ga kamaytirish mumkin.	15-25%
5	Talabalarning tadqiqot va loyihalarida ishtiroki	Ilg‘or analitik kimyo kurslarida dunyo bo‘ylab tahsil olayotgan talabalarning taxminan 50% voltamperometriyani o‘z ichiga olgan tadqiqot loyihalarida ishtirok eta oladi.	30%

6	Nashr va konferentsiyada ishtirok etish	Ilmiy konferentsiyalarda voltamperometriya bilan bog‘liq tadqiqotlarni taqdim etuvchi yoki ko‘rib chiqiladigan jurnallarda nashr etuvchi bakalavriat va magistratura talabalari sonining 10-15% ga o‘sishi kuzatildi, bu esa tadqiqotni integratsiyalashgan o‘rganishga tobora ortib borayotgan e’tiborni namoyish etadi.	10-15%
7	Ilg‘or elektrokimyoviy asboblardan foydalanish	Ta’lim muassasalarida zamonaviy elektrokimyoviy asboblardan foydalanish so‘nggi besh yil ichida 25-30% ga oshdi, Ilg‘or analitik kimyo kurslarida tahsil olayotgan talabalarning taxminan 50% voltametriyani o‘z ichiga olgan tadqiqot loyihalarida ishtirok etadi, talabalar tomonidan o‘tkazilgan voltamperometrik o‘lchovlar va tajribalar sifatini oshiradi.	25-30%
8	Sanoat hamkorliklarining integratsiyasi	Universitetlarning 40% ga yaqini talabalarga voltamperometriya dasturlarini real dunyoda ta’minlash uchun sanoat hamkorlari va tadqiqot institutlari bilan hamkorlikni yo‘lga qo‘yishi mumkin, bu esa mavzuni yanada amaliy tushunishga yordam berdi.	25%
9	Bitiruvchilarning analitik kimyo bo‘yicha ishga joylashish ko‘rsatkichlari	Voltametriyani o‘rgatishda zamonaviy pedagogik yondashuvlarni o‘zida mujassam etgan ta’lim dasturlari o‘z bitiruvchilari uchun ekologiya fanlari, farmatsevtika va oziq-ovqat xavfsizligi kabi sohalarda ishga joylashish ko‘rsatkichlarining 20-30% ga oshishi sohaning dolzarbligini anglatadi.	20-30%

Xulosa

O‘quvchilarga voltamperometriyani o‘rgatish murakkab, ammo foydali ish bo‘lib, har tomonlama puxta pedagogik yondashuvni talab qiladi. Amaliy laboratoriya mashg‘ulotlari, raqamli simulyatsiyalar, muammoli ta’lim va eng so‘nggi ilmiy yangiliklar va tadqiqotlarni birlashtirib, o‘qituvchilar keng qamrovli va qiziqarli o‘rganish tajribasini taqdim etishlari mumkin. Ushbu strategiyalar nafaqat talabalarning voltamperometriya haqidagi tushunchalarini kengaytiribgina qolmay, balki ularni o‘z bilimlarini real dunyo muammolari va innovatsiyalarga qo‘llashga tayyorlaydi, elektrokimyo sohasidagi olimlar va tadqiqotchilarning keyingi avlodini tarbiyalaydi. Voltamperometriyani o‘rgatish bo‘yicha olib borilgan ilmiy tadqiqotlar talabalarning ta’lim natijalarini oshirish uchun turli xil pedagogik strategiyalarni qo‘llash muhimligini ta’kidlaydi.

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DOI: https://doi.org/10.5281/zenodo.14498808

АЁЛЛАРДА БАЧАДОН КИСТАСИ ВА УНИ ДАВОЛАШ ПРОФИЛАКТИКАСИ

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Аннотация. *Бачадон аёлнинг асосий репродуктив органидир. Бачадон бўйни унинг муҳим қисмидир. Бу овал шакли ва ўртада канал бўлган зич танадир. Ушбу канал бачадон бўшлиғи ва қин ўртасида боғловчи элемент вазифасини бажаради. Шу билан бирга, ички фаренкс бачадон бўшлиғига қарайди. Ва вагинага этиб борадиган тешик ташқи фаренкс деб аталади. вагина текис кўп қатламли эпителийга эга. Мақолада бачадон касалликлари киста ҳақида ёритилган.*

Калит сўзлар. *Бачадон касалликлари, ташхис, касаллик турлари ва уларни аниқлаш, даволаш учун тавсиялар ва бошқалар.*

Аннотация. *Матка - главный репродуктивный орган женщины. Шейка матки - важная ее часть. Это плотное тело овальной формы с каналом посередине. Этот канал выполняет роль соединительного элемента между полостью матки и влагалищем. При этом внутренний зев смотрит в полость матки. А отверстие, которое доходит до влагалища, называется наружным зевом. влагалище покрыто плоским многослойным эпителием. В статье рассматриваются кисты при заболеваниях матки.*

Ключевые слова: *заболевания матки, диагностика, виды заболеваний и их выявление, рекомендации по лечению и др.*

Annotation: *The uterus is the main reproductive organ of a woman. The cervix is an important part of it. It is a dense oval-shaped body with a channel in the middle. This channel acts as a connecting element between the uterine cavity and the vagina. At the same time, the inner pharynx looks into the uterine cavity. And the opening that reaches the vagina is called the external pharynx. the vagina is covered with a flat multilayered epithelium. The article discusses cysts in diseases of the uterus.*

Keywords: *Uterine diseases, diagnosis, types of diseases and their detection, treatment recommendations, etc.*

Кириш: Кист-бу органлар ёки тўқималарда ривожланадиган ва девор ва таркибга эга бўлган патологик бўшлиқ. Бу нима? Бачадон бўйни кистаси суюқликни ўз ичига олган бўшлиқдир. Бундай шаклланишлар туғиш ёшидаги аёлларда кам учрайди.

Беморларнинг 10 фоизи бу кутилмаган ташхисга дуч келишади, чунки патологик жараённинг ривожланиш белгилари кўпинча ҳеч қандай тарзда ўзини намоён қилмайди. Формацияларнинг энг кенг тарқалган сабаблари аёл танасининг репродуктив тизими органларининг яллиғланиши, шунингдек, аёл танасида гормонал ўзгаришлар. Сервикснинг вагинадаги қисми кўпинча кисталар шаклланишига мойил бўлади. Ендосервикс силиндр шаклидаги шиллиқ ҳужайралардан иборат. Шиллиқ қават туғруқ пайтида бачадон бўйни чўзиш учун зарур бўлган кўп сонли бурмалар билан ифодаланади. Сервикал канал бактерицид хусусиятларига эга бўлган балғамни ишлаб чиқаради ва бачадонни инфекциялардан мукаммал ҳимоя қилади. Ташқи фаренкс қувурли безларнинг тешиклари билан ўралган. Шифокорлар уларни сут безлари деб аташади. Агар бу безлар тиқилиб қолса ва каналларда шилимшиқ тўпланиб қолса, бачадон бўйни тутилиши ёки набот кисталари ҳосил бўлади.

Агар шаклланишлар бачадон бўйни канали билан ўралган бачадон бўйни ва вагина қисмида пайдо бўлса, улар парасервикал деб аталади.Бачадон бўйни кистаси канал ичида ривожланганда, бу эндосервикал бачадон бўйни кисталари.Кўпинча ташхис пайтида бир нечта кичик бачадон бўйни кисталари аниқланади.

Тадқиқот методлари, мазвуни ўрганганлик даражаси. Мавзуга доир кўплаб илмий ишлар қилинган. умумий ва турли хил маълумотларга кўра, рўйхатдан ўтганларнинг 16 дан 25% гача Ҳомиладорлик, ҳомиладорликнинг ярмидан кўпи йўқотишларга боғлиқ деган фикрларни Айламазян Е. К., 2013; Доброхотова Ю.Е., 2013; Овсянникова Т. В., 2013; Подзолкова Н. М., 2013; Радзинскй В. Е., илмий ишларида тахлил қилганлар.

Одатдаги беморларда юқумли асоратлари ҳомиладорлик 56-70% га етади ва инфекцияси деярли барча ҳолатларда аниқланади. Бу бачадон бўйни асосий функцияси – тўсиқнинг бузилиши билан боғлиқ. Кўпгина тадқиқотчиларга кўра, вирусли ҳомиладорлик пайтида инфекциялар эрта қўзғатиши мумкин. туғилиш, аппендентал хомилалик ўлим, хомилалик, интраутерин инфекция, анембриония, ривожланмаган ҳомиладорлик, болани тушиши (самопроизвольный выкидыш) (Сидельникова В.М., 2008; Макаров О.В., Хашукоева А.З., 2009; Агаркова И.А., 2011; Манухин И.Б., 2018; Радзинский В.Е.,2018; Ambühl L.M., 2017).Йилларда олимлар томонидан ўрганилган.

Тахлил ва натижалар. Ҳомила органлари Уларнинг мавжудлиги кўпинча узоқ вақт давомида белгилар ва аломатларсиз давом етади. Ягона бачадон бўйни кисталари энг хавфли ҳисобланади. Улар катта ўлчамлар билан ажралиб туради, бунинг натижасида улар кўпинча канални тўсиб қўйишади, бу эса баъзи шартларни кучайтириш билан таҳдид қилади. Патологик жараён эҳтиёткорлик билан ташхис қўйишни талаб қилади. Бундай неоплазманинг белгилари: тартибсиз ҳайз кўриш, ҳайз пайтида кучли оғриқ, тананинг репродуктив функциясини бузиш. Бачадондаги катталиги диаметри бир сантиметрдан ортиқ бўлган битта кисталар одатда олиб ташланади.

Ушбу касалликнинг белгилари қандай? Касаллик кўпинча асемптоматик аломатлар билан тавсифланади. Бемор ҳайз давридаги аломатлар ва ўзгаришларни, секреция табиатини ва бошқаларни сезмайди. Кўпинча бачадон бўйни бир нечта ёки битта кистани фақат гинекологик текширув вақтида аниқлаш мумкин. Колпоскопия ва бошқа текширувлар пайтида шаклланиш белгилари сезилади.Наботовнинг бачадон бўйни кистаси, даволанишни талаб қилади, оқ ёки оқ-сариқ рангнинг юмалоқ шаклланиши, зич мустаҳкамликка эга, унинг ҳажми 3 мм дан ошмайди.

Аёл гинекологияга ташрифни кечиктириш мумкин эмаслигини тушуниши керак бўлган бир қатор белгилар мавжуд ва бугунги кунда замонавий тиббиёт таклиф қиладиган йўқ қилишнинг энг самарали усулларидан фойдаланиш мумкин. Тиббий ёрдамга мурожаат қилишнинг белгилари ва кўрсатмалари қуйидагилар:

* Ҳайз давринг бузилиши, чунки катта бачадон бўйни кисталари кўпинча бачадон бўйни каналини торайтиради.

* Худди шу сабабга кўра ҳомиладор бўла олмаслик – каналнинг торайиши туфайли.

* Гинеколог томонидан текширилгандан ёки жинсий алоқадан кейин енгил қон кетиш. Шунга ўхшаш аломатлар шаклланиш каналнинг орқа лабида жойлашганида мумкин.

* Ноқулайлик ҳисси. Бундай аломатнинг мавжудлиги фақат катта бачадон кисталари билан мумкин.

* Ҳайз кўриш оралиғида аёлда қонли оқимнинг намоён бўлиши.

* Қориннинг пастки қисми оғриши бу бачадон бўйни кистасининг яна бир аломати хисобланади

Бачадон бўйни кисталарига зарар етган бўлса даволашдан олдин бир қатор диагностика чораларини кўриш керак.. Бачадон бўйни кистаси ташхиси касалхонада гинекологик текширув вақтида қўйилади ва керакли текширувлар билан тасдиқланади. Неоплазма вагинал нометалл орқали ташхис қилинади.

Тутувчи кист-оқ ёки сарғиш қаварик неоплазма. эндэмэтриоид кист жинсий алоқа пайтида қон кетадиган тўқ қизил ёки бинафша рангнинг фокуси. Кичик шаклланишлар колпоскопия, эндосервикал шаклланишлар трансвагинал ултратовуш ёки ҳистероскопия орқали аниқланади.

Касалликни сабаблари. Бачадон бўйни кистасини қўзғатган сабабларни аниқлаш қийин, аммо муаммонинг пайдо бўлишига таъсир қилиши мумкин бўлган бир қатор омиллар мавжуд:

* Боланинг туғилиши. Бу сабаб дейилади, чунки туғиш пайтида аёллар Сервикси шикастланган. Унинг тикланиши жуда тез бошланади. Бу безларнинг нормал ишлашини бузадиган шифо жараёнининг ҳаддан ташқари тезлиги, натижада уларнинг каналлари тиқилиб қолади, патология пайдо бўлади.

*Аборт. Касаллик манипуляцияга профеционал бўлмаган ёндашув ёки бундай пайтида ёки ундан кейин асоратлар пайдо бўлиши туфайли юзага келади.

* Аёлларда менопауза хавфнинг ошиши билан боғлиқ. Репродуктив ёшни тарк этишнинг сабаби бачадон шиллиқ қаватининг ингичкалаши, безларнинг заифлиги ва бошқа аломатлар билан бирга келади. Уларнинг барчаси ҳар қандай тирнаш хусусияти билан кэскин реаксияга киришиб, катта ҳажмларда шилимшиқ ҳосил қилади.

* Касалликнинг сабаби инфекция деб аталади. Бунинг учун биринчи навбатда таклиф қилинади. Касаллик жинсий аъзоларга таъсир қилади, онкоген ўсмаларнинг шаклланишига ёрдам беради.

Даволаш, ушбу касалликни қандай даволаш керак-бу ташхисни шифокордан эшитган ҳар бир аёл вакили учун долзарб савол. Ҳеч ким касал бўлишни хоҳламайди. Касалликни даволаш тамойиллари ҳар бир алоҳида ҳолатда ҳар хил. Агар кичик шаклланиш аниқланса, даволаш одатда амалга оширилмайди. Баъзи ҳолларда касаллик билан курашиш ва беморни фақат жарроҳлик ёрдамида даволаш мумкин. Масалан, шифокорлар бачадондаги тутилиш кисталарини фақат жарроҳлик йўли билан, вагинал санитария билан даволашади.

Бачадон бўйни кисталарини олиб ташлаш усуллари:

* Кистни лазер билан олиб ташлаш.

* Радиотўлқинли муолажа тўқималарга нисбатан энг кам шикастли усуллардан биридир. Ушбу процедура махсус ускуналар ёрдамида амалга оширилади. Контаксиз сэнсорлар ёрдамида кистанинг локализация зонаси таъсирланади, унинг коагуляцияси ва буғланиши юқори частотали радио тўлқинлар таъсирида амалга оширилади. Техника тўқималарда чандиқлар йўқлиги билан тавсифланади, тутилиш неоплазмаларининг бундай терапияси туғилмаган беморларга мос келади.

* Бачадон бўйни кистасининг криодеструкцияси суюқ азот ёрдамида кўрсатмаларга мувофиқ амалга оширилади. Паст ҳароратларнинг тўқималарга таъсири туфайли бўйнидаги шаклланиш йўқ қилинади. Жараён ҳайз кўриш тугагандан сўнг дарҳол амбулатория шароитида амалга оширилади.

* Диатермокоагуляция бугунги кунда бу усул деярли қўлланилмайди. Бу даволашнинг эскирган усулларидан биридир. Усулнинг моҳияти шундаки бўйинга юқори частотали оқим таъсир қилади ва тўқима некрозига олиб келади. Бироз вақт ўтгач, бу жойда қобиқ пайдо бўлади, чандиқланади, бу кейинчалик туғруқ пайтида бачадон бўйни эластиклиги ва очилишига салбий таъсир қилади.

Шифокор касаллик учун бошқа, камроқ шикастли кимёвий терапия усулини буюриши мумкин У туғилмаган беморларда қўлланилади. Кичик ва саёз шаклланишлар билан. Кислоталарни ўз ичига олган препарат таъсирида кист йўқ қилинади, чандиқ йўқ ва шиллиқ қават тикланади.

Бачадон бўйни кисталари ўз вақтида аниқланса, хавфли эмас. Касаллик учун кўрсатмалар: Бачадон бўйни кистаси билан аёлга овқатланиш, жисмоний фаоллик ва жинсий алоқада махсус чекловларга риоя қилиш шарт эмас. Шунингдэк, киста билан очиқ сувларда сузишга, сауна ва бассейнга ташриф буюришга рухсат берилади. Аммо бундай касалликларнинг ривожланишига ва аёлларда гормонал фоннинг барқарорлигига йўл қўймаслик учун кўрсатмалар орасида тўлиқ соғлом овқатланиш, витаминлар ва микроелементлардан фойдаланиш мавжуд.

Хулосалар.

1.Технологик тараққиётнинг ривожланиши ва Интернетнинг машҳурлиги билан беморлар кўпинча кўплаб форумлар ва веб-сайтлар саҳифаларида ўз касалликларидан халос бўлиш йўлларини излайдилар, шифокор билан боғланмасдан, ўз-ўзини даволаш, гормонал дориларни қабул қилиш. Бу принципиал жиҳатдан қабул қилиниши мумкин эмас, чунки бу билан фақат касалликнинг кечишини мураккаблаштириш мумкин.

2.Контрендикациялар касаллик учун бир қатор контрендикациялар беморга унинг аҳволини енгиллаштиришга имкон беради, СПА ва физиотерапия муолажалари даволаниш тугагунча кутишга тўғри келади. Сауналар, ванналар ва иссиқ ванналар тақиқланади. Қуёшда кўп ишлашдан сақланиш керак бўлади.

3. Касалликни даволаш пайтида оғирликни кўтаришни, мушак билан бажариладиган машқларни бажаришни тавсия этмайди.

4.Анъанавий тиббиётга мурожаат қилиш маслахат берилмайди. турли хил ўсимлик лосонлари, инфузиялар ва бошқа рецептлар нафақат фойдасиз, балки зарар ҳам келтириши мумкин.

5.Кистларнинг ўсишини рағбатлантирадиган кўплаб маҳсулотлар мавжуд тузланган карам, тузланган бодринг, пастеризация қилинмаган пиво, мева ва винолар тақиқланган. Шу билан бирга, қайнатилган тухум сариғи, қовоқ уруғи ва кунгабоқар ёғини мунтазам равишда истеъмол қилиш тавсия этилади.

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DOI: https://doi.org/10.5281/zenodo.14498814

UDK:636.31

SUR RANGLI QO‘ZILARINING TERISIDA GUL UZUNLIGI VA KENGLIGINING KO‘RSATKICHLARI

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Annatotsiya. *Maqolada turli xil gul tipiga mansub bo‘lgan sur rangga qo‘zilarni gul uzunligi, kengligi bo‘yicha farqlanish va o‘zgarishlarga ega bo‘lgan qo‘zilardan olingan ko‘rsatakichlar o‘rganilgan.*

Kalit so‘zlar: *Sur rang, gul tip, rangbaranglik, yassigul, qovurg‘asimon, yarim doira, gullar eni, uzunligi, jun qoplami.*

Qorako‘lchilik chorvachilikning cho‘l hududlarida rivojlanadigan muhim tarmoqlaridan biri bo‘lib, uning asosini tashkil etuvchi qorako‘l qo‘y zoti etishtiriluvchi mo‘ynabop qorako‘l terilari rang va rangbarangliklarining, gullar hamda jun-tola qoplami sifat ko‘rsatkichlarining xilma-xilligi bo‘yicha tengsiz hisoblanadi. Qorako‘l qo‘y zoti tarkibida 10 dan ortiq ranglar mavjud va ularning ichida eng ko‘p sonlilari qora (60%), sur (30%) va ko‘k (8%) rangli qorako‘l qo‘ylari bo‘lib qolgan 2% qismini oq, guligaz, qambar, zarmalla, xalili, shaturi va boshqa rangli qo‘ylar tashkil etadi.

Ular orasida sur rangi o‘zining jun qoplami va uchki qismining ochroq bo‘lishi bilan ajralib turadi va sur qorako‘l terilarning rangbarangligini va xilma-xilligini ta’minlaydi. Sur terilarning bunday xususiyati ularning yuqori narxda sotilishi va keng iste’mol talabini belgilaydi.

SHu bilan birga ta’kidlash joizki, etishtirilayotgan bunday qorako‘l terilari nafaqat sifatiy, balkim miqdoriy jihatdan ham bozor, ayniqsa tashki bozor talabini qondira olmayapti, ushbu tiplardagi qorako‘l qo‘ylarining yuqori mahsuldor genotiplari respublika miqyosida etarli emas. Qorako‘lchilikda sur rangli yassigul tipli qorako‘l qo‘ylarining nasliy va mahsuldorlik ko‘rsatkichlarini o‘rganish, undan sohada qo‘ylarning naslini yaxshilash va sifatli mahsulot etishtirishni ko‘paytirish yo‘nalishlarida samarali foydalanish yo‘llarini aniqlash dolzarb va muhim

muammolardan biri bo‘lib, vazifalarni echimini topishga muayyan darajada xizmat qiladi.

Bu yo‘nalishda tanlash ishlari, asosan gullarning tip va shakllari, uzunligi, eni, mustahkamligi, joylashish rasmi kabi muhim seleksion belgilar bo‘yicha olib boriladi. Ushbu ko‘rsatkichlar qanchalik yuqori darajada namoyon bo‘lsa qo‘ylarning nasliy qimmatliligi shunchalik ortadi. Tadqiqotlarda qo‘zilarda ushbu belgilarning namoyon bo‘lish darajalari o‘rganildi.

Olingan natijalarda turli gul tipiga mansub qo‘zilar gullarning uzunligi va kengligi bo‘yicha ma’lum farqlanish va o‘zgaruvchanlikka ega. Gullarning uzunligi bo‘yicha olingan ma’lumotlar ko‘rsatadiki, uzun gulli avlodlar chiqimi bo‘yicha qovurg‘asimon tipli qo‘zilarning yuqori (64,2±6,83 %) ko‘rsatkichga ega bo‘lib, bu ko‘rsatkich yassi tipli qo‘zilarda ham etarli darajada yuqori (56,5±6,22) ekanligi aniqlandi. YArim doira qalamgul tipli qo‘zilarda uning 54,3±5,96 foizni tashkil etganligi qayd etildi.

1-jadval

Turli gul tipiga mansub qo‘zilarning gul uzunligi va kengligi bo‘yicha taqsimlanishi

Gul tipi	n	Gul uzunligi, % (X±Sx)			Gul kengligi, % (X±Sx)		
		uzun	o‘rta uzun	kalta	mayda	o‘rta	katta
Yassi	63	56,5±6,22	30,2±5,68	14,2±4,42	-	72,4±5,66^{x}	27,3±5,64
Yarim doira qalamgul	72	54,3±5,96	35,4±5,66	15,1±4,14	14,6±3,92	72,5±5,41^{x}	15,1±4,31
Qovurg‘asimon	52	64,2±6,83	28,2±6,82	12,4±4,45	-	73,2±6,24^{x}	25,1±6,26
O‘sikgul	50	-	47,9±7,46	52,4±7,46	18,7±5,70	45,6±7,45	36,4±7,13

X-R<0,05

Bu borada etarli nasliy qimmatlikni ko‘rsatuvchi gullarning o‘rta uzunligiga ega qo‘zilar salmog‘i yassi tipida (30,2± 5,68) foizni, yarim doira qalamgul tipida 35,4±5,66 foizni, qovurg‘asimon tipida 28,2±6,82 foizni tashkil etganligi aniqlandi. O‘siqgul tipli qo‘zilar asosan kalta (50,2±7,46 %) va o‘rta uzunlikdagi (47,9±7,46 %) gullar bilan xarakterlanishi kuzatildi. O‘rta uzunlikdagi gullar bo‘yicha birinchi uch

tipdagi qo‘zilar ko‘rsatkichining o‘siqgul tipi ko‘rsatkichidan statistik ishonchli (R<0,05) ustunligi qayd etildi.

Gullarning kengligini o‘rganish natijalari yassi va qovurg‘asimon tiplariga gullarning o‘rta (72,4-72,5 %) va katta (27,3-28,2 %) kengligi, yarim doira qalamgul tipiga mayda (12,6±3,96 %) va o‘rta (73,2 ±6,26 %) kengligi, o‘siqgul tipiga qisman mayda (18,7±5,70 %), asosan o‘rta (45,6 ± 7,45 %) va katta (36,4±7,13 %) kengligi xosligini ko‘rsatdi. O‘rta kenglikdagi gullar bo‘yicha tahlillar bu ko‘rsatkichning yarim doira qalamgul tipida 5-7 millimetrni, yassi va qovurg‘asimon tiplarida 7-9 millimetrni, o‘siqgul tipida esa 6-9 millimetrni tashkil etganligini ko‘rsatdiki, bu borada yarim doira qalamgul tipi eng optimal, qolgan tiplar esa nisbatan yirikroq gullar bilan xarakterlanishi aniqlandi.

Yassi va qovurg‘asimon tipli qo‘ylarni seleksiyalashda gullarning kengligini biroz ensizlantirishga, ya’ni yarim doira qalamgul tipi ko‘rsatkichi darajasiga etkazishga e’tibor qaratish maqsadga muvofiq hisoblanadi.

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DOI: https://doi.org/10.5281/zenodo.14498827

ОПТИМИЗАЦИИ ТЕХНОЛОГИЧЕСКИХ ПРОЦЕССОВ ДИСКРЕТНО-КОМБИНАТОРНЫХ ЗАДАЧ ЭВРИСТИЧЕСКИЕ МЕТОДЫ РЕШЕНИЯ

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Аннотация: *существует класс некоторых задач, являющихся многомерными как по числу альтернативных вариантов их решения, так и по их объему вычислений критерия эффективности. Оптимизация этих задач технологических и логистических решений являются эвристическими методами решения дискретно-комбинаторных задач они позволяют сравнительно быстро выделить подмножество рациональных решений задачи, среди которых находится оптимальное решение.*

Ключевые слова*: критерий эффективности, оптимизация, эвристический метод, логистика, технологическая задача*

Abstract: *there is a class of some problems that are multidimensional both in the number of alternative solutions and in the volume of calculations of the efficiency criterion. The peculiarity of these problems of optimization of technological and logistic solutions presented in this paper are heuristic methods for solving discrete-combinatorial optimization problems, and they allow relatively quickly to select a subset of rational solutions to the problem, among which the optimal solution is found.*

Keywords: *efficiency criterion, optimization, heuristic method, logistics, technological problem.*

В многообразии прикладных задач оптимизации в химической технологии и логистике энерго ресурсосбережения надо выделить особый класс задач, являющихся многомерными как по числу альтернативных вариантов их решения, так и по объему вычислений критерия эффективности (КЭ) - (критерия

оптимальности, или целевой функции) каждого полученного решения. Ход поиска оптимальных решений для указанного класса задач имеет дискретно-комбинаторный характер и не может быть реализована с использованием классических методов поиска экстремума функций. К задачам этого типа комбинаторной оптимизации относятся задачи поиска среди множества дискретных объектов (элементов) специальных комбинаций этих элементов в виде перестановок (перечислений), сочетаний и размещений [1]. Несмотря на кажущуюся простоту, задачи дискретно-комбинаторной оптимизации относятся к числу наиболее многомерных и трудоемких (ресурсо затратных). Эти особенности обусловлены тем, что для нахождения оптимального решения необходимо рассмотреть каждый возможный вариант, вычислить для этого варианта величину критерия оптимизации, а затем выбрать среди всех вариантов то оптимальное решение, для которого критерий эффективности имеет минимальное или максимальное значение. Объем вычислений, необходимый для просмотра вариантов, и объем памяти персонального компьютера (ПК), необходимый для хранения промежуточных результатов, быстро увеличиваются с ростом размерности исходной задачи и числа возможных альтернативных решений. Очевидно, что для решения таких многомерных и трудоемких дискретно-комбинаторных задач необходимо применять специальные методы, позволяющие значительно сократить множество просматриваемых альтернативных вариантов решений, среди которых обязательно должно находиться оптимальное решение. В настоящее время существуют две основные группы дискретно-комбинаторных методов поиска оптимальных технологических и логистических решений [2]. К первой группе относятся методы упорядоченного ограниченного перебора решений, в которых множество возможных решений определенным образом разделяется (декомпозируется), или структурируется, с целью последующего исключения из рассмотрения заведомо неперспективных подмножеств решений. Эти методы гарантируют получение оптимального решения. Ко второй группе относятся эвристические методы, которые существенно сокращают множество просматриваемых решений за счет применения эвристик - правил, разработанных на основе обобщения опыта решения однотипных задач оптимизации и с использованием которых генерируются только рациональные решения. Однако в этом случае такого сокращения числа рассматриваемых вариантов решений возможна потеря точности решения [2,3].

Постановка задач комбинаторной оптимизации логистических решений.

Любая логистика производственных предприятий непосредственно связана с

решением задач планирования и координации материальных потоков в пространстве и во времени с целью удовлетворения потребителя с наименьшими общими издержками. Примерами таких задач являются задачи составления производственных расписаний и задачи поиска оптимальных маршрутов транспортирования сырья или готовой продукции. Указанные выше классы задач комбинаторной оптимизации в химической технологии и логистике имеют схожую математическую постановку, обладают общими свойствами и могут решаться с применением одних и тех же методов, относящихся к методам комбинаторной оптимизации, из которых наиболее эффективным является метод ветвей и границ (МВГ). В англоязычной литературе для обозначения этого метода применяется термин branches and bounds method [3].

Рассмотрим примеры постановки подобных задач оптимизации в логистике. Пусть производственное предприятие использует совмещенную схему производства нескольких продуктов в некотором фиксированном технологическом цикле (на одной переналаживаемой установке). В каждый момент времени технологическая установка может вырабатывать только один продукт, и этот процесс происходит без прерывания, т.е. следующий продукт можно начать выпускать только после окончания получения партии предыдущего продукта. Переналадка установки для выпуска очередного продукта связана с определенными затратами (время переналадки, денежные затраты, расход растворителя для очистки технологической установки и т.д.). Затраты на переналадку технологической установки для выпуска очередного продукта известны и зависят от того, какой продукт выпускался до этого, поэтому различные последовательности выпуска будут неравнозначными по затратам. Задача определения оптимальной стратегии переналадки технологической установки сводится к выбору такой последовательности выпуска продуктов, для которой затраты на выпуск всех продуктов в данном технологическом цикле будут минимальными.

Метод решения задач комбинаторной оптимизации [4]. При решении приведенных выше технологических и логистических задач комбинаторной оптимизации требуется выбрать оптимальное решение из некоторого конечного числа возможных дискретно-комбинаторных вариантов решений этих задач. При этом найденное оптимальное решение должно обеспечивать экстремальное значение некоторого критерия оптимизации, или критерия эффективности. Метод перебора — это один из методов решения дискретно-комбинаторных задач. Классические методы поиска экстремума функций, применяемые в математическом программировании, здесь

оказываются бессильными. К типовым задачам комбинаторики, или задачам комбинаторной оптимизации, относятся задачи поиска среди множества дискретных объектов (элементов) специальных комбинаций этих элементов в виде перестановок, сочетаний и размещений.

Рассмотрим, задачу об оптимальной последовательности выпуска продуктов на перенастраиваемой технологической установке. Пусть на данной установке выпускаются в цикле n различных продуктов $\{p_1, p_2, \ldots, p_n\}$. Фактически, задача поиска наилучшей последовательности выпуска продуктов связана с решением комбинаторной задачи выбора одной из возможных перестановок (без повторений) для n элементов, соответствующих номерам продуктов. Число перестановок из n элементов определяется известной из комбинаторики формулой: P(n) = n!. Для расчета величины факториала известна приближенная формула (формула Стирлинга): $n! = \sqrt{(2\pi * n)} * n^n * e^{-n}$. С учетом того, что n - натуральное число, из формулы Стирлинга следует, что n! с увеличением n растет быстрее, чем любой полином от n, и быстрее, чем exp(n).

В этом случае говорят, что комбинаторная задача относится к классу NP-полных задач, или задач не полиномиальной сложности. Решение таких задач методом полного перебора вариантов решений уже при сравнительно небольших значениях n становится практически невозможным (рис. 1).

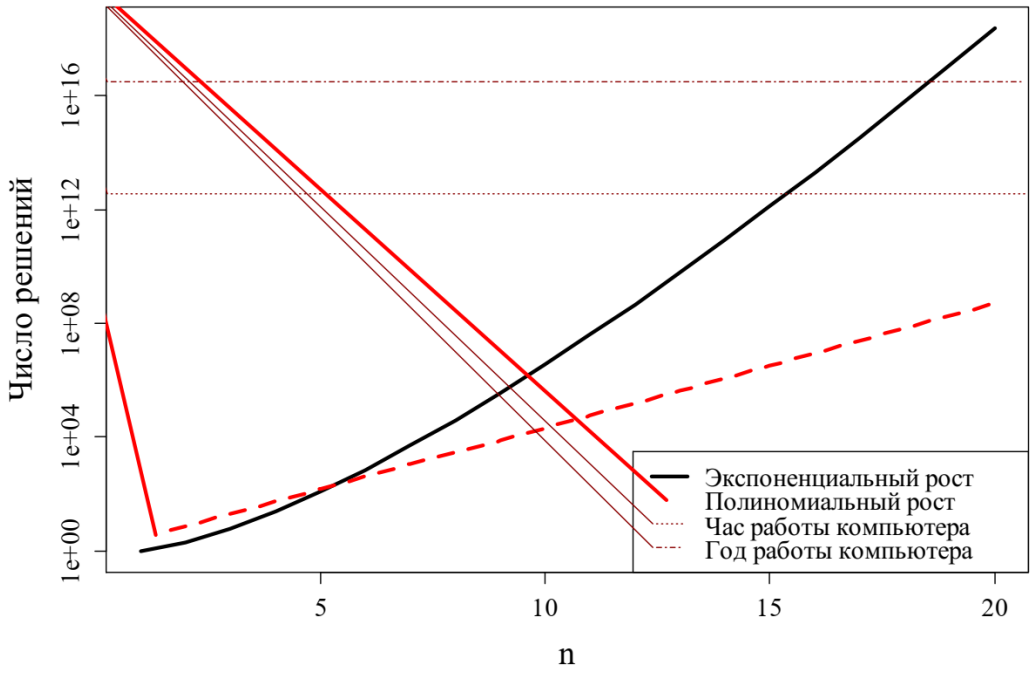

Рис. 1 «Комбинаторный взрыв» - не полиномиальный рост числа просматриваемых решений при увеличении размерности задачи

Например, при n=10 нужно просмотреть более 3.5 миллионов (3.629·106) решений, а для n=20 - $2.433 \cdot 10^{18}$ решений. Это огромное число вариантов будет просчитываться на ПК, то для хранения всего множества альтернативных вариантов решений задачи и поиска на этом множестве оптимального решения потребуется $1{,}1*10^{7}$ терабайт памяти. Очевидно, что для решения таких многомерных и трудоемких дискретно-комбинаторных задач необходимо применять специальные методы, позволяющие значительно сократить множество просматриваемых альтернативных вариантов решений, среди которых обязательно должно находиться оптимальное решение.

Таким образом, эвристические методы решения дискретно-комбинаторных задач оптимизации не гарантируют нахождение оптимального решения, хотя и позволяют сравнительно быстро выделить подмножество рациональных решений задачи, среди которых находится оптимальное или близкое к оптимальному решение [5].

Любая прикладная задача вычислительного характера имеет содержательную (смысловую, технологическую) и математическую постановки. Особенностью задач оптимизации технологических и логистических решений, представленных в настоящей работе, является то, что несмотря на их различную содержательную постановку в весьма различных предметных областях, они имеют одинаковую математическую постановку и могут быть сведены к одинаковым классическим комбинаторным задачам, а следовательно, решены с использованием одних и тех же методов. Эвристические методы часто дают противоречивые и неоднозначные результаты. Если задача решается с применением эвристик, то обычно поиск решения должен проводиться несколько раз и с разными наборами эвристик. Затем из полученных решений выбирается лучшее. В такую эвристическую процедуру поиска можно ввести «обратную связь» - присвоить каждой из имеющихся эвристик некоторый показатель полезности (коэффициент значимости эвристики), и затем «обучить» процедуру, выполняя пересчет показателей полезности эвристик в зависимости от результатов, которые были получены с их помощью. В дальнейшем в процедуре предпочтение отдается наиболее полезным эвристикам. И тем не менее эвристические методы могут гарантировать получение лишь некоторого хорошего решения.

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DOI: https://doi.org/10.5281/zenodo.14498833

REVMATOID ARTRIT VA OSTEOARTROZNI DAVOLASH MAQSADIDA QO‘LLANGAN DORI PREPARATLARINING ME’DA OSTI BEZIGA TA’SIRI

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Annotatsiya: *Ma’lumki, autoimmun kasalliklarni davolash immun tizim faolligini, agressivligini kamaytirishga qaratilgan bo‘ladi. Immun yallig‘lanish faolligini pasaytirish uchun immunodepressantlar dori vositalaridan foydalaniladi. Kortikosteroid preparatlarni qabul qilgan bemorlarda ko‘pincha og‘ir, pankreonekroz tipida kechuvchi, aksariyat hollarda letallik bilan yakunlanuvchi “steroid” pankreatit vujudga kelishini oldini olish kerak.*

Kalit so‘zlar: *Autoimmun kasalliklar, Steroid pankreatit, me’da osti bezi, revmatoid artrit.*

Аннотация: *известно, что лечение аутоиммунных заболеваний направлено на снижение активности и агрессивности иммунной системы. Иммунодепрессанты применяют для снижения активности иммунного воспаления. Необходимо предотвратить возникновение «стероидного» панкреатита, который часто протекает тяжело, в виде панкреонекроза и заканчивается летально в большинстве случаев у больных, получающих кортикостероидные препараты.*

Ключевые слова*: аутоиммунные заболевания, стероидный панкреатит, поджелудочная железа, ревматоидный артрит.*

Annotation*: It is known that treatment of autoimmune diseases is aimed at reducing the activity and aggressiveness of the immune system. Immunosuppressants are used to reduce the activity of immune inflammation. It is necessary to prevent the occurrence of “steroidal” pancreatitis, which is often severe, in the form of pancreatic necrosis and is fatal in most cases in patients receiving corticosteroid drugs.*

Key words*: autoimmune diseases, steroid pancreatitis, pancreas, rheumatoid arthritis.*

Asosiy immunodepressant prednizolon (yoki uning analoglari), sitostatiklar (metotreksat, azatiopirin, siklofosfamid va yallig‘lanishning alohida zvenolariga ta’sir etuvchi monoklonal antitelolar hisoblanadi [1,2]. Autoimmun kasalliklar ayniqsa, revmatoid artritda, shu bilan birga osteoartroz kasalligida uzoq muddat uzluksiz ravishda yallig‘lanishga qarshi nosteroid vositalar, glyukokortikosteroidlar va xondroprotektorlar qabul qilish natijasida me’da osti bezida “steroid pankreatit” deb ataladigan yallig‘lanish jarayonlari yuzaga keladi. Bu jarayon boshlanishida pankreonekroz bilan boshlanib davom etib, letallikka olib kelgan xollari ham kuzatilgan. Steroid pankreatitda bezning nafaqat tashqi sekretor faoliyati balki inkretor faolyati ham buziladi. Uzoq muddat qabul qilinganda interstitsial yallig‘lanish va fibroz rivojlanadi [3]. So‘nggi o‘n yillikda farmakologiyaning sezilarli rivojlanishi va klinik amaliyotda yuqori faollikdagi dori preparatlarining keng qo‘llanila boshlanishi bilan birga ularning nojo‘ya ta’sirlari ham ko‘rinmoqda, bular qatorida, jumladan me’da osti beziga ham shikastlantiruvchi ta’sir ko‘rsatmoqda. Bu qator ta’sirlar haqidagi dastlabki ma’lumotlar XX-asr 50 – yillarida aniqlangan, keyinchalik ko‘payib bordi. Dori pankreatitiga V.M. Lashevker adabiyotlardagi (1981) ushbu mavzudagi katta obzori bilan e’tiborni qaratdi. Me’da osti beziga dorilarning nojo‘ya ta’sirlari haqidagi dastlabki ma’lumotlar kortikosteroid preparatlariga tegishli bo‘lgan, ya’ni og‘ir va azobga soladigan kasalliklar: bronxial astma, revmatoid artrit, qavarchiq, trombotsitopenik purpura, aplastik anemiya va boshqalarda qo‘llaniladigan kortikosteroid preparatlar. Kortikosteroid preparatlarni qabul qilgan bemorlarda ko‘pincha og‘ir, pankreonekroz tipida kechuvchi, aksariyat hollarda letallik bilan yakunlanuvchi “steroid” pankreatit vujudga kelgan. V.M. Lashevker (1981) shuni alohida ta’kidlaydiki, dastlabki yozilgan o‘lim bilan yakunlangan pankreonekroz kortikosteroidlar bilan davolangan bolalarda bo‘lgan, vaholangki, pankreatit bolalarda juda kam uchraydi. Bir qator bemorlarda o‘tkir pankreatit bilan bir qatorda me’da osti bezining tashqi sekretor va ko‘pincha inkretor funksiyasi (“steroid” qandli diabet) buzilganligi qayd qilingan. Bu holatda me’da osti bezining shikastlanish patogenezi to‘liq ma’lum emas, va ko‘rinishidan har xil bemorlarda har xil asosga ega bo‘ladi. Bir qism bemorlarda berilgan preparatga o‘ziga xos allergik reaksiya asosiy o‘rinda bo‘lsa, boshqa holatlarda to‘qimaning o‘choqli destruksiyasi, preparatni uzoq vaqt qo‘llaganda interstitsial yallig‘lanish va fibroz rivojlangan [3]. Me’da osti bezining doridan shikastlanishi Me’da osti bezining murakkab regulyatsion sistemasi va uning yuqori faollikdagi strukturasi – atsinar hujayralar, Langergans orolchalari, kanal epiteliysi – yuqori darajada shikastlanishni va bezning qator patologik holatlarda keng ishtirokini shartlaydi. Me’da osti bezi shikastlanishi klinik jihatdan unchalik yaqqol bo‘lmasligi, monotipligi va boshqa yondosh shikastlangan a’zolar klinik simptomlari ortida qolib ketishi bilan farqlanadi. Ushbu o‘ziga xos patogenez bilan me’da osti

bezining dorilardan shikastlanishining kam darajada ma’lumligi tushuntiriladi. Bu a’zoning o‘ziga xos tuzilishi va funksional hususiyatlari e’tiborga olinsa, bunday shikastlanishlar ancha ko‘p desa ham bo‘ladi [4,5]. Dorilardan me’da osti bezining tashqi sekretsiyasi buzilishi Kortikosteroid gormonlarning sekretogen ta’siri bilan bog‘liq bir necha xil qarashlar mavjud. Pevchix ma’lumotlariga ko‘ra, bu ta’sir bezning bazal sekretsiyasi bilan chambarchas bog‘liq. Kam sekretsiya bo‘lganda bu preparatlar bilan davolaganda sekretsiya normallashadi, normal sekretsiya bo‘lganda esa sekretsiya oshishiga olib keladi. Shligin va hamkorlari o‘tkazgan tadqiqotlar ham qiziqarli natijalar bergan. Ular ba’zi antimetabolitlarni – aminopterin (foliy kislota antimetaboliti) va Zatsetilpiridin (nikotin kislota antimetaboliti) qo‘llab, me’da osti bezining ekzokrin sekretsiyasini to‘liq yo‘qotishga va enzimlar va bikarbonatlarni sezilarli darajada kamaytirishga erishganlar. Me’da osti bezi ekzokrin funksiyasining dorilar ta’sirida zararlanishi deyarli klinik ko‘rinishni namoyon qilmaydi: aftidan bu funksiyaning zararlanishi, ya’ni yo‘qolishi ichak enzim tizimi sekretsiyasining kuchayishi bilan kompensatsiyalanadi [6]. Dori pankreatiti Yaqin paytlargacha me’da osti bezining dorilardan shikastlanishi juda-juda kam uchraydi, deb hisoblanar edi. Ammo keyingi yillarda bu nisbatan ko‘p kuzatilmoqda: ham uchrash chastotasi ko‘paymoqda, ham shikastlantiruvchi dorilar soni oshmoqda. Scott ma’lumotlariga qaraganda, hozirgi kunda qo‘llaganda o‘tkir pankreatitni keltirib chiqaradigan 20 dan ortiq dori vositalari ma’lum [6]. Dori pankreatiti orasida “steroid pankreatitlar” deb ataladigan – kortikosteroid va adrenokortikotrop gormon ta’sirida kelib chiqadigan pankreatitlar nisbatan oldindan ma’lumdir. Bu pankreatitlarning aniq chastotasini aniqlamoq juda mushkul. Adabiyotlarda bu haqda kamdan-kam uchragan holatlar yoki unchalik katta bo‘lmagan guruhlar – 3-5 ta bemorda kuzatilgani to‘g‘risida ma’lumotlar keltirilgan xolos. Odatda bu bemorlar boshqa ko‘rsatmalar bo‘yicha – ayniqsa, revmatoid artrit, nefrotik holatlarda uzoq muddat davomida kortikosteroidlarni qabul qilganlar. Ban bo‘yicha steroid pankreatit bolalarda nisbatan kam uchraydi. Bu pankreatit kamdan-kam klinik jihatdan namoyon bo‘ladi, u murdani yorib ko‘rish jarayonida ajablanarli darajada ko‘p kuzatiladi. Sagop bo‘yicha uzoq muddat kortikosteroidlar bilan davolangan 54 bemordan 28,5 %ida bu aniqlangan. O‘tkir pankreatit tipidagi me’da osti bezining shikastlanishini tajriba ostidagi hayvonlarda aniqlash imkoni bo‘ldi, bu asosan quyonlarga gormonlarni uzoq muddat berish orqali amalga oshirildi [6]. Steroid pankreatitning aniq patogenetik mexanizmi to‘liq o‘rganib chiqilmagan. Kasallikning rivojlanishi asosida allergik jarayon yotishi o‘z davrida e’tiborga molik bo‘lgan, ammo aftidan bu faqat ayrim holatlardagina kuzatilgan. Gormonal regulyatsiya buzilishi natijasida kanalchalardagi pankreatik shira qovushqoqligi oshadi va shira dimlanadi, bu esa enzim tizimni faollashishiga olib keladi. Bu faraz autopsiyada quyuq va tiqilib qolgan sekret va mayda kanalchalarning

kengayishi bilan o‘z tasdig‘ini topadi. Shubhasizki, steroid pankreatit rivojlanishida asosiy kasallikning ba’zi ko‘rinishlari, masalan, revmatoid artritdagi immun aberratsiyalar, nefrotik holatlardagi giperlipemiyalar muhim rol o‘ynaydi. Aftidan, preparatning tabiati ahamiyat kasb etmaydi, steroid pankreatitlar “eski” gormonal preparatlarni qo‘llaganda ham, yangi yarim sintetik steroidlarni qo‘llaganda ham kuzatilgan [6]. Steroid pankreatitlar klinik jihatdan turli xil simptomlarni namoyon qilishi mumkin. Hayotida pankreatit klinikasi kuzatilmagan ko‘pchilik murdalarni yorib ko‘rilganda pankreatit aniqlangan. Ko‘rinishidan, gormonal preparatlar bilan davomli davolanish bemorning 23 sezuvchanligini va reaktivligini jiddiy ravishda o‘zgartiradi, - bu “niqoblantiruvchi samara” deyiladi. Ushbu muallifning fikriga ko‘ra, steroid pankreatitlar ko‘pincha davolashni to‘xtatgandan keyin yoki dorining dozasini kamaytirgandan keyin klinik namoyon bo‘ladi. Steroid pankreatitlar namoyon bo‘lganda, klinik ko‘rinishi va laborator ko‘rsatkichlari “spontan” o‘tkir pankreatitga o‘xshash bo‘ladi. Bezda chuqur morfologik o‘garishlar bo‘lib, deyarli barcha hollarda o‘lim bilan yakunlanadi. Steroid pankreatitlarning bunday klinikasi, kechishi va natijasi ham bezdagi o‘zgarishlar ham asosiy kasallikdagi o‘zgarishlar hisobiga yuzaga keladi. Asosiy kasallik aniq bo‘lganda va uni kortikosteroid preparatlar bilan davolaganda o‘tkir steroid pankreatit tashxisini qo‘yish qiyinchilik tug‘dirmaydi. Unchalik yaqqol bo‘lmagan, mos keladigan klinik ko‘rinish va laborator ko‘rsatkichlar bo‘lmaganda tashxisni aniqlash qiyin bo‘ladi. Nelk kuzatuvlarida 6 ta holatdan tashxis atigi bittasida to‘g‘ri qo‘yilgan, qolganlarni steroid yaraning teshilishi deb, kerak bo‘lmagan va hayot uchun havfli bo‘lgan jarroxlik aralashuvigacha olib borilgan [6,7]. Surunkali pankreatit rivojlanishiga olib keladigan preparatlar 3 guruhga ajratiladi: 1) pankreatit rivojlanishiga “aniq” sabab bo‘luvchi preparatlar – tiazid diuretiklar, tetratsiklin, azatiopirin, sulfanilamidlar va sulfasalazin, esterogenlar; 2) “ehtimoliy” sababchilar – glyukokortikosteroidlar, metronidozol; 3) “bo‘lishi mumkin bo‘lgan” – bu preparatlarning surunkali pankreatit keltirib chiqarishi taxmin qilinadi [8,9].

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DOI: https://doi.org/10.5281/zenodo.14498854

УДК 621.311.14

МИНИМИЗАЦИЯ ПОТЕРЬ В РАСПРЕДЕЛИТЕЛЬНЫХ ЭЛЕКТРИЧЕСКИХ СЕТЯХ ГЕНЕТИЧЕСКИМИ АЛГОРИТМАМИ

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АННОТАЦИЯ

В статье приводится математическая формулировка задачи минимизации потерь в распределительных электрических сетях с учетом всех видов режимных и технологических ограничений и генетический алгоритм её решения. Использование генетического алгоритма позволяет эффективно решить ряд проблем связанных с учетом различных видов ограничений при решении рассматриваемой задачи.

Ключевые слова: *Электрическая сеть, потери в электрических сетях, минимизация потерь, целевая функция, ограничение, штрафная функция, алгоритм решения, генетический алгоритм.*

MINIMIZATION OF LOSSES IN DISTRIBUTION ELECTRICAL NETWORKS BY GENETIC ALGORITHMS

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ANNOTATION

The article presents a mathematical formulation of the problem of minimizing losses in distribution electrical networks taking technological limitations and into account all types of regime and a genetic algorithm for solving it. Using a genetic algorithm allows you to effectively solve a number of problems associated with taking into account various types of limitations when solving the problem under consideration.

Keywords: *Power network, losses in electrical networks, losses minimization, target function, limitation, penalty function, algorithm of solving, genetic algorithm.*

Минимизация потерь в распределительных электрических сетях, в общем случае, представляет собой сложную задачу нелинейного математического программирования с множеством простых и функциональных в виде равенств и неравенств. Поэтому, до сих пор не существует универсальный алгоритм её решения на основе использования соответствующих математических моделей. В связи с этим вопросы усовершенствования существующих и разработки новых алгоритмов решения этой задачи в направлении преодоления трудностей, связанные с использованием традиционных алгоритмов остаётся актуальной задачей.

В работе предлагается новый алгоритм минимизации активных потерь в распределительных электрических сетях путём оптимизации в регулируемых реактивных мощностей узлов.

Задача, в общем случае, математически формулируется в следующем виде [1, 2]:

минимизировать функции суммарных потерь активной мощности в электрических сетях, представляющей собой алгебраическую сумму активных мощностей всех узлов

$$\pi = \sum_{i=1}^{n} P_i \qquad (1)$$

при условиях:

а) баланса мощности в узлах:

$$\left.\begin{aligned} W_i^{'} &= P_i - P_{iз} = 0, \quad i = \Gamma + H; \\ W_i^{''} &= Q_i - Q_{iз} = 0, \quad i \in \Gamma_1 + H \end{aligned}\right\}; \qquad (2)$$

б) выполнения режимных и технических ограничений в форме неравенств:

$$U_{i,\min} \le U_i \le U_{i,\max}, \quad i \in \Gamma + H; \qquad (3)$$

$$Q_{i\min} \le Q_i \le Q_{i,\max}; \quad i \in \Gamma - \Gamma_1; \qquad (4)$$

$$K_{Tl\min} \le K_{Tl} \le K_{Tl},\max; \qquad l \in T; \qquad (5)$$

$$I_{l\min} \le I_l \le I_{l\max} \qquad l \in L_I; \qquad (6)$$

где n- число узлов в электрической сети (кроме балансирующей); H- множество нагрузочных узлов; Γ- множество генераторных узлов; Γ_1 - множество генераторных узлов с нерегулируемыми реактивными мощностями T- множество ветвей, содержащих трансформаторы с регулируемыми коэффициентами трансформации; L_I – множество ветвей, в которых контролируются токи.

Несмотря на существование множества методов и алгоритмов решения рассматриваемой задачи проблемы обеспечения эффективности расчетов для

современных электрических сетей в условиях наличия простых и функциональных ограничений не является до конца решенной. В связи с этим в данной работе предлагается эффективной алгоритм решения данной задачи путём оптимизации регулируемых реактивных мощностей узлов на основе генетического алгоритма.

Генетические алгоритмы предлагают новый и мощный подход к решению задач оптимизации. Их применение стало возможным благодаря расширению возможностей вычислительных средств при относительно низких затратах. Последнее время эти алгоритмы находят применение в решении глобальных проблем поисковой оптимизации, когда традиционные алгоритмы оптимизации не могут быть использованы. Они используют параллельные и глобальные поисковые методы, имитирующие природные генетические операторы. Вероятность сходимости генетического алгоритма к глобальному решению задачи наиболее высокая, так как она, одновременно, оценивает множество точек в пространстве параметров. Эти алгоритмы также не требуют дифференцируемости и непрерывности пространство поиска [2-4].

Простой генетический алгоритм состоит из последовательности следующих операций:

1. Генерация случайной популяции бинарных или вещественных рядов кандидатов решения.

2. Расчет функции соответствия для каждого ряда в популяции.

3. Создание потомства строк (хромосом) путем отбора, скрещивания и мутации.

4. Оценка новых рядов (хромосом) и расчет для каждого из них функции соответствия.

5. Проверка достижения цели поиска или допустимого поколения. В случае выполнения этого условия – выдача наилучшей хромосомы (кандидата решения); в противном случае – возврат к п.п.3.

Оценивание популяции осуществляется для выявления более и менее приспособленных особей. Для определения степени приспособленности каждой особи используется функция соответствия. В задачах оптимизации в качестве такой функции можно использовать целевую функцию.

Селекция (отбор) необходима для выбора более приспособленных особей для скрещивания. Существует множество вариантов селекции [5]. Наиболее известными из них являются рулеточная селекция, селекция усечением и турнирная селекция.

Отобранные в результате селекции особи, называемые родителями, скрещиваются и дают потомство. Созданные в процессе обмена генетической

информацией между родительскими особями (с применением оператора кроссовера) потомки составляют популяцию следующего поколения. Скрещивание может осуществляться на основе целочисленного или вещественного кодирования особей. В результате скрещивания двух случайно выбираемых особей (родителей) создаются два потомка. Такой процесс повторяется до получения столько же особей, сколько их было в исходной популяции. На этом этапе алгоритма важным параметром является вероятность скрещивания, определяющая число скрещиваний относительно общего числа особей в популяции.

При использовании целочисленного кодирования каждая хромосома (особь) представляет собой битовую строку, в которой закодированы параметры решения поставленной задачи.

При вещественном кодировании избавляется от операций кодирования и декодирования, используемых в целочисленном кодировании. Пример вещественного кодирования приведен на рисунке.

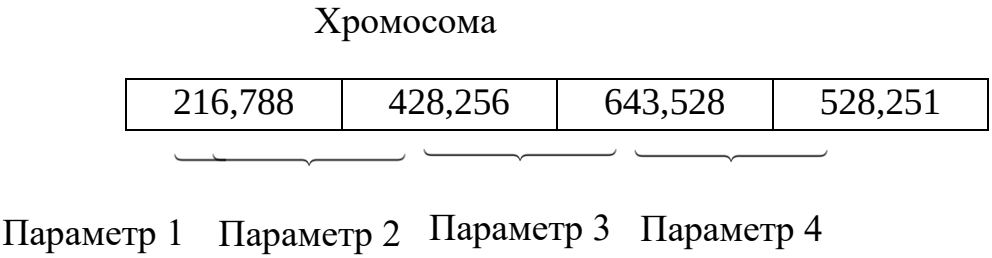

Рисунок. Пример вещественного кодирования.

Для скрещивания могут применятся 1-точечный, 2-точечный и однородный операторы кроссовера.

Согласно этому алгоритму задача условной минимизации функции, представляющей собой функцию суммарных потерь активной мощности в электрических сетях π (1) с учетом всех ограничений сводится к безусловной минимизации обобщенной функции, состоящей из суммы целевой функции исходной задачи и штрафных функций, учитывающих ограничений (2), (3) и (6). Простые ограничения (4) и (5) учитываются автоматически в соответствии с процедурой генетического алгоритма.

Штрафные функции, учитывающие этих ограничений должны равняться нулю при их выполнении и увеличиться при нарушении пропорционально степени нарушения.

В соответствии с этим для учета ограничения в виде равенства (2) принята штрафная функция в виде

$$Ш_p = \frac{\alpha}{2}\left(\sum_{i=1}^{n} P_i - P_H\right)^2. \quad (4)$$

Ограничения (3) и (5) учитываются штрафной функцией в виде

$Ш_l = \beta e^{\gamma\left(P_l - P_l^{\max}\right)}$ или $Ш_l = \beta e^{\gamma\left(-P_l + P_l^{\min}\right)}$, (5)

где α, β, γ- весовые (штрафные) коэффициенты.

Таким образом, обобщенная целевая функция, при минимизации генетическим алгоритмом с учетом ограничений описанными методами, представляется в следующем виде

$$F=\pi+Ш_p+Ш_Q+\sum Ш_l . \quad (6)$$

Эффективность описанного алгоритма исследована на примере минимизации активных потерь оптимизацией регулируемых реактивных мощностей узлов реальной распределительной электрической сети 35 кВ.

При этом функция (6) принята как функция соответствия. Популяция состоялось из 50 хромосом особей. Вероятность скрещивания принята как $P_c=0,6$, а вероятность мутации $P_м=4^{-1}=0,25$.

Оптимизация произведена описанным генетическим алгоритмом с использованием 1-точечного и 2-точечного кроссовера. Сходимость итеративного процесса при использовании вещественного кодирования с 2-точечным кроссовером оказалось быстрее чем с 1-точечным коссовером.

Точность расчета предлагаемым алгоритмом проверялась на основе сравнения результатов с результатами, полученными при использовании классических алгоритмов.

Результаты исследований показали высокую эффективность описанного генетического алгоритма минимизации потерь в электрических сетях с учетом всех видов ограничений.

Выводы:

1. Предложен эффективный генетический алгоритм минимизации активных потерь в электрических сетях с учетом режимных и технологических ограничений.

2. Генетический алгоритм минимизации потерь в электрических сетях обладает достаточно высокой точностью и надежной сходимостью итеративного расчетного процесса. Он также не требует дифференцируемости и непрерывности пространства поиска.

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DOI: https://doi.org/10.5281/zenodo.14499080

MATEMATIK INDUKSIYA METODI

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Matematika fani o‘qituvchilari

Annotatsiya: *Ushbu maqolada matematik induksiya metodi yaratilish tarixi, fanlarda qo‘llanilishi, shuningdek akademik litseylar va umumiy o‘rta ta’lim maktablari uchun olimpiada masalalari hamda elementar matematikada mavjud ayrim murakkab tengliklarni isbotlashning ba’zi usullari keltirilgan.*

Kalit so‘zlar: *o‘xshatish tushunchasi, proporsiya, tabiiy tanlash, P.Ferma, L.Eyler, deduksiya, induksiya, Gersonid, 1321 yil.*

Induksiya tushunchasiga o‘tishdan avval o‘xshatish tushunchasini tahlil qilamiz. O‘xshatish belgisi qadimgi yunonlarda boshlanishida sonlar proporsiyasi shaklida ifodalangan. Masalan, $50 \div 5 = 70 \div 7$. Keyinchalik o‘xshatish so‘zi shakllarga vaboshqa narsalarga ham tadbiq etila boshlandi.

Hozirgi paytda o‘xshatish barcha fanlarda xizmat qiladi. Kimyo, biologiya, fizika va geologiya fanlarida o‘xshatishdan keng foydalaniladi.

Matematikada shunday masalalar mavjudki, ba’zi farazlar yakuniy natijalarga ko‘ra, noto‘g‘ri kelib chiqadi. Shunday masalalardan biri1640-yilda tug‘ilgn P.Fermaning o‘ziga tegishli hisoblanadi: u $fn = 2^{2^n} + 1$ ko‘rinishidagi natural sonlarning barchasi tub son deb faraz qilingan va faqat $n = 0,1,2,3,4$ lar uchun tekshirilgan. Lekin 1732-yili Leonard Eyler Pyer Fermaning farazini inkor etdi. Uning xatoligi shunda ediki, $fn = 2^{2^n} + 1$ bir nechta xususiy qiymatlar uchun hisoblab (bu xususiy tasdiq), $fn = 2^{2^n} + 1$ ning qiymati ixtiyoriy n natural son uchun tub son degan umumiy xulosaga kelgan. L.Eyler soda induksiya xatolikka olib kelishi haqida haqiqatni aytgan.

Matematikada cheksiz to‘plam haqida mulohaza bildirilganda, chekli to‘plamni tekshirish isbotlashni almashtira olmaydi.

Shunday qilib, ikkita tushunchani farqlash lozim:

1) Xususiy tasdiq:
2) Umumiy tasdiq.

Umumiy tasdiqdan xususiy tasdiqqa o‘tish *deduksiya* deyiladi.

Misol. Quyidagi tasdiqlardan qaysi biri xususiy, qaysi biri umumiy:

1) Nol raqami bilan tugallanuvchi son 5 ga bo‘linadi?
2) 60 soni 5 ga bo‘linadi?

Xususiy tasdiqdan umumiy tasdiqqa o‘tish *induksiya* deyiladi. Induksiya ham to‘g‘ri, ham noto‘g‘ri natijaga olib kelishi mumkin. Induksiya Metodi matematikada keng qo‘llaniladi, lekin undan to‘g‘ri foydalanish lozim.

Xulosa:

1) Barcha nol raqami bilan tugallanuvchi sonlar 5 ga bo‘linadi (to‘g‘ri)
2) Barcha uch xonali sonlar 5 ga bo‘linadi (noto‘g‘ri).

Bu usul hozirgi kunda matematik induksiya metodi deyiladi. Ushbu metodni ba’zi qadimgi grek olimlariham foydalanishgan. Dastlab bu metod 1321-yil Gersonid tomonidn foydalanilgan. XIX asrning ikkinchi yarmigacha bu metod asosiy isbotlash metodi hisoblangan.

Matematik induksiya – matematik induksiya prinsipiga asoslangan matematik tasdiqni isbotlovchi metod.

Matematik induksiya metodi — matematikada xususiy natijalarni isbotlashda ishlatiladigan qulay va samarali usul bo‘lib, odatda nisbatan aniq yoki umumiy formula yoki xulosani ko‘rsatishda qo‘llaniladi. Ushbu metod, biror matematik xulosaning barcha tabiiy sonlar uchun to‘g‘riligini isbotlashda keng qo‘llaniladi. Matematik induksiya metodini tushunish va to‘g‘ri ishlatish matematikada murakkab muammolarni hal qilishda katta yordam beradi.

Induksiya usulining asosi

Matematik induksiya, ikki asosiy bosqichga bo‘linadi:

1. *Birinchi bosqich (Asosiy qadam yoki “induksiya boshlanishi”)*: Bu bosqichda, odatda, n = 1 bo‘lgan holat tekshiriladi. Bu, xulosaning to‘g‘riligini boshlang‘ich nuqtada isbotlashni anglatadi. Agar bu bosqich to‘g‘ri bo‘lsa, induksiya boshlanishi o‘rnatiladi.
2. *Ikkinchi bosqich (Induksion qadam)*: Bu bosqichda, xulosa, agar u n = k uchun to‘g‘ri bo‘lsa, n = k + 1 uchun ham to‘g‘ri ekanligini ko‘rsatish orqali isbotlanadi. Ya’ni, biz k=1, 2, 3,... kabi har qanday tabiiy son uchun xulosaning to‘g‘riligini isbotlashni boshlaymiz va agar n = k uchun to‘g‘ri bo‘lsa, n = k + 1 uchun ham to‘g‘ri bo‘lishini isbotlaymiz.

Shu tarzda, birinchi bosqichda to‘g‘ri bo‘lgan xulosa, keyingi barcha tabiiy sonlar uchun ham to‘g‘ri bo‘lishi ko‘rsatiladi. Demak, matematik induksiya metodini qo‘llaganimizda, boshlang‘ich holatni va induksiya qadamini to‘g‘ri bajarish kerak.

Matematik induksiya metodining formal ko‘rinishi

Matematik induksiya metodini quyidagi tarzda formallashtirish mumkin:

Teorema: Agar xulosa $P(n)$ har bir tabiiy son n uchun to‘g‘ri bo‘lsa, unda:

1. $P(1)$ to‘g‘ri ekanligini ko‘rsating (induksiya boshlanishi).
2. Agar $P(k)$ to‘g‘ri bo‘lsa, $P(k+1)$ ham to‘g‘ri ekanligini ko‘rsating (induksiya qadam).

Shundan so‘ng, $P(n)$ har bir tabiiy son uchun to‘g‘ri ekanligi isbotlanadi.

Matematik induksiya misollari

1-masala: Oddiy formulalar yordamida induksiya

Teorema: Har bir tabiiy son n uchun quyidagi tenglama to‘g‘ri:

$$S(n) = 1 + 2 + 3 + \cdots + n = \frac{n(n+1)}{2}$$

Isbot:

1. *Induksiya boshlanishi (n = 1):*

   $S(1) = 1$ va $\frac{1(1+)}{2} = 1$

   Demak, boshlang‘ich holat to‘g‘ri.
2. *Induksiya qadam*: Faraz qilaylik, $S(k)$tenglama to‘g‘ri bo‘lsin, ya’ni:

   $$S(k) = 1 + 2 + 3 + \cdots + k = \frac{k(k+1)}{2}$$

   Endi, $S(k+1)$ ni isbotlashimiz kerak.

   $$S(k+1) = S(k) + (k+1) = \frac{k(k+1)}{2} + (k+1)$$

   Ushbu ifodani to‘g‘ri soddalashtiramiz:

   $$S(k+1) = \frac{k(k+1)}{2} + \frac{2(k+1)}{2} = \frac{(k+1)(k+2)}{2}$$

   Demak, induksiya qadamini ko‘rsatdik va teorema to‘g‘ri.

2-masala: Matematikaning nisbiy murakkabligi

Teorema: Har bir $n \geq 2$ uchun:

$$2^n > n^2$$

Isbot:

1. *Induksiya boshlanishi (n = 2):*

   $2^2 = 4$ va $2^2 \geq 4$ bo‘lib, to‘g‘ri.

2. *Induksiya qadam*: Faraz qilaylik, $2^k > k^2$to‘g‘ri bo‘lsin, ya’ni $k \geq 2$ uchun to‘g‘ri. Endi 2^{k+1} ni isbotlaymiz.

$$2^{k+1} = 2^k \cdot 2$$

Induksiya gipotezasi bo‘yicha, $2^k > k^2$shuning uchun:

$$2^{k+1} = 2 \cdot 2^k > 2 \cdot k^2 = 2k^2$$

Endi $2k^2 > (k+1)^2$ ekanligini ko‘rsatishimiz kerak. Bu to‘g‘ri, chunki:

$$2k^2 - (k+1)^2 = 2k^2 - (k^2 + 2k + 1) = k^2 - 2k - 1 > 0$$

Bu tenglama $k \geq 2$ uchun to‘g‘ri bo‘ladi.

Shu bilan, teoremni isbotladik.

Induksiya metodining afzalliklari va kamchiliklari

Afzalliklari:

- Induksiya metodi matematik xulosalarni isbotlashda kuchli vositadir.
- Ko‘plab aniq xulosalarni, formulalarni va natijalarni isbotlashda ishlatiladi.
- Oddiy va to‘g‘ri bajarilishi oson bo‘lishi mumkin.

Kamchiliklari:

- Ba’zi hollarda induksiya qadamini to‘g‘ri olib borish qiyin bo‘lishi mumkin.
- Tabiiy sonlar uchun bo‘lgan umumiy xulosalarni isbotlashda ba’zida noto‘g‘ri qadamlar yoki xatoliklar kiritilishi mumkin.

Xulosa

Matematik induksiya metodi, aniq formulalar va xulosalarni isbotlashda samarali usul bo‘lib, matematikada keng qo‘llaniladi. Bu metodni o‘rganish va to‘g‘ri ishlatish, turli matematik masalalarni yechishda yordam beradi.

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DOI: https://doi.org/10.5281/zenodo.14499156

THE IMPORTANCE OF MATHEMATICAL STATISTICS IN MEDICINE

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Annotation: *Mathematical statistics is widely used in medicine as an essential tool for forecasting diseases, evaluating the effectiveness of treatments, and improving the efficiency of healthcare systems. Through statistical methods, the dynamics of disease spread, clinical trials, genetic research, and the effectiveness of healthcare systems are analyzed. This article discusses the role of mathematical statistics in medicine, including disease forecasting, clinical trials, and personalized treatment.*

Keywords: *mathematical statistics, medicine, clinical trials, disease forecasting, epidemiology, healthcare systems.*

Introduction. Mathematical statistics is a fundamental tool for scientific research in medicine. With the help of medical statistical methods, the spread of diseases can be analyzed, new treatments can be tested, and the effectiveness of healthcare systems can be assessed. Statistical analysis plays a significant role in identifying patients, preventing diseases, and improving the effectiveness of treatments. Furthermore, statistics is also used in developing personalized treatment approaches and in genomic analysis.

Studying the Spread of Diseases. Epidemiological studies are a major field of application for mathematical statistics in analyzing the spread of diseases. Statistical analyses, such as regression analysis and multivariate modeling, are used to identify disease spread and risk factors. For example, the spread of cardiovascular diseases or oncological diseases can be forecasted and public health improvement strategies can be developed. During the COVID-19 pandemic, statistical models were employed to analyze disease spread, high-risk groups, and coverage rates. A study by Flaxman et al. (2020) used mathematical models to assess various scenarios of the pandemic’s spread, leading to the implementation of strict measures worldwide. Statistics can be

used to predict the spread of diseases and develop effective measures to prevent pandemics.

Clinical Trials and Statistics Clinical trials are crucial in determining the effectiveness and safety of new treatments in medicine. Clinical trials, particularly randomized controlled trials (RCTs), are widely used to assess the efficacy of treatments. Statistical methods are applied to analyze the results of these trials, compare patient groups, and measure the safety and effectiveness of treatments. For example, a study by Dixon et al. (2017) used statistical methods to analyze the efficacy of statin therapy in cardiovascular diseases. Through statistical methods, error rates, p-values, and risk assessments of clinical trials are evaluated.

The results of clinical trials are typically based on medical statistical models, such as the Cox regression model or Kaplan-Meier analysis, which provide the most accurate and reliable results in evaluating new treatments. Additionally, statistical methods allow for the creation of personalized approaches by considering the individual characteristics of patients, the stages of diseases, and the treatment methods applied.

Genomics and Personalized Medicine In the field of genomics, mathematical statistics plays a crucial role, especially in analyzing genomic data. In personalized medicine, statistics are used to develop treatment plans tailored to individual patients. For example, in cancer treatment, genetic markers are used to analyze a patient's unique genetic characteristics and develop treatment strategies based on that analysis. A study by Esteva et al. (2019) demonstrated the successful application of machine learning algorithms and statistical models in the early detection of dermatological diseases, particularly skin cancer. Statistical analysis aids in the study of genomic data and is also useful in identifying genetic factors contributing to diseases.

Through genomics and bioinformatics, statistical methods are employed in genomic research, such as integrating genetic variants, mutations, and data. These methods help study the genetic factors of diseases and develop treatment approaches based on new biomarkers.

Healthcare Systems and Statistics In improving the efficiency of healthcare systems, statistical methods can be applied to analyze the functioning of healthcare systems, allocate resources effectively, and predict the number of patients. A study by Porter and Kaplan (2014) emphasized the importance of using statistical analysis methods to improve the efficiency of medical services. In healthcare systems, statistical models are vital for analyzing costs and optimizing resource allocation.

Through statistical analysis, it is possible to predict the effectiveness of healthcare systems, improve patient admission processes, and enhance treatment outcomes. Additionally, statistical models are used to optimize resource allocation in healthcare settings, such as managing patient flow in hospitals and clinics.

Conclusion: Mathematical statistics is an indispensable tool in scientific research and clinical practice in medicine. Through statistical methods, it is possible to analyze disease spread, evaluate clinical trial results, study genetic data, and improve the efficiency of healthcare systems. Moreover, statistics creates opportunities for integrating new technologies, such as artificial intelligence and genomics, in medicine. However, to effectively utilize these technologies, it is crucial to ensure data security and further deepen statistical analysis.

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DOI: https://doi.org/10.5281/zenodo.14499174

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Annotatsiya. *Ushbu maqolada boshlang‘ich-nolokal chegaraviy shartli vaqt kasr to‘lqin tenglamasi uchun teskari masala o‘rganildi. Biz boshlang‘ich-nolokal chegaraviy shartli masalani tadqiq etishda, dastlab fazo o‘zgaruvchisiga bog‘liq spektral masala o‘rganildi. Spektral masalaning xos soni va xos funksiyalari aniqlandi. Vaqt o‘zgaruvchisi bo‘yicha Koshi masalasi olindi. Bu Koshi masalasi ekvivalent bo‘lgan integral tenglama olindi. Integral tenglamaning yechimi mavjudligi va yagonaligi isbotlandi. So‘ngra boshlang‘ich chegaraviy masala yechimi qator ko‘rinishda izlaymiz. Qatorning tekis darajada uzluksizligi isbotlaymiz. Shundan so‘ng kasr tartibli umumlashgan Riman Liuvill differensial operatorli tenglama uchun teskari masala” tadqiq etamiz, unda to‘g‘ri masala yechimiga qo‘shimcha shart berish orqali tenglamada qatnashuvchi nomalum koeffitsiyentni aniqlash masalasi o‘rganamiz. Bunda asosan teskari masala unga ekvivalent integral tenglamaga keltiramiz, so‘ngra siqiluvchan akslantirishlar prinsipi yordamida teskari masalaning yechimi mavjudligi va yagonaligi isbotlaymiz.*

Tayanch so‘zlar: *Hilfer kasr hosilasi, boshlang‘ich chegaravir shart, Koshi masalasi, integral tenglama, mavjudlik, yagona , tekis yaqinlashuvchi qator.*

$\Omega = \{(x,t): 0 < x < l,\ 0 < t \le T\}$ sohada quyidagi kasr to‘lqin tenglamasini ko‘rib chiqamiz

$$\left(D_{0+,t}^{\alpha,\beta}u\right)(x,t) - u_{xx} + q(t)u(x,t) = f(x,t), \qquad (1)$$

Koshi tipidagi boshlang‘ich shartlar bilan

$$I_{0+,t}^{(1-\alpha)(1-\beta)}u(x,t)|_{t=0} = \varphi(x), \qquad (2)$$

va chegara shartlari

$$u(0,t) = u(l,t),\ u(0,t) = \int_0^1 u(x,t)\,dx,\quad 0 \le t \le T. \qquad (3)$$

Bu yerda $D_{0+,t}^{\alpha,\beta}$ – operator tartibli $0 < \alpha < 1$ tartibli va $0 \le \beta \le 1$ tipli umumlashgan Riman-Liouville (Hilfer) kasr differentsial operatori bo‘lib quyidagicha aniqlanadi **[1, pp. 112-118], [2, pp. 62-65]:**

$$D_{0+,t}^{\alpha,\beta}u(\cdot,t)) = \left(I_{0+,t}^{\beta(1-\alpha)}\frac{\partial^2}{\partial\, t^2}\ \left(I_{0+,t}^{(1-\beta)(1-\alpha)}u\right)\right)(\cdot,t),$$

$$I_{0+,t}^{\gamma}u(x,t) = \frac{1}{\Gamma(\gamma)}\int_0^t \frac{u(x,\tau)}{(t-\tau)^{1-\gamma}}d\tau,\qquad \gamma \in (0,1)$$

$u(x,t)$ funksiyaning t o‘zgaruvchiga nisbatan Riman-Liuvil kasr integrali **[1, s. 112-118], [2, s. 62-65]**, $\Gamma(\cdot)$ – Eylerning Gamma funksiyasi. $f(x,t), \varphi(x)$, funksiyalar berilgan yetarlicha silliq funksiyalar.

$f(x,t), \varphi(x), q(t)$ berilgan funksiyalar va $\alpha \in (0,1),\ \beta \in [0,1]$ sonlar uchun (1)-(3) boshlang‘ich chegaraviy masala yechimini topish masalasi to‘g‘ri masala deb ataladi.

Faraz qilaylik, ushbu maqola davomida berilgan $\varphi(x), f(x,t)$ funksiyalar quyidagi shartlar o‘rinli bo‘lsin:

A1) $\varphi(x) \in C^3[0,1],\ \varphi^{(4)} \in L_2[0,1],\ \varphi(0) = \varphi(1) = 0, \varphi''(0) = \varphi''(1) = 0, i = 1,2;$

A2) $f(x,\cdot) \in C[0,T]$ va $t \in [0,T],\ f(\cdot,t) \in C^3[0,1],\ f(\cdot,t)^{(4)} \in L_2[0,1], f(0,t) = f(1,t) = 0,\ f_{xx}(0,t) = f_{xx}(1,t) = 0.$

Keyingi b**o‘**limda biz ba’zi kerakli dastlabki ma’lumotlarni taqdim etamiz.

Dastlabki tushunchalar

Ikki parametrli Mittag-Leffler funksiyasi $E_{\alpha,\beta}(z)$ quyidagi qatorlar orqali aniqlanadi:

$$E_{\alpha,\beta}(z) = \sum_{k=0}^{\infty}\frac{z^k}{\Gamma(\alpha k+\beta)},$$

bu yerda $\alpha, \beta, z \in \mathbb{C}$ va $\Re(\alpha) > 0$, bunda $\Re(\alpha) -$ α kompleks sonining haqiqiy qismi hisoblanadi. Mittag-Leffler funksiyasi ko‘plab mualliflar tomonidan o‘rganilgan va ular turli umumlashmalar va qo‘llanmalar taklif qilishgan va o‘rganishgan.

Biz uzluksiz funksiyalarning og‘irlikli fazolarini ko‘rib chiqamiz:

$$C_\gamma[a,b] := \{g\colon (a,b] \to R\colon (t-a)^\gamma g(t) \in C[a,b],\ 0 \le \gamma < 1,\},$$

$$C_\gamma^{2,\alpha,\beta}(\Omega) = \{u(x,t)\colon u(\cdot,t) \in C^2(0,1),\ t \in\ [0,T]$$

$$va\ D_{0+,t}^{\alpha,\beta}\ u(x,\cdot) \in\ C_\gamma(0,T],\ x \in [0,1],\ 1 < \alpha \le 2,\ 0 \le \beta \le 1\Big\},$$

1-Lemma. [19, 189b] Faraz qilaylik, b $b \ge 0,\ \alpha > 0$ va $a(t)$ nol bo‘lmagan, mahalliy integrallanuvchi funksiya bo‘lib, $0 \le t < T$ (ba’zi $T \le +\infty$ bo‘lsin. Shuningdek, $u(t)$ ham nol bo‘lmagan va $0 \le t < T$ da mahalliy integrallanuvchi bo‘lib,

$$u(t) \le a(t) + b\int_0^t (t-s)^{\alpha-1}\,u(s)ds,$$

ni qanoatlantirsa, u holda:

$$u(t) \le a(t) + b\Gamma(\alpha)\int_0^t (t-s)^{\alpha-1}\,E_{\alpha,\alpha}(b\Gamma(\alpha)(t-s)^\alpha)a(s)ds.$$

To‘g‘ri masalaning yechimi uchun mavjudlik va yagonalik natijalari

Avvalo, o‘z-o‘ziga qo‘shma bo‘lmagan operator uchun quyidagi tenglama

$$X''(x) + \lambda^2 X(x) = 0 \tag{5}$$

va quyidagi shartlar bilan

$$X(0) = X(l),\ X(0) = \int_0^1 X(x)\,dx. \tag{6}$$

masala qaraylik. Xos qiymat va xos funksiyalar uchun (5)-(6) masalaning yechimi quyidagi shaklda keltirilgan:

$$X_n(x) = c_1 \sin(\lambda_n x) + c_2 \cos(\lambda_n x), \tag{7}$$

Bu yerda c_1 va c_2 doimiy sonlar, $\lambda_n -$ esa quyidagi transsendent tenglamaning yechimi:

$$\lambda_n = 2tg\frac{\lambda_n l}{2}. \tag{8}$$

Furye usulini qo‘llash orqali (1)-(3) masalaning $u(x,t)$ yechimini shaklning xos funksiyalari bo‘yicha tekis yaqinlashuvchi qatorga yoyamiz:

$$u(x,t) = \sum_{n=0}^{\infty} u_n(t)X_n\,(x). \tag{9}$$

$n \ge 1$ uchun $u_n(t)$ koeffitsientlarini xos funksiyalarning ortogonalligidan foydalanib topamiz. Ya’ni, (1) ni (7) ning xos funksiyalariga ko‘paytiramiz va $(0,l)$ oraliqda integrallaymiz. $L_2[0,l]$ dagi skalyar ko‘paytma $(f,g) = \int_0^l f\,(x)g(x)dx.$ bilan aniqlanadi. $n \ge 1$ uchun mos ravishda (7) ning xos

funksiyalarida $f(x,t)$ va $\varphi(x)$ funksiyalarning Fur'e koeffitsiyentlarini yozamiz:

$$f_n(t)=\int_0^l f\,(x,t)X_n(x)dx, \qquad \varphi_n=\int_0^l \varphi\,(x)X_n(x)dx. \tag{10}$$

In view of (1) for $\left(u(x,t),Y_0(x)\right)=u_0(t)$, we obtain the Cauchy type problem

$$\left(D_{0+,t}^{\alpha,\beta}u_n\right)(t)+q(t)u_n(t)=f_n(t), \tag{11}$$

$$I_{0+,t}^{(2-\alpha)(1-\beta)}u_n(t)|_{t=0}=\varphi_n. \tag{12}$$

Biz (11)-(12) masalalarni hal qilamiz.

(11)-(12) boshlang'ich masala $C_\gamma^{\alpha,\beta}[0,T]$ fazosida ikkinchi tur Volterra integral tenglamasiga ekvivalentdir:

$$u_n(t)=\frac{t^{(\beta-1)(1-\alpha)}}{\Gamma\left(1+(\beta-1)(1-\alpha)\right)}\varphi_n+\frac{1}{\Gamma(\alpha)}\int_0^t(t-\tau)^{\alpha-1}f_n(\tau)d\tau$$

$$-\frac{1}{\Gamma(\alpha)}\int_0^t(t-\tau)^{\alpha-1}q(\tau)u_n(\tau)d\tau. \tag{13}$$

$u_n(t)$ integral tenglamaning yechimi mavjudligi [A] ishda isbotlangan.

(9) tenglikni t o'zgaruvchi bo'yicha differensiallab quyidagi qatorni tuzamiz

$$\left(D_{0+,t}^{\alpha,\beta}u\right)(x,t)=\sum_{n=1}^{\infty}\left(D_{0+,t}^{\alpha,\beta}u_n\right)(t)X_n(x), \tag{14}$$

$$u_{xx}(x,t)=-\sum_{n=1}^{\infty}\lambda_n^2\,u_n(t)X_n(x). \tag{15}$$

$\overline{\Omega}:=\{(x,t):0\le x\le 1,\ 0\le t\le T\}$ sohadagi (9), (14) va (15) qatorlarning tekis yaqinlashuvchanligini isbotlaylik. Bu qator har qanday $(x,t)\in\overline{\Omega}$ uchun majaranta qator tuzamiz. Majaranta qatorlar yaqinlashuvchi bo'lishi uchun quyidagi qatorning yaqinlashuvchilikga tekshirish yetarli

$$\sum_{n=1}^{\infty}\lambda_n^2\left(|\varphi_n|+\|\,f_n\,\|_{C_\gamma[0,T]}\right). \tag{16}$$

(16) qatorning yaqinlashishini tekshirishda yordamchi lemmani kiritamiz:

2-Lemma. Faraz qilaylik, A1), A2) shartlar bajarilsin, u holda

$$\varphi_{n,i} = \frac{1}{\lambda_n^4}\varphi_{n,i}^{(4)},\ i = 1,2,\ \ f_n = \frac{1}{\lambda_n^4}f_n^{(4)}, \tag{17}$$

bu yerda

$$\varphi_{n,i}^{(4)} = \int_0^1 \varphi_i^{(4)}(x)Y_n(x)dx,\ i = 1,2, \tag{18}$$

$$f_n^{(4)} = \int_0^1 f^{(4)}(x)Y_n(x)dx, \tag{19}$$

hamda bular uchun quyidagi tengsizliklar o‘rinli:

$$\sum_{n=1}^{\infty}\left|\varphi_{n,1}^{(4)}\right|^2 \le \| \varphi_1^{(4)} \|_{L_2[0,l]}, \tag{20}$$

$$\sum_{n=1}^{\infty}\left|\varphi_{n,2}^{(4)}\right|^2 \le \| \varphi_2^{(4)} \|_{L_2[0,l]}, \tag{21}$$

$$\sum_{n=1}^{\infty}\left|f_n^{(4)}\right|^2 \le \| f^{(4)} \|_{L_2[0,T]}. \tag{22}$$

Isbot. 3-lemma shartlarida (17) tenglik $\varphi(x),\ \psi(x)$ va $f(x,t)$ funksiyalarning Furye koeffitsientlari uchun integrallarda qismlarga ikki marta integrallash orqali osonlik bilan olinadi. (20)-(22) munosabatlar $\varphi''(x),\ \psi''(x)$ va $f_{xx}(x,t)$ funksiyalari uchun Bessel tengsizliklaridir.

E’tibor bering, 2-lemma shartlarida v qatorlar yaqinlashadi. 20)-(22) qatorlarga va Koshi-Bunyakovskiy tengsizligini qo‘llasak, quyidagini olamiz

$$\sum_{n=1}^{\infty}\lambda_n^2\left(|\varphi_n| + \| f_n \|_{C_\gamma[0,T]}\right) = \sum_{n=1}^{\infty}\left(\frac{\varphi_n^{(4)}}{\lambda_n^2} + \frac{\| f_n^{(4)} \|_{C_\gamma[0,T]}}{\lambda_n^2}\right)$$

$$\le \left(\sum_{n=1}^{\infty}\frac{1}{\lambda_n^2}\right)^{\frac{1}{2}}\left(\sum_{n=1}^{\infty}\left|\varphi_n^{(4)}\right|^2\right)^{\frac{1}{2}} + \left(\sum_{n=1}^{\infty}\frac{1}{\lambda_n^2}\right)^{\frac{1}{2}}\left(\sum_{n=1}^{\infty}\left\|f_n^{(4)}\right\|^2_{C_\gamma[0,T]}\right)^{\frac{1}{2}}$$

$$\le C\left(\| \varphi_2^{(4)} \|_{L_2[0,l]} + \| f^{(4)} \|_{L_2[0,l]}\right).$$

Yuqoridagi tengsizlikdan (16) qatorning yaqinlashuvchanligi kelib chiqadi.

Bundan esa (9), (14) va (15) qatorlarning tekis yaqinlashuvchanligi kelib chiqadi. Shunday qilib, biz quyidagi teoremani isbotladik.

1-Teorem. Faraz qilaylik, q(t) ∈ C[0, T] bo‘lib, A1), A2) shartlar bajarilsin, u holda (1)-(1) to‘g‘ri masalaning $u(x,t) \in C_{\gamma}^{2,\alpha,\beta}\left(\overline{\Omega}\right)$ sinfga tegishli yagona yechimi mavjud bo‘ladi.

Endi kasr tartibli umumlashgan Riman Liuvill differensial operatorli tenglama uchun teskari masala

Teskari masalada (1)-(3) masalaning yechimi quyidagi qo‘shimcha shartni qanoatlantirsa, (1) tenglamadan $q(t)$, $t \in [0,T]$ funksiyani aniqlash talab qilinadi:

$$\int_0^1 w(x)u(x,t)dx = h(t), \quad 0 \le t \le T, \tag{23}$$

bu yerda $w(x)$ va $h(t)$ funksiyalar berilgan yetarlicha silliq funksiyalar.

Faraz qilaylik, ushbu maqola davomida berilgan φ_1, φ_2, f, w va h funksiyalar quyidagi shartlar o‘rinli bo‘lsin:

B1) $w(x) \in C^2[0,1]$ va $w(0) = w(1) = 0$ va $w'(0) = w'(1)$;

B2) $\left(D_{0+,t}^{\alpha,\beta}h\right)(t) \in C[0,T]$, $|h(t)| \ge h_0 > 0$, h_0 – berilgan son,

$$\int_0^1 w(x)\varphi_1(x)dx = I_{0+,t}^{(2-\alpha)(1-\beta)}h(t)_{t=0+}, \int_0^1 w(x)\varphi_2(x)dx = \frac{\partial}{\partial t}\left(I_{0+,t}^{(2-\alpha)(1-\beta)}h\right)(t)_{t=0+}.$$

(11) tenglamani $w(x)$ ga ko‘paytiramiz va x bo‘yicha 0 dan 1 gacha integrallaymiz. Natijada biz quyidagiga ega bo‘lamiz

$$\int_0^1 w(x)\left\{\left(D_{0+,t}^{\alpha,\beta}u\right)(x,t) - u_{xx} + q(t)u(x,t)\right\}dx = \int_0^1 w(x)f(x,t)dx.$$

Yuqoridagi tenglikda qavslarni ochib, ko‘rinishini o‘zgartiramiz:

$$\int_0^1 w(x)\left(D_{0+,t}^{\alpha,\beta}u\right)(x,t)dx - \int_0^1 w(x)u_{xx}(x,t)dx + \int_0^1 w(x)q(t)u(x,t)dx = \int_0^1 w(x)f(x,t)dx. \tag{24}$$

(3) chegaraviy shart va B1) shartga ko‘ra biz quyidagiga ega bo‘lamiz:

$$\int_0^1 w(x)u_{xx}(x,t)dx = \int_0^1 w''(x)\mathrm{u}(x,t)dx. \qquad (25)$$

(23) qo‘shimcha shart va (25) tenglikga ko‘ra, (24) ifodani ko‘rinishini o‘zgartiramiz:

$$\left(D_{0+,t}^{\alpha,\beta}h\right)(t) + q(t)h(t) - \int_0^1 w''(x)u(x,t)dx = \int_0^1 w(x)f(x,t)dx.$$

Bundan $q(t)$ nomalum koeffitsiyentni topamiz:

$$q(t) = \frac{1}{h(t)}\left(\int_0^1 w(x)f(x,t)dx - \left(D_{0+,t}^{\alpha,\beta}h\right)(t)\right) + \\ + \frac{1}{h(t)}\int_0^1 w''(x)\sum_{n=0}^{\infty} u_n(t)X_n(x)dx. \qquad (26)$$

$u_n(t)$ funksiya aniqlanishiga ko‘ra $q(t)$ koeffitsiyentga bog‘liq, ya’ni $u_n(t;q)$.

Oddiy almashtirishlardan so‘ng, q(t) koeffitsiyentni aniqlash masalasini unga ekvivalent quyidagi integral tenglamaga keltiramiz:

$$q(t) = q_0(t) + \frac{1}{h(t)}\sum_{n=1}^{\infty} w_n\, u_n(t;q), \qquad (27)$$

bu yerda

$$q_0(t) = \frac{1}{h(t)}\left(\int_0^1 w(x)f(x,t)dx - \left(D_{0+,t}^{\alpha,\beta}h\right)(t)\right),$$

$$w_n = \int_0^1 w''(x)X_n(x)dx,$$

$u_n(t)$ funksiya (13) munosabat orqali aniqlanadi.

(27) tenglikning o‘ng tomoni bilan aniqlanadigan F operatorni kiritamiz:

$$F[q](t) = q_0(t) + \frac{1}{h(t)}\sum_{n=1}^{\infty} w_n\, u_n(t;q).$$

So‘ngra (27) tenglamani operator tenglama ko‘rinishda yozib olamiz:

$$F[q](t) = q(t). \qquad (28)$$

Operator tenglamaning ozod hadi $q_0(t)$ ni baholab olamiz:

$$q_{00} := \max_{t\in[0;T]}|q_0(t)| = \left\| \frac{1}{h(t)} \left(\int_0^1 w(x) f(x,t)dx - \left(D_{0+,t}^{\alpha,\beta} h\right)(t) \right) \right\|_{C[0,T]}.$$

$\rho > 0$ tayinlaymiz (o‘zgarmas) va Markazi $q_0(t)$ da radiusi ρ bo‘lgan sharni kiritamiz:$B(q_0,\rho) := \{q(t): q(t) \in C[0,T],\ \| q - q_0 \| \leq \rho\}$.

Teskari masala uchun quyidagi teorema o‘rinli:

2-Teorema. Faraz qilaylik, 1 teorema shartlari bajarilsin, bundan tashqari B1)-B2) shartlar bajarilsin. U holda shunday $T^* \in (0;T)$ soni mavjud bo‘lib, (1)-(3), (23) teskari masalaning $q(t) \in C[0,T^*]$ sinfga tegishli yagona yechimi mavjud bo‘ladi.

Isbot. Teskari masala uchun ushbu teoemani isbotlashda siqib akslantirish prinsipidan foydalanamiz. Buning uchun, birinchidan, yetarlicha kichik $T > 0$ uchun F operatori $B(q_0,\rho)$ sharni o‘ziga akslantirishini tekshiramiz, ya’ni $\forall q \in B(q_0,\rho)$ uchun $F[q](t) \in B(q_0,\rho)$ bo‘lishini isbotlaylik. Haqiqatan ham, har qanday uzluksiz funksiya $q(t)$ uchun (27) formulaning o‘ng yordamida aniqlangan $F[q](t)$ funksiya uzluksiz bo‘ladi. Birinchi shartni tekshirish uchun quyidagi ayirmaning normasini baholab, biz buni topamiz:

$$\|\mathrm{F[q](t)} - \mathrm{q_0(t)}\| = \left| \frac{1}{h(t)} \sum_{n=1}^{\infty} w_n u_n(T;q) \right|$$

$$\leq \frac{w_0}{h_0} \sum_{n=1}^{\infty} \left(\frac{T^{\gamma+(\beta-1)(1-\alpha)}|\varphi_n|}{\Gamma\left(1+(\beta-1)(1-\alpha)\right)} + \frac{\| f_n \|_{C_\gamma[0,T]}\, T^\alpha B(\alpha,1-\gamma)}{\Gamma(\alpha+1)} \right)$$

$$\times E_{\alpha,\gamma}\left(\left(\| q \|_{C[0,T]}\, T^\gamma \right)^{\frac{1}{\alpha+\gamma-1}} T \right).$$

Oxirgi tengsizlikning o‘ng tomondagi qatorning tekis yaqinlashuvchanligini tekshiramiz. Buning uchun tengsizlikni quyidagicha yozamiz:

$$\|\mathrm{F[q](t)} - \mathrm{q_0(t)}\| \leq \frac{w_0}{h_0} \left(\frac{T^{\gamma+(\beta-1)(1-\alpha)}}{\Gamma\left(1+(\beta-1)(1-\alpha)\right)} \sum_{n=1}^{\infty} |\varphi_n| + \right.$$

$$\left. + \frac{T^\alpha B(\alpha,1-\gamma)}{\Gamma(\alpha+1)} \sum_{n=1}^{\infty} \| f_n \|_{C_\gamma[0,T]} \right) E_{\alpha,\gamma}\left(\left(\| q \|_{C[0,T]}\, T^\gamma \right)^{\frac{1}{\alpha+\gamma-1}} T \right).$$

3-Lemmaga ko‘ra

$$\|\mathrm{F[q](t)} - \mathrm{q_0(t)}\| \leq \frac{w_0}{h_0} \left(\frac{T^{\gamma+(\beta-1)(1-\alpha)}}{\Gamma\left(1+(\beta-1)(1-\alpha)\right)} \sum_{n=1}^{\infty} \frac{|\varphi'_n|}{\lambda_n} + \right.$$

$$+\frac{T^{\alpha}B(\alpha,1-\gamma)}{\Gamma(\alpha+1)}\sum_{n=1}^{\infty}\frac{\|\ f_{nx}\ \|_{C_{\gamma}[0,T]}}{\lambda_n}\Bigg)E_{\alpha,\gamma}\left(\left(\|\ q\ \|_{C[0,T]}\ T^{\gamma}\right)^{\frac{1}{\alpha+\gamma-1}}T\right). \quad (29)$$

Bundan esa quyidagi tengsizlikga ega bo‘lamiz

$$\|\mathrm{F[q](t)}-\mathrm{q_0(t)}\|\leq\frac{Cw_0}{h_0}\Bigg(\frac{T^{\gamma+(\beta-1)(1-\alpha)}\ \|\ \varphi'\ \|_{L_2[0,l]}}{\Gamma\left(1+(\beta-1)(1-\alpha)\right)}+$$
$$+\frac{T^{\alpha}B(\alpha,1-\gamma)\ \|\ f_x\ \|_{L_2[0,l]}}{\Gamma(\alpha+1)}\Bigg)E_{\alpha,\gamma}\left(\left(\|\ q\ \|_{C[0,T]}\ T^{\gamma}\right)^{\frac{1}{\alpha+\gamma-1}}T\right).$$

E’tibor bering, bu tengsizlikda o‘ng tomonda hosil bo‘lgan funksiya T ga bog‘liq ortib boruvchi monoton bo‘lib, $q(t)$ funksiyaning $B(q_0,\rho)$ sharga tegishli ekanligi $\|\ \|q\|_{C[0,T]}\leq\|q_0\|_{C[0,T]}+\rho$ tengsizlikni qanoatlantirishini bildiradi. Demak, bu tengsizlikdagi $\|q\|_{C[0,T]}$ ni $\|q_0\|_{C[0,T]}+\rho$ ifoda bilan almashtirsakgina tengsizlikni kuchaytiramiz. Ushbu almashtirishlarni amalga oshirib, biz quyidagi bahoni olamiz

$$\|\mathrm{F[q](t)}-\mathrm{q_0(t)}\|\leq\frac{Cw_0}{h_0}\Bigg(\frac{T^{\gamma+(\beta-1)(1-\alpha)}\ \|\ \varphi'\ \|_{L_2[0,l]}}{\Gamma\left(1+(\beta-1)(1-\alpha)\right)}+$$
$$+\frac{T^{\alpha}B(\alpha,1-\gamma)\ \|\ f_x\ \|_{L_2[0,l]}}{\Gamma(\alpha+1)}\Bigg)E_{\alpha,\gamma}\left(\left(\left(\|q_0\|_{C[0,T]}+\rho\right)T^{\gamma}\right)^{\frac{1}{\alpha+\gamma-1}}T\right)$$

Faraz qilaylik, quyidagi T ga nisbatan tenglamaning musbat ildizi T_1 bo‘lsin. Shuning uchun agar T_1 bilan tenglamaning musbat ildizini belgilaymiz (T uchun)

$$\frac{Cw_0}{h_0}\Bigg(\frac{T^{\gamma+(\beta-1)(1-\alpha)}\ \|\ \varphi'\ \|_{L_2[0,l]}}{\Gamma\left(1+(\beta-1)(1-\alpha)\right)}+$$
$$+\frac{T^{\alpha}B(\alpha,1-\gamma)\ \|\ f_x\ \|_{L_2[0,l]}}{\Gamma(\alpha+1)}\Bigg)E_{\alpha,\gamma}\left(\left(\left(\|q_0\|_{C[0,T]}+\rho\right)T^{\gamma}\right)^{\frac{1}{\alpha+\gamma-1}}T\right)=\rho,$$

u holda $T\leq T_1$ uchun $\|\ F[q](t)-q_0(t)\ \|\leq\rho$ tengsizlik bajariladi, yani $F[q](t)\in B(q_0,\rho)$ bo‘ladi. Demak, F operator $B(q_0,\rho)$ sharni o‘ziga akslantirdi.

Siqib akslantirishning ikkinchi sharti: $\forall q,\tilde{q}\in B(q_0,\rho)$ uchun

$$\|\ F[q](t)-F[\tilde{q}](t)\ \|\leq \mathrm{N}\ \|\ q-\tilde{q}\ \|_{C[0,T]}$$

ekanligini tekshiramiz, bu yerda $0<\mathrm{N}<1$.

Avval biz, (13) integral tenglamaga mos $\tilde{u}_n$ yechimni quyidagi ko‘rinishda yozib olamiz

$$\tilde{u}_n(t)=\frac{t^{(\beta-1)(2-\alpha)}}{\Gamma\left(1+(\beta-1)(2-\alpha)\right)}\tilde{\varphi}_n+\frac{1}{\Gamma(\alpha)}\int_0^t(t-\tau)^{\alpha-1}\tilde{f}_n(\tau)d\tau$$

$$-\frac{1}{\Gamma(\alpha)}\int_0^t (t-\tau)^{\alpha-1}\,\tilde{q}(\tau)\tilde{u}_n(\tau)d\tau. \qquad (30)$$

(13) va (30) integral tenglamalardan $u_n(t)-\tilde{u}_n(t)=\bar{u}_n(t)$ ayirmani tuzamiz

$$\bar{u}_n(t)=\frac{t^{(\beta-1)(2-\alpha)}}{\Gamma\big(1+(\beta-1)(2-\alpha)\big)}\bar{\varphi}_n+\frac{1}{\Gamma(\alpha)}\int_0^t (t-\tau)^{\alpha-1}\,\bar{f}_n(\tau)d\tau$$

$$-\frac{1}{\Gamma(\alpha)}\left(\int_0^t (t-\tau)^{\alpha-1}\,q(\tau)u_n(\tau)d\tau-\int_0^t (t-\tau)^{\alpha-1}\,\tilde{q}(\tau)\tilde{u}_n(\tau)d\tau\right).$$

Bunda quyidagidan foydalansak

$$q(\tau)u_n(\tau)-\tilde{q}(\tau)\tilde{u}_n(\tau)=u_n(\tau)\bar{q}(\tau)+\tilde{q}(\tau)\bar{u}_n(t),$$

quyidagini olamiz

$$\bar{u}_n(t)=\frac{t^{(\beta-1)(2-\alpha)}}{\Gamma\big(1+(\beta-1)(2-\alpha)\big)}\bar{\varphi}_n+\frac{1}{\Gamma(\alpha)}\int_0^t (t-\tau)^{\alpha-1}\,\bar{f}_n(\tau)d\tau$$

$$-\frac{1}{\Gamma(\alpha)}\int_0^t (t-\tau)^{\alpha-1}\,u_n(\tau)\bar{q}(\tau)d\tau-\frac{1}{\Gamma(\alpha)}\int_0^t (t-\tau)^{\alpha-1}\,\tilde{q}(\tau)\bar{u}_n(\tau)d\tau. \qquad (31)$$

$u_n-\tilde{u}_n$ ayirmaning $C_\gamma^{\alpha,\beta}[0,T]$ dagi norma bo‘yicha bahosini olamiz.

$$t^\gamma|\bar{u}_n|\le\left(\frac{t^{\gamma+(\beta-1)(2-\alpha)}|\bar{\varphi}_n|}{\Gamma\big(1+(\beta-1)(2-\alpha)\big)}+\frac{\|\,\bar{f}_n\,\|_{C_\gamma[0,T]}\,t^\alpha B(\alpha,1-\gamma)}{\alpha\Gamma(\alpha)}\right)$$

$$+\frac{\|\bar{q}\|_{C[0,T]}B(\alpha,1-\gamma)}{\Gamma(\alpha)}\left(\frac{t^{\gamma+(\beta-1)(2-\alpha)}|\varphi_n|}{\Gamma\big(1+(\beta-1)(2-\alpha)\big)}\right.$$

$$\left.+\frac{\|\,f_n\,\|_{C_\gamma[0,T]}\,t^\alpha B(\alpha,1-\gamma)}{\alpha\Gamma(\alpha)}\right)$$

$$\times\,E_{\alpha,\gamma}\left(\big(\|q\|_{C[0,T]}B(\alpha,1-\gamma)t^\gamma\big)^{\frac{1}{\alpha+\gamma-1}}t\right)$$

$$+\frac{\|\tilde{q}\|_{C[0,T]}}{\Gamma(\alpha)}\int_0^t (t-\tau)^{\alpha-1}\,|\bar{u}_n(\tau)|d\tau.$$

Oxirgi tengsizlikda Gronoul integral tengsizligini qo‘llasak, quyidagi tengsizlikni olamiz

$$t^\gamma|\bar{u}_n|\le\left[\left(\frac{t^{\gamma+(\beta-1)(2-\alpha)}|\bar{\varphi}_n|}{\Gamma\big(1+(\beta-1)(2-\alpha)\big)}+\frac{\|\,\bar{f}_n\,\|_{C_\gamma[0,T]}\,t^\alpha B(\alpha,1-\gamma)}{\alpha\Gamma(\alpha)}\right)\right.$$

$$+\frac{\|\bar{q}\|_{C[0,T]}B(\alpha,1-\gamma)}{\Gamma(\alpha)}\left(\frac{t^{\gamma+(\beta-1)(2-\alpha)}|\varphi_n|}{\Gamma\left(1+(\beta-1)(2-\alpha)\right)}\right.$$

$$\left.+\frac{\|\,f_n\,\|_{C_\gamma[0,T]}\,t^{\alpha}B(\alpha,1-\gamma)}{\alpha\Gamma(\alpha)}\right)$$

$$\times E_{\alpha,\gamma}\left(\left(\|q\|_{C[0,T]}B(\alpha,1-\gamma)t^{\gamma}\right)^{\frac{1}{\alpha+\gamma-1}}t\right)\Bigg]$$

$$E_{\alpha,\gamma}\left(\left(\|\tilde{q}\|_{C[0,T]}B(\alpha,1-\gamma)\right)^{\frac{1}{\alpha+\gamma-1}}t\right). \qquad (230)$$

Endi, ixtiyoriy $q(t),\ \tilde{q}(t)\in B(q_0,\rho)$ funksiyalarni olib, $C[0,T]$ fazoda ularning $F[q](t)$ va $F[\tilde{q}](t)$ tasvirlari orasidagi masofani hisoblaymiz. $\tilde{q}(t)$ ga mos keladigan $\tilde{u}_n(t)$ funksiyasi $\varphi_n=\tilde{\varphi}_n,\ \psi_n=\tilde{\psi}_n$ va $f_n=\tilde{f}_n$ bilan (13), (27), (31) integral tenglamalarni qanoatlantiradi. (13), (27), (31) tenglamalar yordamida $F[q](t)-F[\tilde{q}](t)$ ayirmasini tuzib, keyin uning normasini baholaymiz:

$$\|\,F[q](t)-F[\tilde{q}](t)\,\|\leq\frac{w_0}{h_0^2}\frac{B(\alpha,1-\gamma)}{\Gamma(\alpha)}\sum_{n=1}^{\infty}\left[\frac{t^{\gamma+(\beta-1)(2-\alpha)}|\varphi_n|}{\Gamma\left(1+(\beta-1)(2-\alpha)\right)}+\right.$$

$$\left.\frac{\|\,f_n\,\|_{C_\gamma[0,T]}\,t^{\alpha}B(\alpha,1-\gamma)}{\alpha\Gamma(\alpha)}\right]E_{\alpha,\gamma}\left(\left(\|q\|_{C[0,T]}B(\alpha,1-\gamma)t^{\gamma}\right)^{\frac{1}{\alpha+\gamma-1}}t\right)$$

$$\times E_{\alpha,\gamma}\left(\left(\|\tilde{q}\|_{C[0,T]}B(\alpha,1-\gamma)\right)^{\frac{1}{\alpha+\gamma-1}}t\right)\|q-\tilde{q}\|_{C[0,T]}. \qquad (231)$$

(t) va $\tilde{q}(t)$ funksiyalar $B(q_0,\rho)$ sharga tegishli, bu funksiyalarning har biri uchun $\|q\|_{C[0,T]}\leq\|q_0\|_{C[0,T]}+\rho$ tengsizlikka ega. E'tibor bering, $\|\,q-\tilde{q}\,\|_{C[0,T]}$ koeffitsientidagi tengsizlikda (231) o'ng tomondagi funksiya $\|\,q\,\|$, $\|\,\tilde{q}\,\|$ va T bilan ortib boruvchi monotondir. Demak, $\|q\|$ va $\|\tilde{q}\|$ o'rniga $\|q_0\|_{C[0,T]}+\rho$ qo'yiladi. tengsizlikda (231) bilan $\|q_0\|_{C[0,T]}+\rho$ faqat tengsizlikni kuchaytiradi. Bundan biz ushbuga ega bo'lamiz

$$\|\,F[q](t)-F[\tilde{q}](t)\,\|\leq\frac{w_0}{h_0^2}\frac{B(\alpha,1-\gamma)}{\Gamma(\alpha)}\sum_{n=1}^{\infty}\left[\frac{t^{\gamma+(\beta-1)(2-\alpha)}|\varphi_n|}{\Gamma\left(1+(\beta-1)(2-\alpha)\right)}+\right.$$

$$\left.\frac{\|\,f_n\,\|_{C_\gamma[0,T]}\,t^{\alpha}B(\alpha,1-\gamma)}{\alpha\Gamma(\alpha)}\right]E_{\alpha,\gamma}\left(\left(\left(\|q_0\|_{C[0,T]}+\rho\right)B(\alpha,1-\gamma)t^{\gamma}\right)^{\frac{1}{\alpha+\gamma-1}}t\right)$$

$$\times E_{\alpha,\gamma}\left(\left(\left(\|q_0\|_{C[0,T]}+\rho\right)B(\alpha,1-\gamma)\right)^{\frac{1}{\alpha+\gamma-1}}t\right)\|q-\tilde{q}\|_{C[0,T]}.$$

Shunday qilib, agar T_2 −quyidagi tenglamaning musbat ildizi bo‘lsa (T uchun)

$$\frac{w_0}{h_0^2}\frac{B(\alpha,1-\gamma)}{\Gamma(\alpha)}\sum_{n=1}^{\infty}\left[\frac{t^{\gamma+(\beta-1)(2-\alpha)}|\varphi_n|}{\Gamma\left(1+(\beta-1)(2-\alpha)\right)}+\right.$$

$$\left.\frac{\|f_n\|_{C_\gamma[0,T]}\,t^{\alpha}B(\alpha,1-\gamma)}{\alpha\Gamma(\alpha)}\right]E_{\alpha,\gamma}\left(\left(\left(\|q_0\|_{C[0,T]}+\rho\right)B(\alpha,1-\gamma)t^{\gamma}\right)^{\frac{1}{\alpha+\gamma-1}}t\right)$$

$$\times E_{\alpha,\gamma}\left(\left(\left(\|q_0\|_{C[0,T]}+\rho\right)B(\alpha,1-\gamma)\right)^{\frac{1}{\alpha+\gamma-1}}t\right)=1,$$

u holda $T\in(0,T_2)$ uchun F operatori $q(t)$, $\tilde{q}(t)\in B(q_0,\rho)$ elementlari orasidagi masofani qisqartirib akslantiradi.

Shunday qilib, siquvchan akslantirishlar prinsipining ikkila shartini tekshirdik. Binobarin, agar $T^*<min(T_1,T_2)$ ni tanlasak, F operatori $B(q_0,\rho)$ shardagi qisqarish akslantirishdir. Bundan, Banax teoremasiga ko‘ra, F operatori $B(q_0,\rho)$ sharida yagona qo‘zg‘almas nuqtaga ega, ya’ni tenglamaning yagona yechimi mavjud ([26]). 23-teorema isbotlandi.

Xulosa

Ushbu maqolada kasr tartibli umumlashgan Riman Liuvill differensial operatorli tenglama uchun to‘g‘ri hamda teskari masala qaralgan. Boshlang‘ich-nolokal chegaraviy shartli masalani tadqiq etishda, dastlab fazo o‘zgaruvchisiga bog‘liq spektral masala o‘rganildi. Spektral masalaning xos soni va xos funksiyalari aniqlandi. Xos funksiyalari qaralayotgan fazoda to‘la bazis tashkil etganligidan boshlang‘ich chegaraviy masalaning yechimi shu bazis orqali qatorga yoyilgan holda qidirildi. Vaqt o‘zgaruvchisi bo‘yicha Koshi masalasi olindi. Bu Koshi masalasi ekvivalent bo‘lgan integral tenglama olindi. Integral tenglamaning yechimi mavjudligi va yagonaligi isbotlandi. So‘ngra boshlang‘ich chegaraviy masala yechimi qator ko‘rinishda izlaydi. Qatorning tekis darajada uzluksizligi isbotlaydi. Shundan so‘ng kasr tartibli umumlashgan Riman Liuvill differensial operatorli tenglama uchun teskari masala” tadqiq etildi, unda to‘g‘ri masala yechimiga qo‘shimcha shart berish orqali tenglamada qatnashuvchi nomalum koeffitsiyentni aniqlash masalasi o‘rganildi. Bunda asosan teskari masala unga ekvivalent integral tenglamaga keltirildi, so‘ngra siqiluvchan akslantirishlar prinsipi yordamida teskari masalaning yechimi mavjudligi va yagonaligi isbotlandi.

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DOI: https://doi.org/10.5281/zenodo.14499332

ELEKTR ENERGETIKA TIZIMIDA GES REJIMINING XUSUSIYATLARI

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Annotatsiya. *Gidroelektr stansiyalar (GES) O'zbekiston energetika tizimida muhim rol o'ynaydi. Ushbu maqola GES rejimlarining samaradorligini oshirish uchun boshqaruv strategiyalarini tahlil qiladi. Tadqiqot GES faoliyatining asosiy omillarini aniqlash va ularni rivojlantirish bo'yicha tavsiyalar berishni maqsad qiladi. GES rejimlarining ekologik, iqtisodiy va texnik jihatlari hamda zamonaviy boshqaruv texnologiyalari muhokama qilinadi.*

Kalit so'zlar: *gidroelektr stansiyalar, rejim boshqaruvi, suv resurslari, ekologik samaradorlik, O'zbekiston energetika tizimi.*

Аннотация. *Гидроэлектростанции (ГЭС) играют важную роль в энергетической системе Узбекистана. В данной статье анализируются стратегии управления для повышения эффективности режимов работы ГЭС. Исследование направлено на выявление ключевых факторов деятельности ГЭС и разработку рекомендаций по их улучшению. Обсуждаются экологические, экономические и технические аспекты работы ГЭС, а также современные технологии управления.*

Ключевые слова: *гидроэлектростанции, управление режимами, водные ресурсы, экологическая эффективность, энергетическая система Узбекистана.*

Annotation. *Hydroelectric power plants (HPPs) play a significant role in Uzbekistan's energy system. This article analyzes management strategies to improve the efficiency of HPP operating modes. The study aims to identify the key factors influencing HPP performance and provide recommendations for their development. The ecological, economic, and technical aspects of HPPs, as well as modern management technologies, are discussed.*

Keywords: *hydroelectric power plants, regime management, water resources, ecological efficiency, Uzbekistan energy system.*

Kirish. Elektr energetika tizimi har qanday davlat iqtisodiyotining asosiy tayanch sohalaridan biri bo‘lib, uning barqaror va samarali ishlashi sanoat, qishloq xo‘jaligi, xizmat ko‘rsatish sektori hamda aholi turmush tarzining yaxshilanishida muhim ahamiyat kasb etadi. Ushbu tizimda gidroelektr stansiyalarining (GES) o‘rni alohida ahamiyatga ega, chunki ular qayta tiklanuvchi energiya manbalari asosida ishlab chiqariladigan elektr energiyasi bilan tizimni barqaror ta’minlashga xizmat qiladi [1]. GESlarning asosiy afzalligi — ularning ekologik toza, iqtisodiy jihatdan tejamkor va uzoq muddatli ekspluatatsiyaga mo‘ljallanganligi bilan bog‘liq.

Elektr energetika tizimi har qanday davlat iqtisodiyotining asosiy tayanch sohalaridan biri bo‘lib, uning barqaror va samarali ishlashi sanoat, qishloq xo‘jaligi, xizmat ko‘rsatish sektori hamda aholi turmush tarzining yaxshilanishida muhim ahamiyat kasb etadi. Gidroelektr stansiyalar (GES) qayta tiklanuvchi energiya manbalariga asoslanganligi sababli ushbu tizimda alohida o‘rin tutadi [1]. Ularning ekologik tozaligi, iqtisodiy tejamkorligi va uzoq muddatli foydalanish imkoniyati energiya manbalarini diversifikatsiya qilishga xizmat qiladi.

GESlar O‘zbekiston uchun nafaqat energiya ta’minotida muhim manba, balki ekologik xavfsizlikka xizmat qiluvchi vosita sifatida ham katta ahamiyatga ega. Mamlakatning tabiiy suv resurslari gidroenergetika sohasini rivojlantirish uchun keng imkoniyatlar yaratadi. Shu bilan birga, gidroelektr stansiyalarni samarali boshqarish masalalari suv resurslarini oqilona taqsimlash, texnologiyalarni modernizatsiya qilish va ekologik xavfsizlikni ta’minlash zaruriyatini keltirib chiqaradi [1].

GESlarning ahamiyati faqat iqtisodiy samaradorlik bilan cheklanmaydi. Ularning mavjudligi iqlim o‘zgarishlariga moslashish jarayonida O‘zbekistonning barqaror rivojlanishiga xizmat qiladi. Shu sababli, mazkur tadqiqot O‘zbekiston energetika strategiyasida gidroenergetik salohiyatni rivojlantirishga qaratilgan muhim yondashuvlarni shakllantirishni maqsad qilgan [2].

Metodologiya. GES rejimlarini tahlil qilishda suv omborlari va suv oqimi o‘rtasidagi bog‘liqlik, shuningdek, mavsumiy va yillik rejimlarni boshqarish usullari o‘rganildi. Quyidagi asosiy metodologik yondashuvlar qo‘llanildi:

Suv oqimini boshqarish: Gidrotexnik inshootlar va suv resurslarini boshqarish bo‘yicha mavjud amaliyotlar o‘rganildi. Suv resurslarini mavsumiy va yillik rostlash orqali GES samaradorligini oshirish usullari tahlil qilindi. Bunga ko‘ra

Gidroelektrostansiya oqimini rostlash darajasi suv omborining hajmi va daryo oqimi miqdori nisbatidan hisob yili uchun aniqlanadi.

$$\beta = \frac{V}{W}, \beta = 0{,}05 \dots 0{,}5. \quad (1)$$

Oqimni rostlash darajasiga ko‘ra, suv omborlari quyidagicha bo‘ladi: rostlanmaydigan, sutkalik (s.r), haftalik (h.r), mavsumiy (mav.r), yillik (y.r) va ko‘p yillik (k.r) [2].

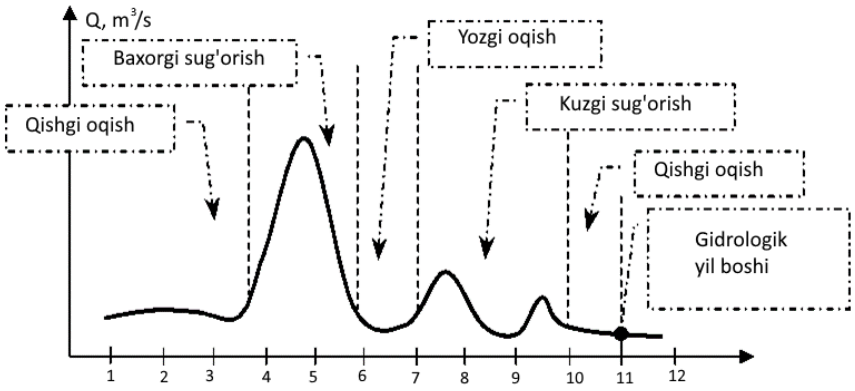
Sutkalik rostlash uchun W oqim tegishli hisobli suvi kam kuniga to‘g‘ri keladi. Mavsumiy uchun - hisobiy yilning kam suvli, yillik - o‘rtacha suvli, uzoq muddatli - kam suvli yillar davri (5...10 yil) hisoblanadi.

Ba’zan, GEShing balansga doir muammolari suvning yillik oqimini rostlash orqali hal qilinadi. Suv omborining butun hajmidagi oqimni yillik rqstlash turli stansiyalar uchun 10 ... 30% va daryoning o‘rtacha ko‘p yillik oqimi $,\beta$= 0,1...0,3 ni tashkil qiladi. Shunday qilib, suv omborining hajmi

$$V = V_{sutka} + V_{hafta} + V_{yil} \quad (2)$$

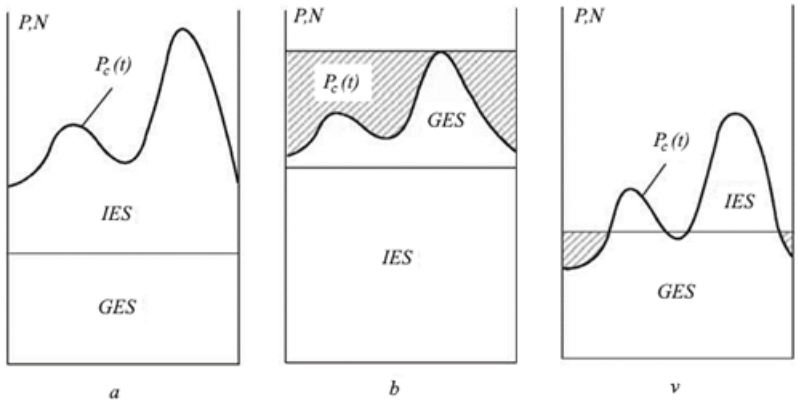
GES energetika va suv ho‘jaligini boshqarish xususiyatiga ega bo‘lgan ob’ekt sifatida qarash mumkin. GESning katta qismi kompleks maqsadli bo‘laklardan iborat.

Gidro elektr stansiyalarni boshqarishda operatsion vazifalar ikki guruhga bo‘linadi [3]. Birinchisi, uzoq muddatli rejimlarni boshqarish. Har bir gidro elektr stansiya suvning mavjudligi sharoiti va oqimni rostlanishiga muvofiq, tizimning energetik balansida turlicha ishtirok etadi. Deyarli barcha gidro elektr stansiyalar yilning turli kalendar davriga muvofiq turlicha ishlaydi (1-rasm).



1-rasm. Daryoning umumiy gidrografi va oqimni suv omborida rostlash imkoni

2. Oqimni rostlash darajasi: Suv omborlarining sutkalik, mavsumiy va yillik rostlash imkoniyatlari tahlil qilinib, ularning energetika tizimiga ta’siri o‘rganildi [3]. Bunday gidro elektr stansiyalar QBS=const belgisida suv oqimi rejimida ishlaydi. Ularning quvvati maishiy iste’moli bilan belgilanadi. Ular sutkali yuklamalar grafigining asosiy qismida faoliyat yuritib (2-rasm), tig‘iz qismida ishlashda suvning ortiqcha quruq oqishi aniqligi va o‘zini oqlamaydigan energiya yo‘qotishlari yazaga keladi (2-rasmdagi kesmali maydon) [4].

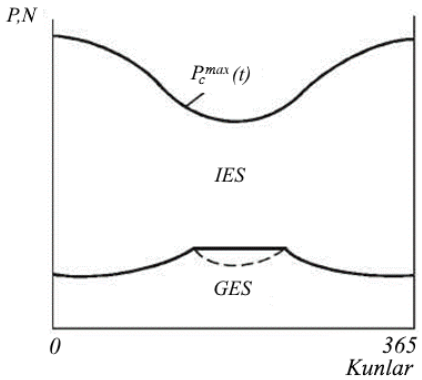


2-rasm. Suvning turlicha sharoitida *rostlanmaydigan GES ning ishlashi;* a) yuklamalar grafigining asosiy qismi; b) yuklamalar grafigining tig‘iz qismi; v) tashlamalarni xisobga olgandagi yuklamalar grafigining asosiy qismi;

Demak, rostlanmaydigan GES daryoning tabiiy oqimidan foydalangan xolda quvvatni va zaruriy rejimni rostlay olmaydi. U doimo yuklamalar grafigining asosiy qismida ishlab, bunda daryo oqimi to‘liq ishlatiladi. Uning ishchi quvvati rostlanmaydi, stansiyada zaxira mavjud emas, oqimning o‘zgarishi ishchi quvvatni o‘zgartiradi (3-rasm) [4].

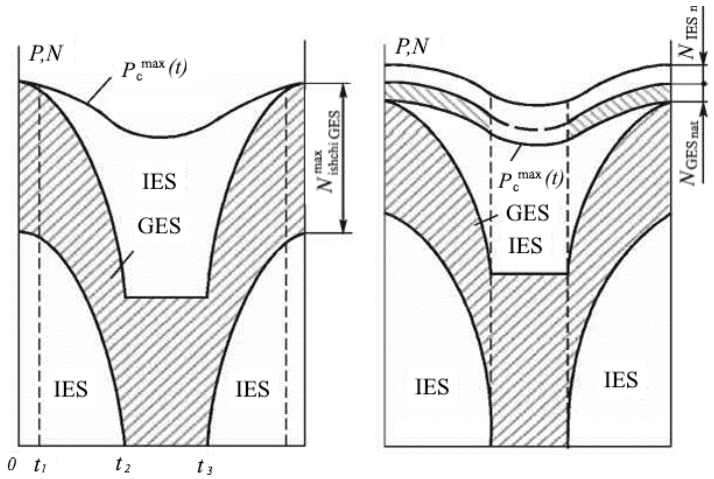
Sutkali rostlanadigan GESda sutkali oqim, elektr energiyasi ishlab chiqarish va quvvat grafigi o‘rtasida qat’iy bog‘liqlik mavjud. GESning sutkali suv oqimi to‘liq ishlatilganligini tizimning yuklamalar grafigidan aniqlash muxim. Sutkali rostlanadigan GES suv omborining kam suvli sutkasiga mos xolda tanlanganligi sababli, suv oqimining ortishi bilan GES ishlab chiqarishi ortib stansiya yarim tig‘izli qismdan, keyin esa tizimning yuklama grafining asosiy qismiga o‘tadi [1].

Energiya tizimining ishchi quvvati yillik balansda (4-rasm, *a)* 0 dan t_1 gacha va t_4 dan yil oxirigacha bo‘lgan davrlar, GESning eng kam suvli davrlariga to‘g‘ri kelib, rasmda ko‘rinib turibdiki, sutkali yuklama grafigining eng tig‘iz qismida ishlaydi. t_1 dan t_2 gacha bo‘lgan vaqt davomida va t_3 *dan* t_4 gacha, daryodagi maishiy sarflar oldingi holatidan bir oz yuqori bo‘lsa, oldingi xolatiga ko‘ra, GES sutkali oraliq xolatida o‘z navbatida tizimning yillik yuklamalar grafida ham o‘rin tutadi. Nihoyat, suv toshqini davrida (t_2. *momentidan* t_3 momentgacha) GES grafikning asosiy qismida joylashadi va rostlanmay ishlaydi. Agar bu xolatda tayziqqa mos bog‘lovchi qubbat bo‘lmasa, u xolda ishchi quvvat o‘rnatilganiga teng bo‘ladi [4].



3-rasm. Rostlanmaydigan GES ning yillik ishlash rejimi

Sutkalik rostlanadigan gidroelektrostansiya yuqori sifatli manevrliligi tufayli, yuklama zaxirasi sifatida yaxshi qo‘llaniladi. Suv toshqini paytida bo‘sh tushuvlarni kamaytirish uchun tabiiy ravishda yuklama zahirasi ishchi quvvat sifatida ishlatiladi va bunda GES rostlanmay ishlaydi va yuklamali zahira IESga o‘tkaziladi (4-rasm, *b).*



4-rasm. **Sutkali rostlanadigan GESning yillik ishchi rejimi**

Suv omborining sutkali rostlash nisbatan katta emas, avariyali (yuklamani "olish" zaxiradan tashqari) yoki ta’mirlash zaxirasini ta’minlash uchun alohida hajmni ajratishni imkoni yo‘q [5]. Shu jihatdan sutkali rostlanadigan GES rostlanmaydigan GESdan farq qilmaydi. O‘rnini bosuvhci mavsumiy quvvatning mavjudligi, yuqorida aytib o‘tilganidek, stansiyani avariya yoki ta’mirlash zaxirasini ta’minlash imkonini beradi [6].

GESning yillik rostllanishi. Gidro elektr stansiyasining suv omborida yillik rostllanuchi tizim talablariga muvofiq ishlab chiqarilgan energiyani taqsimlash imkonini beradi. Ko‘pgina gidro elektr stansiyalar uchun xos bo‘lgan yillik oqimni rostlashga solishga alohida to‘xtalib o‘tamiz.

Elektr energiyasi ishlab chiqarish yillik davr mobaynida $Э = Э_{maysh}$ foydalanilgan maishiy ta’minotga to‘g‘ri keladi. Stansiyaning quvvati yillik, haftalik va kunlik davrlar uchun maishiy elektr energiyasini ishlab chiqarishni rostllash hisobiga ortadi, ya’ni.

$$N = N_{maish} + \Delta N_{yil} + \Delta N_{hafta} + \Delta N_{sutka} \quad (3)$$

Yillik oqimni rostllash katta suv omborini, qimmatbaho gidrotexnik inshootlarni talab qiladi va stansiyani loyihalashda iqtisodiy hisob-kitoblar bilan tanlanadi [4]. Mavsumiy oqimni rostllash bilan, bo‘sh tushuvlar hajmi ortadi. 4-rasmda mavsumiy va yillik oqimni rostllash grafiklari ko‘rsatilgan.

Natijalar. Tadqiqot davomida quyidagi asosiy natijalar aniqlandi:
1. GES samaradorligi: Suv oqimining mavsumiy va yillik boshqaruvi gidrotexnik

inshootlarning iqtisodiy samaradorligini oshiradi. Mavsumiy rejimlarda suv omborlarining hajmi va suv oqimi o‘rtasidagi bog‘liqlik quyidagi grafikda tasvirlangan 2. Raqamli boshqaruv texnologiyalari: Monitoring tizimlarini joriy etish orqali GES samaradorligi va xavfsizligi yaxshilandi. Grafik tahlillar real vaqt rejimida monitoring tizimlarining samaradorligini oshirishini ko‘rsatadi.

3. Ekologik ta’sir: GES faoliyati atrof-muhitga zarar yetkazmaydi, bu esa O‘zbekistonning iqlim o‘zgarishlariga qarshi kurashdagi hissasini oshiradi. GES rejimlarini boshqarishning samarali usullarini ishlab chiqish suv resurslarini optimal taqsimlash imkonini beradi. Natijalar shuni ko‘rsatadiki, gidrotexnik inshootlarning ishlash muddati va samaradorligi bevosita suv resurslarini boshqarish strategiyasiga bog‘liq.

Muhokama. GES rejimlarini boshqarishda quyidagi omillar muhim ahamiyatga ega: Suv resurslarining mavsumiyligi: Suvning mavjudligi mavsumiy omillarga bog‘liq bo‘lib, bu GES ish samaradorligiga bevosita ta’sir qiladi. Mavsumiy rejimlar gidrologik sharoitlarga mos ravishda moslashtirilishi kerak.

GES va boshqa energiya manbalari integratsiyasi: Elektr energiyasi ishlab chiqarishda GESning boshqa manbalar bilan muvofiqligi muhim ahamiyatga ega. Bu jarayonda yuklamalarni optimal taqsimlash alohida o‘rin tutadi.

Raqamli texnologiyalar: Raqamli monitoring va boshqaruv texnologiyalari yordamida suv va energetika resurslarini samarali boshqarish imkoniyati kengayadi. Shuningdek, sun’iy intellekt yordamida rejimlarni avtomatlashtirish istiqbolli yondashuv hisoblanadi. GES rejimlarini boshqarish bo‘yicha innovatsion yondashuvlar iqtisodiy samaradorlikni oshirish va resurslardan oqilona foydalanishni ta’minlashga xizmat qiladi.

Xulosa. Mazkur tadqiqot gidroelektr stansiyalarning O‘zbekiston energetika tizimidagi o‘rni va ahamiyatini yoritdi. GES rejimlarini samarali boshqarish bo‘yicha quyidagi xulosalar qilindi:

1. Suv resurslaridan oqilona foydalanish GES samaradorligini oshiradi.

2. Raqamli monitoring tizimlarini joriy etish GESlarning texnik va iqtisodiy imkoniyatlarini kengaytiradi.

3. GES rejimlarining ekologik afzalliklari ularni global iqlim o‘zgarishlariga moslashish jarayonida muhim vosita sifatida qaralishini ta’minlaydi.

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ANALYSIS OF INCREASING THE OPERATIONAL RELIABILITY OF ELECTRICAL INSTALLATIONS

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Abstract: *This article reviews the current literature on the various factors that cause electrical wiring failure, such as temperature, humidity, and vibration, and best practices and techniques for improving electrical wiring reliability.*

Keywords: *Electricity, temperature, reliability, insulation.*

Agriculture is an important sector of the world economy, contributing to food security, job creation and economic growth. In recent years, the use of electric drives, which replace traditional mechanical and hydraulic systems, has become increasingly widespread in agriculture. Electric drives have a number of advantages over traditional systems, such as increased energy efficiency, lower maintenance costs, and increased efficiency. However, their operational reliability remains a challenge, especially in harsh agricultural environments.

This article is aimed at solving the issue of operational reliability of electric drives used in agriculture. The article examines the various factors that contribute to the failure of electric drives and reviews the available literature on best practices and methods to improve their reliability. In addition, the article suggests new solutions that can be implemented to improve the reliability of electric drives in agriculture.

The proposed strategies can be implemented at various stages of the design, development and maintenance of electrical equipment used in agriculture.

For a long time, it is known that the main and decisive factor affecting the reliability of insulation of electric machines is thermal wear. Therefore, methods for calculating the rate of thermal wear of insulation for the analysis of different operating modes are of particular importance. A model is proposed that connects temperature and insulation service life:

$$T_r = T_{r0} * e^{-\beta\theta} \quad (1)$$

The dispersion in the values of the β coefficient obtained during the processing of the experimental results did not have a well-founded explanation. For the convenience of using the expression (1), a rule was proposed, according to which overheating of the insulation by 8 °C halves the service life and leads to the following expression:

$$T_r = T_{r0} * 2^{-\frac{\theta}{\Delta\theta}} \quad (2)$$

Expressions (1) and (2) describe the process of thermal wear of insulation in the same way, therefore, based on their equality, the following model is obtained:

$$T_r = T_{r0} * e^{-ln2\frac{\theta}{\Delta\theta}} \quad (3)$$

Nevertheless, the model described by the expression (3) expanded the possibility of further research and served as the beginning of the formulation of new rules for levels.

To assess reliability and determine an indicator capable of evaluating operating conditions, it seems to us that the Montzinger model is the most appropriate, in which the magnitude of the temperature rise is taken as an indicator of insulation wear under certain operating conditions and is determined from the following expression:

$$\Delta\theta = \frac{-ln2*\theta}{lnT_r^{'} - lnT_{r0}^{'}} \quad (4)$$

It can be seen from the expression (4) that the value of insulation wear index Δth is directly proportional to the increase in the temperature of the coil and the failure of the electric motor, and is inversely proportional to the difference between the logarithms of the initial resource obtained by observing the dynamics . Table 1 shows the dependence of the working time of the electric motor on $\Delta\theta$.

Table 1.

Average time between failures of electric motors by test mode.

Test mode for electric motors with heat resistance class "E" insulation.	average working time	$\Delta\theta$, ^{0}C
1. Thermal wear at artificial load mode at t = 160 0C	1432	10.11
2. Wear at temperature t = 160 0C and vibration acceleration with A = 1.5 g	593	9.37
3. wear at temperature t = 160 0C in idle mode and reverse mode at A = 0.5 g	330	8.92

In Table 2, different classes of heat resistance determined during the production process are defined for insulation

Table 2.

Temperature design limits

Issiqlikka qarshilik sinfi.	A	E	B	F
Issiqlik qarshilik sinflariga mos keladigan harorat, $\Delta\theta$ ^{0}C	105	120	130	155

To determine a single indicator that reflects the entire set of operating conditions, we propose the well-known Montzinger expression, in which the value of Δth depends on the complete set of operating conditions.

$$T_r = T_{r0} * e^{-ln2\frac{\theta}{\Delta\theta_{st}*K}} \quad (2.6)$$

Eliminating all dominant factors leads to an eightfold increase in resources. Correctly selected and well-tuned protection is required to eliminate faults related to overload and open-phase modes.

Ways to increase operational reliability. The most effective solution to increase operational reliability is related to the limitation of the maximum possible temperature of the insulation of the windings of electric motors, which reduces the level of destruction from the effects of aggressive environments in agricultural production and, in case of emergency overload, inevitable overheating elimination of departure.

Conclusions. In order to evaluate the operational reliability of electric motors working in real technological processes of agricultural production, an integral index of working conditions (K) is proposed and the range of its change from 0.6 to 1.2 is determined. For the exponential law of the distribution of random variables, the method of separation of influencing factors, Weybull - Gnedenko and a model that allows forecasting of the resource in the elimination of failures and individual causes that take into account the influence of individual operational factors are proposed.

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DOI: https://doi.org/10.5281/zenodo.14499366

СИНХРОН КОМПЕНСАТОРЛАРНИ ЭЛЕКТР ТАРМОҒИДАГИ КУЧЛАНИШНИ РОСТЛАШ УЧУН ҚЎЛЛАШ МАСАЛАСИНИ ТАҲЛИЛИ

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Maqolada 10 kV kuchlanishli elektr tarmoqlarida sinxron konpensatorlari qo‘llanilganda tarmoqdagi kuchlanish og‘ishi va tebranishlarini rostlash masalalari tahlil qilindi.

Kalit so‘zlar: *Sinxron kompensator, avtomatik boshqaruv tizimi, kuchlanish tebranishi, kuchlanish og‘ishi, elektr energiya sifat ko‘rsatkichlari, qo‘zg‘atuvchi tok, tok va kuchlanishhihg nosinusoidalligi.*

В статье проанализировано задачи регулировки отклонения и колебания напряжения в сетях 10 кВ при применение синхронных компенсаторов.

Ключевые слова: *Синхронный компенсатор, система автоматического управления, колебания напряжения, отклонения напряжения, качественные показатели электроэнергии, ток возбуждения, несинусоидальность тока и напряжения.*

In the article, the reduction of voltage fluctuations in the network with the help of motors with an automatic control system in synchronous motors in the 10 kV electric network was analyzed in a physical model.

Keywords:*Synchronomus motor, automatic control system, voltage fluctuation, quality indicators of electric power, excitation current, nonsinusoidal current and voltage.*

Электр таъминоти сифатининг муҳим кўрсаткичларидан бири– кучланишнинг барқарорлигидир. Электр энергетика тизимининг исталган нуқтасида уни керакли даражада ушлаб туриш муаммоси ҳозирги вақтда ҳам долзарб бўлиб қолмоқда. Электр энергияни муҳим сифат кўрсаткичларидан бири кучланишни ҳақиқий қиймати ҳисобланиб у истеъмолчини уланиш схемасига боғлиқ ҳолда фаза ёки линия кучланиши бўлиши мумкин.

Кириш. Ишлаб чиқариш жараёнларини жадаллаштириш, янги технологияларни такомиллаштириш ва жорий этиш натижасида вентилли ўзгартиргичлар, бир фазали ва уч фазали электр пайвандлаш ускуналари, катта қувватли электр ёй печлари, вольт–ампер тавсифи ночизиқли истеъмолчилар тобора кўпроқ қўлланилмоқда. Куч трансформаторлари, магнитли кучайтиргичлар ва газ разрядли лампалар шундай хусусиятларга эга. Ушбу қурилмаларнинг хусусияти–уларнинг уланиш жойларига (қисқичларига) синусоидал кучланиш қўлланилганда тармоқдаги носинусоидал токларни истеъмол қилади. Носинусоидал ток эгри чизиқларини ҳар хил частотали оддий гармоник тебранишлар мажмуасидан иборат мураккаб гармоник тебранишлар деб қараш мумкин. Тармоқ элементлари орқали ўтадиган юқори гармоника элементлар қаршилигида кучланиш пасайишига олиб келади, бу эса асосий синусоидал кучланишга қўшилиб, кучланиш синусоидаллигини бузилишига, таъминот тармоғидаги электр энергия сифати бузилишига олиб келади, яъни электр қабул қилгичларни электр таъминоти билан электромагнит мослиги муаммоси ҳосил бўлади.

Ишнинг долзарблиги. Синхрон **компенсатор**лар, айниқса юқори қувватлилари, таъминот тармоғидаги кучланиш тебранишларини пасайтириш учун самарали ишлатилиши мумкин. Бироқ, амалда, **компенсатор**ларнинг бу хоссаси фақат кескин ўзгарувчан юкланган тармоқларда амалга оширилади. Бу ерда улар тебраниш манбалари ҳисобланади. Бундай **компенсатор**лар, қоида тариқасида, ишлаш параметрларининг ҳоссаларига таъсир кўрсатадиган кучли ишлайдиган автоматик қўзғатиш тизимлари билан жиҳозланган [1].

Тажриба ўтказилиб исботланганки, кучли таъсир қилувчи автоматик қўзғатиш тизимлари билан жиҳозланган синхрон **компенсатор**лар, кучланишнинг ўзгаришини мутаносиб ишлайдиган автоматик бошқариш тизимларига қараганда 4 баробар самарали бўлиб ва кучли тартибга солувчи автоматик бошқариш тармоқдаги кучланиш оғишлари ва тебранишларини амалда тўлиқ бартараф этишга имкон беради[2].

Синхрон компенсаторлар валида юклама бўлмаган, осонлаштирилган конструкциядаги синхрон моторларни ифодалайди. Улар реактив қувватни ишлаб чиқариш режимида (компенсаторни қўзғатилганда) ҳам ишлашлари мумкин ва ҳам уни истеъмол қилиш режимида (компенсатор тўла қўзғатилмаганда) ҳам ишлаши мумкин.

Ҳозирги пайтда қуввати 5000–160000 кВА га тенг бўлган синхрон компенсаторлар фаолият кўрсатмоқда.

Реактив энергия манбаси сифатида синхрон компенсаторлар қуйидаги афзалликларга эга: тармоқда кучланишни пасайиши натижасида компенсатор

томонидан ишлаб чиқарилаётган қувватни ортиши орқали акс этадиган ижобий ростлаш эффекти, тизим иши режимларини барқарорлигини оширадиган ва тармоқни режимлари параметрларини яхшилайдиган автоматик тарзда силлиқлик билан ишлаб чиқарилаётган реактив қувватни ростлаш имконияти, ҚТ пайтида компенсатор чўлғамларининг электродинамик ва термик мустаҳкамлиги; таъмирлаш ишларини олиб бориш билан бузилган синхрон компенсаторни тиклаш ва ишга яроқли қилиш имкониятларининг мавжудлиги.

Компенсаторлар очиқ ҳавода ўрнатилган бўлганлиги учун уларга кетадиган сарф–ҳаражат ҳам арзонроқдир.

1–расм. 220 кВ подстанциясининг ташқарисига ўрнатилган синхрон компенсаторлар

Кучланиш кескин ўзгариши шароитида ишлайдиган салт ишлаш режимидаги **компенсатор**ларга келсак, уларнинг кучланиш тебранишини пасайтириш қобилиятини ўрганишга бир нечта тадқиқотларда [3] табиий тартибга солувчи таъсири ўрганилган, бу реактив қувват кўринишидаги реактив қаршилик пайдо бўлишидан иборат бўлиб, у синхрон **компенсатор** шиналарида кучланиш тебранишлари пайтида тебранишни камайтиради. Реактив оқимнинг ўзгарувчан компонентининг синхрон **компенсатор** билан компенсация даражаси синхрон **компенсатор** шиналаридаги компенсация қуввати ва қисқа туташув токига ва $X_d^{"}$ вa X_d' бўйлама ўқи бўйлаб **компенсатор**нинг вақтинчалик қаршилигига боғлиқ. Шунингдек, синхрон **компенсатор**лар, ҳатто қўзғалишни автоматик назоратисиз ҳам, тармоқ ичидаги кучланишни маълум чегаралар ичида ушлаб туришга қодир эканлиги қайд этилган[4]. Бироқ, автоматик бошқариш тизими ёрдамида олинган режим параметрлари ёрдамида энг катта таъсирга эришиш мумкин.

Муаммо ва уларнинг ечилиши. Кучланиш тебранишини пасайтиришни самарали воситаси табиий ростловчи таъсирга эга бўлган синхрон компенсаторлардан фойдаланиш ҳисобланади.

Синхрон компенсаторнинг табиий ростлаш таъсиридан келиб чиққан ҳолда кучланиш тебраниши K_u ни пасайиши қуйидаги ифода орқали аниқланади:

$$К_{и} = \frac{1}{X_d'} - \frac{1}{X_d''} \quad (1)$$

Бу ерда:

X_d' ва X_d'' – синхрон компенсаторни бўйлама ўқи бўйлаб вақтинчалик ва юқори ўтказувчанлик реактивлигининг нисбий қийматлари.

Тармоқ режимида синхрон компенсаторлардан фойдаланиш тармоқдаги қувват коэффициенти ва кучланиш даражасини оширишга, шунингдек, носимметрия ва носинусоидал кучланиш даражасини камайтиришга имкон беради, бу тескари кетма–кетликни эквивалент қаршилиги ва гармоникалар частоталаридаги қаршиликларини камайиши билан изоҳланади.

Актив ва реактив юкламаларни зарбаларидан келиб чиқадиган кучланиш тебранишини қуйидаги формуладан фойдаланиб ҳисоблаш мумкин [5]:

$$\delta U = \frac{\Delta PR + \Delta QX}{U^2} \quad (2)$$

Бу ерда:

ΔP ва ΔQ – актив ва реактив қувватнинг ўзгариши (тўлқинлари), МВт ва Мвар;

R ва *X*–фазадаги актив ва реактив қаршилик, Ом;

U–линия кучланиши, кВ.

Юқоридаги формулани қуйидаги кўринишга айлантириш мумкин [6]:

$$\Delta U = \frac{\left(\Delta P\frac{R}{X} + \Delta Q\right)}{S_K\frac{Z}{X}} \quad (3)$$

Бу ерда:

S_K – кучланиш тебраниши текшириладиган тармоқ нуқтасидаги ҚТ қуввати, (MVA);

Z–тўла қаршилик, Ом.

Электр таъминоти тизими элементларини актив қаршилиги реактив қаршиликдан (кабель линиялардан ташқари) сезиларли даражада камроқ эканлигини ҳисобга олсак, юқоридаги (3) формулани соддалаштириш мумкин[7]:

$$\delta U = \pm\frac{\Delta Q}{S_K} \quad (4)$$

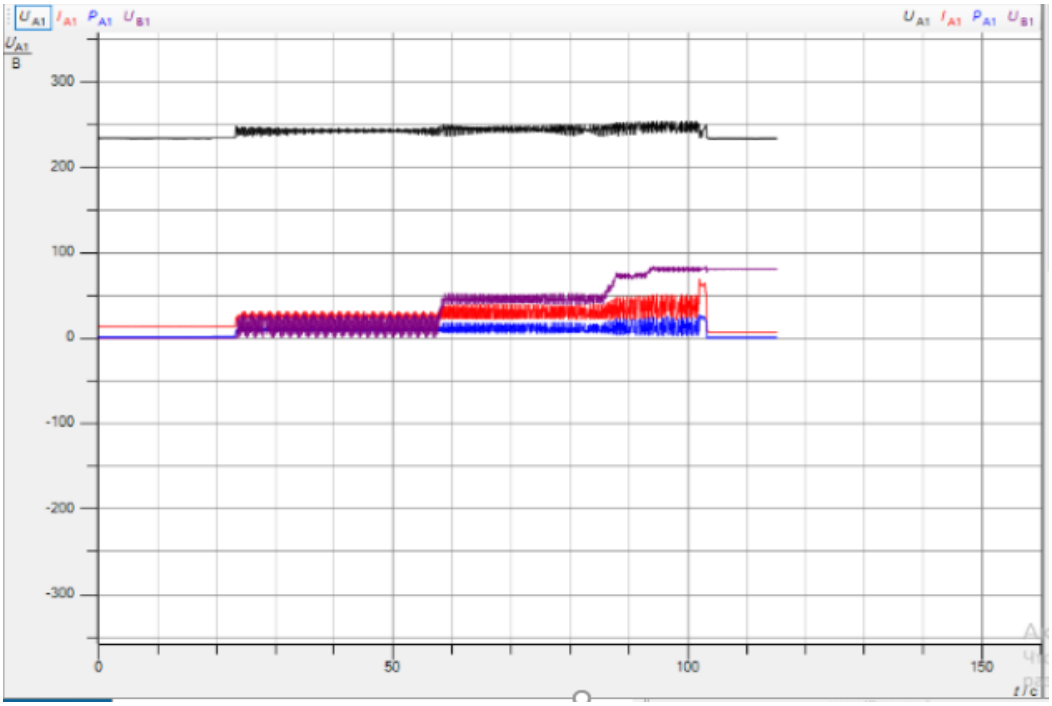
Шундай қилиб, (2) формуладан келиб чиққан ҳолда, кучланиш тебранишининг қиймати реактив қувват ва тармоқнинг қисқа туташув қуввати

билан аниқланади. Шунинг учун, кучланиш тебранишини чеклаш учун зарбали (кескин ўзгарувчан) юкламали истеъмолчилар энг катта ҚТ қувватига эга тармоққа уланиши керак.

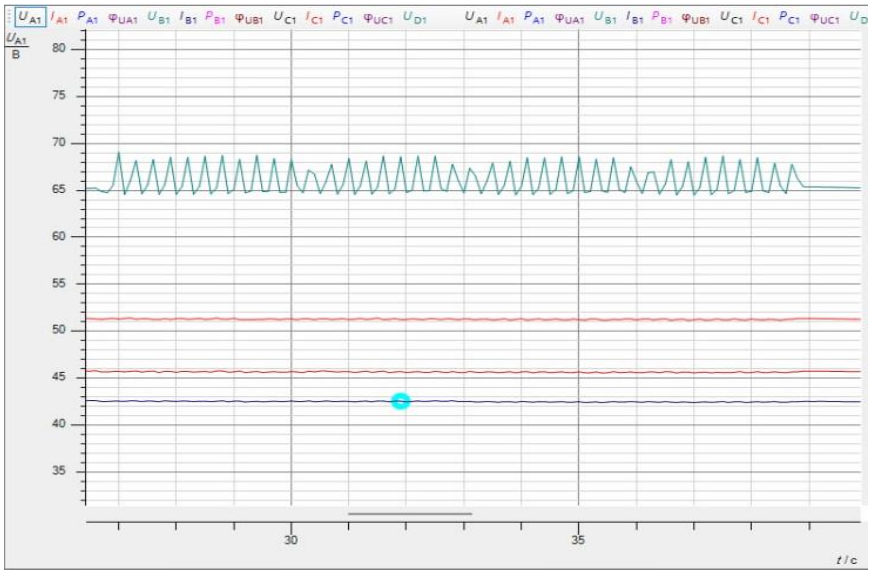
Электр ёйли пўлат эритиш печлари ва умумий цехлар юкламаси пасайтирувчи трансформаторнинг 6÷35 кВли шиналаридаги кучланиш тебраниши амалиёт учун етарли аниқлик билан юқоридаги формулалар ёрдамида аниқланиши мумкин[7].

Юқоридаги ўрганишлардан келиб чиқиб LD–DIDACTIC GMBH физик моделда ўтказилган тажрибаларда синхрон мотор билан тармоқдаги кучланиш тебранишларининг пасайиши икки хил ҳолат бўйича тажрибалар ўтказилган. Дастлабки тажрибада синхрон мотор автоматик бошқариш тизимига эга бўлмаган қўзғатиш тизимли режимда, кейинг тажрибада конденсатор сиғимли тиристорли автоматик қўзғатиш тизимли режимда юргизиш вақтидаги ўткинчи жараёнидаги тармоқ параметрлари ўзгариши осциллограммаси келтирилган.

Қуйида синхрон моторларда автоматик бошқариш тизимига эга бўлмаган қўзғатиш тизимли режимда юргизиш вақтидаги ўткинчи жараёнидаги тармоқ параметрлари ўзгариши осциллограммаси келтирилган.



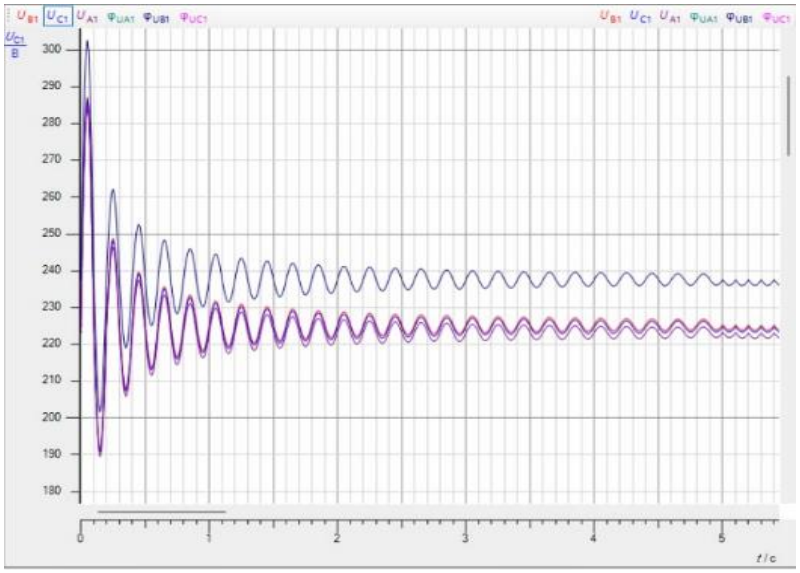
2–расм. Автоматик бошқариш тизимига эга бўлмаган синхрон моторнинг юргизиш вақтидаги ротор занжиридаги токнинг ўткинчи жараёнлари осциллограммалари



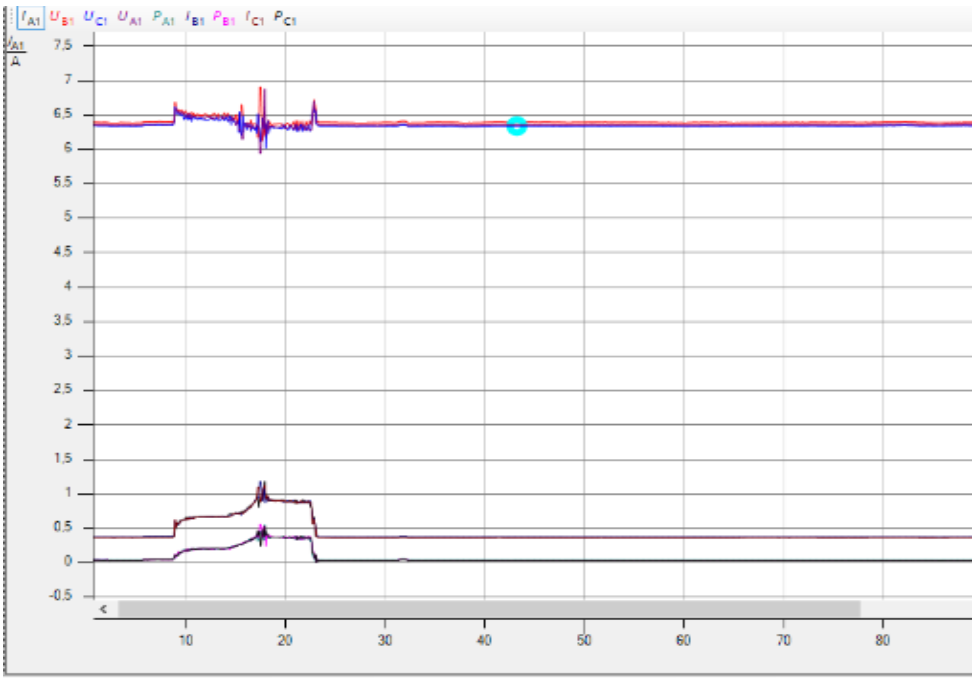
3–расм. Автоматик бошқариш тизимига эга бўлмаган синхрон моторнинг юргизиш вақтидаги ротор занжиридаги кучланишнинг ўткинчи жараёнлари осциллограммалари;

Ушбу осциллограммалардан кўринадики автоматик бошқариш тизими мавжуд бўлмаган синхрон моторларда кучланиш тебранишини сўниш давомийлиги кўплиги ва қўзғатиш токининг қиймати кучланиш тебранишига мутаносиб равишда даврий ўзгаришини кўришимиз мумкин. Юргизиш моментидан кейинги иш режимларида юкламанинг ўзгариши билан бир қаторда кучланиш тебраниши кузатилаётганини таъкидлаш лозим.

Кейинги ўтказилган тажрибада синхрон моторнинг конденсатор сиғимли тиристорли автоматик қўзғатиш тизимли режимда юргизиш вақтидаги ўткинчи жараёнидаги тармоқ параметрлари ўзгариши осциллограммаси келтирилган.



4–расм. Конденсатор сиғимли тиристорли автоматик бошқариш тизимли синхрон моторнинг юргизиш вақтидаги ротор занжиридаги кучланишнинг ўткинчи жараёнлари осциллограммалари;



5–расм. Конденсатор сиғимли тиристорли автоматик бошқариш тизимли синхрон моторнинг юргизиш вақтидаги ротор занжиридаги токнинг ўткинчи жараёнлари осциллограммалари

Ўтказилган тажрибада автоматик бошқариш тизимли моторда юргизиш вақтдаги ҳосил бўлган кучланиш тебраниши автоматик бошқариш тизими ёрдамида 5 с да номинал ҳолатга қайтмоқда. Юргизиш моментидан кейинги кескин ўзгарувчан юкламали иш режимларида ҳам кучланиш тебранишларини номинал қийматда ушлаб туриш имконини беради.

Хулоса қилиб айтганда тажрибада синхрон моторнинг автоматик бошқариш тизими мавжуд бўлмаган тармоқларда ёки бошқа тизим ёрдамида маҳаллий кучланишни тартибга солиш, қоида тариқасида, амалий эмаслиги аниқланди. Синхрон моторларнинг қўзғатиш тизими қанча мукаммал бўлса, унинг бошқариш тизими аниқлиги шунча ортиб боради ва тармоқдаги кучланиш тебранишларини пасайтириш имконини бериб, қўшимча қувват йўқотишлари ҳам мос равишда камаяди. Бу эса электр энергия сифати кўрсаткичларини номинал қийматда таъминлаш имконини яратади.

Синхрон компенсаторлар энергетик тизимларни иш режимларини ростлаш, кучланиш сатҳини оптимал қийматларида ушлаб туриш, тармоқдаги электр энергия йўқотишларини пасайтириш, ўтказувчанлик қобилиятини ошириш ва энергетик тизимларни барқарорлигини таъминлаш учун қўлланилади.

Синхрон компенсаторлар бу–синхрон машиналар бўлиб, актив юкламаларсиз мотор режимида ишлайди ва тармоққа реактив ўзиб кетувчи (сиғимли) ёки кеч қолувчи (индуктивли) ток ишлаб чиқариб беради.

Синхрон моторлар ёрдамида реактив қувватни ишлаб чиқаришда ўрин тутадиган актив қувват йўқотиши моторни номинал қувватига ва айланиш частотасига боғлиқ. Масалан, СДН серияли кучланиши 6 кВ ли моторлар учун. Юкланиш номинал миқдорда бўлганида, бу қиймат 0,009–0,054 кВт/кВар оралиқда бўлади ва ҳ.к.з.

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DOI: https://doi.org/10.5281/zenodo.14499381

УДК 621.311.

САНОАТ КОРХОНАЛАРИДА ҚУВВАТ КОЭФФИЦИЕНТИНИ ОШИРИШ МУАММОЛАРИ

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Мақолада электр тармоқларининг асосий истеъмолчилар асинхрон моторлар бўлганлиги учун қувват коэффициентининг пасайиши таҳлил қилинган ва сабаблари кўриб чиқилган ҳамда уни компенсация қилишаг тавсиялар келтирилган, чунки бу масала катта халқ хўжалиги аҳамиятига эга эканлиги келтирилган.

Таянч сўзлар. *Реактив қувват, компенсация, қувват коэффициенти, актив ва реактив қувват, қувват коэффициенти ошириш усуллари, махсус фильтрли компенсацияловчи қурилмалар, синхрон моторлар.*

В статье рассмотрена анализ и причины понижение коэффициента мощности электрических сетей, так как, основными потребителями являются асинхронные двигатели, поэтому даются рекомендации для повышение коэффициента мощности с помощью компенсирующих устройств имеющий большое народно хозяйственное значение.

Ключевые слова.
Реактивная мощность, компенсация, коэффициент мощности, активная и реактивная мощность, способы повышения коэффициента мощности, фильтр-компенсирующий устройства, синхронные двигатели.

The article examines the analysis and causes of the decrease in the power factor of electrical networks, since the main consumers are asynchronous motors, therefore recommendations are given for increasing the power factor using compensating devices that have great national economic significance.

Key words.
Reactive power, compensation, power factor, active and reactive power, methods for increasing the power factor, filter-compensating devices, synchronous motors.

Кириш. Бизга маълумки, саноат электр таъминоти тизимларини лойиҳалаш босқичларида ҳам ва уларни ишлатиш жараёнларида ҳам асосий масалалардан бири бу–реактив қувватни тўлдириш (компенсация) масаласидир, яъни қувват коэффициентини оширишдир. Бу муаммо реактив қувват истеъмолчига етарли энергияни ишлаб чиқариб бериш билан уни ўрнини қоплаш деб ҳам аталиб, ўз ичига мақсадга мувофиқ бўлган манбаларни танлаш, уларни қувватларини ҳисоблаш ва ростлаш, электр таъминоти тизимида манбаларни жойлаштириш масалаларини ўз ичига олади[1].

Саноат корхоналарини, йирик шаҳар ва туманларни, қолаверса, барча турдаги энергия истеъмолчиларини электр таъминотида юз бераётган барча сон ва сифат ўзгаришлари бу масалага алоҳида аҳамият берилиши даркор эканлигини тақозо этади. Ҳозирги пайтда реактив қувватни истеъмол қилинишини ўсиши актив қувватни истеъмолини ўсишига қараганда бирмунча юқори. Бунда реактив қувватни ишлаб чиқарилаётган еридан истеъмол қилинаётган еригача узатилиши электр таъминоти тизимини техник–иқтисодий кўрсаткичларини сезиларли даражада ёмонлаштиради.

Юкламалар йиғиндисининг умумий хажмидан жуда катта қисмини кескин ўзгаувчан ва ночизиқли юкламалар ташкил этиб, улар аксарият ҳолатларда кўп миқтордаги реактив энергиясини истеъмол қилинишини тақозо этади (ўзгарувчан ва ўзгармас ток электр юритмаларининг вентилли ўзгартирувчиларини. Термик қурилмаларининг ўзгартир–гичлари ва ҳ.к.). Бундай шароитларда конденсатор батареяларини ҳимоянинг махсус чора–тадбирларисиз ўрнатиш, юқори гармоникали токларда ўта юкланишига йўл қўйиш мутлақо мумкин эмас. Реактив энергияни ўрнини қоплаш ва электр энергиясини талаб қилинаётган даражадаги сифати билан таъминлаш учун, (айнан шундай кескин ўзгарувчи юкламаларда, носимметриялик ўрин тутганида ва ток ҳамда кучланиш эгри чизиқлари шаклида носинусоидаллик кузатилганда!) махсус фильтрли компенсацияловчи қурилмалар (ФСҚ) ишлаб чиқарилади[2].

Амалда ФҚҚ ва ФСҚ қурилмалари оқлаб бўлмайдиган даражада капитал маблағларни ортиб кетишига ва электр энергиясини қўшимча миқторда сарф бўлишига олиб келади. Бунинг исботи тариқасида қуйидагини келтириш мумкин: бу қурилмаларнинг белгиланган қувватлари йиғиндиси, электр энергиясининг талаб қилинаётган сифати билан таъминлашлари учун, носимметриявийлик ва носинусоидалликни келтириб чиқараётган юклама қувватидан кам бўлмаслиги керак ва ўлчам катталиги билан нарҳларнинг солиштирма кўрсаткичларини унга мос келувчи юклама кўрсаткичларидан юқори бўлиб кетади: Афсуски, бир неча йиллар аввал қабул қилинган [3] даги ва

бошқа директив материаллардаги реактив қувватни ўрнини қоплаш масалалари тўла–тўкис ижобий ҳал бўлгани йўқ. Уларнинг ичида биринчи навбатдагиси белгиланган қувватни ҳисоблашнинг услубий томони, ўрин қоплаш қурилмасини ўрнитиш жойини танлаб олиш, ночизиқли занжирлардаги конденсаторларни ҳимоя қилиш кабилардир.

Энг оптимал вариантни танлаб олишда техник–иқтисодий ҳисоблашларни бажарилганлиги асос бўлмоғи зарур. Техник–иқтисодий ҳисоблар реактив қувватни ўрнини қоплаш қурилмани масалага тизимли ёндошиш орқали бажарилиши керак. Бу эса том маънода, ҳам электр таъминоти тизимининг талаб ва истакларини бажара оладиган, ва ҳам, бутун тизимда юз бериши мумкин бўлган ҳодисаларни хисобга олган ҳолда барча истеъмолчиларни таъминлаши керак бўлган оптимал ечим бўлмоғи лозим.

Асосий қисм. Юқоридагилардан келиб чиқиб, қувват коэффициентининг паст бўлганлигидан кўриладиган зарар ва уни компенсациялаш масаласини таҳлил қилиш ва уни ечиш халқ хўжалиги аҳамиятига эгадир.

Электр тармоғидан электр қурилма истеъмол қиладиган ток актив қувват ва реактив қувват вужудга келтиришга сарф қилинади. Бунда реактив қувват манба билан истеъмолчи орасида тебраниб юриб, электр қурилмада фойдали иш бажармайди.

Электр энергиянинг асинхрон двигателлар, трансформаторлар, пайвандлаш аппаратлари ва бошқалар каби кенг тарқалган истеъмолчиларида реактив ток индуктив токдир ва бу ток фаза бўйича кучланишдан орқада қолади. Бу ток электр машиналарда айланувчан магнит майдонини ва трансформаторларнинг ўзгарувчан магнит оқимини вужудга келтириш учун зарурдир.

Актив нагрузкали электр тармоқларида (чўғланма лампочкалар, иситиш асбоблари) cosφ нинг қиймати 1 га тенг; чўғланма лампочкалар билан ёритиш кўпроқ бўлган аралаш нагрузкали (двигателлар ва ёритиш лампочкалари) электр тармоқларида cosφ=0,85÷0,95 бўлади; куч юкламаси устун (двигателлар кўпроқ) бўлган тармоқларида cosφ=0,7÷0,85 бўлади[8].

Двигатель ва трансформаторлар салт ёки кичик юклама билан ишлаганда косинус “фи” жуда ҳам паст бўлади[4].

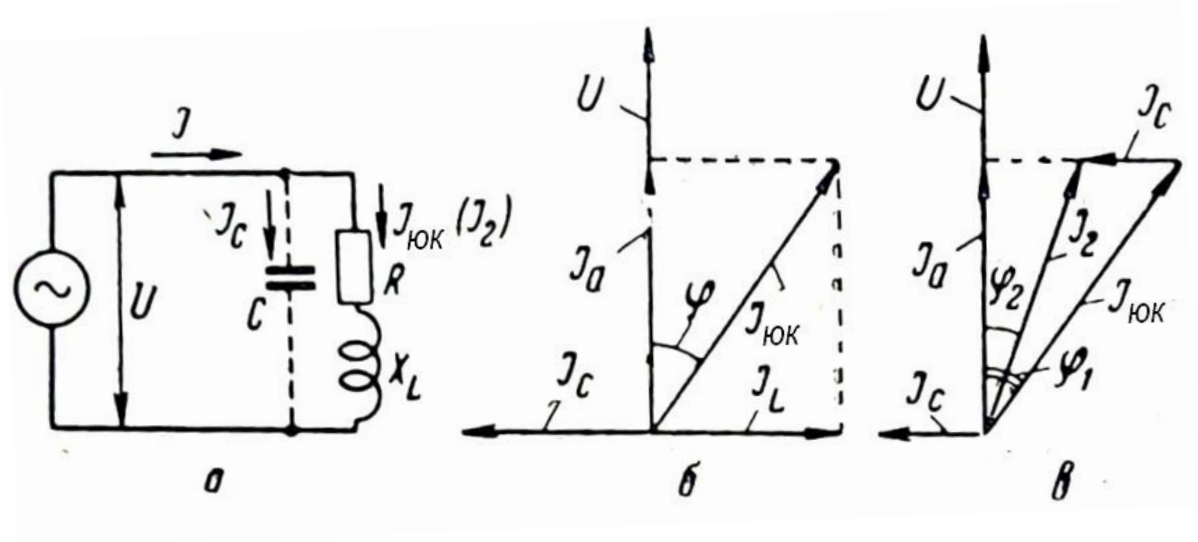
Электр тармоғида индуктив ток бўлиши генератор, трансформаторлар подстанциялари ва электр тармоқлари қувватидан тўлиқ фойдаланишга имкон бермайди. cosφ нинг камайиши билан симлар ва электр аппаратлари чўлғамларининг исишига кетадиган энергия исрофи анча ошади.

Масалан, агар актив қувват миқдори ўзгармасдан cosφ=1 бўлганда, тармоқдаги актив ток I_a=100 А бўлса, cosφ нинг қиймати 0,8 гача камайганда

электр тармоғидаги ток катталиги 1,25 марта ошади ($I_a=I_{тарм}*cos\varphi$, $I_{тарм}=I_a/cos\varphi=100/0.8=125$ А).

Электр тармоғининг симлари ва генератор (трансформатор) чўлғамларининг исишига кетадиган $P_{ис}=I^2_{тарм}.*R_{тарм}$ исрофлар токнинг квадратига пропорционал бўлади, яъни исрофлар $1,25^2=1,56$ марта ошади. Актив қувват худди ўшандай бўлганда $cos\varphi=0,5$ бўлса, электр тармоғидаги токнинг катталиги 100/0.5=200 А бўлади. Бунинг натижасида электр тармоғида кучланишларнинг исрофлари ошади, бу эса ўз навбатида бошқа истеъмолчиларнинг нормал ишлашининг бузилишига олиб келади[6].

Истеъмолчининг счётчиги ҳамиша вақт бирлигида айни бир миқдор актив энергия истеъмол қилинишини кўрсатиб туради, лекин $cos\varphi=0,5$ бўлганда генератор тармоққа $cos\varphi=1$ бўлгандагига қараганда 2 марта ортиқ ток бериши керак. Генераторнинг нагрузкаси (иссиқлик режими) истеъмолчиларнинг актив қуввати билан эмас, балки киловольт–ампер ҳисобида ифодаланган умумий қувват билан, яъни чўлғамлар орқали ўтаётган токнинг кучланишга кўпайтмаси билан аниқланади.



1–расм. Реактив қувватни компенсациялаш ($cos\varphi$ ни яхшилаш) учун конденсаторлар улаш:
а–схема; б– тўла компенсациялаш вектор диаграммаси ($cos\varphi=1$ гача); в–қисман компенсациялаш вектор диаграммаси ($cos\varphi$ нинг қиймати 1 га яқинлашиб қолгунча).

Электр қурилмаларининг қувват коэффициентини ошириш учун реактив кувватни компенсациялаш мақсадида анча тадбирлар амалга оширилади[7].

$cos\varphi$ ни ошириш (ток ва кучланиш фазаларининг силжиш бурчаги ни камайтириш) учун қуйидаги усуллар қўлланилади:

1. тўлиқ нагрузка билан таъминланмаган двигателлар ўрнига кичикроқ қувватли двигателлар ишлатилади;

2. тўлиқ нагрузка билан ишламайдиган двигателларнинг чўлғамларида кучланиш пасайтирилади;

3. салт ишлаётган двигатель ва трансформаторлар узиб қўйилади;

4. электр тармоғига илгарилаб кетадиган (сиғим) ток генераторлари бўлмиш компенсацияловчи махсус қурилмалар (конденсаторлар) уланади.

Бу мақсадда қувватли район подстанцияларида махсус синхрон компенсаторлар–қайта уйғотилган синхрон электр двигателлар ўрнатилади.

Қуввати бир неча юз кВА гача бўлган электр қурилмаларда cosφни компенсациялаш учун КМ (конденсатор маслянный) типидаги статик конденсаторлар қўлланилади. Улар 0,22 кВ дан 10 кВ гача бўлган кучланишли тармоқларда ишлашга мўлжаллаб чиқарилади.

Паспортда кучланиш кВ ҳисобида, сиғим мкФ ҳисобида ва қувват кВАР ҳисобида кўрсатилади.

Компенсацияловчи статик конденсаторларнинг сиғими қуйидагича танлаб олинади. 1–расмда R ва X, лардан иборат бўлган ва кучланиш билан ток орасида фазаларнинг силжиш φ бурчагини вужудга келтирадиган нагрузка схемаси кўрсатилган. Фазаларнинг силжиш бурчагини компенсациялаш учун (φ ни 0° га, cosφ ни эса 1 га етказиш учун) С сиғим (конденсаторлар группаси) нагрузкага параллел уланади. Фазалар силжиш бурчаги φ ни тўлиқ компенсациялаш учун (1–расм, б), конденсаторлар орқали ўтаётган сиғим токи индуктив токка тенг бўлиши керак, яъни:

$I_C=I_L$

Бу ерда:

$I_L=I_{ис}*\sin\varphi$

Сиғим токи қуйидагича аниқланади:

$I_C=U/Xc=\omega CU$,

Бу ерда:

U–электр тармоғининг кучланиши;

ω–ўзгарувчан токнинг бурчак частотаси;

С–конденсаторлар сиғими.

Компенсацияловчи қурилмаларнинг сиғими қуйидагича аниқланади:

$C=I_C U\omega=I\sin\varphi*U/U\omega U=S*\sin\varphi/\omega U^2=P*tg\varphi/\omega U^2$.

Агар фазалар силжишини қисман компенсациялаш зарур бўлса (1–расм, в), сиғим токи қуйидагига тенг бўлади:

$I_C=I_a tg\varphi_1–I_a tg\varphi_2=P/U(tg\varphi_1–tg\varphi_2)=U\omega C$.

Бундан

$C=P/\omega U^2(tg\varphi_1-tg\varphi_2)$.

Саноат корхоналаридаги реактив қувватнинг асосий истеъмолчилари бу–асинхрон двигателлар (умумий истеъмолдаги энергияни 60–65% ни ташкил этади), трансформаторлар (20–25%), вентилли ўзгартиргичлар, реакторлар, ҳаво электр тармоғи чизиқлари ва бошқалардир (10%).

(2) дан кўриниб турибдики,

$$S=\sqrt{p^2+Q^2};$$

$Q/P=tg\varphi$;

$P/S=cos\varphi$

Яқин вақтларгача реактив қувватни тавсифловчи асосий норматив кўрсаткич бўлиб, қувват коэффициенти $cos\varphi$ саналар эди. Саноат корхоналарини озиқлантирувчи киришларда бу коэффициентнинг ўртача қиймати 0,92–0,95 га тенг бўлиши керак эди. Аммо, *P/S* муносабатни танлаб олиш реактив қувватни ўзгариш динамикаси хақида аниқ маълумот бермайди. Масалан, қувват коэффициентини 0,95 дан 0,94 га ўзгариши юз берса, реактив қувват 10% га ўзгаради,айнан шу коэффициентни 0,99 дан ўзгариши эса реактив қувватни 42% га ўзгаришига олиб келади.

Ҳисоблаш ишларини амалга оширишда $K_{р,м}=Q/P=tg\varphi$ муносабатга таяниш қулайроқдир.

Бу коэффициент реактив қувват коэффициенти деб аталади.

Реактив қувватни қоплаш бўйича қабул қилинган директив хужжатлар электр таъминоти тизимидаги энерго тизим генераторларидан тортиб токи, электр энергиясини қабул қилувчиларга иш жараёнини самарадорлигини кўтаришга қаратилгандир. Унга яхши кўрсаткич саналмаган қувват коэффициенти реактив қувват қийматига алмаштирилган бўлиб, у саноат корхонаси энергетика тизимининг тармоқлари орқали узатилиши мумкин.

Компенсацияловчи қурилмаларнинг қуввати, ўрнатиш жойи ва иш режими электр энергияси ишлаб чиқиш ва тақсимлаш учун келтирилган сарф–ҳаражатларни минимал мезонлари бўйича техник–иқтисодий ҳисоблашлар билан асосланмоғи даркор.

Саноат корхоналарида реактив қувват истеъмолини камайтириш табиий усуллар билан амалга ошириш мумкин. Бундай усулларга электр қабул қилувчиларини иш режимларини яхшилаш, двигателларни такомиллаштирилган конструкцияларини қўллаш, уларни кам юкланганлигини бартараф қилиш ва махсус ўрин қоплаш қурилмаларидан фойдаланиш киради.

Реактив энергия қабул қилувчилари томонидан истеъмол миқдорини камайтириш тадбири биринчи навбатда кўриб чиқилмоғи лозим, негаки уларни амалга ошириш учун унча катта капитал маблағ талаб қилинмайди.

Хулоса. Мадомики реактив қувватни асосий истеъмолчилари бўлиб асинхрон двигателлар, трансформаторлар ва вентилли ўзгартиргичлар саналар экан, атрофлича таҳлил қилиш предмети бўлиб қуйидаги масалалар саналмоғи лозим:

1) Кам юкланган асинхрон двигателларни қуввати кичик бўлган двигателларга алмаштириш;
2) Тизимли равишда кам юкланган ҳолатда ишлайдиган двигателлар кучланишини пасайтириш;
3) Двигателларни ва ковшарлаш трансформаторларини салт ишлашини чегаралаш;
4) Технологик жараён шарт–шароитлари йўл қўядиган ҳолларда асинхрон двигателлар ўрнига синхрон двигателларни қўллаш;
5) Синхронизацияланган асинхрон двигателларни қўллаш.
6) Вентилли ўзгартиргичнинг кўпроқ мақсадга мувофиқ бўлган куч схемаларини ва бошқарув тизимини қўллаш.

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DOI: https://doi.org/10.5281/zenodo.14499392

YUQORI KUCHLANISHLI 220 KVLI HAVO UZATISH TARMOQLARIDAGI AVARIYALI O‘CHISHLARNI BARTARAF ETISH USULLARI

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Annotatsiya. *Ushbu maqolada 220 kVli elektr uzatish liniyalarining ishonchliligi, quvvat yo‘qotishlari, kuchlanish tushishi, reaktiv quvvatni boshqarish va quvvat oqimlari kabi nazariy jihatlar tahlil qilinadi. Liniyalardagi quvvat yo‘qotishlari tok va qarshilik orqali aniqlanadi, bunda kuchlanish tushishi induktivlik va faza burchagi bilan bog‘liq. Reaktiv quvvatni boshqarish energiya tizimining barqarorligini ta’minlashda muhim ahamiyatga ega bo‘lib, grafiklar orqali ushbu parametrlardagi o‘zgarishlar vizual tarzda ko‘rsatildi. Shuningdek, avariyaviy holatlarda liniyaning avtomatik boshqaruv tizimlari va himoya mexanizmlarining roli ham ko‘rib chiqildi. Maqolada energiya yo‘qotishlarini kamaytirish va uzatish samaradorligini oshirish usullari muhokama qilinadi.*

Kalit so‘zlar: *220 kVli liniya, quvvat yo‘qotishlari, kuchlanish tushishi, reaktiv quvvat, quvvat oqimi, avariya, himoya tizimi, energiya tizimi.*

Abstract. *This article examines the theoretical aspects of the reliability of 220 kV power transmission lines, power losses, voltage drops, reactive power management, and power flows. Power losses on the line are determined by current and resistance, while the voltage drop is related to inductance and phase angle. Reactive power management is essential for maintaining the stability of the energy system. The graphs visually demonstrate changes in these parameters. The role of automatic control systems and protection mechanisms in emergencies is also discussed. The article addresses methods for reducing energy losses and improving transmission efficiency.*

Keywords: *220 kV line, power losses, voltage drop, reactive power, power flow, accident, protection system, energy system.*

Аннотация. *В данной статье рассматриваются теоретические аспекты надежности линий электропередач напряжением 220 кВ, потери мощности, падение напряжения, управление реактивной мощностью и потоки энергии. Потери мощности на линии определяются током и сопротивлением, в то время как падение напряжения связано с индуктивностью и фазовым углом. Управление реактивной мощностью является важным для поддержания стабильности энергосистемы. Графики наглядно демонстрируют изменения этих параметров. Также обсуждается роль систем автоматического управления и защитных механизмов в аварийных ситуациях. В статье рассматриваются методы снижения потерь энергии и повышения эффективности передачи.*

Ключевые слова*: линия 220 кВ, потери мощности, падение напряжения, реактивная мощность, поток энергии, авария, система защиты, энергосистема.*

Kirish.220 kVli elektr uzatish liniyalari bugungi kunda energiya tizimlarining asosiy qismi hisoblanadi. Ular katta hajmdagi elektr energiyani uzoq masofalarga samarali tarzda yetkazib berish imkonini beradi va bu energiya ta’minotining barqarorligi va ishonchliligi uchun muhim rol o‘ynaydi. Shunday bo‘lsa-da, bu liniyalar avariyaviy holatlarga duch kelganda, elektr energiyasi uzatish tizimining umumiy ishonchliligiga katta ta’sir ko‘rsatadi. Avariya holatlari nafaqat texnik nosozliklar, balki tabiiy ofatlar, yaroqsiz infrastruktura va ortiqcha yuklamalar tufayli yuzaga kelishi mumkin. Ayniqsa, O‘rta Osiyo mintaqasidagi kuchlanishli tarmoqlarda kuzatiladigan muammo va kamchiliklar energiya ta’minotini samarali boshqarishga alohida e’tibor qaratishni talab etadi. 220 kVli liniyaning avariyadan keyingi holatini boshqarish va ishonchliligini tiklash elektr energiyasi ta’minotining uzluksizligini ta’minlash uchun muhimdir. Avariya sodir bo‘lganidan so‘ng liniyaning tez tiklanishi va samarali foydalanish xususiyatlari energiya tizimining umumiy barqarorligini belgilaydi. Bu jarayonda avtomatlashtirilgan boshqaruv tizimlari, zamonaviy monitoring texnologiyalari va ehtiyotkorlik bilan ishlab chiqilgan reabilitatsiya strategiyalari katta ahamiyat kasb etadi. Shu bilan birga, liniyaning texnik xizmat ko‘rsatish bo‘yicha rejali ishlarining muntazam ravishda olib borilishi avariyalarni oldini olishda va ishonchlilikni oshirishda muhim omillardan biri hisoblanadi. Shunday qilib, 220 kVli liniyalarda avariyadan keyingi ishonchlilik faqat bir mintaqaning energiya tizimi uchun emas, balki butun tarmoqning uzluksiz ishlashi uchun ham katta ahamiyatga ega. Ushbu tarmoqlarda yuzaga keladigan avariyalarning qisqa vaqt ichida bartaraf etilishi, texnologik rivojlanish va ilmiy izlanishlar orqali takomillashtirilgan boshqaruv tizimlari bilan amalga oshirilishi mumkin[5].

Adabiyotlar tahlili. Adabiyotlardagi ma’lumotlarni o‘rganish jarayonida 220 kVli elektr uzatish liniyasining nazariy qismi keng qamrovli masalalarni o‘z ichiga oladi. Bu elektr tarmog‘ining ishonchliligini tahlil qilish, avariyadan keyin uni tiklash jarayonlarini aniqlash, elektr yo‘qotishlari, energiya oqimlarining o‘zgarishi va liniyadagi kuchlanishlar hamda tokning taqsimlanishini matematik ifodalar bilan izohlashni o‘z ichiga oladi.

Elektr uzatish liniyalari katta kuchlanish ostida ishlaydi, chunki uzoq masofalarga energiya yetkazib berish uchun kuchlanishni oshirish zarur. 220 kVli liniyalarda ishlatiladigan yuqori kuchlanish elektr energiyasini uzatishda yo‘qotishlarni kamaytirish uchun mo‘ljallangan. **Ma’lumotlarni yig‘ish:** 220 kV uzatish liniyalarining texnik parametrlari (liniya uzunligi, tok zichligi, o‘tkazgich turi) va statistik ko‘rsatkichlar (avariyalar va texnik xizmat ko‘rsatish ma’lumotlari) yig‘iladi. Bu ma’lumotlar energiya tizimi operatorlari va o‘tkazgich materiallari ishlab chiqaruvchilaridan olinadi.

Quvvat yo‘qotishlarini hisoblash: Liniyada quvvat yo‘qotishlarini hisoblash uchun Om qonuni asosida tok va qarshilik qiymatlari orqali har bir liniya segmentida quvvat yo‘qotishlarining miqdori aniqlanadi. Bu hisoblashlarda qarshilik va liniyaning uzunligi ta’siri, shuningdek, harorat va boshqa iqlimiy sharoitlarning yo‘qotishlarga ta’siri ham inobatga olinadi.

Kuchlanish tushishini o‘lchash: Liniyaning turli segmentlarida kuchlanish tushishi aniqlanadi, bunda qarshilik va induktiv reaktans hisobga olinadi. Kuchlanish tushishini aniqlash uchun o‘lchov asboblari va matematik modellashtirish usullari, masalan, MATLAB, Dig SILENT, Inor XL yoki ETAP dasturlari orqali simulyatsiyalar o‘tkaziladi.

Reaktiv quvvatni boshqarish tahlili: Reaktiv quvvatning tizimga ta’sirini o‘rganish uchun liniyada reaktiv quvvat boshqaruv usullari, masalan, kondensatorlar va induktiv yuklar orqali kompensatsiya qilish usullari o‘rganiladi. Ushbu usullar liniyada quvvat omilini boshqarish va tizim barqarorligini ta’minlash uchun qo‘llaniladi. Grafik tahlil va simulyatsiya usullari yordamida reaktiv quvvat boshqaruvi natijalarining samaradorligi baholanadi.

Energiya samaradorligini oshirish usullari: Quvvat yo‘qotishlarini kamaytirish va uzatish samaradorligini oshirish uchun zamonaviy usullar, materiallar va texnologiyalar qo‘llash imkoniyatlari tahlil qilinadi. Masalan, uzatish liniyasining izolyatsiyalangan o‘tkazgichlardan foydalanish, avtomatizatsiya darajasini oshirish va energiya yo‘qotishlarini kamaytiruvchi texnikalar o‘rganiladi[2].

Liniyaning uzatilish qobiliyatini quvvat bilan ifodalash mumkin:

$$S=P+jQ \quad (1)$$

Bu yerda:S – to‘liq quvvat (VA), P – aktiv quvvat (W), Q – reaktiv quvvat (VAr)

Elektr uzatish liniyasida yo‘qotishlarni hisoblash. Elektr uzatish liniyalarida quvvat yo‘qotishlarini hisoblashda asosiy faktorlar tok, qarshilik va liniya uzunligi hisobga olinadi. Elektr energiyasi yo‘qotishlari liniya orqali o‘tayotgan tokning kvadratiga va liniya qarshiligiga bog‘liq. Bu yo‘qotishlar quyidagi tenglama yordamida aniqlanadi:

$$P_{yo‘qotish} = I^2R \quad (2)$$

bu yerda: $P_{yo‘qotish}$ – quvvat yo‘qotishlari (W), I – elektr liniyasidagi tok (A),

R – liniyaning qarshiligi (Om).

Yuqori kuchlanishli liniyalarda tok kichik bo‘lganligi sababli quvvat yo‘qotishlari ham nisbatan kichik bo‘ladi. Shu sababli 220 kVli liniyalar uzoq masofalarga energiya uzatishda qo‘llaniladi.

Liniyada kuchlanish tushishi. Elektr uzatish liniyasida kuchlanish tushishi liniyaning qarshiligi, induktivligi va tok bilan bo**g‘**liq. 220 kVli liniyalarda kuchlanishning tushishi **o‘**zgaruvchan tok tarmoqlarida k**o‘**pincha induktivlik bilan bo**g‘**liq b**o‘**ladi, chunki liniyaning reaktiv komponentlari kuchlanishga ta**’**sir qiladi.

Kuchlanish tushishini quyidagi formula orqali ifodalash mumkin:

$$\Delta U=I(R\cos\phi+X\sin\phi) \quad (3)$$

bu yerda:ΔU – kuchlanish tushishi (V), I – liniyadagi tok (A), R – liniya qarshiligi (Om),

X – liniyaning induktiv reaktivligi (Om), ϕ – tok va kuchlanish orasidagi faza burchagi.

Avariya holatlarida liniyaning ishonchliligiga ta’sir etuvchi omillar, 220 kVli liniyada avariyaviy holatlar yuzaga kelganda uning ishonchliligi va qayta tiklanishi asosiy masala bo‘lib qoladi. Avariya yuzaga kelganda elektr energiyasining uzatilishida uzilishlar va quvvat yo‘qotishlari ro‘y beradi. Bunday vaziyatlarda liniyaning avtomatik himoya tizimlari ishga tushadi va uzatilayotgan quvvat taqsimlanishi qayta o‘zgartiriladi. Elektr tarmog‘ining avtomatik boshqaruv tizimlari avariyaviy holatlar yuzaga kelganidan keyin tizimni tiklash uchun juda muhim hisoblanadi. Bu jarayonda quyidagi tenglamalar va algoritmlar qo‘llaniladi:

Qayta yuklanish jarayoni: Elektr tizimlarida avariya sodir bo‘lganidan keyin qayta yuklanish algoritmi tarmoqni muvozanatga keltiradi va iste’molchilarga elektr

energiyasini qayta yetkazadi. Bu jarayon uzatilayotgan quvvatni tiklash uchun elektr tarmog‘idagi kuchlanishlarni va tokni qayta taqsimlashni o‘z ichiga oladi.

Himoya tizimlari: Elektr uzatish liniyalarida himoya tizimlari juda muhim rol o‘ynaydi. Ushbu tizimlar ortiqcha yuklanish, qisqa tutashuv yoki boshqa avariyaviy holatlarda liniyani avtomatik ravishda o‘chiradi. Himoya tizimlarining ishlashi odatda avtomatik rostlash mexanizmlari bilan bog‘liq bo‘lib, bu holatlarda kuchlanish, tok va qarshilikni hisobga olish orqali liniya ishi tiklanadi[1].

Reaktiv quvvatni boshqarish. 220 kVli liniyalar uzoq masofalarga elektr energiyasini yetkazib berganda reaktiv quvvatning ahamiyati ortadi. Reaktiv quvvat liniyadagi kuchlanish darajasini saqlashga yordam beradi va tizimning barqaror ishlashi uchun zarurdir. Reaktiv quvvatni boshqarish uchun kompensatsiya usullari qo‘llaniladi, jumladan, shunt reaktorlar yoki shunt kompensatorlar.

Reaktiv quvvatni boshqarishda quyidagi tenglama ishlatiladi:

$$Q=UI\sin\phi \quad (4)$$

Bu yerda: Q – reaktiv quvvat (VAr), U – kuchlanish (V), I – tok (A), ϕ – faza burchagi.

Reaktiv quvvatni to‘g‘ri boshqarish liniyada kuchlanishning me’yoridan oshib ketishini oldini oladi va tizimni barqarorlashtiradi.

Elektr tizimlarining ishonchliligi nazariyasi. Elektr tarmo**g‘**ining ishonchliligi uni avariya holatlarida samarali tiklash va uzilishlardan keyin tezda tiklanish qobiliyatiga bo**g‘**liq. 220 kVli elektr liniyasining ishonchliligini **o‘**lchash uchun k**o‘**p hollarda ishonchlilik koeffitsienti va boshqa statistik k**o‘**rsatkichlar q**o‘**llaniladi. Elektr tarmo**g‘**ining umumiy ishonchliligini quyidagi tenglama bilan ifodalash mumkin:

$$R(t)=e^{-\lambda t} \quad (5)$$

bu yerda: R(t) – vaqt o‘tishi bilan ishonchlilik darajasi, λ – nosozlik darajasi,

t – vaqt (soat).

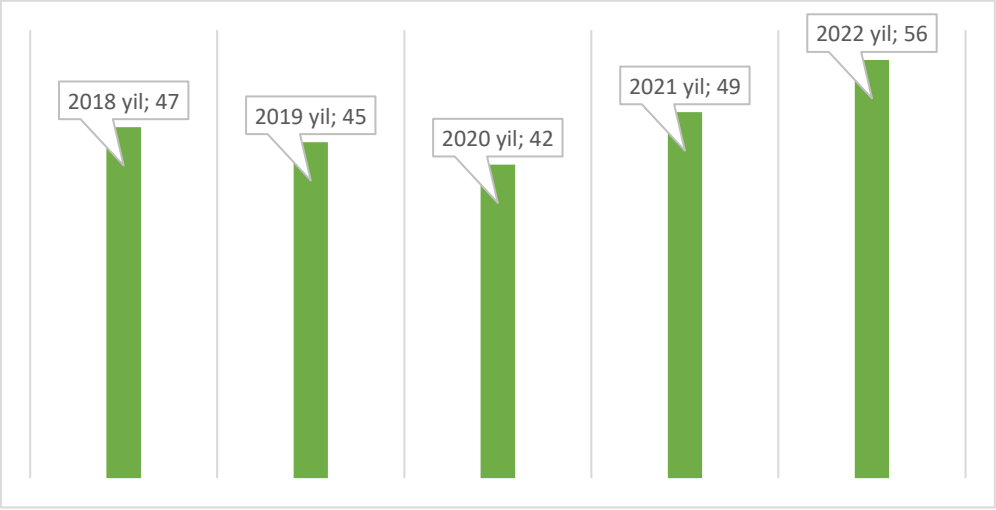
Avariya sodir bo‘lganidan keyin elektr tarmog‘ining tiklanish jarayoni bu ko‘rsatkich bilan tavsiflanadi. Elektr tarmog‘idagi tiklanish jarayoni avtomatik tizimlar va texnologiyalar orqali amalga oshiriladi.

Energiya oqimlarini tahlil qilish va optimallashtirish. 220 kVli liniyalarda quvvat oqimlari tarmoqning yuklanishiga va tarmoqdagi iste’molchilarning talablariga qarab o‘zgaradi. Energiya oqimlarini optimallashtirish elektr energiyasini samarali yetkazib berishda muhim omil hisoblanadi. Elektr tarmog‘ida quvvat oqimlarini optimallashtirish uchun matematik modellardan foydalaniladi.

Quvvat oqimlarining tahlili va optimallashtirish algoritmlari elektr tarmog‘ining samaradorligini oshirishda va yo‘qotishlarni kamaytirishda muhim ahamiyat kasb etadi.

Natijalar. Elektr energiyasini uzoq masofalarga yetkazib berish uchun havo uzatish liniyalari orqali yetkazilayotganligi uchun qolgan qurilmalarga nisbatan havo uzatish liniyalariga tashqi ta’sirlar natijasida ishdan chiqish holatlari kuzatiladi. Bu esa liniyalarni avariyali o‘chishlarga va ishonchlilik ko‘rsatkichini pasayishiga olib keladi. Elektr energetika tizimida elektr energiyasini uzatishning barqarorligi har bir qurilmaning texnik holati sharoitiga bog‘liq bo‘ladi. Ishlab chiqarilgan elektr energiya uzoq masofalarga havo uzatish liniyalari orqali yetkazilayotganligi uchun qolgan qurilmalarga nisbatan havo uzatish liniyalariga tashqi ta’sirlar natijasida ishdan chiqish holatlari kuzatiladi. Bu esa liniyalarni avariyali o‘chishlarga va ishonchlilik ko‘rsatkichini pasayishiga olib keladi. Havo liniyalarining ishonchliligini pasayishi iste’molchilarga elektr energiyasining kam ta’minlanishiga yoki energiya tizimining barqaror ishlashini buzilishi hamda energiya tizimining qismlarga bo‘linishi va salbiy hodisalarning paydo bo‘lishi shaklida o‘zini namoyon qiladi[1].

Quyidagi diagrammada yillar kesimida o‘chishlar sonining o‘zgarishini ko‘rishimiz mumkin.

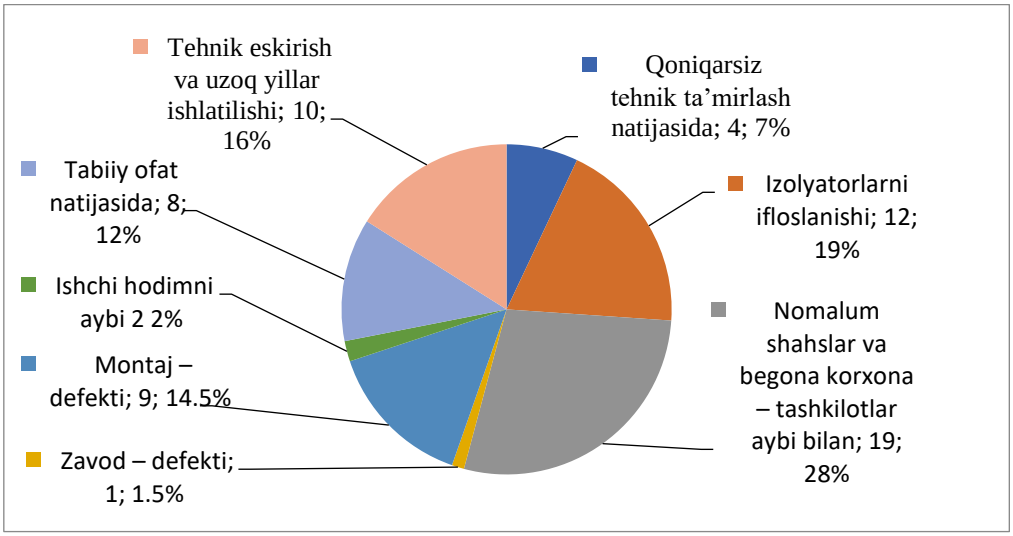


1 – rasm. Havo liniyalarining o‘chishlar soni

Havo liniyalarining ishonchliligini pasayishi iste’molchilarga elektr energiyasining kam ta’minlanishiga yoki energiya tizimining barqaror ishlashini buzilishi hamda energiya tizimining qismlarga bo‘linishi va salbiy hodisalarning paydo bo‘lishi (asinxron ish rejimlari, havo liniyalarining ortiqcha yuklanishi va boshqalar) shaklida o‘zini namoyon qiladi.

Havo liniyalarining ishlashiga salbiy ta’sir ko‘rsatadigan holatlarga, birinchi navbatda, atmosfera hodisalari va tabiiy ofatlar, o‘simlik va hayvonot dunyosining ta’siri, inson faoliyati bilan bog‘liq noodatiy omillar, shuningdek havoning o‘zaro ta’siri (shu jumladan elektromagnit) va texnik nosozliklarni misol keltirish mumkin. Havo liniyalarining barqaror ishlashi natijasida ishonchlilikni oshirish va bu orqali uzluksiz elektr energiyasini yetkazib berish dolzarb deb olindi[6].

2022 – yil davomida avariyali o‘chgan 500, 220, 110 kV Vodiy halqasiga ulangan havo uzatish tarmoqlarni o‘chish sabablarining tahlili.



2 – rasm. Avariyali o‘chishlarini yuzaga keltiruvchi omillar.

500, 220, 110 kV Havo uzatish tarmoqlarni vodiy halqasiga ulanganliklari uchun , har bir avariyali o‘chish tarmoqni tarmoqni 2 tomonidan murakkab rele himoyalari ta’siridan o‘chiriladi. Ushbu o‘chishlardan so‘ng TAPV, OAPV qoniqarli yoki qoniqarsiz bo‘lishidan qat’iy nazar iste’molchilarda elektr ta’minoti uzilmaydi. Shuning uchun iste’molchilarga uzatilmay qolgan elektr energiya miqdori qayd qilinmaydi, chunki halqaga 8 tomondan ulangan elektr stansiyalardan uzluksiz ta’minlash uzilmaydi[8].

O‘chish sabablarining 28 % o‘chishlari noma’lum shahslar va begona korxona tashkilotlar aybi bilan sodir bo‘lgan .

Ushbu sabablarni tahlili quyidagicha: Aholi va tashkilotlar bilan tarmoqlarni himoya zonasida o‘zboshimcha yuklash kranlarini ishlatish, tarmoqlar ostidan baland yuklar olib o‘tish, tarmoqlar ostiga qurilishlar qurish, 4 metr balandlikdan yuqori o‘sgan daraxtlar, ovchilar tomonidan tarmoqlarga qo‘ngan qushlarga o‘q uzish natijasida tayanchlardagi izolyatorlar va similarni shikastlanishi haqida viloyat, shahar va tuman ijroya qo‘mitalariga yozma eslatmalar berilishi, hamda gazeta va televideniyada maqolalar bilan

chiqshlarni ahvoli qoniqarsiz ekanligi[3].

O‘chish sabablarining 19 % sabablari izolyatorlarni ifloslanishi:

- Izolyatorlar o‘rnatilgan traversa tayanchlariga qushlar qo‘nib o‘z chiqindilari bilan

izolyatorlarni iflos qilinishi va unga qarshi mahsus himoya to‘siqlarining qoniqarsiz holati.

- Atmosferik changlarni izolyatorlarga o‘rnashib qolishiga qarshi bajariladigan tadbirlarni qoniqarsizligi

O‘chish sabablarining 16 % sabablari tehnik eskirishi va uzoq yillar ishlatilishi.

- Tayanchlarni kontur zazemleniyasining uzilib qolishi.
- Uzoq yil (50–60 yil) ishlatilgan simlarni salqiligini ortishi.
- Simlarni ulangan joylaridagi apparat zajimlari va svarkalarni qoniqarsiz holatlari.
- Izolyatorlar shodasida defektli izolyatorlar paydo bo‘lishi.
- Metall tayanchlardan burchak ulovchi qismlarning o‘g‘irlanishi[3].

Montaj defekti 14.5 % sababiga ko‘ra asosan 2019–2020 yillarda To‘raqo‘rg‘on IES qurilishi bilan bog‘liq bo‘lgan 8 ta 220 kV li Havo uzatish tarmoqlarining montaj vaqtidagi sifatsiz va bajarilgan ishlar simlarni eng salqi joyining yergacha bo‘lgan masofaning ortib ketganligi, anker tayanchlardagi aylanib o‘tish shleyflarini uzunligi kuchli shamol vaqtida tayanchga yaqinlashuviga olib kelishi.

Avariya o‘chishlarini kamaytirish bo‘yicha belgilangan tadbirlarining bajarilishi va mavjudligi bo‘yicha ishlarni davom etirish bo‘yicha xulosalar.

Eng ko‘p foizni tashkil etgan avariyali holatlar 28 % avariya o‘chishlarini tashkil qilgan no‘malum shahslar va begona korxona–tashkilotlar tomonidan sodir etilgan o‘chishlar hisoblanmoqda. Bu avariyalarni oldini olish bo‘yicha amaliy va moddiy ishlar qilinishi zarur hisoblanadi. Oxirgi 5 yil ichida radio va televideniyada chiqarilgan eshittirishlar va eslatmalarning shu yillar davomida aholiga elektr tarmoq korxonalari tomonidan gazeta berilgan maqolalarining soni yillik ikki marta bo‘lishi maqsadga muvofiq hisoblanar edi, afsuski oxirgi yillik hisobotda faqatgina bitta e’lon berilgan ekan. Ammo ijtimoiy tarmoqlar orqali matbuot anjumanlari va hokimliklarga yozma bildirishnomalar orqali amaliy yordam berishi borasida xatlar chiqarilmoqda[4].

Havo uzatish liniyalarining himoya zonasida bajariladigan ishlar zarurat tug‘ilganda elektr tarmoqlari korxonalariga yozma murojat etish bo‘yicha yuqori kuchlanishli hududlar ostida qurilish ishlari qilinishidan oldin kadastr bo‘limidan ruxsat olish jarayonida elektr tarmoqlaridan ham ruxsat olish talab etiladi. Ariza yozilgandan keyin elektr tarmoq hodimlari qurilish joyini ko‘zdan kechirib xulosa yozib beradi. Afsuski o‘zboshimcha tadbirkorlar tomonidan bunday qilmasdan qurilish

ishlarini qilishi oqibatida insonlarni hayoti havf ostida qolmoqda va elektr energiyasida uzilishlar sodir bo‘lmoqda. Havo uzatish liniyalarining himoya zonalarida har qanday qurilishlar qurishni taqiqlanishi bo‘yicha ogohlantirishlar berilmoqda.

Havo uzatish liniyalar ostiga 4 metrdan baland o‘tadigan daraxtlar ekmaslik va shunday holatlar aniqlanganda ularni bartaraf etish bo‘yicha ko‘pincha yurtimizda past kuchlanish havo liniyalarida ko‘p salbiy holatlar kuzatiladi, yuqori kuchlanishli liniyalarimizning atrofidagi daraxtlar aniqlansa ogohlantirish berilib daraxtlardan tozlanadi va baland o‘smaydigan mevali daraxtlar ekish tavsiya beriladi. Havo uzatish liniyalarining tayanchlari va fundamentlari atrofida har qanday qazish ishlarini bajarishni taqiqlash bo‘yicha qazish ishlarini olib boruvchi shaxslarning elektr tarmoqlarining muxofaza zonasi haqida tushunchaga ega emasligi oqibatida inson hayotiga zarar keltiruvchi hodisalar yuz bermoqda va buning natijasida liniyada avariyali o‘chishlar sodir bo‘lyapti[6].

19 % avariya o‘chishlarini tashkil qilgan izolyatorlarni ifloslanishi masalalari bo‘yicha:

Izolyatorlar osilgan tayanch traversalariga qushlarni qo‘nishiga qarshi to‘siqlar o‘rnatish. Mavjud to‘siqlarni tehnik holatini nazorat qilish va ta’mirlash masalalarining holati. Tayanchlarning traverslariga qushlarga qarshi himoyalarning dastlabki holati purjinaga bayroqcha qo‘yilgan. Bayroqcha shamol ta’sirida hilpirab qushlarni qo‘rqitgan, yillar o‘tib qushlarni o‘rganib qolishi natijasida bu usul effect bermay qolgan. Nega aynan qushlarga qarshi jihoz deyishimizning sababi tayanchlarga qo‘ngan katta qushlarning qanotlarini ochgan liniyaning fazalar aro qisqa tutashuv hosil qilishi, tayanchga qo‘ngan qushlarning izolyatorlarga axlatlarini tushishi natijasida izolyatorlarda qisqa tutashuv hosil bo‘lib izolyatorni ishdan chiqarishi, qushni esa o‘limi bilan tugashi mumkin. To‘siqlarni qo‘llashdan asosiy maqsad ekologiyaga ham, elektr iste’molchilariga ham zarar bermaslik hisoblanadi[5].

Muhokama. Hozirgi kunda keng ko‘lamda foydalanib keliniyotgan qushlarga qarshi jihozimizni ko‘rinishi tipratikanga o‘xshash bo‘lib, tross simlarini yoyib qo‘yilishi natijasida himoya qurilmasi yasaladi. Va u izolyatorlar o‘rnatilgan traverslarni yuqoriga qismiga o‘rnatiladi. Buning natijasida tayanchlarning traverslariga qushlar qo‘na olmaydi. Hozirgi kunda bunday himoya vositalarni turlari ko‘payib bormoqda, bunga sabab qushlar ham himoya vositalariga moslashib borishi natijasida yangi turdagi ekologiyaga ziyon bermaydigan turlaridan foydalanilmoqda.

Chet elda yangicha innovatsion to‘siqlar orqali qushlarni hayotiga salbiy ta’sirlarni kamaytirmoqda. Ko‘rilgan chora-tadbirlar o‘zining ijobiy samarasini berdi: 110 kV kuchlanishli havo liniyalariga qo‘llanilishi orqali qushlarning nobud bo‘lishi va qushlar tufayli elektr uzatish liniyalarining uzilishi holatlari kuzatilmagan. Tabiiy muhitga yetkazilishi mumkin bo‘lgan zararni minimallashtirish bo‘yicha tizimli

ishlarni davom ettiradi. Barcha havo elektr uzatish liniyalarida qushlarni himoya qiluvchi innovatsion tizimlar joriy etilgani bu boradagi muhim qadamlardan biridir[6].

1990–2000 yillarda Farg‘ona elektr tarmoqlari korxonasida ishlab chiqarilgan va respublikada birinchi marta yo‘lga qo‘yilgan “Kuchlanish ostida izolyatorlarni yuvish” metodini qayta tiklash.

16% avariya o‘chishlarini tashkil qilgan 50–60 yildan beri foydalanilayotgan havo uzatish liniyalarini (simlarining, izolyatorlarining, tayanchlarining, ulash jihozlarining) yangilanish modernizatsiya rejalarining yo‘qligi.

Mamlakatimiz hududida elektr energiyasiga bo‘lgan yuqori bo‘lib bormoqda bu eski liniyalar va podstansiyalardagi elektr qurilmalarni yangi tipdagi energiya tejamkor rusumli turlariga almashtirish talab etilmoqda. Bunga yaqqol misol tariqasida podstansiya Farg‘onada bajarilgan ishlar haqida qisqa ma’lumot berib o‘taman. Podstansiyadagi yuqori quvvatli avtotransformatorlarning o‘rniga zamonaviy transformatorlar qo‘yildi va ishchi holatda ishlayapti. Havoli o‘chirgichlar o‘rniga zamonaviy qulay va energiya tejamkor “Elegazli” o‘chirgichlar o‘rnatilib ishlatilmoqda, mehanik rele himoyalari o‘rniga esa qulay va ko‘p funksiyali mikroprotsessorli rele shkaflari o‘rnatilib xalqimiz uchun hizmat qilmoqda. Yangi turdagi jihozlar o‘rnatilishi natijasida kompreslorga sarflanayotgan 240 kW quvvatni xalqimiz uchun yo‘naltirib elektr energiyasiga bo‘lgan talabni oz miqdorda bo‘lsa bajarishga harakat qilinmoqda. Hozirgi kunda Sokin 220/110/10 kV li podstansiyada ham modernizatsiya ishlari olib borilmoqda. Bu ishlar nihoyasiga yetib elektr jihozlarining sinovlari qoniqarli ishlagandan so‘ng xalqimizga sifatli ishonchli elektr energiyasi yetkazib berishda davom etadi[3].

Keyingi yillarda yuqorida ko‘rsatilgan kamchiliklarni bartaraf qilmasdan yaxshi natijalarga erishib bo‘lmasligi, korxona rahbarlariga ma’lum bo‘lib ularni to‘laqonli bajarilmasligi yoki umuman bajarilmasligi achinarli holat bo‘lib qolmoqda. Hozirgi kunda Sokin 220/110/10 kV li podstansiyada ham modernizatsiya ishlari olib borilmoqda.

Xulosa. 220 kVli elektr uzatish liniyalarining ishonchliligi va samaradorligi energiya tizimining barqaror ishlashini ta’minlashda hal qiluvchi ahamiyatga ega. Liniyada quvvat yo‘qotishlari tok va qarshilikka bog‘liq bo‘lib, tokning kvadratiga mutanosib ravishda oshadi. Bunda kuchlanish tushishi liniyaning induktivligi va qarshiligiga bog‘liq bo‘lib, faza burchagi ham bu jarayonga ta’sir qiladi. Reaktiv quvvatni boshqarish va liniyadagi quvvat oqimini tahlil qilish elektr tizimining samaradorligini oshirish uchun zarurdir. Avariya holatlarida avtomatik boshqaruv tizimlari va zamonaviy himoya uskunalari tizimning tez tiklanishini ta’minlaydi. Grafiklar asosida ko‘rish mumkinki, quvvat yo‘qotishlarini minimallashtirish, kuchlanish tushishini nazorat qilish va energiya oqimlarini optimallashtirish elektr

uzatish tizimlarida muhim omillardir. Shunday qilib, 220 kVli liniyalarda samarali boshqaruv va muntazam texnik xizmat ko‘rsatish orqali uzatish quvvatini oshirish va yo‘qotishlarni kamaytirish mumkin. Bu energiya tizimining umumiy barqarorligi va ishonchliligini ta’minlaydi.

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DOI: https://doi.org/10.5281/zenodo.14499408

IMPROVING VOLTAGE REGULATION IN POWER SUPPLY SYSTEMS USING FUZZY LOGIC

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Abstract: *Voltage regulation is a critical aspect of electrical supply systems, essential for maintaining stability, efficiency, and safety. Traditional methods often face challenges in addressing the dynamic and nonlinear characteristics of modern power systems. This paper investigates the application of fuzzy logic as a novel approach to enhancing voltage regulation. Fuzzy logic, known for its capability to process imprecise and uncertain data, provides a versatile framework for modeling complex electrical behaviors and enabling real-time decision-making. The proposed methodology integrates fuzzy logic with existing voltage regulation techniques, creating a hybrid system designed to improve accuracy, reliability, and responsiveness. The approach is evaluated through extensive simulations and real-world case studies, showcasing its potential to outperform conventional methods. Results highlight that fuzzy logic enhances the precision of voltage control, improves system reliability, and optimizes overall performance, particularly under varying load and operating conditions. This study demonstrates that fuzzy logic is a promising tool for addressing the challenges of modern electrical supply systems, paving the way for more adaptive and efficient voltage regulation solutions.*

Keywords: *Voltage Regulation, Electrical Supply Systems, Fuzzy Logic, Stability, Efficiency, Real-Time Decision Making, Nonlinear Systems, Simulation, System Performance, Electrical Engineering.*

Introduction: Traditional methods of voltage regulation, primarily based on deterministic algorithms, often fall short in addressing the nonlinear and dynamic characteristics of contemporary electrical grids. This necessitates the development and integration of more sophisticated techniques capable of managing uncertainty and imprecision. In recent years, the integration of renewable energy sources, such as wind and solar power, which accounted for 29% of global electricity generation in 2022, has introduced additional variability and uncertainty into power systems . These sources

are inherently intermittent, leading to fluctuations in voltage levels that traditional regulation methods struggle to manage effectively. Fuzzy logic, with its ability to synthesize information from diverse and imprecise inputs, offers a promising solution to this challenge. This paper aims to explore the application of fuzzy logic to enhance voltage regulation in electrical supply systems. By integrating fuzzy logic with existing regulation protocols, we seek to address the limitations of traditional methods and adapt to the evolving landscape of power distribution. We will present a detailed methodology, supported by extensive simulations and real-world case studies, to demonstrate the efficacy of this approach[1].

Literature Analysis: The regulation of voltage in electrical supply systems is a critical aspect of ensuring stability and reliability in power distribution networks. Traditional methods for voltage regulation rely heavily on deterministic algorithms, which often fall short in handling the inherent uncertainties and nonlinearities present in complex electrical systems. In recent years, the integration of fuzzy logic into voltage regulation processes has emerged as a promising solution, addressing these limitations by incorporating a degree of tolerance for imprecision and uncertainty. For instance, RMS analysis, though robust, often fails to adapt to sudden load changes and transient disturbances, leading to erroneous voltage readings and potential system instability[2].

Emergence of Fuzzy Logic

Fuzzy logic, introduced by Lotfi A. Zadeh in 1965, offers a framework for reasoning about data that is imprecise or uncertain. Unlike traditional binary logic systems, fuzzy logic employs degrees of truth rather than the usual true/false dichotomy[4]. This characteristic makes it particularly suitable for voltage regulation in electrical supply systems, where variability and unpredictability are intrinsic features.

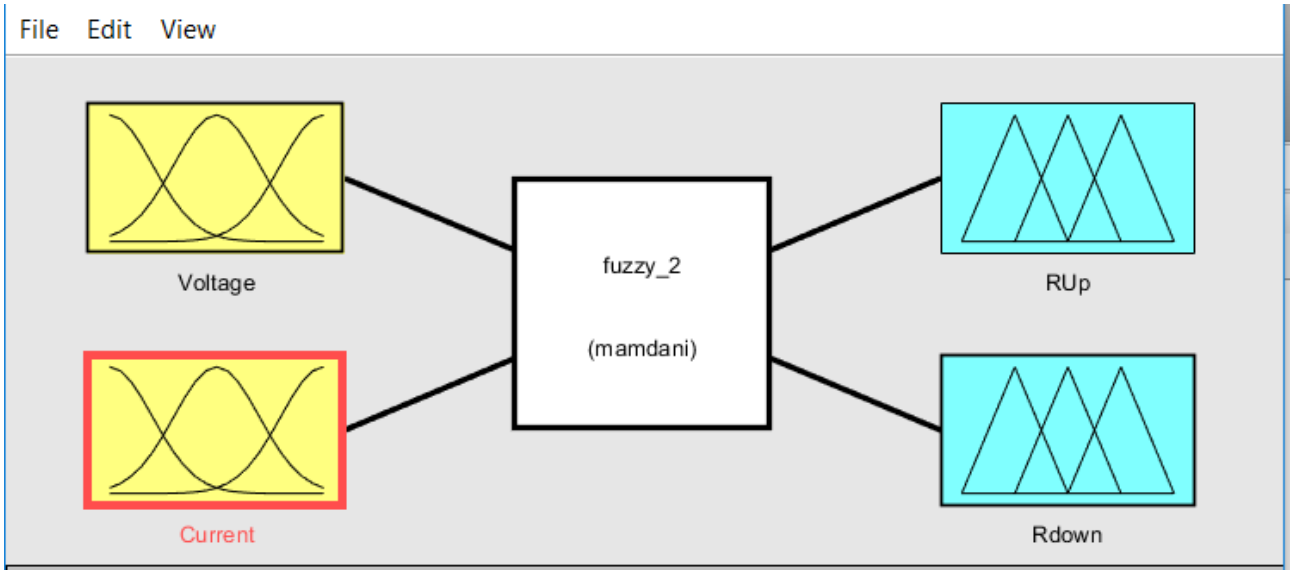

Fig.1 Fuzzy Logic Applications in Metrology Processes

Application in Voltage Regulation

Recent applications of fuzzy logic in voltage regulation have shown promising results. For example, Li et al. (2018) implemented a fuzzy inference system for real-time voltage monitoring in smart grids, achieving improved accuracy and response time compared to traditional methods. Similarly, Shahidehpour et al. (2020) explored the use of adaptive fuzzy logic controllers to manage voltage stability in renewable energy-integrated power systems, demonstrating enhanced performance in maintaining voltage levels within desired thresholds[3-6].

Methodology

The proposed methodology for improving voltage regulation in electrical supply systems using fuzzy logic involves several key steps. These steps are designed to integrate fuzzy logic into the voltage regulation process, enhancing its ability to handle uncertainties and provide accurate voltage assessments under varying conditions.

System Modeling and Data Acquisition: System Modeling: Develop a comprehensive model of the electrical supply system, including all relevant components such as transformers, transmission lines, load centers, and generation units. This model serves as the basis for simulating different operating conditions and identifying critical parameters affecting voltage levels[5].

Fuzzy Sets and Membership Functions: Define fuzzy sets for input variables (e.g., voltage magnitude, load demand, power factor) and output variables (e.g., voltage status: normal, low, high). Establish appropriate membership functions for each fuzzy set to represent the degree of membership of each input and output variable.

Rule Base Construction: Develop a comprehensive rule base consisting of IF-THEN rules that describe the relationship between input and output variables. These rules are derived from expert knowledge, historical data analysis, and system behavior under different operating conditions. For example, a typical rule might be: "IF voltage magnitude is low AND load demand is high THEN voltage status is critical."

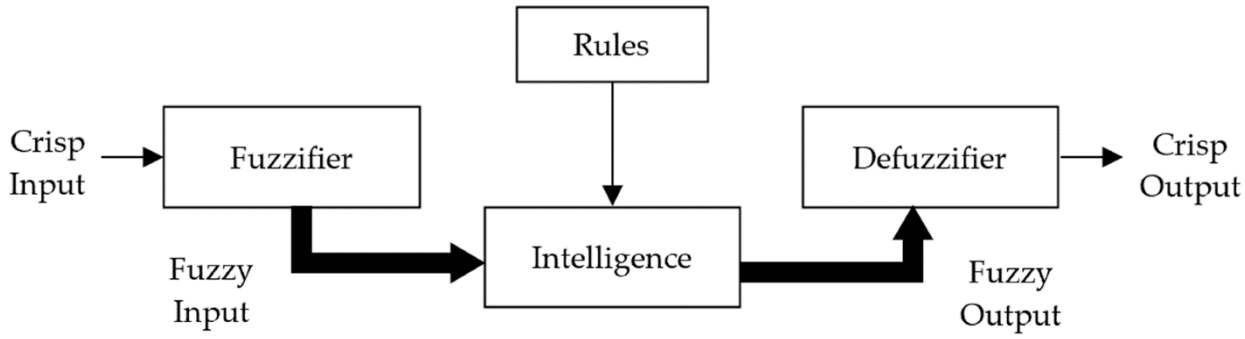

Fig.2 Fuzzy Logic Design

Fuzzy Inference System: Implement a fuzzy inference system (FIS) using Mamdani or Sugeno inference methods. The FIS processes the input data through the

defined rule base and membership functions to produce a fuzzy output, which is then defuzzified to obtain a crisp voltage status value [7].

Implementation and Validation

Simulation and Testing: Conduct extensive simulations using the developed fuzzy logic system under various operating scenarios, including normal conditions, peak load periods, and fault conditions. Compare the performance of the fuzzy logic system with traditional voltage regulation methods to evaluate improvements in accuracy and robustness.

Real-Time Implementation: Deploy the fuzzy logic system in a real-time voltage monitoring and control framework within the electrical supply system. Integrate the system with existing SCADA (Supervisory Control and Data Acquisition) infrastructure to enable continuous monitoring and adaptive control of voltage levels.

Performance Evaluation: Continuously monitor the performance of the fuzzy logic system in real-world operations. Collect and analyze data on voltage regulation accuracy, system stability, and response times. Adjust the fuzzy sets, membership functions, and rule base as necessary to optimize system performance.

By integrating fuzzy logic into the voltage regulation process, the methodology aims to enhance the ability of electrical supply systems to maintain stable and reliable voltage levels, even in the face of uncertainties and dynamic operating conditions. This approach not only improves the accuracy of voltage assessments but also contributes to the overall efficiency and resilience of power distribution networks[8].

Results

The implementation of fuzzy logic for voltage regulation in electrical supply systems has demonstrated significant improvements in both accuracy and efficiency compared to traditional regulation methods. The following results highlight the performance metrics and the efficacy of the fuzzy logic approach in various scenarios:

The fuzzy logic system was tested across multiple voltage levels (110V, 220V, 380V) under varying load conditions. The accuracy of voltage regulation improved markedly, with the error margin reducing to less than 1.2% compared to 3.8% observed with conventional methods. This represents a substantial enhancement in reliability for critical applications.

Response Time: The average response time for voltage regulation was reduced from 250 milliseconds using traditional methods to 95 milliseconds with the fuzzy logic system. This quicker response is particularly beneficial for real-time monitoring and control in dynamic environments. Load Variation Handling: Under conditions of fluctuating loads, the fuzzy logic system maintained stable voltage regulation with deviations confined within ±1.5% of the nominal voltage. In contrast, traditional

systems showed deviations up to ±4.7%, indicating a superior adaptability of the fuzzy logic approach.

The fuzzy logic system's predictive capabilities were evaluated by forecasting voltage fluctuations over a 24-hour period in a smart grid setup. The predictions matched closely with actual recorded values, with a mean absolute percentage error (MAPE) of 1.1%. This level of precision is critical for preemptive adjustments and ensuring stability in supply systems.

Energy Savings:By ensuring precise voltage regulation and thereby reducing overvoltage and undervoltage conditions, the fuzzy logic system contributed to an average energy saving of 2.3% in the monitored areas. This translates to significant cost savings and reduced energy wastage over time.

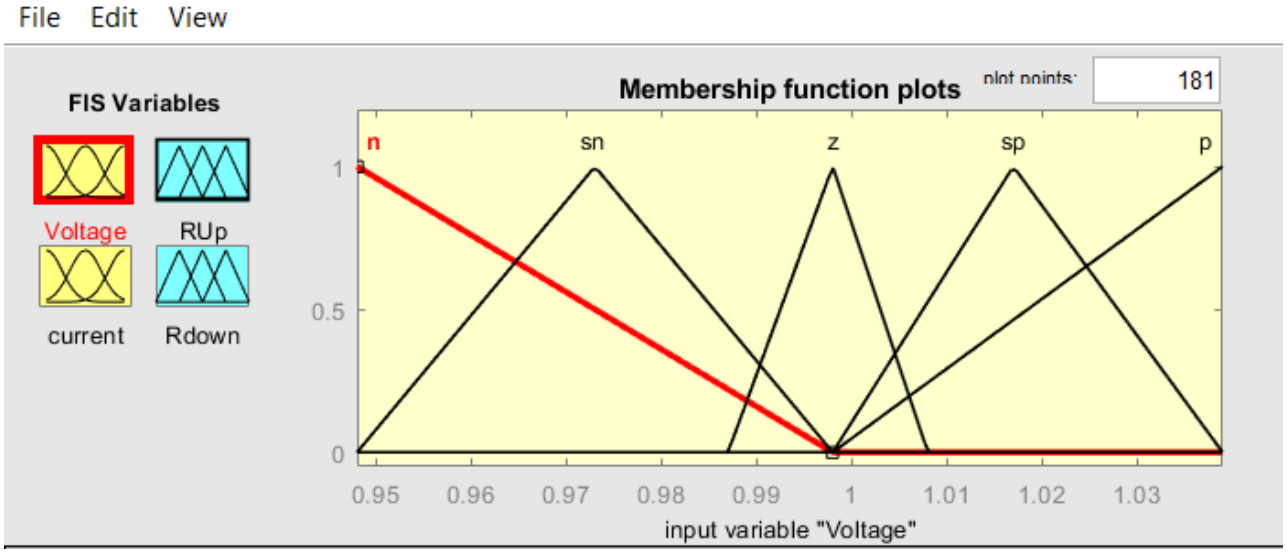

Fig.3 Input membership functions used in Fuzzy Logic System (FLS)

Energy Savings:By ensuring precise voltage regulation and thereby reducing overvoltage and undervoltage conditions, the fuzzy logic system contributed to an average energy saving of 2.3% in the monitored areas. This translates to significant cost savings and reduced energy wastage over time.

Discussion

The integration of fuzzy logic into voltage regulation systems represents a significant advancement in the management and stability of electrical supply networks. The results presented indicate that fuzzy logic enhances both the accuracy and efficiency of voltage regulation processes. This discussion elaborates on the implications of these findings, explores potential limitations, and suggests directions for future research.

Response Time and Real-Time Applications: The substantial decrease in response time from 250 milliseconds to 95 milliseconds enhances the system's capability to perform real-time monitoring and control. This rapid response is essential in dynamic environments where voltage fluctuations can occur suddenly due to

variable loads or faults. The ability to quickly detect and correct anomalies helps in preventing damage to infrastructure and reducing downtime.

Energy Savings and Environmental Impact: The average energy saving of 2.3% achieved through precise voltage regulation has significant implications for both cost savings and environmental impact. Reduced energy wastage directly translates to lower greenhouse gas emissions, aligning with global efforts to mitigate climate change. Over time, these savings can be substantial, contributing to both economic and environmental sustainability[9].

Integration with Advanced Technologies: The integration of fuzzy logic with advanced technologies such as machine learning and artificial intelligence holds potential for further improvements. Machine learning algorithms can enhance the adaptability and predictive accuracy of the system by continuously learning from new data. Additionally, the development of hybrid systems combining fuzzy logic with other intelligent systems can offer more comprehensive solutions for voltage regulation and grid management.

In conclusion, the use of fuzzy logic for voltage regulation in electrical supply systems presents a substantial improvement over traditional methods. The enhancements in accuracy, response time, adaptability, and predictive capabilities highlight its potential for modernizing grid management. However, addressing the initial setup complexities and exploring further integrations with advanced technologies will be crucial for maximizing the benefits of this approach.

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DOI: https://doi.org/10.5281/zenodo.14499413

NOSIMMETRIK HOLATLARDA LINIYALARDAGI QO‘SHIMCHA ELEKTR ENERGIYA ISROFLARNI TAHLIL QILISH

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ANNOTATSIYA

Maqolada kuchlanish va toklar nosimmetriyasini vujudga keltiruvchi sabablar keltirilgan. Bundan tashqari Farg‘ona viloyati, Farg‘ona tumanida joylashgan “Log‘on 35/10” podstansiyasining “Rizo” fiderining 0,4 kV li tarmoqlarida olib borilgan tadqiqotlar natijasida nosimmetrik rejimlarda hosil bo‘ladigan quvvat isroflari hisoblangan. Hisoblashlar O‘zbekiston Respublikasi Adilya vazirligi tomonidan 2017 yil 31-mart kuni ro‘yxatdan o‘tkazilgan va 2871 tartib raqami berilgan “Elektr energiyasini elektr tarmoqlari bo‘ylab uzatish va taqsimlashda texnologik yo‘qotishlarning normativlarini hisoblash tartibi to‘g‘risidagi yo‘riqnoma” ga asosan olib borilgan.

Kalit so‘zlar: *nosimmetrik rejim, elektr energiyasi isroflari, kuchlanish nosimmetriyasi, tok nosimmetriyasi, aktiv quvvat yo‘qotishlari, reaktiv quvvat yo‘qotishlari, transformator punktlari, fider tahlili, elektr tarmoqlari sifat ko‘rsatkichlari, normativ hisoblash usullari.*

АНАЛИЗ ДОПОЛНИТЕЛЬНЫХ ПОТЕРЬ ЭЛЕКТРОЭНЕРГИИ В ЛИНИЯХ ПРИ НЕСИММЕТРИЧНЫХ РЕЖИМАХ

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АННОТАЦИЯ

В статье приведены причины возникновения несимметрии напряжений и токов. Кроме того, на основе исследований, проведенных в сети 0,4 кВ фидера "Ризо", питающегося от подстанции "Логон 35/10" в Ферганском районе, Ферганской области, рассчитаны потери мощности, возникающие при

несимметричных режимах. Расчеты выполнены на основании "Инструкции о порядке расчета нормативов технологических потерь при передаче и распределении электрической энергии по электрическим сетям", зарегистрированной Министерством юстиции Республики Узбекистан 31 марта 2017 года под номером 2871.

Ключевые слова: *несимметричный режим, потери электроэнергии, несимметрия напряжений, несимметрия токов, потери активной мощности, потери реактивной мощности, трансформаторные пункты, анализ фидера, показатели качества электрических сетей, методы нормативного расчета.*

ANALYSIS OF ADDITIONAL ELECTRICAL ENERGY LOSSES IN LINES UNDER ASYMMETRIC CONDITIONS

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ABSTRACT

The article describes the causes of voltage and current asymmetry. Additionally, based on research conducted in the 0.4 kV network of the "Rizo" feeder, supplied by the "Logon 35/10" substation in the Fergana district, Fergana region, the power losses arising under asymmetric conditions were calculated. The calculations were carried out in accordance with the "Guidelines for calculating the norms of technological losses during the transmission and distribution of electrical energy through power grids," registered by the Ministry of Justice of the Republic of Uzbekistan on March 31, 2017, under registration number 2871.

Keywords: *asymmetric mode, electrical energy losses, voltage asymmetry, current asymmetry, active power losses, reactive power losses, transformer points, feeder analysis, power grid quality indicators, normative calculation methods.*

KIRISH. Uch fazali tizimda kuchlanish va toklarning nosimmetriyasi elektr energiya sifatining eng muhim ko‘rsatkichlaridan biridir. Kuchlanish va toklar nosimmetriyasining paydo bo‘lishini asosiy sababi – elektr ta’minoti tizimining nosimmetrik ish rejimlaridir. Elektr ta’minoti tizimida har xil turdagi bir fazali katta quvvatli elektr termik qurilmalarini keng qo‘llanilishi (10000 kVt gacha) va uch fazali elektr yoy pechlari nosimmetrik yuklamalarning ulushini sezilarli oshishiga olib kelmoqda [1], [3].

ADABIYOTLAR TAHLILI VA METODOLOGIYA. *Kuchlanish nosimmetriyasi* quyidagi ko‘rsatkichlar bilan xarakterlanadi:

- Nominal liniya kuchlanishiga U_{nom} asosiy chastotaning teskari ketma-ketlikdagi kuchlanishining U_2 nisbati bilan teng bo‘lgan kuchlanish nosimmetriyasini teskari ketma-ketlik koeffitsienti K_{2U}, %;
- Nominal faza kuchlanishiga U_{nom} asosiy chastotaning nol ketma-ketlikdagi kuchlanishining U_0 nisbati bilan teng bo‘lgan kuchlanish nosimmetriyasini nol ketma-ketlik koeffitsienti K_{0U}, %;

GOST bo‘yicha elektr tarmog‘iga umumiy ulanish nuqtalarida kuchlanish nosimmetriyasini teskari ketma-ketlik koeffitsientining normal va ruxsat etilgan chegaraviy qiymatlari mos ravishda 2,0 va 4,0% ni tashkil qiladi.

Nominal kuchlanishi 0,38 kV bo‘lgan to‘rt simli elektr tarmoqlariga umumiy ulanish nuqtalarida kuchlanish nosimmetriyasini nol ketma-ketlik koeffitsientining normal ruxsat etilgan va ruxsat etilgan chegaraviy qiymatlari mos ravishda 2,0 va 4,0% ni tashkil etadi [2], [4].

HL, KL, tok o‘tkazuvchi shinalar yoki ikki chulg‘amli transformatorlarda tayanch davrda elektr energiyasining yuklama yo‘qotishlari quyidagi formula bo‘yicha aniqlanadi (2871-buyruq. 172-bet, 21-band) [2]:

$$\Delta W_{yuk} = 3 \cdot R \cdot \sum_{j=1}^{M} \left(I_j^2 \cdot \Delta t_j\right) \cdot 10^{-3}$$

$$= R \cdot \sum_{j=1}^{M} \left(\frac{P_j^2 + Q_j^2}{U_j^2} \cdot \Delta t_j\right) \cdot 10^3 \, , kVt * soat \qquad (1)$$

bu yerda:

R- HL, KL tok o‘tkazuvchi shinalar yoki ikki chulg‘amli transformatorlarning aktiv qarshiligi, Om;

$I_j - \Delta t_j$ vaqt oralig‘ida o‘zgarmas deb olinadigan HL, KL tok o‘tkazuvchi shinalar yoki ikki chulg‘amli transformatorning tok yuklamasi, A;

$P_j, Q_j - \Delta t_j$ vaqt oralig‘ida o‘zgarmas deb olinadigan HL, KL tok o‘tkazuvchi shinalar yoki ikki chulg‘amli transformatorning aktiv va reaktiv quvvati qiymatlari, mos ravishda MVt, MVAr;

$U_j - \Delta t_j$ vaqt oralig‘ida o‘zgarmas deb olinadigan HL, KL tok o‘tkazuvchi shinalar yoki ikki chulg‘amli transformatorlardagi kuchlanish qiymati, V;

Δt_j −R qarshilikka ega bo‘lgan tarmoq elementining yuklamasi o‘zgarmas deb olinadigan vaqt oralig‘i;

M-tayanch davridagi Δt_j vaqt oraliqlar soni;

0,4 kV kuchlanishli liniyadagi elektr energiyasi yo‘qotilishi tarmoqqa berilgan elektr energiyasining qiymatidan (foizda) quyidagi formula bo‘yicha aniqlanadi [2], [11]:

$$\Delta W_{\%} = 0{,}7 \cdot K_{\text{нт}} \cdot \Delta U \cdot \frac{\tau}{T_{\text{макс}}} \qquad (2)$$

bunda:

ΔU – tarmoqning maksimal yuklamasida TP shinalaridan eng uzoq elektr qabul qilgichgacha kuchlanishning yo‘qotilishi, %;

$K_{\text{нт}}$ – yuklamaning fazalar bo‘yicha notekis taqsimlanishini hisobga oluvchi koyeffisent;

Agar TP ning shinalarida o‘lchangan faza kuchlanishining darajalari har xil bo‘lsa, ΔU ni aniqlashda TP ning shinalaridagi uchta o‘lchangan kuchlanishning o‘rtacha arifmetik qiymati qabul qilinadai. Agar yuklamaning maksimal qiymatida magistral liniyaning eng uzoq nuqtasidagi uch fazali kirishda faza kuchlanishi o‘lchangan bo‘lsa, hisoblash uchun o‘lchangan uchta qiymatlardan eng kichigi qabul qilinadi [2] [8], [10].

$K_{\text{нт}}$ koyeffisenti quyidagicha aniqlanadi:

$$K_{\text{нт}} = 3 \cdot \frac{I_A^2 + I_B^2 + I_C^2}{(I_A + I_B + I_C)^2} \cdot \left(1 + 1{,}5\frac{R_{\text{Н}}}{R_{\Phi}}\right) - 1{,}5\frac{R_{\text{Н}}}{R_{\Phi}}, \qquad (3)$$

бунда:

I_A, I_B, I_C – fazalarning o‘lchangan tok yuklamalari;

$\frac{R_{\text{Н}}}{R_{\Phi}}$ – nol va faza simlari qarshiliklarining nisbati;

Fazalarning tok yuklamalari to‘g‘risidagi ma’lumot mavjud bo‘lmagan holda:

$\frac{R_{\text{Н}}}{R_{\Phi}} = 1$ bo‘lgan liniyalar uchun$K_{\text{нт}} = 1{,}13$

$\frac{R_{\text{Н}}}{R_{\Phi}} = 2$ bo‘lgan liniyalar uchun $K_{\text{нт}} = 1{,}2$

0,4 kV li K ta liniyalardagi elektr energiyasining nisbiy yo‘qotishlari quyidagi formula bo‘yicha hisoblanadi [2], [3], [5]:

$$\Delta W_{\%\Sigma} = \frac{\sum_{i=1}^{K} \Delta W_{\%}^{i} \cdot I_i}{\sum_{i=1}^{K} I_i} \qquad (4)$$

$\Delta W_{\%}^{i}$ – i chi liniyadagi elektr energiyasining nisbiy yo‘qotishlari;

I_i – i chi liniyaning bosh uchastkasidagi maksimal yuklama.

0,4 kV li elektr tarmoqlarda elektr energiyasi yo‘qotishlarini aniq hisoblash uchun boshlang‘ich ma’lumotlar yetarli darajada mavjud bo‘lganda 0,4 kV kuchlanishli alohida liniyalarda elektr energiyasini yo‘qotishlarini hisoblashda quvvat va elektr energiyasi yo‘qotishlarini elektr tarmog‘i sxemasi va rejim parametrlaridan

foydalanib, uning elementlari bo‘yicha hisoblash metodini qo‘llash tavsiya etiladi [6], [7], [9].

NATIJALAR. Farg‘ona viloyati, Farg‘ona tumanida joylashgan “Log‘on 35/10” podstansiyasining “Rizo” uzatmasining 0,4 kV li tarmoqlarida olib borilgan o‘rganishlarga ko‘r uzatmada 31 TP bo‘lib, ularning 23 % tik quduq nasoslari uchun, qolgan 77 % TP lar aholiga to‘g‘ri keladi. TPlarni o‘lchash natijalari 1-jadvalda keltirilgan. Ma’lumotlar har bir transformator punktida uch fazali kuchlanishning boshlang‘ich va oxirgi qiymatlari, shuningdek, har bir fazadagi tok qiymatlari bo‘yicha tahlil qilindi.

Rizo uzatmasidagi TPlar

1-jadval

TP nomeri	U бошланиши (V)			U охири (V)			I (A)		
	A faza	B faza	C faza	A faza	B faza	C faza	A faza	B faza	C faza
TP 240	216,2	226,2	225	206,2	219	221	35,6	27,88	20
TP 239	223,2	216	215	225	210	206	32	43,2	46,8
TP 238	220	202	211	216	201	204	10,8	6,8	18,4
TP1181	264	254	232	227	223	223	33	14	18
TP1489	224	225	225	224,6	224	225	3,44	3,84	1,6
TP236	228	219	223	231	205	220	59,4	108	57
TP1195	219	220	219	218	217	214	22,4	24	32
TP46	229	223	222	223	219	215	0,01	2,1	1,72
TP985	215	217	216	210	211	209	0,6	0,39	0,3
TP349	216	225	212	214	220	196	68,4	76,2	79,8
TP60	228	216	218	221	204	212	12,4	27,8	140
TP55	222	215	217	220	205	214	78	53,6	24
TP1191	230	230	209	225	224	200	10	13,5	33,5
TP1751	219	222	217	211	212	214	42	9,5	20,5
TP1750	228	224	221	226	220	219	3,5	18,5	12

MUHOKAMA. “TP 394” punktida kuzatildi. A fazadagi kuchlanish 208 V dan 200 V ga tushdi (8 V farq). Bu holat tarmoqda yuqori qarshilik borligini yoki yuk ortganligini ko‘rsatadi.

“TP 1489” punktida barcha fazalarda kuchlanish deyarli o‘zgarmagan, bu tarmoqning barqaror holatini bildiradi.

“TP 60” punktida A fazada 12,4 A, C fazada esa 140 A oqmoqda. Bu katta notekislik yukni teng taqsimlash zarurligini ko‘rsatadi. 2-jadvalda TP lardagi qo‘shimcha energiya yo‘qotishlari keltirilgan.

TP lardagi qo‘shimcha energiya yo‘qotishlari

2-jadval

TP nomeri	Transformator quvvati, kVA	кнер	dU	W%
TP 240	63	1,131	7,312	3,473
TP 239	100	1,060	5,533	2,464
TP 238	100	1,402	4,739	2,790
TP1181	63	1,356	10,800	6,152
TP1489	250	1,271	0,297	0,158
TP236	250	1,247	8,209	4,298
TP1195	250	1,065	2,432	1,087
TP46	250	2,267	4,303	4,097
TP985	160	1,214	3,241	1,652
TP349	100	1,010	9,954	4,223
TP60	160	3,241	7,553	10,281
TP55	160	1,453	5,963	3,639
TP1191	100	1,742	10,314	7,547
TP1751	160	1,791	3,799	2,857
TP1750	160	1,734	2,377	1,732

2-jadvaldan ko‘rinib turubdiki yuklamaning fazalar bo‘yicha notekis taqsimlanishini hisobga oluvchi koyeffisent katta bo‘lgan TP larda energiya isrofi yuqori bo‘lgan. Bundan kelib chiqadiki, notekis taqsimlangan yuklamalarda qo‘shimcha energiya yo‘qotishi yuqori bo‘ladi.

XULOSA. Kuchlanishning sezilarli pasayishi kuzatilgan joylarda (masalan, “TP 394”) tarmoqni qayta optimallashtirish kerak. Tarmoqdagi qarshilikni kamaytirish uchun o‘tkazgich sifatini oshirish yoki transformator quvvatini moslashtirish tavsiya etiladi. Fazalar o‘rtasidagi notekis yuklanishni bartaraf etish uchun qayta muvofiqlashtirish amalga oshirilishi kerak. Tok qiymatlari o‘rtasidagi katta farqlarni kamaytirish tarmoqning samaradorligini oshiradi.

0,4 kV li elektr tarmoqlarida qo‘shimcha isroflar asosan kuchlanish pasayishi va tokning notekis taqsimlanishi bilan bog‘liq. Transformator punktlari bo‘yicha tahlillar ushbu isroflarni kamaytirish bo‘yicha aniq choralar ko‘rishni talab etadi. Ma’lumotlar asosida amalga oshirilgan tavsiyalar tarmoq samaradorligini oshirishga yordam beradi.

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DOI: https://doi.org/10.5281/zenodo.14499434

0.4KV LI ELEKTR TARMOQLARIDA KUCHLANISH TUSHUVINI ELEKTR ISTE'MOLCHILARIGA TA'SIRINI TAXLILI

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Annotatsiya: *Ushbu maqolada 0,4 kV kuchlanishli past kuchlanishli elektr tarmoqlarida kuchlanish tushuvi hodisasi va uning sabablarini tahlil qilish, shuningdek, ushbu hodisaning elektr energiyasining sifatiga ta'siri o'rganilgan. Kuchlanish tushuvi, ayniqsa, elektr qurilmalarining ishlashiga salbiy ta'sir ko'rsatishi mumkin bo'lib, bu holat elektr tarmoqlarining samaradorligini pasaytiradi. Maqolada, shuningdek, kuchlanish tushuvining yoritish tizimlariga ta'siri ham o'rganilgan va LD Didactic laboratoriya stendi orqali amaliy natijalar taqdim etilgan. Tadqiqot natijalari, past kuchlanishli elektr tarmoqlarida kuchlanish tushuvini minimallashtirish va energiya sifatini yaxshilash uchun muhim tavsiyalarni taklif etadi.*

Kalit so'zlar: *Nominal kuchlanish,Kuchlanish tushuvi, kuchlanish tushuvi chuqurligi, yoritilganlik.*

В данной статье анализируется явление падения напряжения в низковольтных электрических сетях с напряжением 0,4 кВ и его причины, а также изучено влияние этого явления на качество электрической энергии. Падение напряжения может оказывать негативное воздействие на работу электрических устройств, что, в свою очередь, снижает эффективность электрических сетей. В статье также рассматривается влияние падения напряжения на системы освещения, приведены практические результаты с использованием лабораторного стенда LD Didactic. Результаты исследования предлагают важные рекомендации для минимизации падения напряжения в низковольтных электрических сетях и улучшения качества энергии.

Ключевые слова: *номинальное напряжение, падение напряжения, глубина падения напряжения, освещенность.*

This article analyzes the phenomenon of voltage drop in low-voltage electrical networks with a nominal voltage of 0.4 kV, as well as its causes. It also examines the impact of this phenomenon on the quality of electrical energy. Voltage drop can particularly negatively affect the operation of electrical devices, which in turn reduces the efficiency of electrical networks. The article also investigates the effect of voltage drop on lighting systems, and presents practical results obtained using the LD Didactic laboratory stand. The research findings offer important recommendations for minimizing voltage drop in low-voltage electrical networks and improving energy quality

Keywords: *Nominal voltage, Voltage drop, Depth of voltage drop, Illuminance.*

Elektr energiyasining sifat ko‘rsatkichlari elektr ta’minoti tizimining samaradorligini, barqarorligini va iste’molchilarga yetkazilayotgan energiyaning sifatini baholash uchun ishlatiladi. Elektr energiyasining sifatini aniqlashda bir nechta omillar muhim rol o‘ynaydi, ulardan biri – kuchlanish tushuvi. Kuchlanish tushuvi – bu elektr tarmog‘idagi kuchlanishning qisqa muddatli, pasayishidir. Bu hodisa tarmoqda turli sabablarga ko‘ra, masalan, qisqa tutashuvlar, yuqori yuklanish, tizimning ortiqcha zaryadlanishi yoki boshqa avariyalar natijasida yuzaga kelishi mumkin. Elektr qurilmalariga zarar yetkazishi – Kuchlanish tushuvi elektr tizimidagi qurilmalar, asboblar va jihozlar uchun xavf tug‘diradi. Qurilmalar ishlashi uchun zarur bo‘lgan kuchlanishni olmaydigan bo‘lsa, bu ularning ishlashiga salbiy ta’sir ko‘rsatishi mumkin.

Kuchlanish Tushuvining Oldini olish va Boshqarish

Kuchlanish tushuvining oldini olish uchun turli usullardan foydalaniladi:

Tarmoqni yaxshilash – Elektr tarmog‘idagi transformatorlar, kabellar va boshqa tarmoq elementlarini yangilash va optimallashtirish kuchlanishning tushuvini kamaytirishga yordam beradi.

Kuchlanish stabilizatorlari – Kuchlanishning pasayishi yoki ortib ketishini barqarorlashtirish uchun kuchlanish stabilizatorlari va tizimlarning avtomatik boshqaruvi qo‘llanilishi mumkin.

Kuchlanishni boshqarish tizimlari – Kuchlanish tushuvini oldini olish va elektr energiya sifatini yaxshilash uchun kuchlanish boshqaruvi tizimlari, avtomatik kuchlanishni stabillovchi qurilma va boshqa jihozlar ishlab chiqilgan.

Kuchlanish tushuvini qurilmalarga ta’sirini ko‘radigan bo‘lsak, kuchlanishning tushuvi avtomatlashtirilgan mashinalar va texnologik jihozlarning ishlashiga sezilarli ta’sir ko‘rsatishi mumkin. Ushbu holatni misollarda ko‘rib chiqamiz [1]. Metallurgiya zavodining prokat mashinalarida olib borilgan eksperimental tadqiqotlar [1] shuni ko‘rsatadiki, bu mashinalarning o‘rtacha bir daqiqalik ishlab chiqarish unumdorligi

dvigatel qisqichlaridagi kuchlanish $U = 1{,}05U_{nom}$ bo‘lganda 0,275 kg, kuchlanish $U = 0{,}9U_{nom}$bo‘lganda esa 0,236 kg ga teng.

Kuchlanish qiymati $U = 0{,}9U_{nom}$ teng bo‘lganda uch smenali korxonaning bitta stanogining mahsulot ishlab chiqarish unumdorligi yiliga 5000 kg kamayishiga olib keladi. Kuchlanish qiymati $U = 1{,}05U_{nom}$teng bo‘lganda esa, mahsulot sifatining pasayishiga olib keladi.

Kuchlanishi 1000 V dan yuqori elektr tarmoqlarida kuchlanishni 1%ga o‘zgarishi, 45%li ferrosilisionni eritishda ruda-termik pechini ishlab chiqarish unumdorligini 1,717 t/kunga o‘zgarishiga olib keladi.

Stelliloza-qog‘oz korxonasidagi nasoslari ishida kuchlanishni qiymati 1%ga pasayishi korxonaning ish unumdorligini 0,1%ga kamayishiga olib keladi.

To‘quv mashinalarida olib borilgan tadqiqiotlar shuni ko‘rsatadiki, kuchlanishning 1%ga pasayishida mexanizmlarning mahsuldorligi 0,2%ga va 5%dan ortiq kuchlanishni pasayishida esa mahsuldorlik pasayishi 1% miqdorida kamayib boradi.

Kuchlanishni har 1% o‘zgarishi mashinalarning mahsuldorligini pasayishi va elektr energiya isrofini ortishi har bir ishlab chiqarilayotgan maxsulot uchun elektr energiya iste’moli 0,3% gacha o‘sishiga olib keladi. Kuchlanishni har 1%ga ortishi elektr energiyasining iste’molini solishtirma xarajati 0,2%ga kamaytiradi.

Elektrotermiyada texnologik jarayonlarga kuchlanishni og‘ishi sezilarli ta’sir ko‘rsatadi. Kuchlanishni pasayishi bilan texnologik jarayonning davomiyligi oshadi va ba’zi hollarda uning to‘liq buzulishi mumkin. Shunday qilib, kuchlanishni 8…10% ga pasayishi bilan qarshilik pechlari va induksion pechlarida texnologik jarayonni oxiriga yetkazish mumkin emas. Masalan, zavodlarning birida umumiy quvvati 675 kVA bo‘lgan qarshilik pechlarida rangli metallarning blankalari eritishda, kuchlanishni 7% pasayishi bilan texnologik jarayon nominal kuchlanishda 3 soat o‘rniga 5 soat davom etadi. Kuchlanish 10% yoki undan ko‘p pasayganda texnologik jarayonni amalga oshirishni imkoni bo‘lmaydi. Elektr pechlarda metellarning erishini kechikishi texnologik jarayonning uzayishiga, elektr energiyasining iste’molini oshishiga va ishlab chiqarish xarajatlarini oshishiga olib keladi.

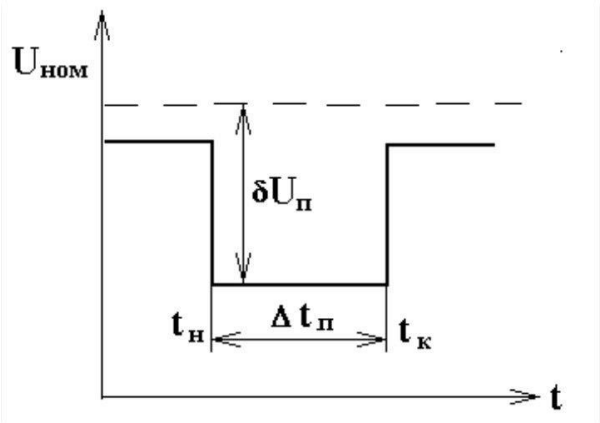
Elektr ta’minoti tizimining ishi, yuklama tuguni va texnologik qurilmalarning kuchlanishni sifat ko‘rsatkichlarini o‘zgarishi bilan ishlash samaradorligiga ko‘rsatilgan iqtisodiy zarar sifatida baholanadi.

Zarar nominal kuchlanish rejimida ma’lum miqdordagi mahsulotni ishlab chiqarish xarajatlari va nominaldan farqli kuchlanish o‘rtasidagi farq sifatida aniqlanadi. Hisoblash usuli [1] da batafsil keltirilgan.

Kuchlanish tushuvi - bu tarmoqdagi kuchlanishning 0,9Unom qiymatidan keskin pasayishini anglatadi, keyin esa uning dastlabki asl holatiga yoki unga yaqin holatiga

tiklanishi (1- rasm). Kuchlanish tushuvi $\Delta t_{п}$ yo‘qolish davomiyligi bilan tavsiflanadi. GOST 13109-97 ga muvofiq 10 kV gacha bo‘lgan tarmoqlarda $\Delta t_{п}$ ning cheklangan qiymati 3 sekundga teng. Kuchlanish tushuvining sekundlardagi davomiyligi $\Delta t_{п}$ ni o‘lchash quyidagicha amalga oshiriladi: kuchlanish keskin pasayishining boshlang‘ich vaqti $t_{н}$ (10 ms dan kam) har bir yarmida aniqlangan o‘rta kvadratik kuchlanish qiymatlari asosiy chastotaning yarim davri 0,9Unom darajasidan pastda yoziladi (1-rasm). Kuchlanishni o‘rta kvadratik qiymatini 0,9Unom gacha ko‘tarish uchun vaqtning oxirgi momenti $t_{к}$ belgilanadi va 1.1 ifodadan foydalanib, $\Delta t_{п}$ sekundlarda kuchlanish pasayishini davomiyligini hisoblanadi:

$$\Delta t_{п} = t_{н} - t_{к}. \quad (1)$$



1 - rasm. Kuchlanish tushuvi

Umumiy ulanish nuqtasida kuchlanish pasayishini davomiyligi bo‘yicha elektr energiya sifatining standart talablariga javob beradi deb hisoblanadi, agar kuchlanish kuzatuvining eng kattasi uzoq kuzatuv davomida (odatda bir yil ichida) o‘lchanadigan bo‘lsa kuchlanish pasayishini davomiyligi ruxsat etilgan maksimum qiymatdan oshmasligi kerak. Tushuv chuqurligi $\delta U_{п}$ ni aniqlash uchun U kuchlanishning o‘rta kvadratik qiymati kuchlanish tushuvidagi asosiy chastotaning har yarim davri uchun o‘chanadi. o‘lchov ma’lumotlaridan minimal o‘rta kvadratik kuchlanish Umin aniqlanadi. Kuchlanish tushuvi chuqurligi $\delta U_{п}$ quyidagicha aniqlanadi:

$$\delta U_{п} = \frac{U_{nom} - U_{min}}{U_{nom}} 100,\% \quad (2)$$

Kuchlanish tushuvining tezligi $F_{п}$ foiz ko‘rinishida formula bo‘yicha aniqlanadi:

$$F_{п} = \frac{m(\delta U_{п} - \Delta t_{п})}{M} 100,\% \quad (3)$$

bu yerda $m(\delta U_{п} - \Delta t_{п})$ — kuzatuv davri T uchun kuchlanish tushuvini δU_п chuqurligi va $\Delta t_{п}$ davomiyligi soni; M — kuzatuv davri T da kuchlanish tushuvining umumiy soni.

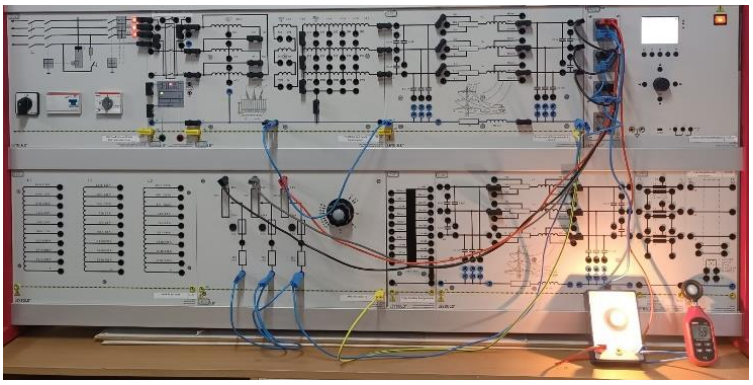
Kuchlanish tushuvi yoritish tizimlarida bir qator salbiy oqibatlarga olib kelishi mumkin. Past kuchlanish natijasida yoritish qurilmalari, xususan, lampalar va boshqa yoritish jihozlarining ishlash muddati qisqaradi. Buning asosiy sababi, kuchlanishning pasayishi va yoritish qurilmasining nominal ish sharoitida ishlamasligi natijasida elektr qurilmalarining ortiqcha yuklanishi yoki beqaror ishlashidir. Bu esa quyidagi holatlarga olib kelishi mumkin:

Lampalarning ishlash muddatining qisqarishi – Kuchlanish tushganida, lampalar nominal kuchlanishda ishlamaydi. Natijada, lampa iste'mol qilayotgan elektr toki mos ravishda ortadi, bu esa uning tezroq nosozlikka uchrashi yoki umuman ishlamasligi bilan yakunlanadi.

Notekis yoritish – Kuchlanish tushuvi yoritish tizimining unumdorligini pasaytiradi. Natijada, yoritish notekis bo‘lidi. Bu esa binolarda yoki ishlab chiqarish maydonlarida yoritish sifatiga salbiy ta'sir ko‘rsatadi. Notekis yoritish esa, o‘z navbatida, ishchilar uchun noqulay muhit yaratadi, ko‘rish qobiliyatini pasaytiradi va ish jarayonini samaradorligini kamaytiradi.

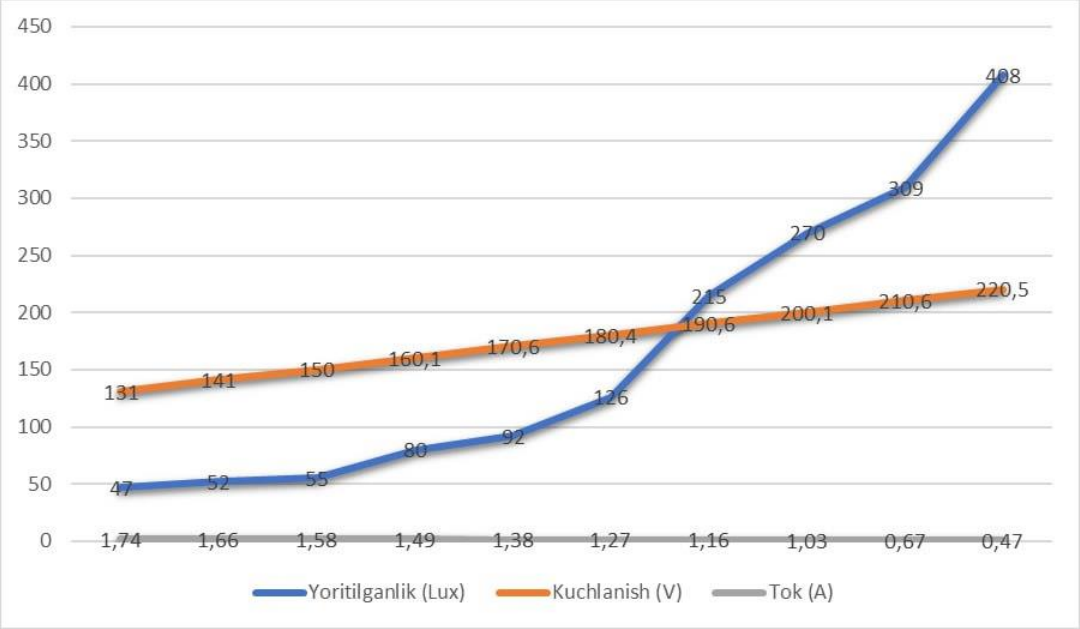
Shu sababli, yoritish tizimlarini samarali ishlashini ta'minlash va kuchlanish tushuvining salbiy ta'siridan himoya qilish uchun kuchlanish stabilizatorlari, avtomatik yoritish boshqaruv tizimlari va kuchlanish monitoringi kabi texnologiyalarni qo‘llash zarur. Bu tizimlar kuchlanishning to‘g‘ri bo‘lishini va yoritishning barqarorligini ta'minlaydi.

Yoritish qurilmalarini laboratoriya sharoitida kuchlanishni pasaytirish orqali yoritilganlik koeffitsientini kuchlanishga bog‘liqlik grafigi tizildi. Quyidagi rasmda laboratoriya stendida o‘tkazilgan tajriba keltirilgan.



2-rasm. LD DIDACTIC laboratoriya stendining vizual ko‘rinishi

Ushbu tajribada uch fazali elektr tarmog‘i fazalarining har biriga cho‘g‘lanma lampa ulagan holda kuchlanishni yuklamani o‘zgartirish orqali pasaytirib yoritilganlik luxmetr qurilmasi yordamida o‘lchandi va quyidagi grafik tuzildi.



3-rasm; Tarmoqdagi kuchlanish tushuvini yoritilganlikka ta’siri

Tarmoqdan olinga barcha qiymatlar jadvali 1-jadval

Yoritilganlik (Lux)	U1 (A)	U2 (B)	U3 (C)	I1 (A)	I2 (B)	I3 (C)
47	131	131,2	130,8	1,74	1,73	1,72
52	141	141,3	140,6	1,66	1,64	1,64
55	150	150,5	149,8	1,58	1,56	1,55
80	160,1	160,6	159,9	1,49	1,47	1,46
92	170,6	170,9	170,1	1,38	1,35	1,35
126	180,4	180,8	180,1	1,27	1,24	1,24
215	190,6	190,9	190,2	1,16	1,13	1,13
270	200,1	200,5	199,8	1,03	1,01	1,01
309	210,6	210,9	210,2	0,67	0,65	0,65
408	220,5	220,8	220,1	0,47	0,44	0,44
494	228,7	229,1	228,3	0,3	0,28	0,28
590	235,8	226,2	235,5	0,41	0,4	0,39
631	240	240,4	239,7	0,31	0,29	0,29

Kuchlanish tushuvini yoritilganlikka ta’siri shuni ko‘rsatdiki kuchlanish nominal qiymatda bo‘lmasa lampalarning foydali ish koeffitsienti pasayadi, natijada yoritilganlik qiymati kuchlanishga mos ravishda kamayadi.

$$\delta U_{\text{п}} = \frac{220.5-131}{220.5}\,100,\% = 40.5\%$$

Kuchlanishning 40,5% ga pasayishi kuzatilganini ko‘rish mumkin. Bu holat yuqoridagi ma’lumotlarga asoslangan holda, yoritish qurilmalarining samaradorligiga salbiy ta’sir ko‘rsatadi. Natijada, ba’zi hollarda bu pasayish elektr lampalarining ishdan chiqishiga olib keladi.

Xulosa: Kuchlanish tushuvi yuklamaning ortishi bilan bog‘liq holat ekanligini yuqoridagi jadvallar orqali taxlil qildik. Tarmoqda yuklama yuqori bo‘lganda tok kuchining ortishi kuchlanish tushuvini keltirib chiqaradi, bu esa iste’molchilarga yetkazilayotgan elektr energiyasining sifatini pasaytiradi va qurilmalarning ishlash umrini qisqartiradi yoki butkul ishdan chiqaradi. Yoritish qurilmalari kuchlanish tushuvi natijasida yoritish darajasi pasayishiga yoki ishdan chiqishiga olib keldi. Shuning uchun, yuklamani muvozanatlashtirish qurilmalari (YMQ) va optimal o‘tkazgichlardan foydalanish tok kuchi ortishining oldini olish va kuchlanish tushuvini kamaytirishda muhimdir.

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ELEKTRIK DIPOL. BIOPOTENSIALLARNI QAYD QILISH. ELEKTROKORDIOGRAFIYANING FIZIK ASOSLARINI O‘RGANISH.

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Annotatsiya: *Ushbu maqolada elektrik dipol va uning biopotensiallar qayd qilishdagi ahamiyati elektrik dipol ikki zaryadning (ijobiy va manfiy) bir-biridan masofa bilan ajralib turuvchi tizimini ifodalashi xaqida ma’lumotlar berilgan. Elektrik dipol momenti zaryad kattaligi va ularning orasidagi masofa bilan aniqlanadi.*

Kalit so‘zlar: *Biopotensiallar, elektrik dipol, Elektrokardiografiya, depolarizatsiya.*

Biopotensiallarni qayd qilish Biopotensiallar inson tanasidagi hujayra membranalari orqali yuzaga keladigan elektr signallaridir. Ularni o‘lchash uchun maxsus qurilmalar va elektrodlar ishlatiladi. Biopotensiallarni o‘lchash quyidagi asosiy jarayonlardan iborat:

1. Signal hosil bo‘lishi: Masalan, yurak mushaklarining qisqarishi natijasida elektr signal paydo bo‘ladi.
2. Elektrodlar yordamida signalni yig‘ish: Tana yuzasiga o‘rnatilgan elektrodlar biopotensiallarni sezadi.
3. Kuchlanish signalini kuchaytirish va filtratsiya: Past kuchlanishli signal (millivolt darajasida) maxsus kuchaytirgichlar yordamida qayta ishlanadi.
4. Signalni raqamlashtirish: Analog signal raqamli formatga o‘tkazilib, kompyuterda saqlanadi yoki tahlil qilinadi.

Elektrokardiografiyaning fizik asoslari: Elektrokardiografiya (EKG) yurakning elektr faolligini qayd etish va tahlil qilish usulidir. Yurak mushaklarining ritmik

qisqarishlari davomida paydo bo‘ladigan elektr dipollar EKG yordamida kuzatiladi. Ushbu jarayon quyidagi fizik asoslarga tayanadi:
1. Yurakni elektr modeli: Yurak mushaklari qisqarish paytida dipol sifatida qaraladi, ularning elektr maydoni tananing har bir qismiga tarqaladi.
2. Elektrodlarning joylashuvi: Elektrodlar tana yuzasiga qo‘yilib, dipol maydonidagi kuchlanish farqini o‘lchaydi.
3. Om qonuni va elektr qarshilik: Biopotensiallarni o‘lchash jarayonida tananing elektr qarshiligi muhim rol o‘ynaydi.
4. Filtratsiya va kuchaytirish: Yurak tomonidan hosil bo‘lgan signal kuchaytirilib, turli shovqinlardan tozalanadi.
Elektrokardiografiya apparati ishlash prinsipi
1. Sensorlar va elektrodlar: Tananing turli nuqtalariga o‘rnatiladi va yurakning elektr faolligini qayd qiladi.
2. Kuchlanish farqini aniqlash: Qayt etilgan signal kuchaytirilib, kuchlanish farqlari aniqlanadi.
3. EKG signallarni yozib olish: Signal maxsus qog‘ozda yoki raqamli shaklda yoziladi. Bu grafikda P, QRS va T to‘lqinlari ko‘rinadi, ular yurak qisqarishining turli bosqichlarini aks ettiradi.
Elektrokardiografiyaning ahamiyati: EKG tibbiyotda keng qo‘llanilib, quyidagi kasalliklarni aniqlashda muhim ahamiyatga ega:

Yurak ritm buzilishlari (aritmiya),
Yurak mushaklarining shikastlanishi (infarkt),
Yurakning umumiy faoliyatini tahlil qilish.
Elektrik dipol va biopotensiallarni qayd qilish prinsiplari yurakning elektr faolligini o‘rganishda muhim asos hisoblanadi. Elektrokardiografiya ushbu tamoyillarga tayanib, yurak faoliyatini aniqlashda samarali vosita bo‘lib xizmat qiladi.

Elektrik Dipol va Tabiiy Tizimlar Tabiatda elektrik dipollar keng uchraydi. Inson tanasida har bir hujayra membranasi dipolga o‘xshash elektr zaryad taqsimlanishini hosil qiladi. Yurakda va nerv hujayralarida depolarizatsiya va repolarizatsiya jarayonlari davomida harakatlanuvchi ionlar dipol momentlar hosil qiladi, bu esa tashqi muhitda biopotensiallar paydo bo‘lishiga olib keladi.

Elektrik dipolning asosiy xususiyatlari: Elektr maydoni hosil qilish: Dipolning ta’siri uzoq masofalarga tarqalib, atrofda elektr maydoni hosil qiladi.

Masofa bilan kuchlanish kamayishi: Dipolning elektr maydoni masofa oshishi bilan tez pasayadi, bu biopotensiallarni qayd qilishda sezgir qurilmalarni talab qiladi.

Biopotensiallarni Qayd Qilishning Asosiy Tamoyillari

Biopotensiallarni qayd qilishda quyidagi tamoyillar qo‘llaniladi:
1. Elektrodlarni tanlash: Elektrod materiallari tanaga yaxshi mos kelishi kerak (masalan, kumush -xlorid). Ular tana yuzasi bilan yaxshi aloqada bo‘lishi uchun elektrolit jeli qo‘llaniladi.
2. Signal amplitudasini o‘lchash: Biopotensiallar juda kichik bo‘lgani uchun (odatda 1 mV dan kichik), kuchaytirgichlardan foydalaniladi.
3. Analog-RAQAM o‘zgartirgichlar: Biopotensiallarni raqamli tahlil qilish uchun signalni raqamlashtirish muhim.
4. Filtratsiya: Biopotensiallarni qayd qilishda atrof-muhit shovqinlari (50/60 Hz elektr shovqinlari yoki mushak faolligi) signalga ta’sir qilishi mumkin. Bu shovqinlarni filtratsiya qilish uchun chastota filtrlari ishlatiladi.
Elektrokardiografiyaning Fizik Modellashtirish Asoslari Yurakning elektr faolligini tushunish uchun yurak elektr modeli ishlatiladi. Yurak mushaklari qisqarishi davomida:
1. Depolarizatsiya: Ijobiy zaryadlarning hujayra ichiga kirishi.
2. Repolarizatsiya: Manfiy zaryadlarning qayta tiklanishi.
Bu jarayonlar vaqt o‘tishi bilan yurak mushaklarida dipol vektorlarini hosil qiladi. Yurakni dipol sifatida qarash Eynthoven uchburchagi modeli bilan tushuntiriladi, unda uchta asosiy elektrod nuqtasi ishlatiladi: o‘ng qo‘l, chap qo‘l va chap oyoq. Ushbu uch nuqta orasidagi kuchlanish farqlari yordamida yurak elektr faolligi qayd etiladi.
EKG Signallarni Talqin Qilish EKG signallaridan yurakning normal va patologik holatlarini aniqlash mumkin. Signal quyidagi asosiy qismlardan iborat:
1. P to‘lqini: Qon atriyalarning depolarizatsiyasi.
2. QRS kompleksi: Qon qorinchalarining depolarizatsiyasi.
3. T to‘lqini: Qon qorinchalarining repolarizatsiyasi.
EKG diagrammasining shakli yurak mushaklarining sog‘lom yoki shikastlanganligini ko‘rsatadi.
Misol uchun: QRS kompleksining kengligi yurak mushaklarining elektr o‘tkazuvchanlik darajasini ko‘rsatadi. P va T to‘lqinlarining o‘zgarishi yurak ritm buzilishlarini ifodalaydi.
Biopotensiallarni Qayd Qilishning Amaliy Tatbiqlari
Biopotensiallarni qayd qilish tibbiyotning turli sohalarida qo‘llaniladi:
1. Elektroensefalografiya (EEG): Miya elektr faolligini qayd qilish.
2. Elektromiografiya (EMG): Mushaklarning elektr signalini qayd qilish.
3. Elektroretinografiya (ERG): Ko‘zning retina faoliyatini o‘rganish.
Elektrokardiografiyaning Texnik Asoslari
EKG apparatlari quyidagi texnologiyalar bilan ishlaydi:
1. Kuchaytirgichlar: Yurak signalini kuchaytiradi.

2. Analog-raqam aylantirgich: Signalni raqamlashtiradi.
3. Filtr tizimi: Tashqi shovqinlarni bartaraf etadi.
4. Chiqarish mexanizmi: Signalni qog‘ozga yoki ekran orqali tasvirlaydi.
Hozirgi zamonaviy EKG apparatlari 12 ta standart elektrod o‘lchovlarini ta’minlaydi, bu esa yurak faoliyatini batafsil o‘rganishga imkon beradi.
Tibbiyot: Elektrokardiografiya yurak kasalliklarini erta aniqlashda eng muhim diagnostik vositalardan biridir.
Fizika va biotibbiyot: Elektrik dipollar va biopotensiallarni o‘rganish fiziologik jarayonlarni matematik modellashtirish imkonini beradi.
Muhandislik: EKG apparatlari signalni qayta ishlash texnologiyalari va qurilmalari sohasida doimiy rivojlanmoqda.
Keling, mavzuni yanada qiziqarli va chuqurroq yoritaman, hayratlanarli faktlar va amaliy tatbiqlarni qo‘shaman.
Yurakning Elektrik Faolligi va Qiziqarli Faktlar
1. Yurak – Tabiiy Elektr Generator: Yurak inson tanasining eng muhim "elektrik stansiyasi" bo‘lib, har bir urish jarayonida 1 mV atrofida kuchlanish ishlab chiqaradi. Bir kun davomida yurak millionlab elektr impulslarini hosil qiladi.
2. Dipollarni Hosil Qilish: Yurakdagi har bir hujayra depolarizatsiya va repolarizatsiya vaqtida kichik dipol sifatida ishlaydi. Bularning jamlanmasi yurakning umumiy elektr faoliyatini hosil qiladi.
3. Har xil holatda EKG: EKGni nafaqat yotgan, balki turib, yugurib yoki suvda turib ham qayd qilish mumkin. Har bir holatda signal o‘ziga xos o‘zgarishlarni ko‘rsatadi.
Elektrokardiografiya Tarixi va Rivojlanishi 1895-yil: Willem Einthoven birinchi marta EKG apparatini ixtiro qildi. U gigant galvanometr yordamida yurak elektr signalini qayd etdi. O‘sha davrdagi apparat bir xonani egallab, o‘lchov uchun ko‘p vaqt talab qilgan.
Hozirgi zamon: Zamonaviy EKG apparatlari kichik hajmga ega, ko‘chma va Wi-Fi texnologiyasi orqali natijalarni smartfon yoki kompyuterga uzatishi mumkin.

Elektrokardiografiya va Kosmik Tibbiyot Astronavtlarning yurak faoliyatini uzoq muddatli parvozlarda nazorat qilish uchun EKGdan foydalaniladi. Nolinchi tortishish sharoitida yurak ritmining qanday o‘zgarishini o‘rganish kosmik tibbiyotning dolzarb masalalaridan biri hisoblanadi. NASA tomonidan maxsus ko‘chma EKG apparatlari ishlab chiqldi.

1. Holter Monitoring: 24-48 soat davomida yurak faoliyatini kuzatish imkonini beradi. Bu usul yordamida yurakdagi vaqti-vaqti bilan yuzaga keluvchi ritm buzilishlarini aniqlash mumkin.

2. Signalning Fraktal Tahlili: Yurak urishlarining matematik xususiyatlarini o‘rganish. Yurak ritmining "fraktalligi" sog‘lom yoki kasallik holatida turlicha bo‘ladi.

3. Oddiy ko‘rinadigan tishlarning sirli ma’nosi: Masalan, EKG diagrammasidagi kichik o‘zgarishlar (masalan, ST segmentining ko‘tarilishi yoki tushishi) infarkt yoki boshqa yurak kasalliklari haqida signal beradi.

Foydalanilgan adabiyotlar

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DOI: https://doi.org/10.5281/zenodo.14499458

AYOLLARDA KO‘KRAK BEZI SARATONI KASALLIGI

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Annatatsiya: *Ushbu maqolada ko‘krak bezi saratoni - ayollar orasida eng keng tarqalgan onkologik kasalliklardan biri bo‘lib u ko‘krak bezining hujayralari o‘sib, nazoratsiz ravishda ko‘payishi natijasida rivojlananishi xaqida ma’lumotlar berilga. Erkaklarda ham uchrashi mumkin, lekin bu holat juda kam uchraydi. Kasallikning o‘z vaqtida aniqlanishi va to‘g‘ri davolash usullarini qo‘llash ko‘pchilik holatlarda bemorning hayotini saqlab qolish imkonini berishi xaqida ma’lumotlar berilgan.*

Kalit so‘zlar: *onkologik kasallik, ko‘krak bezi saratoni, radiatsiya, mammografiya, kimyoterapiya.*

Asosiy sabablari:

1. Genetik moyillik: Agar oila a’zolarida ko‘krak bezi yoki tuxumdon saratoni bo‘lgan bo‘lsa, xavf oshadi.

2. Gormonal o‘zgarishlar: Erta hayz ko‘rish (12 yoshdan oldin) yoki kech menopauza.

3. Yashash tarzi: Nosog‘lom ovqatlanish, semizlik, kam harakatlilik, spirtli ichimliklar istemol qilishda

4. Tug‘maslik yoki kech homladorlik: 30 yoshdan keyin birinchi homladorlik xavfni oshirishi mumkin.

5. Radiatsiya ta’siri: Ko‘krak yoki ko‘krak qafasiga qaratilgan radioterapiya.

Belgilari:

-Ko‘krakda yoki qo‘ltig‘ida paydo bo‘lgan qattiq tugun yoki bo‘rtma.
-Ko‘krak shakli yoki hajmining o‘zgarishi.
-Ko‘rak terisida qizarish, quruqlik yoki yorig‘lar.
-Sut bezi so‘rg‘ichidan qonli yoki boshqa ajalmalar.
-So‘rg‘ichning ichkariga kirib ketishi.

Tashxis qo‘yish usullari:

1. Ko‘rik va o‘zini tekshirish: Har oy ko‘kraklarni qo‘l bilan paypaslab, o‘zgarishlarni tekshirish tavsiya etiladi.

2. Mammografiya: Ko‘krak bezining rentgen tekshiruvi.
3. Ulturatovush (UZI): Ayniqsa yosh ayollarda samarali.
4. Biopsiya: Shubhali o‘simtadan namuna olib, laboratoriya tekshiruvi o‘tkaziladi.

Davolash usullari:

-Jarrohlik: Shish yoki butun ko‘krakni olib tashlash.
-Radioterapiya: Saraton hujayralarini yo‘q qilish uchun nur bilan davolash.
-Kimyoterapiya: Dori vositalari yordamida saratonni davolash.
-Gormonal terapiya: Gormonalar ta’sirini bostirish orqali shishning o‘sishini to‘xtatish.
-Immunoterapiya: Tana immun tizimini saratonga qarshi kurashga safarbar etish.

Oldini olish:

- Sog‘lom turmush tarziga rioya qilish.
- O‘z vaqtida profilaktik ko‘rikdan o‘tish.
- Ko‘krak o‘zini tekshirishni odat qilish.
- Mammografiyani 40 yoshdan oshgach muntazam o‘tkazish.

Xulosa qilib aytish mumkunki: Agar siz yoki yaqinlaringizda yuqorida sanab o‘tilgan belgilar mavzuj bo‘lsa, darhol shifokorga murojaat qilish muhum. Kasalikning dastlabki bosqichida tashxis qo‘yilsa, davolash muvaffaqiyatli bo‘lish ehtimoli yuqori.

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DOI: https://doi.org/10.5281/zenodo.14499481

KITOB GEOLOGIK QO‘RIQXONASI HUDUDIDA TARQALGAN PALEONTOLOGIK YOTQIZIQLAR JOYLASHUVI HAQIDA QISQACHA TAHLIL

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Annotatsiya. *Maqolada Kitob geologik qo‘riqxonasi hududida tarqalgan paleontologik yotqiziqlarga doir ma’lumotlar tahlil qilingan bo‘lib. Hududdagi paleontologik yotqiziqlar Yer kurrasining tabiiy – ilmiy yodgorliklari bo‘lgan geologik va litologik hamda stratigrafik yodgorliklani muhofaza etadi, mintaqadagi geologik ahamiyatga molik yotqiziqlarni reja asosida ular ustida ilmiy – tekshirish ishlari olib borilishini inobatga o‘rganishga oid masalalar muhokama qilingan va tegishli xuloasalar qilingan.*

Kalit so‘zlar: *geologik qo‘riqxona, paleontologiya, litologiya, stratigrafiya, paleozoy, era, devon, ordovik, davr, soy, Tetis dengizi.*

BRIEF ANALYSIS OF THE LOCATION OF PALEONTOLOGICAL DEPOSITS DISTRIBUTED IN THE AREA OF KITOB GEOLOGICAL RESERVE

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Abstract. *The article analyzes data on paleontological deposits scattered in the Kitab geological reserve. Paleontological deposits in the region protect the geological, lithological and stratigraphic monuments that are natural-scientific monuments of the Earth, the issues related to the study of geologically significant deposits in the region in view of conducting scientific-examination work on them based on the plan were discussed and relevant conclusions were made.*

Key words: *geological reserve, paleontology, lithology, stratigraphy, Paleozoic, era, Devonian, Ordovician, era, stream, Tethys Sea.*

KIRISH (ВВЕДЕНИЕ / INTRODUCTION). O‘zbekiston janubida Zarafshon tog‘ining janubiy – g‘arbiy yonbag‘rida Markaziy Osiyo bo‘yicha yagona bo‘lgan Kitob geologik qo‘riqxonasi joylashgan. Bu qo‘riqxona hozirgi kunda butun Mustaqil davlatlar hamdo‘stli (MDH) da yagona bo‘lib, unda boshqa qo‘riqxonalarda olib borilmaydigan ilmiy – geologik ishlar bajariladi. Yer kurrasining tabiiy – ilmiy yodgorliklari bo‘lgan paleontologik litologik va stratigrafik yodgorliklani muhofaza etadi va reja asosida ular ustida ilmiy – tekshirish ishlari olib boriladi.

1978-yilning yozida 13 ta davlatdan kelgan olimlar hozirgi Qo‘riqxona maydonidagi Xo‘jaqo‘rg‘on soyi bo‘yida joylashgan geologik qatlamlardagi paleontologik qoldiqlarni o‘rgandilar. Chunki O‘zbekistonlik hamkasblari paleozoy erasi quyi va o‘rta devon davri yotqiziqlari ichida uchrovchi nodir toshga aylangan organizmlar qoldiqlari to‘g‘risidagi ma’lumotlarni ularga taqdim etgan edilar. Bu qatlamlarni o‘rgangan xalqaro olimlar guruhi toshlarda muhr kabi qolgan paleontologik qoldiqlarning haqiqatdan nodir ekanligini e’tirof etib, ularning davlat muhofazasiga olinishini taklif etishdi.

MUHOKAMA (ОБСУЖДЕНИЕ/DISCUSSION). Kitob geologik qo‘riqxonasi Markaziy Osiyo hududida yagona tashkil etilgan geologik qo‘riqxona bo‘lib, unda Paleozoy erasining quyi Ordovik davridan, yuqori Devon davrigacha o‘tgan vaqt oralig‘idagi qatlamlar uzluksiz yer yuzasiga chiqib yotadi, ular ichida o‘sha davrda yashagn hayvon va o‘simliklarning tosh qotgan qoldiqlari ko‘plab uchraydi. Bu toshga aylangan qoldiqlar yuz million yillab uzoq tarixni so‘ylovchi muhim geologik omil hisoblanadi. Agar, Siz Zarafshon tog‘larining janubiy – g‘arbiy yonbag‘rida Jinnidaryo vodiysi bo‘ylab yuqoriga ko‘tarilsangiz, uning chap irmog‘i Xo‘ja qo‘rg‘on soy bo‘yicha ilgarilab yursangiz, oldingizdan ulug‘vor 2061 metr balandlikdagi Bursi

Xirmon cho‘qqisi ko‘zka bo‘yi cho‘zib turadi. Cho‘qqining ikki yonida Zilzilbon va Xo‘ja qo‘rg‘on soylari joylashgan bo‘lib, ular asosan Paleozoy davri yotqiziqlaridan tashkil topgan. Chekkaroqda esa o‘sha yotqiziqlardan iborat Novobok soyi joylashgandir. Bu soylar va umuman barcha qo‘riqxona maydonining hammasi juda uzoq davrlarda 300 – 420 million yillar oldin, o‘sha davrda mavjud bo‘lgan ulkan Tetis dengizi tagida paydo bo‘lgan. Olimlar fikricha, Tetis dengizining shakllanishi 500 million yil oldin boshlanib, bu joy yer yuzasida paleozoy davrining dengizi sifatida to‘lqinlanib turgan.

Bu vaqtda quruqlik juda kam bo‘lib, u ham hayotsiz bo‘lgan. Barcha hayot ulkan dengiz tagida qolgan. Million – millionlab dengiz hayvonlari dengizda paydo bo‘lganlar, hayot kechirganlar va o‘limidan keyin dengiz tagiga cho‘kib, o‘sha paytda paydo bo‘layotgan dengiz yotqiziqlari ichiga tushib qolganlar. Ularning yumshoq to‘qimalari tezlikda chirib yo‘qolib ketgan, lekin, ustidagi chig‘anoqlari va boshqa qattiq qismlari qulay sharoitda qotib, tosh qatlamlarga aylana boshlagan.

Ma’lum vaqtdan keyin ular o‘zlari rivojlangan davrda paydo bo‘lgan qatlamlar ichida toshga aylangan holda saqlanib qolgan. Keyingi tektonik harakatlar natijasida bu qatlamlar yer yuzasiga chiqqan. Qatlamlarni o‘rgangan mutaxassis geology va paleontology olimlar ularni o‘rganar ekan, go‘yoki ko‘hna kitobni o‘qigan tarixchi kabi tosh qotgan tarix varaqlarini o‘qib, o‘sha joyda yuzlab million yillar oldin o‘tgan hayvonlar tuzilishini, ular tushgan qatlam yoshini va bu qatlamlar paydo bo‘lgan davrdagi tabiiy geologik sharoitni o‘qib beradilar. Qo‘riqxona maydonida joylashgan 13 ta tabiiy yalong‘ochlanib, ichidagi qatlamlari ko‘rinib turgan yonbag‘rlarni o‘rganish natijasida olimlar asta –sekin sobitqadamlik bilan qo‘riqxona joylashgan joyning geologik tarixini o‘qib olish imkoniyatiga ega bo‘ladilar.

Qo‘riqxona hududida joylashgan Shaxriomon – 1, Shaxriomon – 2, Qorasuv, Novabak, Obi – Safit, Zilzilbon, Xodjaqo‘rg‘on, Noviko‘shq soylarida yer yuzasiga chiqib turgan qirqimlar, qo‘riqxona maydonidagi paleogeografik sharoit va qatlamlarning yoshini to‘liq aniqlash imkoniyatini berdi.

O‘tkazilgan geologik izlanishlar shuni ko‘rsatdiki, qo‘riqxona maydonidagi eng keksa qatlamlar – Obikalon qatlamidagi terrigen yotqiziqlaridir va ular to‘rtta pastki qatlamlarida joylashgan. Ularning zarrali tarkibi va tekstura – struktura belgilari asosida hamda nodir paleontologik qoldiqlari bo‘yicha shunday xulosa chiqarildiki, ushbu terrigen materiallar, dengizning shel’f zonasi chekka qismida yig‘ilgan. Karadok asrining boshlanishida, ko‘pchilik maydonlarda har xil korallar, braxionidlar, trilobitlar, ignatanlilar, mshankalar, blastoideyalar va pelisilodlar yashagan. Shu davrdagi dengizning markaziy Osiyo va G‘arbiy Yevropa dengiz basseynlari bilan kuchli aloqasi bo‘lgan.

Qo‘riqxona maydonidagi mahalliy stratigrafik o‘lchovdan yuqori Ordovik Obikanda, Chashmakalon va archalik qatlamlaridan tashkil topgan. Ulardagi har xil toshga aylangan qorallar va chig‘anoqli organizmlar o‘sha davrdagi shel’fning sayozlashganini ko‘rsatadi. Bu sharoit ordovik oxirigacha saqlanib qolgan va bu davrda hozirgi Xitoy, Qozog‘iston, qisman Sibir, Shimoliy Amerika va g‘arbiy Yevropa dengizlari bilan biogeografik aloqa bo‘lgan.

Silurning oxirida, prjidol asrida ikkinchi dengiz bosib kelishi (tranegressiyasi) bo‘lib o‘tgan. Kengaygan dengiz sathida har xil faunalar sharoit yuzaga kelgan. Faunaning yangi turlari paydo bo‘lgan. Geologiya davrining bu qismi Obi – Safit soyi yonbag‘rida Qoratog‘ning shimoliy yonbag‘rida yaqqol ko‘zga ko‘rinadi. Strategrafik sxemada bu vaqt yuqorida arg yoki kupruk qatlamlari taxlami shaklida ko‘rinadi. Litologiyaning dolomitlar, dog‘li yo‘l – yo‘l dolomitlarning ohaktoshlar tomon asta – sekin o‘zgarib borishi dengiz sharoitining keskin o‘zgarmasdan bir – biri bilan almashib borganini ko‘rsatadi. Bu davrda faunaning tarkibiy qismi kengayib brogan va ayniqsa, silur – devon chegaralarida u ko‘zga tashlanadi.

Devonning boshlanish davrida qo‘riqxona maydonida kech silur davri transgressiya vaqtidagi sharoit saqlanib qolgan qo‘riqxona maydonida lohkov va praga asrlari uchun xos massiv ohaktoshlat qatlamlari 1000 metrga qadar qalinlikda yotadi va modmon qatlamlar taxlami deb ataladi. Geologlar A.I.Kim, L.S.Lesovoy olib brogan izlanishlar shuni ko‘rsatdiki, modman taxlamidagi ohaktoshlar qatlamlari qo‘riqxona maydonidan ancha uzoqga cho‘zilib, she’fning markaziy qismida yig‘ilib qolgan.

Shunday qilib, Kitob geologik qo‘riqxonasi o‘z mavqeyi bo‘yicha o‘ta ahamiyatli bo‘lib, u avvalo, tabiatning nodir mahsulotlarini muhofaza qilish uchun yaratildi. Ya’ni Kitob geologik qo‘riqxonasi Yerning geologik tarixini himoya qiluvchi tabiiy – ilmiy ahamiyatga ega bo‘lgan paleontologik – statigrafik qatlamlarni muhofaza etish va rejali o‘rganish uchun yaratildi. U hozirgi Markaziy Osiyo hududida yagona tuzilgan va regional stratigrafiyaning ko‘pchilik bahsli masalalarini hal etuvchi hamda paleontologo – stratigrafik qatlamlardagi tuzilish va qadimiy hayvonlar va o‘simliklarning tosh qotgan qoldiqlarini rejali ravishda o‘rganuvchi qo‘riqxonadir. Bu qo‘riqxonada olib borilayotgan ilmiy ishlarning ahamiyati shundan iboratki, hozir yer kurrasining eng ko‘p qismida yirik masshatbli geologik xaritaga tushirish ishlari olib borilib, bu ishlarni taqqoslash uchun ishonchli etalon namunali joy kerak. Ma’lumki, geologik xaritaga olish ishlari qanchalik sifatli bo‘lsa, mineral xom ashyolarni, yoki foydali qazilmalar yig‘ilib qolgan joyni topis shunchalik tezlashadi. Bu joyda so‘z faqatgina paleontologik qoldiqlarga boy bo‘lgan cho‘kindi tog‘ jinslarida emas, balki ular bilan aloqasi bo‘lmagan, magmatik tog‘ jinslari ustida ham bormoqda. Bu jinslar kam uchrovchi maydonlarning aniq geologik tuzilishini tahlil qilish natijasida undagi

tektono – magmatik aktiv zonalarni aniqlash va paydo bo‘lgan rudali foydali qazilmalar yig‘ilib qolgan maydonlarni toppish imkonini beradi. Birinchi navbatda bunday izlanishlar otrotoform foydali qazilmalar deb ataluvchi hamda cho‘kindi va tektona – magmatik jarayonlarning bir – biriga ta’siri natijasida yuzaga kelgan foydali qazilmalarni toppish imkonini beradi.

Ko‘rinib turibdiki, aniq stratigrafik sxemalar tuzilishi – geologic semkalar asosi ekanligi, ayniqsa, uning markaziy qismi bo‘lgan stratigrafik kolonkalar yasashda ajralmas qismi ekanligi ayon bo‘lmoqda. Buning uchun cho‘kindi jinslarni iloji boricha maksimal aniq ko‘rinuvchi qatlamlarga bo‘lish, har bir qatlamning yoshi va kelib chiqishi paleontologik topilmalar asosida isbotlangan bo‘lishi kerak. Faqatgina paleontologik tosh qoldiqlargina har bir qatlam to‘g‘risida aniq ma’lumot beradi, strukturali – faunal zonalar chegarasini aniq ko‘rsatadi, regional to‘qnashish bo‘lgan joylar aniqlanadi. Qo‘riqxona maydonidagi toshga aylangan o‘tgan davr o‘simlik va hayvon qoldiqlarini o‘rganish yuqoridagi praktik vazifalarni va stratigrafiya fanining umumiy va vazifalarini yoritish imkonini beradi.

XULOSA (ЗАКЛЮЧЕНИЕ/CONCLUSION). Hozirgi vaqtda planetamizning ko‘p joylarida qadim zamonlarda yashagan sodda hayvonlar qoldiqlari yig‘ilib qolgan toshli qatlamlar uchraydi. Ularning har qaysisi fan uchun o‘sha joydagi organik hayotning paydo bo‘lishi va rivojlanishi to‘g‘risida yangi ma’lumotlar beradi. Shu sababli Qashqadaryo viloyati hududidagi Zarafshon tog‘lari janubiiy yonbag‘irlarida joylashgan Kitob geologic qo‘riqxonasi tabiat fenomeni bo‘lib, yerning tuzilishi to‘g‘risidagi bilimni yanada yaqqol tasavvur qilishga, mukammal o‘rganishga yordam beradi.

Yer kurrasida minglab mutaxassis paleontologlar bor. Ular organik hayot paydo bo‘lishi, rivojlanish qonunlarini o‘rganadi. Bu o‘z navbatida geologlarga qo‘l keladi. Umuman yer kurrasining har qanday qismining geologik tuzilishini bilish o‘sha joydagi foydali qazilmalarni ko‘r – ko‘rona izlashga qaraganda oson kechib, geolog qo‘lidagi paleontologlar tuzgan ma’lumotlar asosida topilgan foudali qazilmalar ancha arzonga ham tushadi. Har bir paleontolog o‘zi o‘rgangan region to‘g‘risidagi ma’lumotga ega bo‘ladi va bu ma’lumotlar regiondan – regionga qismma – qism yig‘ilib geolog qo‘lidagi asosiy hujjat, geologik xaritaga aylanadi. Butun dunyo paleontologlari o‘zaro uchrashishar ekan, ular o‘zlaridagi ma’lumotlarni almashishadi, yig‘ishadi va tahlil qilishadi. Shu sababli o‘sha vaqtda tashkil etilgan Kitob geologik qo‘riqxonasi bu mas’ul vazifani butun dunyodagi va Markaziy Osiyo hududidagi paleontologlarning yig‘ilib maslahatlashadigan joyiga aylandi.

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YER QOBIG‘IDA KONVEKSIYA NATIJASIDA SUPERKONTINENTLARNI SHAKLLANISHI VA QAYTA O‘ZGARISHI

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Annotatsiya. *Ushbu maqolada Yer qobig‘ida konveksiya natijasida superkontinentlarni shakllanishi va qayta o‘zgarishiga doir fikr va qarashlar qisqacha muhokama qilingan. Jumladan Yer sayyorasida okeanlar va materiklarning paydo bo‘lishi masalasi yer qobig‘i va litosferaning shakllanishini o‘rnatishga doir mulohazalar va ularni aniqlashni optimal usullarini yoritishda konveksiya jarayonlarining mohiyati haqida mulohazalar yuriligan.*

Kalit so‘zlar: *konveksiya, superkontinent, litosfera, Monogea, Megageya, Rodiniya, Pangeya, overton, mantiya, issiq massa.*

ORGANIZATION OF PAST TECTONIC ACTIVITIES ON EARTH AND METALLOGENY OF RARE ELEMENTS

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Abstract: *This article discusses the distribution of metallic minerals formed in the earth's crust as a result of changes in the Earth's history, and the complications of their formation.*

In particular, issues such as zones of activated structures in geosynclinal regions or analysis of geocyclinal regions, distinctive structures, various sums of sediments and volcanogenic-sedimentary products, their properties related to the magmatism process, and connection of specific metallogeny with activation events were briefly analyzed.

Keywords: *Tectonic activation, geosynclinal, fold, sedimentary, volcanogenic, magmatism, metallogeny, sial, platform, oceanization, belt, orogen, speciation, granite, hypabyssal, dacite, rhyolite, basalt, granosenite, granodiorite, heterogeneous.*

KIRISH (ВВЕДЕНИЕ/INTRODUCTION). Yer sayyorasida okeanlar va materiklarning paydo bo‘lishi masalasi yer qobig‘i va litosferaning shakllanishi masalasidir. Sayyoramizdagi birlamchi qobiq 4,5 milliard yil avval butun sayyorani qalinligi o‘nlab kilometr qalinlikdagi qatlam bilan qoplagan birlamchi magma okeanining sovishi va kristallanishi natijasida paydo bo‘lgan degan fikr-mulohazalar hozirgi geologik ma'lumotlarda aks etadi.

MUHOKAMA (ОБСУЖДЕНИЕ/DISCUSSION). Birinchi magmatik eritmalar paydo bo‘lishidan 200-300 million yil oldin Yer qattiq to‘p bo‘lib, o‘rtacha mineralogik tarkibda bir hil, qobiqlarga bo‘linmagan. Bosim va radioaktiv elementlarning parchalanishi ta'sirida sayyoramizning markaziy qismlarida harorat ko‘tarildi, ammo harorat tog‘ jinslarining erishi boshlangan chegaralarga etib bormadi. Er materiyasining erishi, asosan, Oyning to‘lqinli ta'siri bilan osonlashdi. O‘sha qadimgi davrlarda Oy Yerga ancha yaqinroq edi va oy to‘lqinlarining ta'siri Oyning Yerni aylanib chiqqanidan keyin er yuzasi bo‘ylab ko‘chib yuruvchi balandligi 1 km gacha bo‘lgan ulkan shish shaklida ifodalangan. Oyning jalb etilishi Yer yuzasi qatlamining haroratining dastlabki oshishida hal qiluvchi omil bo‘ldi, bu esa pirovardida tektonik jarayonlarning boshlanishiga va Yer sayyorasining eng murakkab paleogeografik evolyutsiyasiga olib keldi.

Vaqt o‘tishi bilan birlamchi jinslarning erishi sayyoramizning butun yuzasini qoplagan, ammo o‘sha kunlarda 2000 ° C gacha bo‘lgan juda yuqori haroratga ega bo‘lgan jinslar yuqori bosim tufayli 100 kilometrdan ham chuqurroq suyuqlik holatiga kira olmadi. shunday chuqurliklarda. Ko‘pincha qattiq holatda bo‘lishiga qaramay, yer materiyasining konvektiv harakati jarayonlari chuqurlikda, qattiq, lekin juda plastik materiya yuqoriga ko‘tarila boshlaganda va yer yuzasiga yaqin sharoitda sovib, cho‘kishni vaqtida boshlangan. Asta-sekin konveksiya Yerning butun hajmini qamrab oldi. Suyuq magma okeanida konvektiv jarayonlar tabiiy ravishda shunchalik tez sodir

bo‘ldiki, zo‘rg‘a qotib qolgan birlamchi qobiq ko‘tarilgan magma oqimlarining yangi qismlari tomonidan yorilib, chuqurliklarga olib borildi, bu yerda qobiqning bo‘laklari yana erishga duchor bo‘ldi.

Sharoitga, aniqrog‘i magmaning qotib qolish chuqurligiga qarab magmatik jinslar ikki xil - intruziv va effuziv jinslarni hosil qiladi. Cho‘kindi-vulqon jinslari, ya’ni havoga ko‘tarilgan vulqon otilishi mahsulotlari magmatik va cho‘kindi jinslar o‘rtasida oraliq joyni egallaydi.

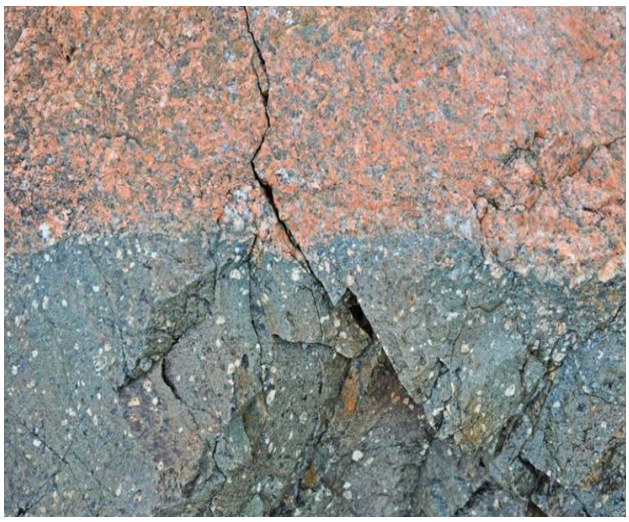
Intruziv jinslar (intruzivlar) ko‘pincha 3 km dan ortiq chuqurlikda hosil bo‘ladi, bu erda magma sekin soviydi va minerallar kristallanish uchun etarli vaqtga ega. Intruziv jinslarning mineral donalari aniq ko‘rinadigan o‘lchamlarga qadar o‘sib boradi va jins golokristalli tuzilishga ega bo‘ladi. Kremniyning (kremniy oksidi) foiziga qarab intruziv jinslar kislotali jinslarga bo‘linadi - masalan, granit; o‘rtacha - diorit; asosiy - gabbro, anortozit; ultrabazik - peridotit, piroksenit. Bu qatorda jinslardagi kvarts miqdori kamayadi, quyuq rangli minerallar va zichlik esa ortadi. Granit och rang-barang jins, piroksenit yashil-qora rangda.

Effuziv jinslar (effuzivlar) intruziv jinslar bilan bir xil magmadan hosil bo‘ladi. Ularning orasidagi farq asl magmatik eritmaning qotib qolish chuqurligidadir. Effuziyalar (vulqonlar) sayoz chuqurliklarda qotib qoladi va shuning uchun asosiy jinslarning past haroratida ularning kristallanishi intruziyalarga qaraganda tezroq sodir bo‘ladi. Mineral tarkibi bo‘yicha effuzivlar intruziyalarga juda yaqin bo‘lib, bu jinslar guruhlari orasidagi asosiy farq ularning tuzilishidadir. Effuziv magma kristallarining muhim qismi ko‘rinadigan o‘lchamlarga o‘sishga vaqtlari yo‘q, lekin alohida kristallar ko‘rinadigan o‘lchamlarga o‘sadi va keyin jinsning tuzilishi porfiriya deb ataladi.

Bundan tashqari, effuziv jinslar to‘g‘ridan-to‘g‘ri lava shaklida er yuzasiga quyiladi yoki vulqon otilishi paytida kul va qoldiqlar shaklida to‘planadi. Bunday jinslar vulkanogen-cho‘kindi yoki magmatik, yer yuzasiga chiqmasdan hosil bo‘lgan effuziv jinslar subvulkanik deyiladi. Yer yuzasiga oqadigan ba’zi lavalar shunchalik tez soviydiki, kristallar umuman hosil bo‘lishga ulgurmaydi va tosh amorf ko‘rinishga ega bo‘ladi - vulqon shishasi hosil bo‘ladi.

Effuziv jinslar kislotali jinslarga ham bo‘linadi - riolit, dasit; o‘rtacha - andezit; asosiy - bazalt; va ultrabazik - pikrit. Ushbu ketma-ketlikdagi zichlik oshadi va kremniy oksidi tarkibi intruziv jinslar qatoriga o‘xshash tarzda kamayadi. Effuziv (vulqon) jinslar, intruzivlar kabi, kvarts miqdori kamayishi bilan qorong‘i va og‘irroq bo‘ladi. Barcha effuziv jinslarning intruziv jinslar orasida o‘xshashi bor.

Intruziya - magmaning chuqur kirib borishi yoki har qanday chuqurlikda qattiq intruziv jismni kiritish jarayoni. Effuziya - magmaning Yer yuzasiga yaqin kirib kelishi va lavaning quyilishi.



1-rasm. Toshko‘mir davri (300 mln. yil) andezit lavasi ordovik davri (450 mln. yil) granitlariga kirib kelganidan keyin magmatik kontakt. Janubi-Sharqiy Qozog‘iston (Aleksandr Babkin surati).

2-rasm. Bazaltli lava oqimlari Gavayi orolidagi o‘rmonlarni muntazam ravishda yo‘q qiladi. (Aleksandr Babkin surati)

Yer yuzida birinchi yarim milliard yil davomida faqat ultramafik va mafik tarkibli magmatik jinslar kristallanib, okean qobig‘ini tashkil etdi. Prinsipial ravishda yangi intruziv kislotali magmatik jinslarning paydo bo‘lishi juda murakkab kontinental qobiqning shakllanishi bilan bevosita bog‘liq.

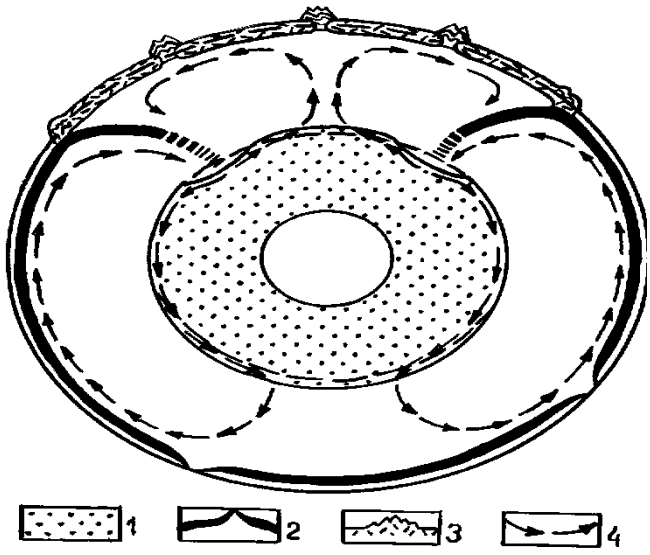
Mantiyadagi konveksiya. Yuqorida ta’kidlab o‘tilganidek, Yerning ichki qismidagi yuqori isitiladigan moddalarning konvektiv aylanishlari butun sayyorani qamrab oldi. Oy konveksiyaning boshlang‘ich omili bo‘lgan, ammo keyinchalik konvektiv harakatlar yer moddasidan temir birikmalarining ajralib chiqishi va ularning sayyora markaziga joylashishi paytida issiqlik chiqishi bilan qo‘llab-quvvatlangan. Bu jarayon yadroning chiqishi bilan sayyoraning zichligi va kimyoviy farqlanishiga olib keldi, bu konvektiv siklni rag‘batlantiruvchi qo‘shimcha omil bo‘ldi. Temirning zonali farqlanishi mantiyadagi elementlarning radioaktiv parchalanishi paytida chiqarilgan issiqlik miqdoridan oshib ketadigan sezilarli issiqlik chiqishi bilan birga keladi.

NATIJALAR (РЕЗУЛЬТАТЫ/RESULTS). Dastlab, konveksiya noma’lum miqdordagi aylanishlar bilan ko‘p darajali xususiyatga ega edi. Konvektiv tizim hujayra tuzilishiga ega bo‘lib, ma’lum miqdordagi ko‘tarilgan magmatik oqimlarning bir markazga to‘planishi va shunga mos ravishda bitta pastga oqim paydo bo‘lgan. Bunday pastga tushadigan oqim ustida birlamchi bazalt qobig‘ining bo‘laklari to‘planib, konvektiv oqimlar bilan parchalanib, keyinchalik sezilarli tezlikka ega edi. Bazaltik qobiq erishi uchun vaqt topa olmadi va konveksiya markazida to‘plandi. Shunday qilib, yuzlab kilometr uzunlikdagi va magma okeaniga o‘nlab kilometrga

cho‘milgan bazalt plitalarining qoziqlari asta-sekin shakllandi. Qoziqning suv ostida qolgan qismida harorat va bosim ta’sirida bazaltlar avval metamorfizmga uchrab, gneyslar va metamorfik shistlarga aylangan, so‘ngra magma kamerasi hosil bo‘lishi bilan qisman erib ketgan. Bundan tashqari, qadimgi bazaltlardan avval kremniy (kremniy oksidi) bilan boyitilgan eritma eritilgan, chunki kremniy oksidi bazaltlar tarkibida eng kam eriydigan mineral hisoblanadi. Ko‘pincha magma erishi shu erda tugaydi. Shunday qilib, magma markazi hosil bo‘lib, kremniy bilan boyitilgan, ya’ni tarkibi kislotali bo‘lib, kremniy dioksidi bazaltdan engilroq bo‘lganligi sababli, eritma yuqoriga ko‘tarilib, metamorfik jinslarni eritib, granit gumbaz yoki er yuzasiga suzadi. bazalt va metamorfik plitalar o‘rtasida yumaloq plato. Shu bilan birga, bazaltik po‘stlog‘i bo‘laklarining to‘planishi kamdan-kam hollarda xaotik xususiyatga ega edi - plitalar bir-birining ostida harakatlanib, granit massivi atrofida halqali tuzilmalar yoki o‘qlarni hosil qildi.

Yer tarixining boshida konvektiv hujayralar soniga ko‘ra 40 ga yaqin granit-gneys gumbazlari guruhi shakllangan deb taxmin qilinadi. Ushbu 40 ta guruh hozirgi kungacha saqlanib qolgan, lekin juda eroziyalangan shaklda va ular qisman keyingi cho‘kindi bilan qoplangan.

3-rasm. Avstraliyaning shimoli-g‘arbiy qismidagi 3,7 milliard yillik granit-gneys gumbazi



4-rasm. Superkontinentning parchalanishiga olib keluvchi ikki zanjirli umummantiya konveksiyasi modeli. (O.G.Soroxtin). 1. Tashqi yadro. 2. Okeanik po‘st. 3. Kontinental litosfera. 4. Konvektiv oqimlar

Granit-gneys gumbazlari zamonaviy qit’alarni tashkil etuvchi kelajakdagi kontinental plitalarning embrionlari edi. Bundan tashqari, kontinental qobiq 2,5 milliard yil davomida arxey eonida allaqachon 70-75% tashkil topgan.

Arxey eonida - Yer rivojlanishining eng dastlabki bosqichida kontinental litosfera ikkita asosiy tektonik jarayon: yupqa bazalt po‘stlog‘ining paydo bo‘lishi va uning g‘arq bo‘lishi, so‘ngra metamorfizm va granit jinslarining erishi natijasida hosil bo‘lgan. Hozirgi vaqtda xuddi shunday litosfera hosil bo‘lish jarayonlari qo‘shnimiz Venerada sodir bo‘lmoqda. Er yuzasining radar tasvirlariga ko‘ra, u erda quruqlikdagi chuqur yoriqlar va o‘rta okean tizmalariga o‘xshash tuzilmalar aniq ko‘rinadi, ammo zamonaviy er usti plitalarining tortishish zonalari tuzilmalari mavjud emas. Venerada quruqlikdagi granit-gneys gumbazlari va shaftalarini kuchli eslatuvchi tepalikli platolar atrofida oqib o‘tadigan cho‘zilgan tizmalar ko‘rinishidagi tarozilarning xarakterli tuzilmalariga ega bo‘lgan qobiq plitalarining keng tarqalgan zonalari mavjud. Lakshmi platosining Maksvell tog‘lari bilan tutashgan joyidagi Venera hududi shunday ko‘rinadi. Plato va tog‘lar o‘rtasidagi chegara plato tekisligidan Maksvell tog‘larining tik yonbag‘iriga keskin o‘tishga o‘xshaydi, 11 km balandlikka yetadi.

Materiklar evolyutsiyasi ichki qismdagi konvektiv oqimlarning evolyutsiyasi bilan bevosita bog‘liq. Tadqiqotlarga ko‘ra, shu jumladan mantiya konveksiyasining rivojlanishini kompyuterda modellashtirish, olimlar er konveksiyasi tarixidagi va, ehtimol, butun Yer tarixidagi eng muhim voqealar - bu sayyoradagi o‘zgarishlar degan xulosaga kelishdi. ko‘p hujayrali ko‘p qavatli bir hujayrali bir qavatli rejimga qadar konvektiv giruslar rejimi. Bu birinchi marta Arxeyda sodir bo‘ldi - keyin ko‘p ko‘tariladigan va tushuvchi oqimlarga ega bo‘lgan tizim o‘rniga bir nechta ko‘tariladigan va bitta tushuvchi oqimli tizim - superko‘chki paydo bo‘ldi. To‘qnashuv pastga yo‘naltirilgan superoqim ustidagi hujayrada sodir bo‘ldi, bu erda barcha birinchi kontinental plitalar to‘planib, granit-gneys gumbazlari va shishlarining murakkab kollajini ifodalaydi. Shunday qilib, arxey va proterozoy davrining burilish chog‘ida, taxminan 2,6 milliard yil oldin, Yerning birinchi birlashgan superkontinenti - Monogea paydo bo‘ldi.

Ikki yarusli konveksiya oqimlari yuz millionlab yillar davomida quyi mantiya haddan tashqari qizib ketganligi sababli yuqori mantiya qatlamiga pastki qatlamdan issiqlik o‘tkazilishiga to‘sqinlik qilgan. Shu bilan birga, yuqori mantiya o‘ta sovib ketdi. Natijada, yuqori mantiyaning sovutilgan og‘ir massalari pastga tomon keskin tezlik bilan cho‘ka boshlagan va quyi mantiyaning issiq massalari yuqoriga ko‘tarila boshlagan almashinuv vaqti keldi. Yuqori va quyi mantiya materiallarini o‘zaro almashinishi sodir bo‘ldi – bu jarayon overton deb ataldi. Sovutilgan material yana bitta superqatlam oqimi shaklida cho‘kdi va quyi mantiyaning issiq moddasi bir yoki bir nechta oqim shaklida ko‘tarildi. Super kuchlanishli ta’sir oqibatida sayyoraning

yana bir superkontinenti - Megageya paydo bo‘ldi. Yangi superkontinentning paydo bo‘lishi taxminan 1,9-1,8 milliard yil oldin sodir bo‘ldi.

Taxminan 1 milliard yil oldin uchinchi yirik o‘zgarish sodir bo‘ldi, ushbu o‘zgarish natijasida Rodiniy (Mezogeya) superkontinenti shakllandi.

Yer tarixidagi so‘nggi, to‘rtinchi superkontinent - Pangeya Perm davrining o‘rtalaridan (taxminan 270 million yil oldin) 200 million yil oldin yura davrining boshigacha mavjud edi.

XULOSA (ЗАКЛЮЧЕНИЕ/CONCLUSION). Monogea, Megageya, Rodiniya va Pangeya superkontinentlarining hosil bo‘lish vaqtini tektonik eralarning tugash vaqti bilan solishtirish kerak: bular quyidagicha nomlanadi:

1. Kenoran 2600 ± 100 million yil oldin.
2. Svekofennian 1800 ± 100 million yil oldin.
3. Grenvil - 1 milliard yil oldin.
4. Gertsin 230 million yil oldin.

Hozirgi vaqtda Yer ikki qavatli konveksiya davrini boshdan kechirmoqda. Beshinchi superkontinent paydo bo‘lgunga qadar, ehtimol, taxminan 250 million yil vaqt qolgandir.

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DOI: https://doi.org/10.5281/zenodo.14499518

ОПРЕДЕЛЕНИЕ МАКРО-МИКРОЭЛЕМЕНТОВ В КОРНЯХ И СТЕБЛЯХ РАСТЕНИЙ RUBUS IDAEUS L., RUBUS CAESIUS L., ПРОИЗРАСТАЮЩИХ В ФЕРГАНСКОЙ ОБЛАСТИ

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АННОТАЦИЯ

Проведено изучение макро- и микроэлементы в корнях и стеблях растений Rubus idaeus L., Rubus caesius L., произрастающих в Ферганской области, с использованием эмиссионного спектрометра с индуктивно связанной плазмой. Показаны также ботаническое описание растений, химический состав и применение их в медицине.

Ключевые слова: *Rubus idaeus L., Rubus caesius L., макроэлементы, микроэлементы, тяжелые металлы, плазменный ИСП-масс-спектрометрия, биологическая пищевая добавка, народная медицина, минерализация, автоклав.*

DETERMINATION OF MACRO-MICROELEMENTS IN THE ROOTS AND STEMS RUBUS IDAEUS L., RUBUS CAESIUS L. PLANTS GROWING IN THE FERGANA REGION

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ABSTRACT

This article presents of the macro- and microelements in the roots and stems of Rubus idaeus L., Rubus caesius L. plants growing in the Fergana region was carried out using an inductively coupled plasma emission spectrometer. A botanical descriotion of plants, their chemical composition and their use in medicine are also shown.

Key words: *Rubus idaeus L., Rubus caesius L., macroelements, trace elements, heavy metals, plasma ICP-mass spectrometry, biological food additive, folk medicine, mineralization, autoclave.*

Введение

В настоящее время виды экспорта и импорта в Узбекистане увеличиваются. При присвоении международных кодовых номеров очень важно знать их химический состав и уметь использовать на практике [1].

Лекарственное использование фруктов и ягод отработано в системах традиционных медицин в течение тысячелетий. Громадную пользу, пищевую и лекарственную ценность фруктов и ягод не станет отрицать ни один диетолог, ни один врач, да и любой здравомыслящий человек, даже не обремененный высшим или средним медицинским образованием [2].

Rubus-это род растений семейства Розовые, включающий в себя около 250 видов. Это кустарники с яркими зелеными листьями и маленькими белыми или розовыми цветками. Некоторые виды рубуса плодоносят ягодами, такими как Rubus idaeus L. (малина) и Rubus caesius L. (ежевика сизая). Представители рода славятся своими ароматными ягодами, которые человечество употребляет в пищу с древних времен. Плоды диких видов вкусны и широко доступны,

поэтому культурные сорта начали селекционирвать в конце XIX века. Сегодня присутствуют десятки сортов Rubus idaeus L. и Rubus caesius L.,а также разнообразные межвидовые гибриды этих растений.

Rubus idaeus L. (малина обыкновенная), вид растений рода рубус семейства розовых. Естественный ареал: Северная Африка, Европа, Кавказ, Сибирь, Центральная Азия, Северная Америка, а также на территории Турции, Китая и Япония.

Rubus caesius L. (ежевика сизая) относится к роду Рубус семейства Розовые (Rosaceae L.). Распространена по всей европейской части Российской Федерации за исключением северо-запада, в Западной Сибири, Средней Азии, Крыму, на Кавказе и Северной Америке.

Rubus idaeus L. обладает лечебными и полезными свойствами. Полезен не только свежий и замороженный плод ягоды, но и листья, ветки и даже корни. Во время простудных заболеваний нередко пьют чай и отвар из сушеных и свежих листьев и ягод. Калорийность свежей малины на 100 г составляет 45 ккал. Питательные вещества продукта практически не утрачиваются во время приготовления, за исключением термической обработки высокой температурой.

Плоды всех ежевик съедобны. В них содержится огромное количество полезных веществ. Калорийность 100 г ягод составляет 31-36 ккал (в зависимости от сорта). В ежевике отсутствуют жиры, количество белков достигает 1,5-2 г, а углеводов 4,4-7,4 г. Ежевика на 88% состоит из воды, потому она очень хорошо утоляет жажду.

Стебли прямостоячие. Побеги первого года травянистые, зелёные с сизым налётом, сочные, покрыты тонкими, обычно частыми миниатюрными шипами. На второй год побеги деревенеют и приобретают коричневый цвет сразу после плодоношения засыхают, но из того же корня на следующий год вырастают новые стебли.

Ежевика сизая кустарник, достигающий 50—150 см в высоту. Годовалые побеги цилиндрические, с жёлто-зелёными гладкими или опушёнными ветками и многочисленными небольшими шипами неправильной формы.

Цветки сравнительно большие, с опушёнными зелёными чашечками и белыми, широко-эллипсоидными лепестками. Тычинки почти равные по длине пестику. Плоды состоят из немногочисленных костяночек чёрного цвета, покрытых сизым налётом, с крупными приплюснутыми косточками. Основное цветение с мая по август, после августа – единичное и нерегулярное. Плодоносит ежевика с конца июля по конец сентября, пик приходится на август.

Цель настоящего исследования заключается в определении макро и микроэлементов растениях Rubus idaeus L. и Rubus caesius L., произрастающих на территории Ферганской области, Республики Узбекистан.

Материалы и методы исследования

Для определения качества и количества макро- и микроэлементов в растениях зимой собирали стебель и корень (на высоте 10 см над почвой). Собранные образцы очищали от остатков почвы и сушили в тенистом месте.

Объект исследования. Два вида рубуса малина обыкновенная Rubus idaeus L (экз. № 1) и ежевика сизая Rubus caesius L. (экз. № 2) был выбран для анализа. 0,1000 г образца переносили в тефлоновые автоклавы. К нему добавляли 3 мл очищенной концентрированной азотной кислоты (HNO_3) и с 2 мл концентрированной перекиси водорода (H_2O_2).

Проводили автоклавное разложение образцов с использованием оборудования ***Berghof (***Speed Wave Xpert или аналогичная микроволновая печь***) по соответствующей программе.*** В этом методе количество указанных автоклавов, а также температура и давление внутри них автоматически контролируются устройством. Информация о процессе контролируется жидкокристаллическим дисплеем. Его проводили в условиях мокрого разложения в течение 35-45 мин в условиях минимальной температуры T (50°C) и максимальной температуры T (230°C), давления P [бар] max 40 [бар] внутри автоклавов.

Автоклавы охлаждали до комнатной температуры и находящуюся в них жидкую смесь разливали в мерные колбы вместимостью 50 или 100 мл (до метки). В этом случае автоклавы промывают 2-3 раза, а затем доливают до трубки бидистиллированную воду.

Минерализованный раствор количественно анализируют с помощью оптико-эмиссионного спектрометра с индуктивно-связанной плазмой Perkin Elmer Avio-200 (ICP-OES) (или аналогичного аналогового прибора) по сравнению со стандартной пробой, содержащей количество макро- и микроэлементов, солей тяжелых металлов, и редкие металлы. Аналитические результаты автоматически рассчитывают значения точности и стандартного отклонения (RSD) путем пересчета результатов на основе массы образца и значений разбавления в конце процесса.

Параметры устройства:

ИСП ОЭС Avio-200 (ICP-OES) или аналогичный масс-спектрометр:

Программируемая микроволновая печь - Berghof или аналогичная микроволновая печь:

Тефлоновые автоклавы, мерные колбы.

Реактивы:

Мультиэлементный стандарт для МС (29):

Мультиэлементный стандарт для МС (редкие металлы):

Стандарт – Hg (ртуть):

Азотная кислота (х/ч) очищенная:

Перекись водорода (х/ч):

Деионизированная вода:

Аргон (уровень чистоты 99,995%).

Результаты и их обсуждение

Установлено, что в растительных образцах *Rubus idaeus L. и Rubus caesius L.* присутствуют 7 макро- и 13 микроэлемента. Их общая сумма в образцах *Rubus idaeus L.* составляет 10386,0058 мг/кг, а в *Rubus caesius L.* – 8789,864 мг/кг.

В надземной части *Rubus idaeus L.* определены 7 макроэлементов, таких как Al, Ca, Cr, Cu, Zn, Se и Fe, общее количество которых составляет 10369,414 мг/кг. А в надземной части *Rubus caesius L.* определены 9 макроэлементов, таких как Cr, Cu, Mg, Mn, Fe, Na, Ni, Zn и Se, общее количество которых составляет 8754,983 мг/кг (Таблицы 1 и 2).

Таблица 1.

Содержание макро- и микроэлементов растения Rubus idaeus L.

№	Элементы	Целые числа	Концентрация-1 (мг/л)	Стандартные отклонения (RSD %)	Концентрация-2 (мг/кг)
1.	Ag	965	-0.0014 мг/л	2.63	-0.8669 мг/кг
2.	Al	152587	0.1646 мг/л	0.30	105.6 мг/кг
3.	Hg	505	0.0007 мг/л	12.26	0.4536 мг/кг
4.	As	163	0.0046 мг/л	11.56	2.984 мг/кг
5.	Ba	117875	0.0354 мг/л	0.54	22.73 мг/кг
6.	Ca	29482267	15.88 мг/л	1.18	10190 мг/кг
7.	Cd	1104	0.0004 мг/л	4.63	0.2668 мг/кг
8.	Co	277	0.0006 мг/л	1.69	0.3572 мг/кг
9.	Cr	3780	0.0067 мг/л	11.48	4.271 мг/кг
10.	Cu	3955	0.0039 мг/л	86.68	2.521 мг/кг
11.	Fe	6882	0.0054 мг/л	23.25	3.441 мг/кг
12.	Mg	4212211	-0.0982 мг/л	3.41	-63.03 мг/кг
13.	Mn	9435	0.0001 мг/л	758.04	0.0694 мг/кг
14.	Na	1576652	-0.1966 мг/л	5.61	-126.2 мг/кг
15.	Ni	524	0.0010 мг/л	12.28	0.6477 мг/кг
16.	Pb	1792	0.0081 мг/л	95.36	5.180 мг/кг
17.	Se	342	0.0020 мг/л	19.28	1.291 мг/кг
18.	Sr	8649657	0.2711 мг/л	0.01	174.0 мг/кг
20.	Zn	111850	0.0971 мг/л	2.59	62.29 мг/кг

Таблица 2.

Содержание макро- и микроэлементов растения Rubus caesius L.

№	Элементы	Целые числа	Концентрация-1 (мг/л)	Стандартные отклонения (RSD %)	Концентрация-2 (мг/кг)
1.	Ag	-138	-0.0020 мг/л	1.12	-1.801 мг/кг
2.	Al	1803	-0.0064 мг/л	3.50	-5.816 мг/кг
3.	Hg	342	0.0001 мг/л	66.19	0.0907 мг/кг
4.	As	92	0.0022 мг/л	26.28	1.956 мг/кг
5.	Ba	-172	-0.0040 мг/л	0.12	-3.614 мг/кг
6.	Ca	2340	-0.1403 мг/л	0.11	-126.6 мг/кг
7.	Cd	927	0.0003 мг/л	50.74	0.2669 мг/кг
8.	Co	542	0.0008 мг/л	10.21	0.7184 мг/кг
9.	Cr	4797	0.0082 мг/л	0.91	7.441 мг/кг
10.	Cu	17037	0.0167 мг/л	1.12	15.08 мг/кг
11.	Fe	167037	0.0871 мг/л	1.26	78.63 мг/кг
12.	Mg	16198757	2.069 мг/л	0.28	1868 мг/кг
13.	Mn	253800	0.0194 мг/л	1.08	17.49 мг/кг
14.	Na	86707913	7.422 мг/л	1.27	6698 мг/кг
15.	Ni	6735	0.0129 мг/л	0.87	11.68 мг/кг
16.	Pb	2939	0.0132 мг/л	1.66	11.88 мг/кг
17.	Se	317	0.0013 мг/л	46.55	1.212 мг/кг
18.	Sr	5606706	0.1748 мг/л	0.41	157.8 мг/кг
20.	Zn	74725	0.0637 мг/л	0.22	57.45 мг/кг

В образцах растений обнаружены токсичные и тяжелые металлы. Образец Rubus idaeus L. содержит особо токсичные металлы As, Hg, Pb в общей массе 8.6176 мг/кг и тяжелые металлы, такие как Ba, Sr, Cd в общей массе 196.9968 мг/кг. Rubus caesius L. также содержит токсичные и тяжелые металлы, но в меньшем количестве, чем малина. Из токсичных металлов As, Hg, Pb в общей массе 13.9267 мг/кг и тяжелые металлы, такие как Sr, Cd в общей массе 158.0669 мг/кг.

Заключение

Результаты исследований показывают, что образцах растений Rubus idaeus L. и Rubus caesius L. содержится 20 химических элементов. Количество тяжелых металлов, таких как ртуть, мышьяк, кадмий, свинец, барий и стронций в составе растений не превышает предельно допустимых концентраций и соответствует санитарным требованиям. Rubus idaeus L. и Rubus caesius L. в составе растений обилие таких элементов, как натрий, кальций, магний, железо, цинк, марганец, селен и медь, доказывает, что они в дальнейшем станут основой для создания препаратов на основе БАК для коррекции минерального баланса.

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DOI: https://doi.org/10.5281/zenodo.14520765

ТЕХНОЛОГИИ ОБУЧЕНИЯ ЦИФРОВОЙ СРЕДЫ В СИСТЕМЕ ПРОФЕССИОНАЛЬНОГО ОБРАЗОВАНИЯ ВУЗА

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Аннотация. *В данной статье приведен анализ некоторых исследований о цифровой среде обучения в системе профессионального образования вуза и уточнены педагогические, информационные технологии целесообразные к применению в данной среде.*

Ключевые слова*: профессиональное обучение, цифровая среда обучения, система дистанционного обучения, педагогические технологии.*

Abstract. *This article provides an analysis of some studies on the digital learning environment in the system of professional education of the university and clarifies the pedagogical and information technologies that are appropriate for use in this environment.*

Keywords: *professional training, digital learning environment, distance learning system, pedagogical technologies.*

Введение. В настоящее время меняется классическая методологическая база преподавания, что ведет к появлению новых форм и технологий обучения, и обусловлено активным применением информационных технологий, дистанционных образовательных новшеств и онлайн обучения в вузе. Все эти изменения ведут к появлению цифровой образовательной среды вуза. В законе РУз. «Об образовании», уделено большое внимание применению «электронного обучения, дистанционных образовательных технологий» [1]. Можно сказать, что необходимость создания цифровой образовательной среды обусловлена современными тенденциями в образовании.

Методология. Цифровая образовательная среда вуза содержит в себе набор информационных ресурсов и систем, позволяющих обеспечить решение различных образовательных задач и позволяет улучшить качество традиционного профессионального образования: применение смешанного

обучения, повышение качества учебного контента, доступность и открытость предоставляемого материала, сопровождение образовательного процесса, наличие синхронного и асинхронного взаимодействия [2,3].

Вопрос применения дистанционных образовательных технологий и электронного обучения в профессиональном обучении рассматривался многими исследователями. Анализируя источников, можно сказать, что цифровая образовательная среда позволяет проводить лекции, практические занятия, лабораторные работы, организовывать проектную деятельность и индивидуальные занятия, осуществлять в автоматическом режиме текущую, промежуточную, итоговую аттестацию, вести диалог on-line и/или off-line режимах [4-7].

Исследователи в своих трудах рассматривая вопрос использования средств организации дистанционных образовательных технологий определили основные критерии выбора средств организации электронного обучения. К основным из них относятся многофункциональность, надежность, стабильность системы; наличие элементов и средств разработки контента; системы проверки знаний; удобство использования и доступность; интерактивность; обновление системы [8].

Технологии. Для организации электронного обучения в профессиональном обучении необходимо использовать программные продукты. На использование в учебных заведениях ориентированы такие программные продукты, как Blackboard, e-College, WebCT, Moodle, Прометей, Pruffme. На сегодняшний день максимально распространенной в государствах СНГ является система дистанционного обучения Moodle. Система Moodle соответствует критериям выбора, предъявляемым к системам дистанционного обучения, поэтому нашла широкое применение среди учебных заведений разного уровня. В вузе Moodle является веб-приложением, расположенным на сервере, и доступ к нему осуществляется через браузер [4,6,7].

В Узбекистане запущена информационная система управления процессами высшего образования (HEMIS) созданная в рамках проекта Всемирного банка. HEMIS позволяет автоматизировать административную, учебную и научную деятельность университетов, предоставлять современные электронные услуги преподавателям и студентам, создать информационно-образовательный корпоративный портал университетов. Как следствие, подготовка кадров в системе профессионального образования, реализуемая в цифровой образовательной среде вуза, выступает катализатором и инициатором новых педагогических процессов [9].

Для реализации программ вуза в цифровой образовательной среде существующие образовательные технологии, формы, методы и средства не обеспечивают в полной мере выполнение социального запроса. Актуальным способом решения выявленных проблем является применение современных моделей обучения и обучающих технологий с усилением инновационных составляющих форм, методов и средств обучения. В теории инновационной педагогики представлено большое количество классификаций «технологий» авторов: Ш.А. Амонашвили, Н.Ф. Тылызиной, В.А. Сластенина, Г.К. Селевко, М.В. Кларина, В. П. Беспалько, Б.Т. Лихачева, В.В. Гузеева и др.

По направлению модернизации и отношению к традиционной системе можно выделить такие группы технологий: по признаку новизны (традиционные и инновационные); по характеру познавательной деятельности (репродуктивная и продуктивная). Педагогические технологии на основе активизации и интенсификации деятельности учащихся (обучение в сотрудничестве, личностно ориентированное, развивающее обучение, игровые технологии, проблемное, обучение в сотрудничестве, обучение через коммуникативность). Педагогические технологии на основе программированного и дифференцированного обучения, технологии обучения по индивидуальной образовательной траектории, групповые и коллективные способы обучения, интегрированное обучение, информационно коммуникационные технологии и др.

В эпоху цифровизации образования важными являются инновационные технологии. К ним относятся технологии проектного обучения, проблемного обучения, разноуровневое обучение, обучение в сотрудничестве, кейс технология, использование в обучении игровых методов, интегрированное обучение, информационно-коммуникационные технологии, кейс-метод, развитие критического мышления [10].

Важным в технологиях обучения на сегодняшний день, является применение передовых технологий обучения Advanced Learning Technologies (ALT). ALT – это технологии, основанные на слиянии «learning» и «e-learning». Это совершенно новый формат обучения, направленный на совершенствование образовательного процесса, который вбирает в себя традиционную педагогику и новшества технологизации. К ним можно отнести индивидуальные потребности и способности обучающегося, индивидуальные траектории обучения, виртуальную, дополненную реальности, симуляторы, интеллектуальные среды обучения и т.д. На стыке «E-learning» и «EdTech» рождается обучение через интернет; гибкое и адаптивное обучение; обучение, основанное на

взаимодействии педагогов и обучающихся с помощью дистанционных образовательных технологий [6,8].

ALT классифицируются на следующие группы: устоявшиеся (технологии учебного процесса на основе LMS; онлайн-оценивания, совместного обучения, менеджмента знаний и совместного производства нового знания, производства учебного контента, видео и мультимедиа в обучении); активно развивающиеся (онлайн-обучение, использование социальных сетей в обучении, адаптивное и персонализированное обучение, геймификация, обучающие игры и среды, симуляторы); прорывные (большие данные и аналитика учебного процесса, искусственный интеллект в обучении, технологически поддерживаемые методы развития навыков мышления, виртуальная и дополненная реальность в учебном процессе, интернет вещей) [11].

Выводы. Таким образом, цифровая образовательная среда вуза позволяет реализовывать образовательный процесс, предоставляя будущим кадрам и педагогам вуза новые возможности. Профессиональная подготовка кадров в такой системе вуза может реализовываться с применением традиционных технологий, методов, форм, средств обучения с обязательным применением специальных для цифровой образовательной среды технологий и специальных средств обучения.

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DOI: https://doi.org/10.5281/zenodo.14520795

617.764.1-008.811.4

СИНДРОМ СУХОГО ГЛАЗА И ГОРМОНАЛЬНАЯ КОРРЕЛЯЦИЯ

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Эндокринная система контролирует работу всех клеток и тканей человеческого организма, влияет на их функционирование. Передняя поверхность глаза постоянно находится под действием гормонов, которые циркулируют в капиллярах и распознают эти гормоны через специальные рецепторы, расположенные здесь. Одной из актуальных проблем века современных технологий является синдром сухого глаза-многофакторное заболевание, одним из таких этиологических факторов являются аномалии эндокринной системы. Физиологические изменения, такие как менапауза, менструальный цикл, патологии, такие как поликистоз яичников, резистентность к андрогенам, длительное использование противозачаточных средств, антиандрогенное лечение, являются именно эндокринологическими причинами синдрома сухого глаза. В данной статье исследуется роль половых гормонов (андрогенов, эстерогенов и прогестерона) в развитии синдрома сухого глаза, механизмы их воздействия на переднюю поверхность глазного яблока.

Ключевые слова: *синдром сухого глаза, рецептор, гормоны, передняя поверхность глазного яблока, менопауза.*

Развитие синдрома сухого глаза зависит от нескольких физиологических состояний и условий окружающей среды. Хотя осмолярность поверхности глазного яблока и различные инфекционные заболевания являются одними из основных причин СПКЯ, это полиэтиологическое заболевание. Среди нескольких этиологических факторов важную роль в возникновении СПС играют нарушения в эндокринной системе.[1] эндокринная система-это система, которая контролирует все физиологические процессы в организме человека. Поверхность глаза, как и другие ткани и органы, не остается незамеченной действием гормонов, циркулирующих в крови.

Передняя поверхность глаза состоит из переплетенной эпителиальной структуры. К ним относятся роговица, конъюнктива, слезная железа, дополнительные слезные железы, мейбомиевые железы, ресницы, железы Молля и Цейса, веки и органы слезных протоков.[2] все эти структуры функционируют в результате совместной управленческой деятельности кровеносных сосудов, нервных волокон и эндокринной системы. Все они покрыты эпителием, который находится в самом поверхностном слое. Этот эпителиальный слой является основным фактором развития поверхностной эктодермы. Поверхность глазного яблока является основной функциональной единицей, и ее гладкая форма позволяет роговице выполнять свои оптимальные функции (преломление света). Гормоны разных типов: половые гормоны, Гормоны щитовидной железы, самототропные, витамин Д и др.k. влияет как на морфологию, так и на физиологию глазной поверхности. Ниже мы рассмотрим эти гормоны один за другим.[3]

Андрогены. Андрогены оказывают прямое трофическое влияние на рост мейбомиевых желез и их функционирование.[4] мейбомиевые железы имеют мРНК ферментов, ответственных за метаболизм тестостерона. Из нескольких исследований известно, что мейбомиевые железы мышей содержат гены, контролирующие андрогены, которые зависят от стимуляции рецепторов андрогенов.[5,6] андрогены стимулируют гены, контролирующие секрецию и транспорт липидов в мейбомиевых железах. Недостаток андрогенов напрямую нарушает морфологию и функцию мейбомиевых желез.[7] исследования показали, что антиандрогенное лечение снижает количество липидов в секрете мейбомиевых желез. На этом этапе следует упомянуть синдром нечувствительности к андрогенам у женщин и увеличение остатков слезной пленки во время антиандрогенного лечения у мужчин, приводящее к смещению краев век, метаплазии мейбомиевых желез и сокращению времени секреции слезы.

Эстрогены и прогестерон. Рецепторы эстерогена и прогестерона также присутствуют во всех структурах глазной поверхности и влияют на их активность. Однако по сравнению с андрогенами он оказывает антагонистическое влияние на морфологию и физиологию мейбомиевых желез. Исследования на животных показали, что 17β-эстрадиол стимулирует гены, участвующие в катаболизме липидов и жирных кислот, а также гены, синтезирующие липиды.[8] инъекции эстрогенов сокращают синтез липидов сальными железами человека и других живых существ и снижают их активность.[9,10]

Заключение

Учитывая влияние гормонального воздействия, рассматриваемого в этой статье, на поверхность глаза, рекомендуется проводить лечение синдрома сухого глаза на основе гормонального дисбаланса. При составлении плана диагностики и лечения синдрома сухого глаза необходимо учитывать любые, будь то физиологический (менструальный цикл, период менопаузы) или патологический (поликистоз яичников, андрогенная недостаточность). Кроме того, вовлечение эндокринологов вместе с офтальмологами в лечение ССГ приводит к более быстрому улучшению процесса.

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DOI: https://doi.org/10.5281/zenodo.14520823

IJTIMOIY INJINERIYA VA UNI HOZIRGI KIBERJINOYATCHILIKDAGI AHAMIYATI

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Buxoro viloyat hokimining raqamlashtirish bo‘yicha maslahatchisi.

ANNOTASIYA:

Hayotda ko‘plab jabhalarda ijtimoiy injineriyaga tegishli muammolarni ko‘rish mumkin. Ijtimoiy injineriya bilan bog‘liq tahdidlar bugingi kunning dolzarb muammosi hisoblanadi. Maqolada ijtimoiy injineriya va uni hozirgi kiberjinoyatchilikdagi ahamiyati, undan himoyalanish usullari haqida ma’lumot berilgan.

Kalit so‘zlar

Ijtimoiy injineriya, fizik xavfsizlik, ma’lumotla, ilovalar, kompyuterlar, ichki tarmoq, tarmoq perimetri, fishing, fribgarlik, tahdid.

ABSTRACT

The problems of social engineering can be seen in many aspects of life. Threats related to social engineering are an urgent problem today. The article provides information about social engineering and its importance in modern cybercrime, as well as ways to protect against it.

Keywords

Social engineering, physical security, information, applications, computers, intranet, network perimeter, phishing, fraud, threats.

Ijtimoiy (sotsial) injineriya - turli psixologik usullar va firibgarlik amaliyotining to‘plami, uning maqsadi firibgarlik yo‘li bilan shaxs to‘g‘risida maxfiy ma’lumotlarni olish. Maxfiy ma’lumotlar – foydalanuvchi ismi/parollari, shaxsiy ma’lumotlari, ayblov dalillari, bank karta raqamlari va moliyaviy yoki obro‘sini yo‘qotadigan har qanday ma’lumot.

Ijtimoiy injineriya bilan bog‘liq tahdidlarni quyidagicha tasniflash mumkin:

Telefon bilan bog‘liq tahdidlar. Telefon hanuzgacha tashkilotlar ichida va ular o‘rtasidagi aloqaning eng keng tarqalgan usullaridan biri hisoblanadi. Shuning uchun, u sotsial injineriya uchun samarali vosita bo‘lib qolmoqda. Telefonda

gaplashayotganda, suhbatdoshining shaxsini tasdiqlashning imkoni yo‘q. Bu hujumchilarga xodimning, xo‘jayinning maxfiy yoki muhim tuyuladigan ma’lumotlarga ishonishi mumkin bo‘lgan har qanday shaxsning o‘rnida bo‘lish imkonini beradi. Mazkur hollarda quyidagi xavfsizlik choralarini amalga oshirish talab etiladi: telefon qiluvchining shaxsini aniqlash; raqamni aniqlash xizmatidan foydalanish; SMS – xabardagi noma’lum havolalarga e’tibor bermaslik.

Elektron pochta bilan bog‘liq tahdidlar. Ko‘pgina xodimlar har kuni korporativ va shaxsiy pochta tizimlaridan o‘nlab, hatto yuzlab elektron pochta xabarlarini qabul qilishadi. Albatta, bunday yozishmalar oqimining har bir harfiga yetarlicha e’tibor berishning imkoni yo‘q. Bu esa hujumlarni amalga oshirishni sezilarli darajada osonlashtiradi. Elektron pochta tizimlarining ko‘plab foydalanuvchilari bunday holni bir papkadan ikkinchisiga qog‘ozlarni o‘tkazishning elektron analogi sifatida qabul qilishadi va xabarlarni qabul qilishda xotirjam bo‘lishadi. Tajovuzkor pochta orqali oddiy so‘rov yuborganida, uning qurboni ko‘pincha uning xatti-harakatlari haqida o‘ylamasdan ular so‘ragan ishni bajaradi. Elektron pochtalarda xodimlarni korporativ atrof-muhit muhofazasini buzishga undaydigan giperhavolalar bo‘lishi mumkin. Bunday havolalar har doim ham da’vo qilingan sahifalarga murojaat qilmaydi.

Xavfsizlik choralarining aksariyati ruxsatsiz foydalanuvchilarning korporativ resurslardan uchun ishlab chiqilgan. Buzg‘unchi tomonidan yuborilgan giperhavolaga murojaat orqali foydalanuvchining zararli dasturni korporativ tarmoqqa yuklashi ko‘plab himoya turlarini chetlab o‘tishga imkon beradi. Giperhavola, shuningdek, ma’lumot yoki yordamni talab qiladigan qalqib chiquvchi ilovalar bilan turli xostlarga murojaatni talab qilishi mumkin.

Firibgarlikni va zararli hujumlarni oldini olishning eng samarali usuli kutilmagan foydalanuvchining elektron pochtasi xabarlariga shubha bilan qarash.

Ushbu yondashuvni butun tashkilotda tarqatish uchun xavfsizlik siyosatida belgilangan elektron pochtadan foydalanishning quyidagi elementlari kiritilishi kerak: hujjatlarga qo‘shimchalar; hujjatdagi giperhavolalar shaxsiy yoki korporativ ma’lumotlarni kompaniya ichida so‘rash; shaxsiy yoki korporativ ma’lumotlarga kompaniya tashqarisidan keladigan so‘rovlar.

Tezkor xabarlardan foydalanishga asoslangan tahdidlar. Tezkor xabar almashish - ma’lumotlarni uzatishning nisbatan yangi usuli. Ammo, u korporativ foydalanuvchilar orasida allaqachon mashhurlikka erishgan. Foydalanishning tezligi va qulayligi tufayli ushbu aloqa usuli turli xil hujumlar uchun keng imkoniyatlarni ochib beradi. Foydalanuvchilar unga telefon kabi qarashadi va uni bo‘lishi mumkin bo‘lgan dasturiy tahdidlar sifatida baholashmaydi. Tezkor xabarlar xizmatidan foydalanishga asoslangan hujumlarning ikkita asosiy turi - zararli dasturga havola va

dasturning o‘zi haqida xabarning ko‘rsatilishi hisoblanadi. Tezkor xabarlar xizmatlarining xususiyatlaridan biri - aloqaning norasmiyligi, unda har qanday nomlarni moslashtirish qobiliyati bilan bir qatorda, bu omil tajovuzkorni o‘zini boshqa odam bo‘lib ko‘rsatishiga imkon beradi. Bu esa muvaffaqiyatli hujum qilish ehtimolini sezilarli darajada oshiradi. Agar kompaniya tezkor xabarlar sababli keladigan xarajatlarni kamaytirish maqsadida boshqa afzalliklardan foydalanmoqchi bo‘lsa, korporativ xavfsizlik siyosatida tegishli tahdidlardan himoya qilish mexanizmlarini ta’minlashi kerak. Korporativ muhitda tezkor xabar almashish ustidan ishonchli boshqaruvga ega bo‘lish uchun quyidagi talablar bajarilishi shart: tezkor xabarlar uchun bitta platformani tanlash; tezkor xabar yuborish xizmatini o‘rnatishda xavfsizlik sozlamalarini aniqlash; yangi aloqalarni o‘rnatish prinsiplarini aniqlash; parol tanlash standartlarini o‘rnatish; tezkor xabarlardan foydalanish bo‘yicha tavsiyalar berish.

Sotsial injineriya mutaxassislari tashkilotlar uchun quyidagi asosiy himoya usullarini qo‘llashni tavsiya etishadi: muhim ma’lumotlar ko‘rinishida bo‘lgan, zararsiz ko‘rinadigan ma’lumot turlarini hisobga oladigan ishonchli ma’lumotlarni tasniflash siyosatini ishlab chiqish; ma’lumotlarni shifrlash yoki foydalanishni boshqarish yordamida mijoz ma’lumotlari xavfsizligini ta’minlash; xodimlarni sotsial injineriya ko‘nikmalariga o‘rgatish, ularni o‘zlari tanimaydigan odamlar bilan muloqotiga shubha bilan qarashni o‘rgatish; xodimlar orasida parollarni almashishni yoki umumiy foydalanishni taqiqlash; shaxsan tanish bo‘lmagan yoki biron – bir tarzda tasdiqlanmagan shaxsga korxonaga tegishli ma’lumotlarni berishni taqiqlash; maxfiy ma’lumotlardan foydalanishni so‘raganlar uchun maxsus tasdiqlash muolajalaridan foydalanish.

Sotsial injineriya hujumlarini oldini olishda ko‘p hollarda kompaniyalar tomonidan murakkab, ko‘p darajali xavfsizlik tizimlari qo‘llaniladi. Bunday tizimlarning ba’zi xususiyatlari va majburiyatlari quyida keltirilgan:

- Fizik xavfsizlik. Kompaniya binolari va korporativ resurslardan foydalanishni cheklaydigan to‘siqlar. Unutmaslik kerakki, kompaniyaning resurslari, masalan, kompaniya hududidan tashqarida joylashgan axlat konteynerlari fizik himoyalanmagan.
- Ma’lumotlar. Biznes ma’lumotlari: qayd yozuvlari, pochta va boshqalar bo‘lib, tahdidlarni tahlillash va ma’lumotlarni himoya qilish choralarini rejalashtirishda qog‘oz, elektron ma’lumot eltuvchilari bilan ishlash prinsiplarini aniqlash kerak.
- Ilovalar - foydalanuvchilar tomonidan boshqariladigan dasturlar. Atrofini himoya qilish uchun elektron pochta dasturlaridan, tezkor xabarlar xizmati va boshqa dasturlardan tajovuzkorlar qanday foydalanishlari mumkinligini ko‘rib chiqish kerak.

- Kompyuterlar. Korporativ kompyuterlarda qaysi dasturlardan foydalanish mumkinligini ko‘rsatadigan qat’iy prinsiplarni belgilash, foydalanuvchilar kompyuterlariga to‘g‘ridan-to‘g‘ri hujumlardan himoya qilish.
- Ichki tarmoq. Korxona tizimlariga ta’sir qiladigan tarmoq, u mahalliy, global yoki simsiz bo‘lishi mumkin. So‘nggi yillarda masofadan ishlaydigan usullarning ommaviylashi sababli, ichki tarmoqlarning chegaralari sezilarli darajada o‘zboshimchalik bilan kengaytirildi. Kompaniya xodimlari har qanday tarmoq muhitida xavfsiz ishlarni tashkil qilishda nima qilish kerakligini tushunishlari lozim.
- Tarmoq perimetri. Kompaniyaning ichki tarmoqlari va tashqi, masalan, Internet yoki hamkor tashkilotlar tarmoqlari o‘rtasidagi chegara.

Sotsial injineriyaga tegishli ko‘plab hujumlar mavjud, quyida ularning ayrimlari keltirilgan:

Fishing. Fishing (ing. Phishing – baliq ovlash) Internetdagi firibgarlikning bir turi bo‘lib, uning maqsadi foydalanuvchining maxfiy ma’lumotlaridan (login/parol) foydalanish imkoniyatiga ega bo‘lish. Bu hozirda keng tarqalgan sotsial injineriya sxemalaridan biri hisoblanadi. Katta hajmdagi shaxsiy ma’lumotlarni keng tarqalishi, fishing “shamolisiz” amalgaoshmaydi. Fishingning eng keng tarqalgan namunasi sifatida jabrlanuvchining elektron pochtasiga yuborilgan rasmiy ma’lumot ko‘rinishidagi bank yoki to‘lov tizimining soxta xabarini ko‘rsatish mumkin.

Quyida keng tarqalgan fishing sxemalariga misollar keltirilgan. Mavjud bo‘lmagan havola. Fishing hujumining mazkur turida biror web saytga o‘xshash web saytga murojaat amalga oshirilishi tavsiya etiladi. Masalan, www.PayPai.com manzilini www.PayPal.com manzili sifatida yuborish mumkin. Bu holda kamdan-kam holda foydalanuvchilar “l” harfini o‘riniga “i” harfi borligiga e’tibor berishadi.
Havolaga murojaat qilinganida esa www.PayPal.com web saytga o‘xshash, biroq soxta web saytga tashrif buyuriladi va talab kiritilgan to‘lov kartasi ma’lumotlari kiritiladi. Natijada, kiritilgan ma’lumotlar xaker qo‘liga tushadi. Bunga yaqqol misol sifatida, 2003 yilda eBay foydalanuvchilariga tarqalgan fishing xabarni keltirish mumkin. Mazkur xabarda foydalanuvchilarning akkauntlari blokirovkalangani va kredit karta ma’lumotlari blokirovkadan chiqarilishi kerakligi keltirilgan va unda rasmiy web-saytga o‘xshash soxta web saytga olib boruvchi havola mavjud bo‘lgan. Ushbu fishing hujumining keltirgan zarari bir necha yuz ming dollarga teng bo‘lgan.

Taniqli korporativ brendidan foydalanishga asoslangan firibgarlik. Firibgarlikning mazkur ko‘rinishida taniqli yoki yirik kompaniyalar nomidan foydalanuvchiga xabar yuboriladi. Xabarda kompaniya tomonidan o‘tkazilgan biror tanlovda g‘alaba qozonilganligi haqidagi tabriklar bo‘lishi mumkin. Unda shuningdek, zudlik bilan qayd yozuvi ma’lumotlari va parolni o‘zgartirish kerakligi so‘raladi.

Shunga o‘xshash sxemalar texnik ko‘maklashish xizmati nomidan ham amalga oshirilishi mumkin.

Soxta lotareyalar. Mazkur fishing sxemasiga ko‘ra foydalanuvchi har qanday taniqli kompaniya tomonidan o‘tkazilgan lotereyada g‘olib bo‘lgani to‘g‘risidagi xabarni olishi mumkin. Tashqi tomondan, bu elektron xabar kompaniyaning yuqori lavozimli xodimlaridan biri nomidan yuborilganga o‘xshaydi.

Soxta antivirus va xavfsizlik dasturlari. Mazkur dasturlar firibgar dasturiy ta‘minoti yoki “chaqqon dastur” deb nomlanib, ular antivirus dasturlariga o‘xshasada, vazifasi boshqacha. Bu dasturiy ta’minot turli tahdidlar to‘g‘risidagi yolg‘on xabarnomalar asosida foydalanuvchini soxta bitimlarga jalb qilishga harakat qiladi. Foydalanuvchi ulardan foydalanganida elektron pochtada, onlayn e’lonlarda, ijtimoiy tarmoqlarda, qidiruv tizimlari natijalarida va hatto foydalanuvchi kompyuterida turli qalqib chiquvchi oynalarga duch kelishi mumkin.

IVR (Interactive Voice Response) yoki telefon orqali fishing. Fishing sxemasining mazkur usuli oldindan yozib olingan xabarlar tizimidan foydalanishga asoslangan, ular bank va boshqa IVR tizimlarining “rasmiy qo‘ng‘iroqlari”ni qayta tiklash uchun ishlatiladi. Bu hujumda jabrlanuvchi bank bilan bog‘lanib, qandaydir ma’lumotlarni tasdiqlash yoki yangilash kerakligi haqidagi so‘ovni qabul qiladi. Tizim PIN kodni yoki parolni kiritish orqali foydalanuvchi tasdig‘ini talab qiladi. Natijada, muhim ma’lumotlarni qo‘lgan kiritgan buzg‘unchi foydalanuvchi ma’lumotlaridan foydalanish imkoniyatiga ega bo‘ladi. Masalan, parolni almashtirish uchun “1” ni bosing va operator javobini olish uchun “2” ni bosing.

Preteksting. Mazkur fishing sxemasida xaker o‘zini boshqa shaxs sifatida ko‘rsatadi va oldindan tayyorlangan senariy (skript) bo‘yicha maxfiy axborotni olishni maqsad qiladi. Ushbu hujumda qurbonni shubhalanmasligi uchun tegishli tayyorgarlik ko‘riladi: tug‘ilgan kun, INN, pasport raqami yoki hisob raqamining oxirgi belgilari kabi ma’lumotlar topiladi. Ushbu fishing sxemasi odatda telefon yoki elektron pochta orqali amalga oshiriladi.

Kvid pro kvo (lotinchadan: Quid pro quo). Ushbu ibora ingliz tilida “xizmat uchun xizmat” degan ma’noni anglatib, sotsial injineriyaning mazkur turida xaker korporativ tarmoq yoki elektron pochta orqali kompaniyaga murojaatni amalga oshiradi. Ko‘pincha xaker o‘zini texnik xizmat ko‘rsatuvchi sifatida tanitib, texnik xodimning ish joyidagi muammolarni bartaraf etishda “yordam berishini” aytadi. Texnik muammoni “bartaraf” etish vaqtida nishondagi shaxsni buyruqlarni bajarishga yoki jabrlanuvchining kompyuteriga turli xil dasturlarni o‘rnatishga undash amalga oshiriladi. Masalan, 2022 yilda Axborot xavfsizligi dasturi doirasida o‘tkazilgan tadqiqot ofis xodimlarining 90% har qanday xizmat yoki to‘lov uchun maxfiy ma’lumotlarni, masalan, o‘zlarining parollarini, berishga tayyor bo‘lishini ko‘rsatdi.

Yo‘l-yo‘lakay olma. Sotsial injineriyaning mazkur usulida xaker maxsus zararli dastur yozilgan ma’lumot eltuvchilardan foydalanadi va zararli dasturlar yozilgan eltuvchilarni qurbonning ish joyi yaqinida, jamoat joylarida va boshqa joylarda qoldiradi. Bunda, ma’lumot eltuvchilari tashkilotga tegishli shaklda rasmiylashtiriladi. Masalan, xaker biror korporatsiya logotipi va rasmiy web-sayt manzili tushirilgan kompakt diskni qoldirib ketadi. Ushbu disk “Rahbarlar uchun ish haqlari” nomi bilan nomlanishi mumkin. Ushbu eltuvchini qo‘lga kiritgan qurbon uni o‘z kompyuteriga qo‘yib ko‘radi va shu orqali kompyuterini zararlaydi.

Ochiq ma’lumot to‘plash. Sotsial injineriya texnikasi nafaqat psixologik bilimlarni, balki, inson haqida kerakli ma’lumotlarni to‘plash qobilyatini ham talab etadi. Bunday ma’lumotlarni olishning nisbatan yangi usuli ochiq manbalardan, ijtimoiy tarmoqlardan to‘plash. Masalan, «Одноклассники», «ВКонтакте», «Facebook», «Instagram» kabi saytlarda odamlar yashirishga harakat qilmaydigan juda ko‘p ma’lumotlar mavjud.

Yelka orqali qarash. Ushbu hujumga ko‘ra buzg‘unchi jabrlanuvchiga tegishli ma’lumotlarini uning yelkasi orqali qarab qo‘lga kiritadi. Ushbu turdagi hujum jamoat joylarida, masalan, kafe, avtobus, savdo markazlari, aeroport va temir yo‘l stansiyalarida keng tarqalgan. Mazkur hujumga doir olib borilgan so‘rovnomalar quyidagilarni ko‘rsatgan: 85% ishtirokchilar o‘zlari bilishlari kerak bo‘lmagan maxfiy ma’lumotlarni ko‘rganliklarini tan olishgan; 82% ishtirokchilar ularning ekranidagi ma’lumotlarini ruxsatsiz shaxslar ko‘rishi mumkinligini tan olishgan; - 82% ishtirokchilar tashkilotdagi xodimlar o‘z ekranini ruxsatsiz odamlardan himoya qilishiga ishonishmagan.

Teskari sotsial injineriya. Jabrlanuvchining o‘zi tajovuzkorga ma’lumotlarini taqdim qilishi teskari sotsial injineriyaga tegishli holat hisoblanadi. Bu bir qarashda ma’noga ega bo‘lmagan qarash hisoblansada, aksariyat hollarda jarblanuvchining o‘zi muammolarini hal qilish uchun tajovuzkorni yordamga jalb qiladi. Masalan, jabrlanuvchi bilan birga ishlovchi tajovuzkor jabrlanuvchi kompyuteridagi biror faylni nomini o‘zgartiradi yoki boshqa katalogga ko‘chirib o‘tkazadi. Faylni yo‘q bo‘lganini bilgan qurbon esa ushbu muammoni tezda bartaraf etishni istab qoladi. Bu vaziyatda tajovuzkor o‘zini ushbu muammoni bartaraf etuvchi sifatida ko‘rsatadi va qurbonning muammosini bartaraf etish bilan birga unga tegishli login/ parolni ham qo‘lga kiritadi. Bundan tashqari, ushbu vazifasi bilan tajovuzkor tashkilot ichida obro‘ga ega bo‘ladi va o‘z qurbonlari sonini ortishiga erishadi. Bu holatni aniqlash esa ancha murakkab ish hisoblanadi.

Mashhur sotsial injinerlar. Kevin Mitnik tarixdagi eng mashhur sotsial injinerlardan biri, u dunyodagi mashhur kompyuter xakeri, xavfsizlik bo‘yicha mutaxassis va sotsial injineriyaga asoslangan kompyuter xavfsizligiga bag‘ishlangan

ko‘plab kitoblarning ham muallifidir. Uning fikriga ko‘ra xavfsizlik tizimini buzishdan ko‘ra, aldash yo‘li orqali parolni olish osonroq.

Sotsial injineriyadan himoyalanish choralari. Hujumlarni amalga oshirishda sotsial injineriya texnikasidan foydalangan tajovuzkorlar tez-tez muloyimlik, dangasalik, xushmuomilalik bilan foydalanuvchi va tashkilot xodimlarining qiziqishlaridan foydalanadilar. Hujumlarni oldini olish esa, xodimlarning aldanayotganliklarini bilmasliklari sababli, murakkab hisoblanadi.

Sotsial injineriya hujumlarini quyidagicha aniqlash mumkin: o‘zini do‘stingiz yoki yordam so‘rab murojaat qilgan yangi xodim sifatida tanishtirish; o‘zini yetkazib beruvchi, hamkor kompaniyaning xodimi yoki qonun vakili sifatida tanishtirish; o‘zini biror rahbar sifatida tanishtirish; biror zaiflikni bartaraf etuvchi yoki jabrlanuvchiga biror nimani yangilash imkoniyatini taqdim qiluvchi sotuvchi yoki ishlab chiqaruvchi sifatida tanishtirish; muammo yuzaga kelganida yordam beruvchi sifatida tanishtirish; ishonchni hosil qilish uchun ichki xotirjamlik va terminologiyadan foydalanish; “maktub”ga turli zararli dasturlarni qo‘shib yuborish; soxta ochilgan oynada login/ parolni qayta kiritishni so‘rash; foydalanuvchi nomi va paroli bilan saytga ro‘yxatdan o‘tish uchun biror sovg‘a taklif etish; jabrlanuvchi kompyuteriga yoki dasturiga kiritilgan kalitlarni yozib olish (keylogger dasturlari); turli xil zararli dasturiy vositaga ega ma’lumot eltuvchilarini foydalanuvchi stoliga tashlash; turli qo‘ng‘iroqlardagi ovozli xabarlar va h.

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