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TURLI SHAKL VA HAJMGA EGA JISMLARNING GRAVITATSION MAYDON POTENSIALI VA KUCHLANGANLIGIGA DOIR MASALALAR YECHISH METODIKASI

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ANNOTATSIYA

Ushbu maqolada bir jinsli sterjen, disk va yerning gravitatsion maydon potentsiali va kuchlanganligig doir uchta masalaning yechish metodikasi keltirilgan. Shuningdek, masala yechish uchun o'quvchilarga zarur metodik tavsiyalar berilgan. Masalalarning tahlili va sintezi keltirilgan.

Kalit so'zlar: masala, sterjen, disk, massa, radius, gravitatsion maydon, potentsial, kuchlanganlik.

DOLOGY FOR SOLVING PROBLEMS ON THE POTENTIAL AND INTENSITY OF THE GRAVITATIONAL FIELD OF BODIES WITH VARIOUS SHAPES AND VOLUMES"

ABSTRACT

"This article presents the solution methodology for three problems related to the gravitational field potential and intensity of a homogeneous rod, disk, and Earth. Additionally, methodological recommendations necessary for students to solve these problems are provided. The analysis and synthesis of the problems are also included."

Keywords: problem, rod, disk, mass, radius, gravitational field, potential, intensity.

KIRISH

Yosh avlodni mustaqil fikirli, zamonaviy bilim va kasb-hunarlarini egallagan, sog'lom hayotiy pozitsiyaga ega chinakkam vatanparvar insonlar sifatida tarbiyalash ustoz va murabbiylarning asosiy vazifasidir. Fan va texnikaning hozirgi taraqqiyoti tabiiy va texnika sohalarida ko'proq yuqori malakali mutaxassislar tayyorlashni taqozo etadi. Fizika fanidan o'quvchilarni oliy o'quv yurtlariga, konkurslarga va olimpiadalarga tayyorlash jarayonlarini loyihalashtirishda ta'lim mazmuni, ta'lim

maqsadi, kutilayotgan natijani to'g'ri belgilash, ta'lim metodlari, shakllari va vositalarini to'g'ri tanlash, o'quvchilarning bilim, ko'nikma va malakalarini baholashni aniq mezonlarini oldindan ishlab chiqish, mashg'ulotlarni amalga oshirish va bir-biri bilan uyg'unlashuviga etiborni qaratish maqsadga muvofiqdir. O'quvchilarning egallagan bilimlarini masala yechish orqali baholashda innovatsion yondashuvlarning ahamiyati juda katta. Masala yechish-kichik hodisa va jarayondagi noma'lum fizik kattaliklarni masala shartida berilgan kattaliklar orqali ifodalangan formulasini chiqarib masala shartida berilgan kattaliklarning son qiymatini o'rniga qo'yib hisoblashdir. Fizika o'qitishda amaliy metodlar ichida masalalar yechish muhim o'rin egallaydi. Masalalar yechishda qo'yiladigan asosiy maqsad o'quvchilar fizik qonuniyatlarni chuqurroq tushunsinlar, ularni ajrata olsinlar va ularni fizik hodisalarni tahlil qilishga, amaliy masalalarga qo'llay olishga o'rganishlaridan iborat[1]. Fizikadan masalalar yechish-o'quv jarayonining zaruriy elementlaridan biridir. Masala yechish o'quvchilarda fizik hodisalar orasidagi bog'lanishlarni, qonunlarni chuqur o'zlashtirishga, ularning mantiqiy fikrlashini va izlanuvchanlik qobiliyatini yanada rivojlantirishga, maqsadga erishish ko'nikmalarini shakllantirishga xizmat qiladi[2]. Fizikadan olimpiada masalalarini yechishda o'quvchilarni mehnatsevarlik, maqsadga erishishda tirishqoqlik, intiluvchanlik va muammoni mustaqil hal qila olish kabi shaxsiy axloqiy xislatlarni shakllantirishga yordam beradi.

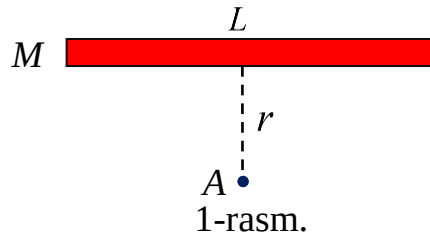
Fizikadan masala yechishda o'quvchilar quyidagi qisqacha metodik ko'rsatmaga amal qiladilar:

1. Masalaning sharti bir necha marta o'qib chiqiladi va u fizikaning qaysi bo'limiga tegishli ekani aniqlandi.
2. Masalaning qaysi bo'limga tegishliligi anglanadi, mazmuni tushuniladi va masala shartida berilgan kattaliklar „XBS“ da ifodalanib, topish kerak bo'lgan kattalik yoziladi.
3. Masalaning shartiga mos keluvchi chizma chiziladi.
4. Masala shartida qanday fizik qonuniyatlar yotgani aniqlanadi.
5. Masalani umumiy ko'rinishda yechish uchun ketma-ketlik asosida masala shartidagi noma'lum kattalikni ma'lum kattaliklar bilan bog'lovchi formulalar hosil qilinadi.
6. Masala yechishda qo'llanilgan har bir qonun, qoida, formula va fizik kattaliklar qisqacha izohlab boriladi.
7. Masala shartiga berilgan kattaliklar aniqlangan formulaga qo'yiladi va hisoblanadi.
8. Masalaning javobini chiqarishda uning aniqligiga ahamiyat beriladi va kerakli xulosalar chiqariladi .

ASOSIY QISM

Aylanma harakat dinamikasidan quyidagi 3 ta masalaning yechish metodikasini keltiramiz:

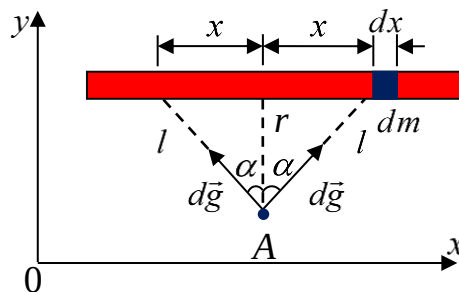
1. Rasmda tasvirlanganidek, sterjen o'rtasidan r masofada joylashgan A-nuqtadagi gravitatsion maydon kuchlanganligini toping. M-sterjen massasi va L-uzunligi.



1-rasm.

Yechilishi: 2-rasmda keltirilgan sterjenning ixtiyoriy kichik dx qismni qarab chiqamiz. Shu qismning massasi dm bo'lsin. Sterjenning m massasi va kichik qism massasi dm larni zichlik orqali quyidagicha yoza olamiz:

$$dm = \rho S dx, \quad m = \rho SL \quad \text{bulardan} \quad dm = \frac{M}{L} dx \quad (1)$$



2-rasm.

A-nuqtada "dg" gravitatsion maydon kuchlanganligining gorizontal tashkil etuvchilari nolga teng.

$$dg_{gor} = dg \sin \alpha - dg \sin \alpha = 0 \quad (2)$$

A-nuqtadagi y o'qi gravitatsion maydon kuchlanganligining vertikal(y o'qi bo'ylab tashkil etuvchilari esa quyidagiga teng bo'ladi: $g_A = \int dg \cos \alpha$ (3)

Rasmdan foydalanib quyidagini yoza olamiz: $\cos \alpha = \frac{r}{l} = \frac{r}{\sqrt{r^2 + x^2}}$ (4)

(4) ni (3) ga qo'yib gravitatsion maydon kuchlanganligining vertikal tashkil etuvchisini integralini quyidagicha hisoblaymiz va matematik amallar bajaramiz:

$$dg_A = \frac{G dm}{r^2 + x^2} \quad (5)$$

$$g_A = \int_{-\frac{l}{2}}^{\frac{l}{2}} \frac{G M dx}{L(r^2 + x^2)} \cdot \frac{r}{\sqrt{r^2 + x^2}} = \frac{G M r}{L} \cdot \int_{-\frac{l}{2}}^{\frac{l}{2}} \frac{dx}{(r^2 + x^2)^{\frac{3}{2}}} \quad (6)$$

Rasmdan foydalanib quyidagilarni yoza olamiz: $\frac{x}{2} = \operatorname{tg} \alpha$ bundan

$$x = r \cdot \operatorname{tg} \alpha = r \cdot \frac{\sin \alpha}{\cos \alpha} \quad (7)$$

(7)- ifodani ikkala tomonini differentsiallaymiz:

$$dx = r \frac{\cos \alpha \cdot \cos \alpha - (-\sin \alpha) \cdot \sin \alpha}{\cos^2 \alpha} \cdot d\alpha \quad \text{bundan} \quad dx = \frac{r}{\cos^2 \alpha} \cdot d\alpha,$$

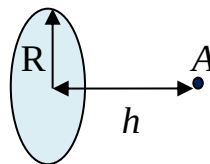
$$(r^2 + x^2)^{\frac{3}{2}} = \left(r^2 + r^2 \cdot \frac{\sin^2 \alpha}{\cos^2 \alpha} \right)^{\frac{3}{2}} = r^3 \cdot \frac{1}{\cos^3 \alpha} \quad (8)$$

$$\int \frac{dx}{(r^2 + x^2)^{\frac{3}{2}}} = \int \frac{\frac{rd\alpha}{\cos^2 \alpha}}{r^3 \cdot \frac{1}{\cos^3 \alpha}} = \int \frac{\cos \alpha}{r^2} d\alpha = \frac{1}{r^2} \int \cos \alpha \cdot d\alpha = \frac{1}{r^2} \sin \alpha, \quad \sin \alpha = \frac{x}{l} = \frac{x}{r^2 l}$$

$$g_A = \frac{GM}{l} \cdot \left[\frac{x}{r^2 \sqrt{r^2 + x^2}} \right] \Big|_{-\frac{l}{2}}^{\frac{l}{2}} = \frac{GM}{lr} \left[\frac{x}{\sqrt{r^2 + x^2}} \right] \Big|_{-\frac{l}{2}}^{\frac{l}{2}} = \frac{2GM}{r(l^2 + 4r^2)}$$

Javob: $g_A = \frac{2GM}{r(l^2 + 4r^2)}$

2. Yupqa bir jinsli disk radiusi R va massasi m ga teng. Disk markazidan h masofadagi A nuqtada 1) gravitasion maydon potentsiyali, 2) gravitatsion maydon kuchlanganligini toping.



3-rasm.

Yechilish: Disk massasi quyidagi formula bilan ifodalaniladi:

$$m = \rho \pi R^2 d \quad (1)$$

Radiusi x bo'lgan qismning massasi esa $m = \rho \pi x^2 d$ buni differentsiallab quyidagiga ega bo'lamiz:

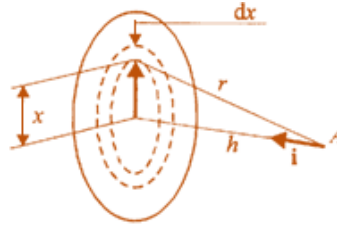
$$dm = \rho \cdot 2\pi x dx \quad (2)$$

(2) ni (1) ga bo'lib quyidagiga ega bo'lamiz:

$$dm = \frac{m}{\pi R^2} 2\pi x dx = \frac{2mx dx}{R^2} \quad (3)$$

Diskning dx qismidan ixtiyoriy r masofada gravitasion maydon potentsiyal quyidagi formula bilan ifodalaniladi(4-rasmga qarang):

$$d\varphi = -G \frac{dm}{r} \quad (4) \quad \text{bunda} \quad r = \sqrt{h^2 + x^2} \quad (5)$$



4-rasm.

(3) va (5) ni (4) ga eltib qo'yib quyidagiga ega bo'lamiz:

$$d\varphi = -G \frac{2m}{R^2} \cdot \frac{xdx}{\sqrt{h^2 + x^2}} \quad (6)$$

Bu ifodani integrallab quyidagiga ega bo'lamiz:

$$\begin{aligned} \varphi &= -G \frac{2m}{R^2} \int_0^R \frac{xdx}{\sqrt{h^2 + x^2}} = -G \frac{2m}{R^2} \left(\sqrt{h^2 + x^2} \right) \Big|_0^R = -G \frac{2m}{R^2} \left(\sqrt{h^2 + R^2} - h \right) \\ \varphi &= -G \frac{2m}{R^2} \left(\sqrt{h^2 + R^2} - h \right) \end{aligned} \quad (7)$$

Gravitatsion maydon kuchlanganligini gradiyent yoki 1-tartibli hosila orqali topamiz:

U holda quyidagiga ega $g = -\text{grad} \varphi = -\frac{d\varphi}{dh} i$
bo'lamiz:

$$\begin{aligned} g &= -\frac{d}{dh} \left[G \frac{2m}{R^2} \left(\sqrt{h^2 + R^2} - h \right) \right] i = - \left[G \frac{2m}{R^2} \left(\frac{1}{2} (h^2 + R^2)^{-\frac{1}{2}} \cdot 2h - 1 \right) \right] i \\ g &= G \frac{2m}{R^2} \left(1 - \frac{h}{\sqrt{h^2 + R^2}} \right) i \\ \text{Javob: } g &= G \frac{2m}{R^2} \left(1 - \frac{h}{\sqrt{h^2 + R^2}} \right) i \end{aligned}$$

3. Yer markazidan r ($r < R$)-masofada gravitatsion maydon potentsialini toping. Yerning massasi $M = 6 \cdot 10^{24} \text{ kg}$ va radiusi $R = 6400 \text{ km}$.

Yechilishi: Yer markazidan r ($r < R$)-masofada gravitatsion maydon kuchlanganligi quyidagiga teng:

$$g_r = G \frac{M}{R^2} r \quad (1)$$

Yer markazidan r ($r > R$)-masofada gravitatsion maydon kuchlanganligi quyidagiga teng:

$$g = G \frac{M}{r^2} \quad (2)$$

Yer markazidan ixtiyoriy r -masofada gravitatsion maydon potentsialini quyidagicha yoza olamiz:

$$\varphi = \int_r^{\infty} g_r dr = \int_r^R G \frac{M}{R^2} r dr + \int_R^{\infty} G \frac{M}{r^2} dr \quad (3)$$

Bu integralni hisoblab, quyidagiga ega bo'lamiz:

$$\varphi = G \frac{M}{2R} \left(3 - \frac{r^2}{R^2} \right) \quad (4)$$

Yer markazida ($r = 0$) gravitatsion maydon potentsialini hisoblaymiz:

$$\varphi_o = \frac{3GM}{2R} = \frac{3 \cdot 6,67 \cdot 10^{-11} \frac{N \cdot m^2}{kg^2} \cdot 6 \cdot 10^{24} kg}{2 \cdot 6400 \cdot 10^3 m} \approx 9,4 \cdot 10^7 \frac{J}{kg}$$

Yer sirtidan $r = \sqrt{3}R$ masofada esa gravitatsion maydon potentsiali $\varphi = 0$ ga teng.

Javob: $\varphi_o \approx 9,4 \cdot 10^7 \frac{J}{kg}$.

XULOSA

Masalalar yechishda, ayniqsa yuqori sinf o'quvchilar analitik usuldan foydalanish samaralidir, chunki bu usul ularning mantiqiy fikrlashning rivojlanishiga yordam beradi. Masalalarni yechishda analiz yoki sintezni bir biridan ajratish qiyin, ular hamma vaqt o'zaro bog'langan holda keladi. Fizika fanidan o'qituvchi tomonidan mustaqil yechish uchun tavsiya etilgan masalalar o'quvchilarning olgan bilimlarini har kungi turmush tarzlariga va tabiatdagi fizik jarayonlarga mantiqiy xulosa chiqara olishlari, oliy o'quv yurtlariga tayyorlanishlari va olimpiadalarga tayyorgarlik ko'rishlari uchun foydali deb hisoblaymiz.

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TEACHING TECHNIQUES OF BADMINTON TO YOUNG LEARNERS: A COMPREHENSIVE GUIDE

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ABSTRACT

Present article explains the full information about teaching techniques of badminton to young learners. However, you'll find out some significant role of badminton to young learners life and also various instructions of teaching techniques of badminton to young learners.

Keywords: teaching techniques, naturally curious, objective, "shuttle" or "birdie", a fast-paced, exciting sport, shake hands with the racket.

INTRODUCTION

Badminton is a popular racket sport played either between two individuals (singles) or two pairs (doubles). It is played on a rectangular court divided by a net, with players using rackets to hit a shuttlecock (also called a "shuttle" or "birdie") over the net and into the opponent's side of the court. The objective is to score points by landing the shuttlecock in the opponent's court or forcing them to make a mistake. Badminton is a fast-paced, exciting sport that can be enjoyed by players of all ages. For young learners, it offers a fantastic opportunity to develop physical fitness, coordination, and teamwork skills. However, teaching badminton to children requires a unique approach that balances technical instruction with fun and engagement.

DISCUSSION

This article explores effective teaching techniques for introducing badminton to young learners, ensuring they develop a love for the sport while building a strong foundation of skills.

1. Understanding Young Learners

Before diving into teaching techniques, it's essential to understand the characteristics of young learners:

- Short Attention Spans: Children may lose focus quickly, so sessions should be dynamic and varied.
- Eager to Learn: Kids are naturally curious and enjoy trying new things.

- Developing Motor Skills: Young players are still refining their coordination, balance, and agility.

- Need for Fun: Enjoyment is key to keeping children engaged and motivated.

With these traits in mind, coaches and teachers must design sessions that are both educational and entertaining.

2. Key Teaching Techniques:

A. Start with the Basics

- Grip: Teach the forehand and backhand grips using simple, relatable analogies (e.g., “shake hands with the racket”).

- Stance and Footwork: Introduce the ready position and basic movements like the split step, chasse step, and lunge.

- Swing Mechanics: Break down strokes into simple steps (e.g., backswing, contact, follow-through) and use demonstrations to reinforce learning.

B. Use Fun Drills and Games

- Shadow Badminton: Have players mimic strokes and footwork without a shuttle to build muscle memory.

- Target Practice: Set up targets on the court for players to aim at, improving accuracy and control.

- Relay Races: Incorporate footwork drills into relay races to make learning movement patterns fun.

- Mini-Games: Play simplified versions of badminton (e.g., using smaller courts or slower shuttles) to keep the game accessible.

C. Progressive Learning

- Start Simple: Begin with basic skills like the forehand grip and underarm strokes before progressing to more complex techniques like smashes and net shots.

- Scaffold Skills: Build on previously learned skills. For example, once players master the forehand clear, introduce the drop shot.

- Adjust Difficulty: Tailor drills and games to match the skill level of the group, ensuring everyone is challenged but not overwhelmed.

D. Demonstration and Repetition

- Show, Don't Just Tell: Demonstrate techniques slowly and clearly, emphasizing key points.

- Repetition: Use repetitive drills to reinforce skills and build confidence. For example, practice serving or clearing multiple times in a row.

3. Creating a Positive Learning Environment

A. Encourage and Motivate

- Positive Reinforcement: Praise effort and improvement, not just results. Celebrate small victories to build confidence.

- Goal Setting: Set achievable goals for each session (e.g., “Today, we’ll learn how to serve correctly”) and celebrate when they’re met.

B. Make It Fun

- Incorporate Games: Use games and challenges to teach skills in a playful way.
- Use Props: Introduce colorful cones, targets, or balloons to make drills more engaging.
- Team Activities: Encourage teamwork through doubles matches or group challenges.

C. Foster a Growth Mindset

- Emphasize Learning: Teach children that mistakes are part of the learning process and encourage them to keep trying.
- Celebrate Effort: Recognize hard work and perseverance, even if the outcome isn’t perfect.

4. Physical Conditioning for Young Players

- Warm-Up and Cool-Down: Start each session with a fun warm-up (e.g., jogging, dynamic stretches) and end with a cool-down (e.g., static stretching).
- Agility and Speed: Use ladder drills, cone drills, and shuttle runs to improve footwork and quickness.
- Strength and Coordination: Incorporate bodyweight exercises (e.g., squats, lunges) and balance activities to build foundational fitness.

5. Communication and Feedback

- Use Simple Language: Avoid technical jargon and explain concepts in a way that children can understand.
- Provide Constructive Feedback: Offer specific, actionable advice (e.g., “Try bending your knees more when you lunge”) and avoid negative criticism.
- Encourage Questions: Create an open environment where children feel comfortable asking questions and seeking help.

6. Parental Involvement

- Keep Parents Informed: Share progress updates and involve parents in their child’s development.
- Encourage Support: Remind parents to focus on effort and enjoyment rather than winning or losing.

7. Sample Session Plan for Young Learners

Here’s an example of a 60-minute session for young badminton players:

1. Warm-Up (10 minutes): Light jogging, dynamic stretches, and a fun game like tag.
2. Skill Focus (20 minutes): Teach and practice a specific skill (e.g., forehand grip and underarm clear). Use demonstrations and repetitive drills.

3. Game-Based Activity (20 minutes): Play a game that reinforces the skill (e.g., target practice with underarm clears).

4. Cool-Down (10 minutes): Static stretching and a recap of what was learned.

8. Common Challenges and Solutions

- Lack of Focus: Keep sessions short and varied. Use games and challenges to maintain interest.

- Frustration with Difficult Skills: Break skills into smaller steps and provide plenty of encouragement.

- Varying Skill Levels: Group players by ability or use differentiated drills to cater to everyone's needs.

CONCLUSION

Teaching badminton to young learners is about more than just imparting technical skills—it's about fostering a love for the sport and helping children develop confidence, coordination, and teamwork. By using fun, engaging, and progressive teaching techniques, coaches and teachers can create a positive learning environment where young players thrive. With patience, encouragement, and a focus on enjoyment, young learners can build a strong foundation for a lifetime of badminton success.

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SUN'IY INTELLEKTNING TELEKOMMUNIKATSIYA TARMOQLARIDAGI AHAMIYATI

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ANNOTATSIYA

Sun'iy intellektning (SI) telekommunikatsiya tarmoqlariga integratsiyalashuvi tarmoq operatsiyalari, boshqaruvi va xizmatlarini bajarish usullarini o'zgartirmoqda. Ayniqsa, 5G texnologiyasi bilan birga yuqori tezlik, ishonchlilik va kam kechikish talablariga javob berish ehtiyoji ortib borayotgan bir paytda, telekommunikatsiya xizmat ko'rsatuvchilar SI dan tobora ko'proq foydalanmoqdalar. SI asosidagi yechimlar tarmoqni avtomatlashtirish, xavfsizlikni kuchaytirish, bashoratli texnik xizmat ko'rsatish va samarali resurslarni taqsimlash imkonini beradi. Ushbu dissertatsiya telekommunikatsiya tarmoqlarining asosiy jihatlari, sun'iy intellektning roli, uning qo'llanilishi, muammolar va kelajakdagi yo'nalishlarini o'rganadi.

Kalit so'zlar: SI, 5G, kirish tarmog'i, baza stansiyalari, nazoratli o'rganish, mashinali o'qitish tamoyillari, supervised learning, unsupervised learning, neyron tarmoqlar.

KIRISH

Telekommunikatsiya tarmoqlarining asosiy tushunchalari.

Telekommunikatsiya tarmoqlari raqamli aloqaning asosini tashkil etib, ovoz, ma'lumot va multimedia uzatish kabi keng turdagi xizmatlarni o'z ichiga oladi. Ushbu tizim bir necha qatlamlardan iborat bo'lib, ularga kirish tarmog'i, transport tarmog'i va asosiy tarmoq kiradi. Ushbu qatlamlar qurilmalar va tizimlar o'rtasida global miqyosda uzluksiz ulanishni ta'minlaydi.

- **Kirish tarmog'i:** Bu oxirgi foydalanuvchiga yetib boruvchi ulanish bo'lib, mobil tarmoqlar, Wi-Fi va optik tolalar orqali amalga oshiriladi.

- **Transport tarmog'i:** Kirish tugunlaridan asosiy tarmoqlarga ma'lumotlarni uzatishni ta'minlaydi va optik tolalar, mikroto'lqinli aloqa va sun'iy yo'ldosh orqali amalga oshiriladi.

- **Asosiy tarmoq:** Har xil tarmoqlar orasida trafikni boshqarish va yo'naltirish bilan shug'ullanadi, shuningdek, kommutatsiya va signalizatsiya kabi xizmatlarni taqdim etadi.

ADABIYOTLAR TAHLILI VA METODOLOGIYA

Asosiy komponentlar:

- **Baza stansiyalari:** Mobil tarmoqlarda ma'lumotlarni uzatish punktlari sifatida ishlaydi.

- **Kommutatorlar va marshrutizatorlar:** Tarmoqdagi turli qismlar o'rtasida trafikni yo'naltiradi.

- **Serverlar va ma'lumotlar markazlari:** Saqlash, qayta ishlash va xizmat dasturlarini boshqaradi.

- **Protokollar:** Har xil qurilmalar va tarmoqlar o'rtasida aloqa o'rnatilishini ta'minlaydi, masalan, TCP/IP, LTE va 5G NR [1-2].

Quyida 2G, 3G, 4G va 5G tarmoq texnologiyalarining rivojlanishini asosiy ko'rsatkichlar bo'yicha ko'rsatadigan jadval keltirilgan:

Tarmoq Texnologiyasi	Tezlik	Kechikish (Latency)	O'tkazuvchanlik (Bandwidth)
2G (GSM)	50 kbps	300-1000 ms	Juda past
3G (UMTS)	384 kbps - 42 Mbps	100-500 ms	O'rtacha
4G (LTE)	100 Mbps - 1 Gbps	30-100 ms	Yuqori
5G	1 Gbps - 10 Gbps	< 1 ms	Juda yuqori (gigabit darajasida)

- **Tezlik:** Tarmoq texnologiyasi orqali erishiladigan maksimal yuklash tezligini ko'rsatadi.

- **Kechikish:** Ma'lumot paketining manzilga yetib borish vaqti (quyi kechikish – yaxshi natija).

- **O'tkazuvchanlik:** Bir vaqtning o'zida tarmoq orqali o'tkazilishi mumkin bo'lgan ma'lumotlar hajmi [3].

Bu jadval har bir tarmoq texnologiyasining asosiy texnik rivojlanishini ko'rsatadi va 5G texnologiyasi bu borada katta yutuqlarni taqdim etayotganini ko'rish mumkin.

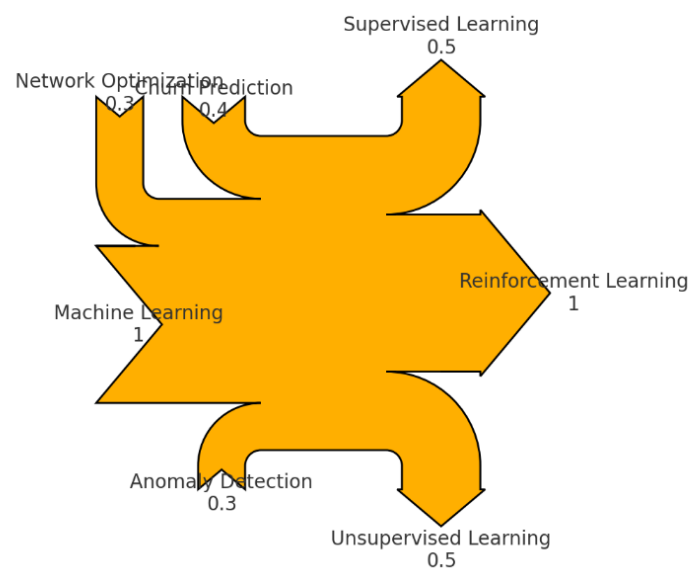
Sun'iy intellektning asoslari. Mashinali o'qitish tamoyillari: Mashinani o'rganish (ML) sun'iy intellektning bir qismi bo'lib, algoritmlar ma'lumotlardan naqshlarni o'rganish va qaror qabul qilishga yordam beradi. Telekommunikatsiya sohasida ML tarmoq trafikini optimallashtirish, nosozliklarni bashorat qilish va foydalanuvchi tajribasini yaxshilashda qo'llaniladi.

- **Nazoratli o‘rganish:** Belgilangan ma’lumotlar asosida o‘rganadi, asosan, trafik naqshlarini va tarmoq foydalanishini bashorat qilish uchun qo‘llaniladi.

- **Nazoratsiz o‘rganish:** Belgilanmagan ma’lumotlarda yashirin naqshlarni aniqlaydi, tarmoq xavfsizligi va nosozliklarni aniqlashda qo‘llaniladi.

- **Mustahkamlangan o‘rganish:** Sun’iy intellekt agentlari mukofot va fikr-mulohaza asosida qarorlar qabul qiladi, bu esa dinamik tarmoq boshqaruvida foydali hisoblanadi [4-5].

Applications of Machine Learning in Telecom



Bu oqim sxemasi telekommunikatsiya sohasida uchta asosiy mashinani o‘rganish yondashuvlari va ularning qo‘llanilish sohalarini tasvirlaydi:

- **Nazorat ostidagi o‘rganish (Supervised Learning):** Mijozlarni yo‘qotishni bashorat qilish uchun qo‘llaniladi.

- **Nazoratsiz o‘rganish (Unsupervised Learning):** Anomaliyalarni aniqlash uchun ishlatiladi.

- **Kuchaytirish orqali o‘rganish (Reinforcement Learning):** Tarmoqni optimallashtirish uchun qo‘llaniladi.

Bu diagramma har bir o‘rganish turi telekommunikatsiya sohasidagi turli sohalarga qanday hissa qo‘shishini ko‘rsatadi, operatsiyalarni avtomatlashtirish va xizmat sifatini yaxshilashda muhim ahamiyatga ega.

Neyron tarmoqlar: Neyron tarmoqlar, ayniqsa chuqur o‘rganish arxitekturalari, telekommunikatsiya tarmoqlarida sezilarli darajada qo‘llanilmoqda. Ular inson miya hujayralari tuzilishini taqlid qilib, katta hajmdagi ma’lumotlarni qayta ishlaydi va tarmoq trafikini bashorat qilish, resurslarni optimallashtirish kabi sohalarda keng qo‘llaniladi.

- **Konvolyutsion neyron tarmoqlar (CNN):** Tarmoq trafikidagi naqshlarni tanib olish uchun foydali.

- **Rekursiv neyron tarmoqlar (RNN):** Ketma-ket ma'lumotlarni qayta ishlash bilan shug'ullanadi, bu esa vaqt ketma-ketligi tahlilida foydali.

NATIJALAR:

Sun'iy intellektning telekommunikatsiya tarmoqlaridagi qo'llanilishi Tarmoqni optimallashtirish

SI telekommunikatsiya tarmoqlarining turli jihatlarini, shu jumladan, o'tkazuvchanlikni taqsimlash, yuk balanslash va quvvat boshqaruvini optimallashtiradi. Real vaqtda tarmoq trafiki tahlilini amalga oshirib, AI o'zgaruvchan talablarga mos ravishda tarmoq sozlamalarini dinamik ravishda o'zgartiradi.

- **Dinamik resurslarni taqsimlash:** SI algoritmlari real vaqtda trafik tahlili asosida o'tkazuvchanlik va hisoblash resurslarini taqsimlaydi.

- **Yukni balanslash:** AI tarmoq trafikini serverlar va tugunlar orasida bir tekis taqsimlab, tirbandlikning oldini oladi.

- Quyida **an'anaviy tarmoqni optimallashtirish usullari** va **SI asosidagi optimallashtirish yondashuvlarini** samaradorlik, xarajat va moslashuvchanlik kabi ko'rsatkichlarga nisbatan solishtiruvchi jadval keltirilgan:

Ko'rsatkich	An'anaviy Optimallashtirish	SI Asosidagi Optimallashtirish
Samaradorlik	Odatda qo'lda sozlanadi, samaradorlik past yoki o'rtacha	Avtomatlashtirilgan, real vaqtda tahlil bilan yuqori samaradorlik
Xarajat	Yuqori operatsion xarajatlari (qo'lda sozlash va monitoring)	Xarajatlari kamayadi (avtomatlashtirilgan jarayonlar tufayli)
Moslashuvchanlik	Cheklangan (o'zgaruvchan tarmoq sharoitlariga sekin moslashadi)	Yuqori darajada moslashuvchan (tarmoq sharoitlariga tezkor javob beradi)
Resurslarni taqsimlash	Statik va oldindan belgilangan qoidalar asosida	Dinamik, real vaqt ma'lumotlariga asoslangan
Nosozliklarni bartaraf etish	Reaktiv, nosozlik sodir bo'lgandan keyin amalga oshiriladi	Proaktiv, nosozliklarni oldindan bashorat qilish va oldini olish
Kengayish qobiliyati	Cheklangan (qo'lda kengaytirish talab qiladi)	Tez kengaytirilishi mumkin (SI asosida moslashuvchan)

- Ushbu jadval AI asosidagi yondashuvlar telekommunikatsiya tarmoqlarini optimallashtirishda qanday afzalliklar berishini ko'rsatadi. Samaradorlik, xarajatlarni kamaytirish va moslashuvchanlik SI yondashuvlarini yanada samarali qiladi.

- **Bashoratli texnik xizmat ko'rsatish:** SI asosidagi bashoratli texnik xizmat ko'rsatish tarmoq uskunalaridan ma'lumotlarni tahlil qilish orqali nosozliklarni

oldindan bashorat qilib, ularni bartaraf etishga yordam beradi. Bu usul xizmat ko'rsatish uzilishlarini kamaytiradi, xizmat ishonchliligini oshiradi va operatsion xarajatlarni kamaytiradi [6].

- **Nosozliklarni aniqlash:** SI modellari tarmoq komponentlaridan tarixiy ma'lumotlarni tahlil qilish orqali apparat nosozliklarini bashorat qilishi mumkin.

- **Texnik xizmat rejalashtirish:** SI texnik xizmat ko'rsatish uchun eng maqbul vaqtni taklif qiladi va tarmoq uzilishlarining oldini olishga yordam beradi.

Grafik taklifi: Bashoratli texnik xizmat ko'rsatish an'anaviy reaktiv texnik xizmat ko'rsatish bilan solishtirilgan holda tarmoq uzilishlarining kamayishini ko'rsatadigan vaqt-qatorli grafik.

Xavfsizlikni kuchaytirish: SI telekommunikatsiya tarmog'i xavfsizligini sezilarli darajada kuchaytirib, tarqatilgan xizmat ko'rsatishni rad etish (DDoS) hujumlari, firibgarlik va tarmoq buzilishlari kabi kiber tahdidlarni aniqlaydi va bartaraf etadi.

- **Anomaliyalarni aniqlash:** SI algoritmlari tarmoq trafigidagi g'ayritabiiy holatlarni aniqlab, potentsial xavfsizlik tahdidlarini aniqlaydi.

- **Firibgarlikni aniqlash:** SI foydalanuvchi xatti-harakatlarini tahlil qilib, SIM kartalarni klonlash yoki qo'ng'iroq firibgarligi kabi shubhali faoliyatlarni aniqlaydi.

Muammolar va kelajak yo'nalishlari: Telekommunikatsiya tarmoqlarida SIDan tobora kengroq foydalanish bir qator etik muammolarni keltirib chiqaradi, masalan, maxfiylik, shaffoflik va algoritmik tarafkashlik. Tarmoqlar foydalanuvchilarning katta hajmdagi ma'lumotlarini yig'adi va qayta ishlaydi. Shu bois, SI tizimlari foydalanuvchi maxfiyligini himoya qiluvchi va ma'lumotlar suiste'molini oldini oluvchi tarzda loyihalashtirilishi kerak.

- **Ma'lumotlar maxfiyligi:** Telekommunikatsiya xizmat ko'rsatuvchilarining foydalanuvchi ma'lumotlarini boshqarish va himoya qilish usullari.

- **Algoritmik tarafkashlik:** SI modellarini xilma-xil ma'lumotlar asosida o'rgatib, qaror qabul qilishda tarafkashlikning oldini olish [7].

5G tarmoqlari bilan integratsiya: SI roli 5G tarmoqlari joriy etilishi bilan yanada muhimlashadi, bu tarmoqlar yuqori tezlik, past kechikish va ulanish qurilmalarining ko'pligi bilan ajralib turadi. SI 5G tarmoq dilimlashini, avtomatlashtirilgan orkestratsiyani va real vaqtdagi xizmat sozlamalarini samarali boshqarishni ta'minlaydi.

- **Tarmoq taqsimlash:** SI har xil foydalanish holatlari uchun, masalan, IoT, avtonom transport vositalari va kengaytirilgan mobil keng polosali xizmatlar uchun tarmoq resurslarini dinamik taqsimlaydi.

• **Real vaqtda tahlillar:** SI 5G tarmoqlari tomonidan yaratilgan katta hajmdagi ma'lumotlarni qayta ishlaydi va tushunchalar beradi hamda real vaqtda qaror qabul qilish imkonini yaratadi [8].

XULOSA

SI telekommunikatsiya tarmoqlarining evolyutsiyasida tobora muhim rol o'ynamoqda. Tarmoqni optimallashtirishdan tortib bashoratli texnik xizmat ko'rsatish va xavfsizlikni kuchaytirishgacha bo'lgan sohalar SI zamonaviy tarmoq boshqaruvi muammolarini hal qilish uchun kuchli vositalarni taqdim etadi. Shu bilan birga, AIning to'liq potensialidan foydalanish uchun, ayniqsa, ma'lumotlar maxfiyligi va adolat bilan bog'liq etik masalalarni hal qilish zarur. Telekommunikatsiya sanoati 5G va undan keyingi bosqichga o'tish jarayonida SI global aloqa infratuzilmasining kelajagini shakllantirishda asosiy rol o'ynashda davom etadi.

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ГЛЮКОКОРТИКОИДЫ И ДИАБЕТ

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АННОТАЦИЯ

Глюкокортикоиды (ГК), гормоны стресса, вырабатываемые корой надпочечников, участвуют во многих процессах физиологии и метаболизма, включая гомеостаз глюкозы и воспаление. Избыток ГК-сигнализации приводит к синдрому Кушинга и, возможно, метаболическому синдрому. Диабет, центральная жировая ткань и гиперлипидемия являются компонентами обоих синдромов. Здесь мы обсуждаем механизмы действия ГК, клинические синдромы избытка ГК, модуляцию гомеостаза глюкозы ГК и будущие методы лечения диабета, основанные на сигнале ГК.

Ключевые слова: глюкокортикоиды, инсулинорезистентность, стрии, минералокортикоиды, остеопороз, сахарный диабет.

Введение. Сахарный диабет 2 типа (СД) поражает 8,7 % населения Узбекистана (ВОЗ 2016-г) и связан с множеством микрососудистых и макрососудистых осложнений. Ожирение является значительным фактором риска развития инсулинорезистентности, которая занимает центральное место в патофизиологии сахарного диабета (СД) 2 типа. При повышении инсулинорезистентности β -клетки поджелудочной железы первоначально компенсируют этот процесс, увеличивая секрецию инсулина для поддержания нормогликемии. Однако со временем β -клетки истощаются, что приводит к дефициту инсулина и, как следствие, к развитию сахарного диабета. Механизмы,

лежащие в основе инсулинорезистентности, остаются активной областью исследований. Одним из ключевых факторов является дисфункция адипоцитов, возникающая в ответ на хроническую перегрузку питательными веществами. У людей с нормальной массой тела свободные жирные кислоты (СЖК) эффективно секвестрируются в виде триглицеридов (ТГ) в периоды избытка калорий и высвобождаются при необходимости в процессе липолиза. У людей с ожирением адипоциты становятся дисфункциональными, в значительной степени из-за воспалительной среды, формирующейся в жировой ткани при длительном избытке калорий. Это состояние впервые было обнаружено на мышинных моделях ожирения, вызванного диетой, и позднее подтверждено в исследованиях на людях. В результате нарушается хранение свободных жирных кислот, накапливаются эктопические липиды, а уровень свободных жирных кислот и воспалительных цитокинов в сыворотке крови повышается⁶. Это приводит к системной инсулинорезистентности. Эти процессы впервые были обнаружены на мышинных моделях ожирения, вызванного диетой, и позднее подтверждены в исследованиях на людях^{4,5}. **Глюкокортикоиды (ГК)**, также известные как гормоны стресса, играют ключевую роль в регуляции гомеостаза глюкозы, развитии адипоцитов и воспалительных процессов. Избыток глюкокортикоидов, как в клинических условиях, так и в экспериментальных моделях, ассоциируется с нарушением метаболизма^{7,8}. Клинические синдромы, характеризующиеся повышенным уровнем глюкокортикоидов, часто сопровождаются развитием сахарного диабета и увеличением висцеральной жировой ткани. Экспериментальные мышинные модели с локализованным избытком глюкокортикоидов в адипоцитах демонстрируют схожие метаболические нарушения, включая накопление висцеральной жировой ткани и развитие инсулинорезистентности. В данном обзоре рассматриваются механизмы, регулирующие выработку и метаболизм глюкокортикоидов, а также клинические и фундаментальные исследования, подтверждающие их роль в патогенезе сахарного диабета. Кроме того, обсуждается потенциал глюкокортикоидов в качестве терапевтической мишени для лечения сахарного диабета.

РЕГУЛЯЦИЯ И ДЕЙСТВИЕ ГЛЮКОКОРТИКОИДОВ.

Глюкокортикоиды (ГК) — это стероидные гормоны, вырабатываемые корой надпочечников. Их циркулирующий уровень контролируется гипоталамо-гипофизарно-надпочечниковой осью (ГГН), которая представляет собой сложную нейроэндокринную систему обратной связи.

Механизм регуляции включает следующие этапы:

Гипоталамус вырабатывает кортикотропин-рилизинг гормон (КРГ), который стимулирует гипофиз.

Гипофиз отвечает секрецией аденокортикотропного гормона (АКТГ).

АКТГ активирует кору надпочечников, стимулируя синтез и выделение кортизола — основного активного глюкокортикоида у человека.

Ось ГГН активируется в ответ на стресс, циркадные ритмы и другие острые стимулы. Циркулирующий кортизол оказывает отрицательную обратную связь, подавляя выработку КРГ и АКТГ, что снижает дальнейшую продукцию кортизола. Только около 5% кортизола циркулирует в свободной, биологически активной форме. Остальная часть связана с белками-переносчиками, такими как кортизол-связывающий глобулин (КСГ) и альбумин⁹. Эти белки обеспечивают транспорт кортизола в тканях и регулируют его доступность. Действие глюкокортикоидов (ГК) опосредуется двумя типами рецепторов: глюкокортикоидными (ГР) и минералокортикоидными (МР). Несмотря на то, что ГК и минералокортикоиды, такие как альдостерон, связываются с МР с одинаковым сродством, концентрация циркулирующих ГК значительно превышает концентрацию альдостерона. Это вызывает вопрос: как ткани, чувствительные к минералокортикоидам, сохраняют избирательную чувствительность к альдостерону? Ключевую роль в этой специфической регуляции играет ферментная система 11 β -гидроксистероидных дегидрогеназ (11 β -ГСДГ):

11 β -ГСДГ2 преимущественно экспрессируется в тканях, чувствительных к минералокортикоидам, таких как почки. Этот фермент инактивирует кортизол, превращая его в кортизон, который не может активировать МР. Это предотвращает чрезмерную активацию МР глюкокортикоидами и позволяет альдостерону эффективно выполнять свою функцию.

11 β -ГСДГ1, напротив, экспрессируется в метаболически активных тканях, таких как печень и жировая ткань. Этот фермент катализирует обратную реакцию, активируя кортизон и преобразуя его в кортизол. Такая активация играет важную роль в патофизиологии метаболического синдрома.

Большинство метаболических эффектов глюкокортикоидов, включая их влияние на гомеостаз глюкозы, реализуются через активацию глюкокортикоидных рецепторов (ГР)^{9,10}.

Глюкокортикоидный рецептор (ГР) принадлежит к семейству ядерных гормональных рецепторов, участвующих в регуляции транскрипции. Связывание глюкокортикоидов (ГК) с ГР запускает несколько ключевых процессов:

Диссоциация цитозольного комплекса: При связывании ГК с ГР рецептор освобождается от своего цитозольного комплекса, включающего белок теплового шока (ГСДГ90).

Транслокация в ядро: Освобожденный ГР перемещается в ядро клетки, где он взаимодействует с ДНК для регуляции транскрипции генов-мишеней.

В ядре ГР регулирует транскрипцию двумя основными способами:

Активация транскрипции: ГР связывается с элементами реагирования глюкокортикоидов (ЭРГР) в промоторных участках генов и взаимодействует с транскрипционными коактиваторами, что усиливает экспрессию генов-мишеней.

Репрессия транскрипции: Репрессивный эффект реализуется через два механизма:

ГР связывается с ЭРГР, после чего взаимодействует с транскрипционными корепрессорами, подавляя экспрессию определённых генов.

Прямое взаимодействие ГР с другими транскрипционными факторами без участия ДНК (ДНК-независимый механизм), процесс, известный как "привязка".

Эти механизмы позволяют ГР оказывать сложное влияние на экспрессию генов, регулируя множество процессов, включая метаболизм, воспаление и иммунный ответ¹¹.

Клинический и субклинический избыток глюкокортикоидов

Хронический избыток глюкокортикоидов ассоциируется с развитием **синдрома Кушинга (СК)**, серьезного клинического состояния, которое характеризуется широким спектром симптомов и осложнений.

Клинические проявления синдрома Кушинга

СК проявляется следующими особенностями:

Метаболические нарушения: центральное ожирение, инсулинорезистентность и/или сахарный диабет.

Мышечные и костные изменения: атрофия мышц и потеря костной массы (остеопороз).

Дерматологические признаки: гиперпигментированные брюшные стрии, истончение кожи, замедленное заживление ран.

Сердечно-сосудистые и нейропсихологические нарушения: резистентная гипертензия, а также депрессия, тревога и когнитивные расстройства.

Диагностика синдрома Кушинга

Диагностика СК представляет собой сложный процесс, требующий сочетания клинических и лабораторных методов. Основные диагностические подходы включают:

Измерение уровня кортизола в слюне в полночь: СК характеризуется отсутствием нормального циркадного ритма кортизола, который в норме достигает минимальных значений ночью.

Ночной тест с дексаметазоном: Введение экзогенного глюкокортикоида (дексаметазона) позволяет оценить подавление выработки эндогенного кортизола. Отсутствие подавления свидетельствует о гиперкортицизме.

Измерение свободного кортизола в моче за 24 часа: Повышенный уровень свободного кортизола подтверждает гиперкортицизм^{12,13}.

Глюкокортикоиды (ГК) широко применяются для лечения различных аутоиммунных заболеваний благодаря их мощным противовоспалительным свойствам. Однако длительная терапия экзогенными ГК остается наиболее частой причиной развития **синдрома Кушинга (СК)**.

Типы синдрома Кушинга, связанного с эндогенными ГК

СК, вызванный гиперпродукцией эндогенных ГК, подразделяется на:

АКТГ-зависимый СК

Наиболее частой причиной является **аденома гипофиза**, секретирующая адренокортикотропный гормон (АКТГ).

Редко СК может быть вызван нейроэндокринными опухолями, секретирующими АКТГ, например:

Мелкоклеточный рак легкого (классический пример).

Другие нейроэндокринные опухоли.

АКТГ-независимый СК

Встречается реже и вызван прямой гиперпродукцией кортизола надпочечниками.

Основные причины:

Аденома надпочечника.

Гиперплазия коры надпочечников.

Эти различия в механизмах развития СК подчеркивают важность точной диагностики для выявления первопричины заболевания, поскольку подходы к лечению зависят от конкретного источника гиперкортицизма^{12,13}.

Влияние глюкокортикоидов (ГК) на глюкозный метаболизм и диагностику диабета

Глюкокортикоиды значительно повышают постпрандиальную экскурсию глюкозы, что предполагает, что такие диагностические методы, как анализ уровня **гемоглобина A1C** и **пероральный тест на толерантность к глюкозе**, могут быть более полезными для диагностики диабета, вызванного терапией ГК¹⁴.

Тем не менее, было отмечено, что существует **положительная корреляция** между уровнем глюкозы в плазме натощак и утренним уровнем кортизола в плазме. Это указывает на то, что отклонения в показателях глюкозы натощак чаще встречаются у людей с более выраженной гиперкортициемией¹⁵.

Влияние дозы и продолжительности терапии экзогенными ГК на развитие диабета

При длительном применении экзогенных ГК вероятность развития диабета пропорциональна дозе и продолжительности терапии. Исследования методом случай-контроль показали, что после начала терапии ГК вероятность развития нового диабета **увеличивается более чем в два раза** по сравнению с контрольной группой. Этот эффект зависит от дозы:

2 мг дексаметазона: коэффициент вероятности развития диабета 3,06.

4 мг дексаметазона: коэффициент вероятности 5,90.

4,5 мг и более дексаметазона: коэффициент вероятности 10,35.

Для сравнения, здоровый человек синтезирует эквивалент **0,55 мг дексаметазона** в сутки^{16,17}.

Повышенная частота развития диабета у пациентов, получающих экзогенные ГК, также оказывает влияние на **смертность**, которая у таких больных в два раза выше. Это подчеркивает важность контроля за уровнем сахара в крови и тщательного мониторинга у пациентов, получающих долгосрочную терапию ГК¹².

Действительно, экзогенные глюкокортикоиды, такие как дексаметазон, преднизон или гидрокортизон, имеют значительное влияние на метаболизм углеводов и гликемический контроль у пациентов с диабетом, что связано с увеличением инсулинорезистентности и повышением уровня глюкозы в крови. В вашем тексте подчеркивается несколько важных аспектов:

Увеличение потребности в инсулине: У пациентов с диабетом, получающих глюкокортикоиды, потребность в инсулине возрастает, иногда на 70% и более, в зависимости от дозы и продолжительности терапии. Например, исследование с использованием 60 мг преднизона (эквивалентно 240 мг гидрокортизона) показало увеличение потребности в инсулине на 70%. Это важно учитывать при корректировке доз инсулина у таких пациентов, чтобы предотвратить гипергликемию и улучшить контроль заболевания.²²

Гипергликемия и рецидивы: В условиях госпитализации, где пациенты получают экзогенные глюкокортикоиды, гипергликемия возникает у более чем половины пациентов, и у многих из них наблюдаются рецидивы гипергликемии. Это подчеркивает важность регулярного мониторинга уровня глюкозы и возможную необходимость корректировки доз инсулина, особенно у пациентов, получающих высокие дозы стероидов.

Циркадные изменения в гликемическом контроле: Использование непрерывного мониторинга глюкозы помогает выявить закономерности уровня глюкозы в течение суток. Гипергликемия чаще наблюдается во второй половине

дня и вечером, что может обосновывать необходимость применения повышенных доз прандиального инсулина или добавления инсулина НПХ, пик активности которого приходится на 6-8 часов. Это позволяет более точно контролировать уровень глюкозы в периоды, когда он наиболее подвержен колебаниям^{18,20,21}.

Индивидуализация терапии: Из-за большого разнообразия реакций на глюкокортикоиды и различий в дозах, важно индивидуализировать схему инсулинотерапии с учетом этих факторов. У пациентов с диабетом 1 типа, принимающих стероиды, могут потребоваться значительные корректировки доз инсулина, в том числе на фоне острых состояний или изменения дозы глюкокортикоидов.

В целом, терапия диабета у пациентов, принимающих экзогенные глюкокортикоиды, требует внимательного мониторинга и гибкой корректировки доз инсулина для предотвращения гипергликемии и поддержания оптимального контроля уровня глюкозы.

КС - редкое заболевание, частота встречаемости которого в Узбекистане составляет примерно семь человека на миллион. Однако описание метаболического синдрома (МетС)²³ состояния, которым страдает почти четверть взрослого населения и характеризуется ожирением, гиперлипидемией и инсулинорезистентностью²⁴, побудило предположить, что МетС может представлять собой подмножество пациентов с КС или субклиническим КС (СКС). СКС чаще всего ассоциируется с кортизол-продуцирующими аденомами надпочечников, а не с гипофизарной болезнью Кушинга, и характеризуется легким гиперкортизолизмом и метаболическими нарушениями, включая ожирение, гипертонию и инсулинорезистентность, без классических клинических признаков КС. Примечательно, что частота клинического гиперкортизолизма у лиц с диабетом или ССЗ, по некоторым данным, составляет 3-10% от общего числа обследованных²⁵.

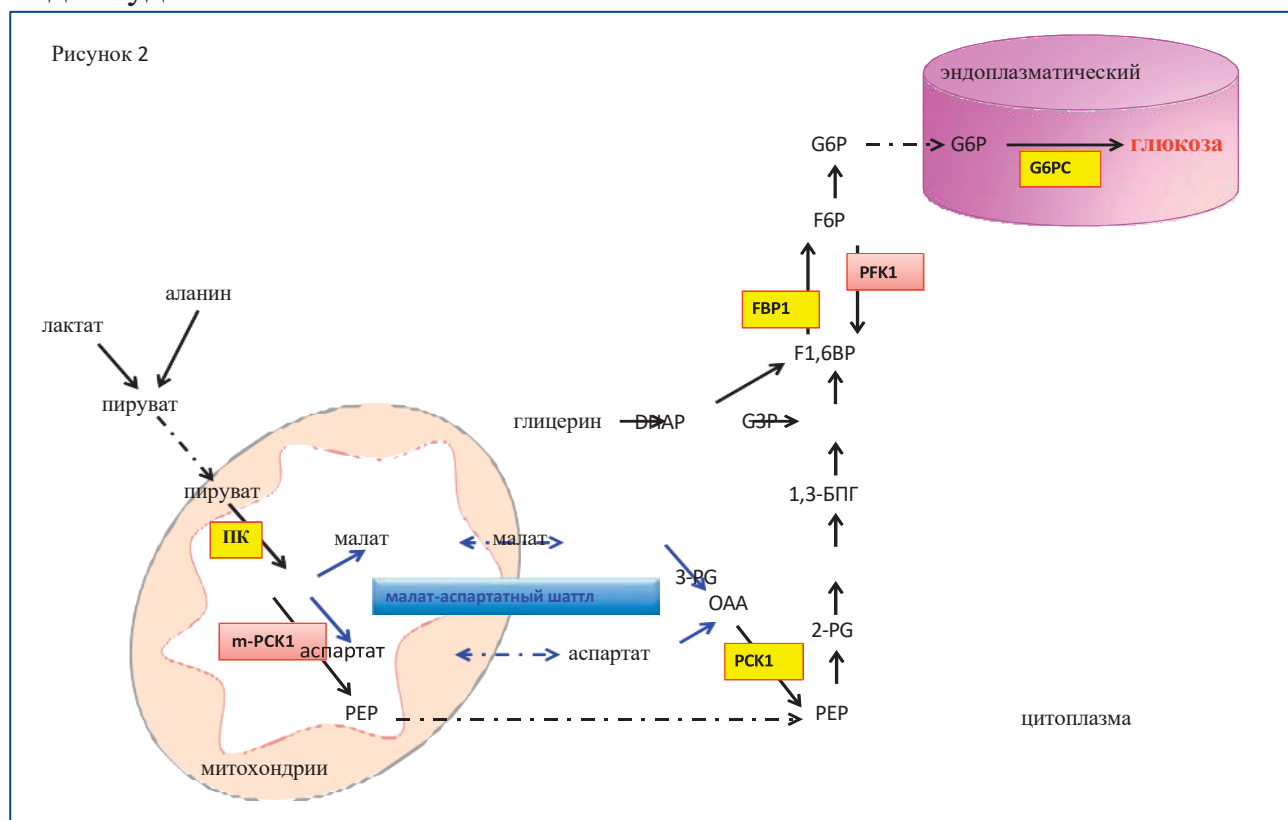
Демонстрируют сильные ассоциации между уровнем циркулирующего кортизола и признаками МетС. Хотя некоторые наблюдали тонкие изменения в активности оси ГН у пациентов с метаболическим синдромом, они не могут полностью объяснить этиологию МетС ²⁶. Однако описание тканеспецифического превращения неактивных ГК в активные ГК под действием 11 β ГСДГ1 в тканях, склонных к ГК-индуцированной инсулинорезистентности, возродило интерес к ГК как к первопричине этиологии метаболического синдрома. Действительно, модели грызунов, использующие направленную сверхэкспрессию 11 β ГСДГ1 в адипоцитах демонстрирует фенотип, сходный с метаболическим синдромом, характеризующимся инсулинорезистентностью, гиперлипидемией и висцеральной жировой массой⁸. Кроме того, исследования на

людях показали корреляцию между экспрессией уровня адипоцитов 11β ГСДГ1 и внутрибрюшного жира, а также ухудшение чувствительности к инсулину²⁷. Эти данные привели к разработке так называемой "дегидрогеназной гипотезы" для объяснения тканеспецифического усиления действия ГК как механизм развития тканеспецифического синдрома Кушинга и системного метаболического синдрома^{28,29}.

Регуляция метаболизма глюкозы глюкокортикоидами

Глюкокортикоиды оказывают влияние на все аспекты метаболизма глюкозы, взаимодействуя с печенью, эндокринной системой поджелудочной железы, скелетными мышцами и жировой тканью. Они противодействуют действию инсулина. Катаболические эффекты избытка глюкокортикоидов способствуют высвобождению энергетических запасов. В краткосрочной перспективе такие эффекты играют ключевую роль в адаптации к острому стрессу или болезни, помогая поддерживать уровень циркулирующей глюкозы и обеспечивая продолжение работы мозга.

долгосрочные последствия избытка глюкокортикоидов (ГК), как уже было отмечено, включают гипергликемию и инсулинорезистентность. Эффекты избытка ГК на различные ткани будут рассмотрены в контексте утилизации глюкозы, глюконеогенеза, метаболизма гликогена и эндокринной функции поджелудочной железы³⁰.



Глюконеогенный путь в гепатоцитах. Предшественники глюконеогена (лактат и аланин) превращаются в пируват, который поступает в митохондрии и под действием пируваткарбоксилазы преобразуется в оксалоацетат (ОАА). Через малат-аспартатный челнок ОАА выходит из митохондрий с образованием фосфоенолпирувата (ФЕП). ОАА может также преобразовываться в ПЭП непосредственно в митохондриях. Затем РЕР поступает в глюконеогенный путь. Кроме того, глицерин метаболизируется до дигидроксиацетонфосфата (ДНАР), который затем превращается

до фруктозо-1,6-бисфосфата (F1,6BP). Конечный продукт, глюкоза, образуется в ЭР под действием каталитической субъединицы глюкозо-6-фосфатазы (G6PC). Ключевые ферменты выделены рамкой, а основные мишени GR показаны желтым цветом. Сокращения: ОАА оксалоацетат, РЕР фосфоенолпируват, ДНАР дигидроксиацетонфосфат, G3P глицеральдегид-3-фосфат, F1,6BP фруктозо-1,6-бисфосфат, 2-PG 2-фосфоглицерат, 3-PG 3-фосфоглицерат, 1,3-BPG

1,3-бисфосфоглицерат, G3P глицеральдегид-3-фосфат, F1,6BP фруктоза-1,6-бисфосфат, F6P фруктоза-6-фосфат и G6P глюкоза-6-фосфат. Ферментные сокращения: PC пируваткарбоксилаза, m-PCK1 митохондриальная фосфоенолпируваткарбоксикиназа, PCK1 цитозольная фосфоенолпируваткарбоксикиназа, FBP1 фруктозо-1,6-бисфосфатаза 1, PFK1 фосфофруктокиназа 1, G6PC глюкозо-6-фосфатазная каталитическая субъединица.

Глюконеогенез, который происходит преимущественно в печени, представляет собой процесс синтеза глюкозы из неуглеводных субстратов, таких как лактат, глицерин и аминокислоты. В этом обзоре детально не рассматривается весь путь глюконеогенеза, однако будут изложены основные этапы, регулируемые глюкокортикоидами (см. рис. 1). Глюкокортикоиды играют важную роль в образовании предшественников глюконеогенеза, активируя липолиз в жировой ткани и расщепление белков в мышцах, что приводит к образованию глицерина и аминокислот, необходимых для синтеза глюкозы^{30,32}. Также ГК стимулируют глюконеогенез, активируя связывание глюкокортикоидных рецепторов с элементами глюкокортикоидного ответа в промоторной области генов, кодирующих ферменты, такие как глюкозо-6-фосфатаза и фосфоенолпируваткарбоксикиназа — ключевые ферменты глюконеогенеза^{30,31}.

Регуляция метаболизма гликогена отличается от глюконеогенеза, так как она специфична для разных тканей. В печени глюкокортикоиды стимулируют образование гликогена, повышая активность гликогенсинтазы, в то время как в

скелетных мышцах они уменьшают синтез гликогена, ослабляя активность этой же фермента^{30,33}.

Утилизация и окисление глюкозы в белой жировой ткани и скелетных мышцах зависит от инсулиновых сигналов. Глюкокортикоиды антагонизируют инсулиновую сигнализацию в скелетных мышцах, в частности, уменьшая транслокацию GLUT4 к клеточной мембране^{30,34}. Кроме того, ГК способствуют развитию инсулинорезистентности, регулируя несколько генов-мишеней глюкокортикоидных рецепторов, что ведет к нарушению передачи инсулиновых сигналов и снижению активности фосфоинозитид-3-киназы и АКТ^{35,36}. Также ГК стимулируют образование липидных медиаторов, таких как жирные кислоты из адипоцитов и церамиды из печени, что может способствовать системной инсулинорезистентности^{6,30,37}.

Механизмы, через которые ГК влияют на утилизацию глюкозы в адипоцитах, менее ясны, но, вероятно, включают модуляцию функции GLUT4 и инсулиновые сигнальные пути³⁰. Глюкокортикоиды также участвуют в дифференцировке и расширении предшественников адипоцитов, что может усугублять инсулинорезистентность и дисфункцию адипоцитов^{30,38}.

Глюкокортикоиды (ГК) оказывают значительное влияние на β -клетки поджелудочной железы, причем их действие отличается в условиях *in vivo* и *in vitro*:

In vivo:

Под воздействием ГК наблюдается вторичная гиперплазия β -клеток, что является адаптивной реакцией организма для поддержания нормального уровня глюкозы в условиях периферической инсулинорезистентности.

In vitro:

В экспериментах на изолированных островках ГК напрямую индуцируют апоптоз β -клеток. Это создает противоречие с адаптивными эффектами, наблюдаемыми *in vivo*³⁰.

Нарушение глюкозо-стимулированной секреции инсулина (ГСИС):

ГК снижают количество транспортера GLUT2 и уровень глюкокиназы, что замедляет преобразование глюкозы в глюкозо-6-фосфат (G6P).

Активность глюкозо-6-фосфатазы возрастает, что дополнительно ограничивает поступление G6P в гликолитический цикл.

Эти изменения снижают соотношение АТФ/АДФ, подавляют мембранную деполяризацию, уменьшают приток кальция и препятствуют экзоцитозу инсулина.

Влияние на калиевые каналы:

ГК усиливают активность калиевого канала Kv1.5, что способствует реполяризации β -клеток, уменьшая приток кальция и угнетая секрецию инсулина.

Модели на трансгенных мышах:

Сверхэкспрессия глюкокортикоидных рецепторов в β -клетках приводит к ухудшению толерантности к глюкозе и нарушению секреции инсулина, что подтверждает негативное влияние ГК на β -клетки.

Таким образом, ГК оказывают комплексное воздействие на β -клетки, угнетая ключевые механизмы секреции инсулина, что объясняет их связь с повышенным риском развития диабета второго типа.

Резюме и будущие направления

Глюкокортикоиды (ГК) играют важную и многогранную роль в регуляции метаболизма глюкозы. В данном обзоре рассмотрены механизмы их действия, особенности регуляции, а также клинические и субклинические состояния, связанные с избытком ГК, включая их влияние на гомеостаз глюкозы.

Краткосрочные и долгосрочные эффекты:

Повышение уровня ГК во время стресса играет защитную роль, но их хронический избыток (эндогенный или экзогенный) связан с множеством осложнений.

Явный избыток ГК наблюдается при синдроме Кушинга (КС), тогда как субклинический избыток характерен для пациентов с метаболическим синдромом.

Исследования новых терапий:

Для лечения осложнений избытка ГК, таких как инсулинорезистентность и сахарный диабет (СД), ведутся разработки селективных модуляторов глюкокортикоидных рецепторов (СМГР).

СМГР стремятся использовать противовоспалительные свойства ГК, минимизируя их негативные метаболические последствия. Однако сложность разработки связана с пересечением механизмов трансактивации и транскрепрессии рецепторов.

Современные препараты:

Мифепристон, антагонист ГК, уже применяется для лечения КС у пациентов с непереносимостью глюкозы и диабетом, если хирургическое вмешательство оказалось неэффективным.

Использование системных антагонистов ГК у пациентов без избытка ГК ограничено из-за риска развития надпочечниковой недостаточности.

Новые подходы в терапии диабета:

Специфические для печени антагонисты ГК, соединенные с желчными кислотами, разрабатываются для снижения глюконеогенеза без влияния на гипоталамо-гипофизарно-надпочечниковую (ГГН) ось.

Антисмысловые олигонуклеотиды, направленные на мРНК ГК-рецепторов в печени, являются еще одним перспективным подходом.

Ингибиторы 11β -гидроксистероиддегидрогеназы 1 (11β -ГСДГ1) показали эффективность в улучшении чувствительности к инсулину и снижении уровня глюкозы в крови, однако их долгосрочные эффекты на иммунную и эндокринную системы остаются неясными.

Перспективы:

Взаимосвязь между ГК и диабетом остается сложной и недостаточно изученной.

ГК оказывают влияние на регуляцию глюкозного обмена в разных органах, антагонизируя эффекты инсулина как напрямую, так и косвенно.

Усиление исследований в области тканеспецифической модуляции ГК-сигналинга может привести к значительному прогрессу в понимании и терапии метаболических нарушений.

Развитие технологий и методов изучения специфических эффектов ГК в различных тканях, вероятно, обеспечит новые возможности для лечения диабета и метаболического синдрома.

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EMPTY SYNDROME SELLA TURCICA

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ABSTRACT

Empty Syndrome sella turcica (PTS) was described as a rare phenomenon in neuroendocrinology. Currently, with the development of non-invasive diagnostic methods such as magnetic resonance imaging (MRI) and the increasing number of patients undergoing radiation, surgery or combined therapy for pituitary adenoma, the problem of PTS has become more relevant.

The term "PTS syndrome" refers to the prolapse of the suprasellar cistern into the sella turcica, which results in the pituitary gland spreading along the bottom and walls of the sella turcica. This condition is accompanied by endocrine, neurological, and visual disturbances.

A distinction is made between primary (idiopathic) and secondary PTS, which may occur after radiation, surgical or combined therapy of chiasmatic-sellar region diseases. This review will focus on primary PTS.

Storystudy of PTSD syndrome

The syndrome of the "empty" sella turcica was first described in 1875. Since then, it remains a subject of study in neuroendocrinology. In 1924, Schaffer proposed a classification of types of diaphragm, which includes two types:

- a dense, fully formed arch over the saddle cavity;
- underdeveloped vault with a sharply enlarged infundibular opening.

Keywords: empty sella syndrome, hyperprolactinemia, serotonin system, feedback mechanism.

INTRODUCTION

In 1935, Hamby reported a case of intrasellar subarachnoid cyst in a child. W. Busch's work "Morphology of the sella turcica and its relationship with the pituitary gland", published in 1951, became a key work in defining PTS. The study was based

on the examination of 788 tissue samples obtained as a result of autopsy of people who died from diseases not associated with pituitary pathology. During the study, 40 people (5.5%), including 34 women, were found to have an almost complete absence of the sella turcica diaphragm and flattening of the pituitary gland in the form of a thin layer of tissue at its bottom. In this case, the sella seemed empty. In his work, E. Engels [20] first described this phenomenon, based on pneumoencephalography data. Later, E. Engels [20] suggested that signs of PTS can be detected when performing contrast myelography. In such cases, the sella turcica was filled with a contrast agent. An analysis of the literature has shown that the problem of PTS has been the subject of works concerning both the anatomical, radiological and endocrinological aspects of this disease. In the literature, the term "PTS syndrome" unites various nosological forms regardless of their origin: intrasellar arachnoid diverticulum, intrasellar cyst, primary arachnoid cyst, intrasellar cistern, intrasellar subarachnoid hernia. Common to all nosological forms is the presence of an expanded subarachnoid space in the sella turcica. M. Colby and T. Kearns [17] understood the term PTS to mean the presence of dense non-tumor, cicatricial tissue surrounding the optic chiasm and sella turcica, formed after operations or radiation therapy for pituitary tumors, accompanied, in addition, by newly occurring visual disturbances. Later, the term PTS began to be used in cases where the sella turcica area was filled with air on the pneumoencephalogram, and the patient had a history of previous surgery or irradiation of the pituitary region. S. Weiss and R. Raskind pointed out the need to differentiate between primary [65] (idiopathic) and secondary PTS, which occurs against the background of previous interventions in the hypothalamic-pituitary region [77].

Etiology and pathogenesis. By now, a wide range of pathological and physiological factors that have a direct or indirect relation to the development of PTSD have been described. They can be conditionally divided into the following groups. 1. Trauma. Damage to the central part of the neuroendocrine system can lead to the development of PTSD. 2. Infectious diseases of various origins, which are particularly severe, ultimately lead to pathological changes in the hypothalamic-pituitary region. 3. Local and general circulatory disorders: bleeding, embolism, necrosis, as well as hypertension and intracranial hypertension. 4. Drug effects: oral contraceptives and dopamine agonists, hormone replacement therapy, radiation therapy, surgery. 5. Tumors. A tumor developing in the hypothalamic-pituitary region can suppress the activity of the pituitary gland and lead to glandular hypofunction, which initiates the development of a number of compensatory processes. 6. Heredity factor. The formation of PTS is facilitated by a violation of the elastic structure of the diaphragm of the sella turcica with congenital inferiority of the connective tissue. 7. The latest studies indicate that autoimmune disorders (lymphocytic adenohypophysitis - LA) can play a certain

role in the development of PTS. 8. Physiological processes: pregnancy, menopause. The mechanism of PTS formation is based on the anatomical features of the structure of the sella turcica. At the entrance to the sella turcica, the dura mater splits into 2 layers, one of which lines the walls and bottom of the sella, the second closes the entrance to the sella turcica, forming the diaphragm of the sella. In the center of the diaphragm there is an opening for the passage of the stalk (peduncle) of the pituitary gland. Normally, the arachnoid membrane and cerebrospinal fluid do not penetrate into the cavity of the sella turcica. R. Mortara and H. Noreli reported cases of penetration of the chiasmatic cistern and the bottom of the 3rd ventricle into the cavity of the sella turcica [48]. Attachment of the diaphragm and its thickness, the nature of the opening are subject to significant anatomical variations. W. Busch also described 3 types of diaphragm [15]: type 1 - the diaphragm is a connective tissue vault with an opening in the center, passing only the stalk of the pituitary gland; Type 2 — the diaphragm is not completely closed and contains an opening up to 3 mm in diameter around the pituitary stalk; Type 3 — the diaphragm is a narrow strip (2 mm or less) of dura mater duplication along the periphery of the sella. Insufficiency of the diaphragm leads to the spread of the subarachnoid space into the intrasellar region and to the emergence of the ability of cerebrospinal fluid pulsation to directly affect the pituitary gland, which can lead to its flattening [36] and pressing against the bottom or back. M. Farber et al. [21] have data on the congenital absence of the diaphragm. Congenital underdevelopment of the diaphragm of the sella turcica, according to various authors, occurs in 40-50% of cases of pathological studies [1]. It should be noted that that diaphragmatic insufficiency may not only be congenital, but also develop as a result of physiological processes such as pregnancy and menopause. During pregnancy, the pituitary gland increases in size approximately twofold, and in women who have given birth to multiples or twins, it can be even larger, not returning to its original size after childbirth. This circumstance explains to some extent the development of primary PTSD mainly in women. When taking oral contraceptives, hormone replacement therapy for hypofunction of the peripheral endocrine glands, transient hypertrophy of the pituitary gland and stalk occurs with their subsequent involution, which ultimately leads to thinning of the diaphragm and an increase in its opening [38]. The formation of PTSD syndrome against the background of congenital [33] or long-term untreated hypothyroidism [49], hypopituitarism gives some authors reason to consider the connection between hypoplasia and hypofunction of the pituitary gland with the development of this syndrome. Another point of view regarding the mechanism of PTS development has an equal right to exist, related to the normal existence of a pituitary cistern located under the diaphragm of the sella turcica [20]. In this regard, it can be assumed that primary PTS is formed not as a result of the descent of the suprasellar

cisterns into the cavity of the sella turcica, but due to the compensatory expansion of the pituitary cistern and a decrease in the volume of the pituitary gland. With the formation of secondary PTS, the suprasellar cisterns may descend into the cavity of the sella turcica, since the pituitary cistern is subject to degenerative changes under the influence of the tumor itself, radiation therapy, or is destroyed during surgical removal of the pituitary adenoma. Kaufmann believed that an important factor in the development of PTS is an increase in pulse cerebrospinal fluid pressure due to intracranial hypertension, hypertension, hydrocephalus, intracranial tumor. In practice, this means a long-term increase in intracranial pressure and a disruption in the circulation of cerebrospinal fluid (block of the fornix and hydrocephalus), which subsequently leads to an increase in the size of the sella turcica and the formation of primary PTS. However, at the moment it is difficult to argue that a transient or permanent increase in the pressure of the cerebrospinal fluid is required to increase the sella turcica in such cases, since the pressure of the cerebrospinal fluid is already normal with the formed PTS [11]. A certain role in the etiology of PTS syndrome belongs to a violation of the volumetric ratios between the pituitary gland and the sella turcica. A decrease in the volume of the pituitary gland can be the result of necrosis of the pituitary adenoma [13]. In search of the causes of the formation of PTS, R. Bjerre conducted studies that yielded evidence that PTS is a consequence of the autolysis of a previously existing pituitary adenoma. This theory explains the frequent presence of a hypoplastic pituitary gland, visual field impairment, phenomena of non-traumatic cerebrospinal rhinorrhea and benign intracranial hypertension in patients with PTS. Thus, in the author's opinion, PTS syndrome is a stage in the spontaneous resolution of a pituitary tumor [63]. J. Montalbay et al. came to the conclusion that pituitary apoplexy is an inevitable cause of the development of subsequent panhypopituitarism and PTS [47]. Along with all the listed factors, an important role in the pathogenesis of PTS is played by arachnoid cysts that develop as a result of optic-chiasmal arachnoiditis; infarctions and necrosis of giant granulomas and gummas of the pituitary gland; necrosis and hemorrhage of pituitary adenomas [13]. It is even considered possible that PTS is an evolutionary stage in the development of the syndrome [Lichen's disease [43]. Some researchers present data on PTS syndrome. which arose as a result of pituitary artery infarction after pulse therapy with prednisolone for systemic lupus erythematosus [37]. Consequently, the group of patients taking glucocorticoids for a long time or in massive doses cannot be excluded from the structure of PTS formation. It is impossible not to note the fact of the occurrence of PTS syndrome, described by Scandinavian scientists, in a patient with hemorrhagic fever caused by the Puumala virus, a complication of which was the development of nephropathy and PTS with pituitary insufficiency [23]. Apparently, the development

of this disease against the background of chronic periorbital vasculitis can be attributed to the same category of causes [29]. Summarizing all of the above, it can be concluded that diaphragmatic insufficiency and increased cerebrospinal fluid pressure are of the greatest importance for the formation of PTS. Other factors are only predisposing. Recent years have been marked by ever-increasing attention to the problems of immunogenesis of diseases, including endocrinopathies [6]. Recent studies indicate the possible involvement of the autoimmune link in the pathogenesis of PTSD syndrome. M. Komatsu et al., when analyzing humoral autoimmunity in patients with primary PTSD, obtained data confirming the involvement of autoimmune processes in the development of lymphocytic hypophysitis, leading to pituitary atrophy [39]. This study showed that antibodies to corticotrophs and lactotrophs were found in 75 and 47% of cases, respectively, and 44% of patients had antibodies to both types of cells (for comparison: in patients with pituitary adenomas, the frequency of antibodies to the surface of adenohypophysial cells is 22%, with diabetes insipidus - 33%, and in patients with other autoimmune diseases and in healthy individuals, antibodies were not found). To substantiate the proposed assumption, we will give the following example. K. Okada and S. Ishikawa reported on a 28-year-old woman who developed persistent amenorrhea, fatigue, weakness, and weight loss after childbirth [54]. Laboratory data showed hyperprolactinemia and decreased levels of adrenocorticotrophic hormone (ACTH). Serological blood testing showed the presence of antibodies to the superficial cells of the adenohypophysis. According to MRI of the brain, a picture of PTS was revealed. It is possible that PTS syndrome and ACTH deficiency are caused by autoimmune destruction of the gland. It has been suggested that PTS syndrome plays a role in the development of ACTH deficiency. The autoimmune nature of the PTS phenomenon may be indicated by the fact that this syndrome exists in the father and his two daughters or the presence of several diseases in one patient, which are based on autoimmune disorders (Sjogren's disease, Hashimoto's thyroiditis, PTS syndrome). LA was first described in 1962 by Goudie and Pinkerton in a woman, at whose autopsy LA and Hashimoto's thyroiditis were found [57]. The histological picture of LA is as follows: infiltration of the adenohypophysis with lymphocytes, plasma cells and eosinophils with lymphoid follicles and interstitial fibrosis. Most patients with LA have concomitant autoimmune diseases. A number of authors note the obligatory presence of antibodies to the superficial cells of the adenohypophysis in the blood of such patients. LA is often accompanied by hyperprolactinemia. However, to date, no correlation has been found between the presence of circulating antibodies to the pituitary gland and the development of pituitary insufficiency [46]. Complaints In most cases, PTSD syndrome occurs in women over 50 years of age and men over 60 years of age, which

is probably associated with age-related involution of the pituitary gland [22]. The main complaints of patients are usually the following: headaches, dizziness, memory impairment, increased blood pressure (the hypothalamic origin of which is being clarified [72]), changes in vision, thirst, swelling of the face and limbs, changes in sexual function, weight gain, weakness, fatigue, decreased performance. The hypothalamic component can manifest itself in a violation of thermoregulation, most often an increase in body temperature to subfebrile numbers. The most common complaint in PTSD syndrome is headache. It, as a rule, constant, more pronounced in the forehead area, has a meningeal character, i.e. occurs as a result of tension of the dura mater. Some researchers believe that PTSD syndrome should be suspected in overweight women, middle-aged, with daily headaches [16]. More than half of the patients complain of excess body weight [33, 67]. It should be noted that the distribution of subcutaneous fat in PTSD is nonspecific. A case of Cushingoid obesity in a patient without any other clinical and laboratory signs of Itsenko-Cushing's disease, whose brain MRI revealed a picture of PTSD [19] is described. The authors of the article emphasize the importance of searching for the causes of obesity, especially if it is combined with external signs of hypothalamic-pituitary diseases. Rare complaints of patients with PTSD syndrome include decreased visual acuity and deterioration of lateral vision; watery nasal discharge diagnosed as cerebrospinal fluid rhinorrhea. Spinal rhinorrhea as a symptom of PTSD was first observed by Ommaya in 1968. Rhinorrhea [75], which occurs more often with coughing, sneezing, is often the only manifestation of this syndrome, which leads to an incorrect diagnosis of allergic or vasomotor rhinitis and incorrect treatment tactics [26]. The cause of rhinorrhea is the presence of a connection between the sella turcica and the oral cavity, which periodically occurs when coughing or sneezing [69]. The resulting connection between the suprasellar subarachnoid space and the sphenoid sinus increases the risk of meningitis. Therefore, it is extremely important to understand the causes of rhinorrhea. Clinical picture Often, PTSD syndrome is asymptomatic and is diagnosed by chance during a tomographic examination. Clinical manifestations of PTSD syndrome can be conditionally divided into 3 groups. 1. Endocrine disorders. The cause of neuroendocrine disorders in PTSD syndrome is considered to be not compression of the secretory cells of the pituitary gland, but compression of its stalk and, accordingly, disruption of hypothalamic control over pituitary functions as a result of periodically occurring disruption of the intake of inhibitory and releasing factors of the hypothalamus. This position is based on the lack of correlation between the degree of compression of the pituitary gland itself and clinical symptoms and is confirmed by the polymorphism and instability of clinical neuroendocrine disorders. The functional state of the pituitary gland in PTSD syndrome changes in half of the patients, and in some

cases PTS can be combined with pituitary adenomas [5]. Endocrine disorders in PTS syndrome can manifest themselves as a change in the tropic functions of the pituitary gland without clinical symptoms. PTS syndrome is characterized by hyperprolactinemia, which acquires a transient character during dynamic observation: from normal to moderately elevated [10]. E. A. Mizetskaya et al. suggest that when conducting a test with parlodel, there is a rapid (after 2 hours) decrease in the prolactin level, and after 4 hours its content reaches the norm, which is a criterion for the primary nature of PTS; in secondary PTS, the prolactin level does not normalize. Celani et al. studied the prolactin level in a test with TRH in patients with primary PTS and patients with prolactinomas. The results of the study showed that in both cases the prolactin response to TRH was reduced, so the value of such a test for differential diagnosis is questionable. It is worth noting that more than half of the patients with hyperprolactinemia have reduced concentrations of luteinizing and follicle-stimulating hormones in the blood. Hyperprolactinemia in PTS syndrome in some cases is not a factor preventing pregnancy, which can proceed favorably even with concomitant osteoporosis [25]. When studying the adrenocorticotrophic function of the pituitary gland, only an insignificant proportion of patients showed an increased level of ACTH. Half of the patients experience a decrease in the concentration of ACTH in the blood serum and secondary adrenal insufficiency, which is often mild and in some cases is accompanied by a deficiency of somatotrophic hormone (STH) [31]. Of interest is the description of two patients with PTS syndrome and ACTH hypersecretion with normal cortisol levels, which may be associated with the production of ACTH peptide with low biological activity and subsequent corticotroph infarction and the development of PTS. The functional activity of the adrenal cortex is reduced in some patients with PTS, which is confirmed by the ACTH stimulation test. On the contrary, there is a long-term observation of a patient with all the signs of hypercorticism, in whom MRI excluded both corticosteroma and pituitary adenoma, and an ectopic source of ACTH production was not found. Repeated control studies came to one diagnosis: PTS syndrome [71]. A study of the pituitary-thyroid gland axis function showed that secondary hypothyroidism was observed in 1/10 patients and was accompanied by a decrease in the level of triiodothyronine, thyroxine and an increase in the level of thyroid-stimulating hormone in the blood. The same number of patients had a subclinical form of hypothyroidism diagnosed by a stimulation test with TRH. Typical disorders of sexual function in women are oligomenorrhea and amenorrhea. Impaired gonadotropic function in men often manifests itself as decreased libido, oligospermia, and infertility. In-depth studies of the pituitary-ovarian (testicular) axis revealed secondary hypogonadism in a number of cases. The results of the test with luteinizing hormone-releasing hormone in men confirmed the pituitary nature of hypogonadism, and in

women - the hypothalamic nature [14]. Secretion of STH in patients with primary PTS in more than half of the cases tends to decrease, as shown in a study on stimulation with insulin hypoglycemia, and the frequent association of PTS syndrome with diseases accompanied by STH deficiency confirms these data. An example is the combination of PTS with congenital septo-pituitary dysplasia syndrome (agenesis of the septum pellucidum or corpus callosum, optic nerve hypoplasia, deficiency of STH, ACTH, thyroid-stimulating hormone and excess prolactin) [24]. In general, patients with PTS syndrome more often have changes in the function of the anterior pituitary gland, less often - the posterior lobe. A case of central diabetes insipidus in combination with hypogonadism is known, and computed tomography data revealed a defect in the diaphragm of the sella turcica and PTS syndrome [42]. To date, many cases of a combination of diabetes insipidus and PTS syndrome have been described, which suggests [34] a high probability of developing central diabetes insipidus against the background of PTS syndrome. It should be noted that panhypopituitarism and hypopituitarism are often observed in PTS syndrome [68]. Here is an example of one case from practice: a 64-year-old woman was examined for persistent hyponatremia [55]. After a complete clinical and laboratory examination, a diagnosis of panhypopituitarism was made, and according to MRI of the brain, PTSD syndrome was diagnosed. It is important to note that the weakening of the tropic functions of the pituitary gland is sometimes less pronounced in primary PTSD, than in the secondary, and does not always require replacement therapy. This fact can be explained by the fact that the presence of a pituitary tumor makes the disorders more profound.

2. Neurological disorders. According to observations of neurologists of the A. M. Vein Clinic, patients with PTSD syndrome have a high severity of emotional-personal, motivational and vegetative disorders [1]. The appearance of clinical symptoms and worsening of the course of the disease is directly associated with the exacerbation of a chronic stress situation. In all patients, a stressful environment affects the level of brain mediators, changing the production of inhibitory and releasing factors of the hypothalamus, which subsequently affects the function of the pituitary gland. The state of stress worsens the course of arterial hypertension, which is often present in patients with PTSD, leading to an increase in vegetative crises, affecting cerebrospinal fluid dynamics. The misalignment of the hypothalamic-pituitary connections in PTSD syndrome inevitably disrupts all functions of the hypothalamus, reducing adaptive properties and increasing susceptibility to stress. In turn, this leads to an increased response to stress, which is manifested by worsening of the disease, aggravation of emotional-motivational and vegetative disorders. Schematically, pathological changes in patients with PTSD syndrome can be presented as follows. Pathology from the central nervous system: - cephalgic syndrome caused by tension headache or increased

intracranial pressure, - cerebroasthenic syndrome without vascular lesions: memory loss, rapid fatigue, tearfulness, decreased tone, leveled by rest and taking nootropic, vasodilator drugs; - vestibular syndrome: dizziness, unsteadiness and uncertainty of gait. Pathology from the autonomic nervous system: - complaints of a cardiovascular, gastrointestinal, respiratory nature. In connection with the position on the increased pressure of the cerebrospinal fluid in the PTSD syndrome, the dependence of intracranial hypertension and pituitary function was studied. It was shown that long-term increased pressure on the anterior pituitary gland led to a decrease in pituitary function [41]. Impaired cerebrospinal fluid circulation was observed with hypopituitarism in most patients, with normal pituitary function in a smaller number of cases, and with concomitant hyperprolactinemia it occupied an intermediate position. Demineralization and erosion of the sella turcica, also indicating increased intracranial pressure, were combined with both normal and impaired pituitary function. There is strong evidence that patients with panhypopituitarism had a history of cerebrovascular episodes or meningoencephalitis before the development of pituitary insufficiency. It is possible that these patients experienced acute attacks of increased intracranial pressure that were not compensated for by enlargement of the sella turcica. Thus, subsequent dysfunction of the pituitary gland in some patients is secondary to disturbances of cerebrospinal fluid circulation.

3. Visual impairment. Visual impairment varies in nature and severity [52]. Typically, it may be a decrease in visual acuity in one or both eyes, changes in the visual fields [4], photophobia. Long-term observation reveals fluctuations in the visual fields, visual acuity, and the state of the optic nerve heads, which can be explained by changes in cerebrospinal fluid circulation in the basal cisterns and the degree of sagging of the optic nerves into the sella turcica. Ophthalmological examination in patients with PTSD is extremely important, since changes in the visual fields and optic nerve heads can be observed in open-angle glaucoma or glaucoma with low or normal intraocular pressure, which is not uncommon and can be combined with PTSD [64]. In this regard, it is necessary to diagnose glaucoma as the cause of visual field defects, since the treatment tactics for these diseases are different. Visual impairment in secondary PTS syndrome has slightly different roots: after surgery on the pituitary gland, the optic chiasm sags into the sella turcica; after X-ray therapy, there is a high risk of negative effects of radiation on the vascular system, the development of vasculitis and visual impairment due to narrowing of the blood vessels. As PTS syndrome was studied, it was found that in half of the cases it can be associated with other endocrine diseases [12, 35. 76]. This is confirmed by the combination of PTS with multiple endocrine tumor syndrome type 1 [53], diabetes mellitus, corticotropinoma [32], etc. An association of PTS syndrome and Itsenko-Cushing's disease is not uncommon [44]. There are also reports in the literature

on an association with Addison's disease in a patient who took glucocorticoids for 14 years, and an MRI of the brain revealed a picture of PTS [9]. When studying the hormonal status, an impaired release of luteinizing and follicle-stimulating hormones was noted, which could be a manifestation of both hypogonadism and PTSD syndrome. Finally, PTSD syndrome can quite often be combined with various congenital anomalies (for example, with Hand-Schüller-Christian syndrome [56]). In 1995, a case of PTSD was described in which STH deficiency was noted in combination with DIDMOAD syndrome [70]. The prevalence of PTSD syndrome in children, according to the literature, is underestimated, although it ranges from 1 to 58% [51]. It has been established that perinatal events, changing the blood supply to the pituitary gland or infundibulum, contribute to the formation of PTSD. It is noteworthy that some authors consider it important to take into account the presence of unfavorable perinatal factors in the development of PTSD, while others argue that they have no etiological significance. In both adults and children, PTSD may be associated with hypofunction and hyperfunction of the pituitary gland [73]. The most common endocrine disorders are: isolated growth hormone deficiency [58, 61] (possibly associated with a biologically inactive form of growth hormone), hypogonadotropic hypogonadism, premature puberty [62], delayed puberty. In addition, it should be noted that PTS syndrome can be combined with polyglandular deficiency syndrome in children. Conflicting opinions regarding the incidence of STH deficiency and polyglandular deficiency in children can only be explained by the polymorphism of this disease. Thus, the high incidence of endocrine disorders in PTS syndrome emphasizes the exceptional importance of assessing the function of the pituitary gland in individuals with this disease. Diagnostics. The diagnosis of PTS syndrome is based on the results of various examination methods. Craniography data in the lateral projection are usually as follows: no changes in the bone structure and size of the sella turcica, closed cylindrical shape of the sella turcica. In 1/3 of patients, signs of increased intracranial pressure are found: hyperpneumatization of the sinus of the sphenoid bone, increased vascular pattern, digital impressions of the bones of the cranial vault, an increase in the size of the sella turcica with changes in the bone structure. Characteristic craniographic signs are usually more pronounced in secondary PTS. Radiography cannot be used as the sole criterion for diagnosing PTS, since the frequency of detection of intrasellar tumors and PTS syndrome during this study is almost the same. However, there are still frequent cases when an enlarged sella turcica is assessed as a pituitary adenoma and unjustified surgical intervention is undertaken, so further examination should be carried out. Previously, a reliable method for diagnosing PTS syndrome was pneumoencephalography, in which the cavity of the sella turcica is filled with gas to one degree or another. In 76% of cases, air contrasts well with the basal cisterns and

penetrates into the cavity of the sella turcica. In 24% of cases, pneumoencephalography data do not allow us to judge the presence of PTS. At present, this technique has no practical application due to its high trauma and low diagnostic value. Computed tomography combined with the introduction of contrast agents intravenously or directly into the cerebrospinal fluid has a higher resolution [60, 78]. In typical cases, the changes are localized below the diaphragm of the sella turcica; the bottom of the sella turcica is symmetrically located in the frontal projection and has a closed shape. The sella turcica is enlarged mainly in the vertical size, there are no signs of thinning and erosion of the cortical layer, a two-contour bottom is visible on the sagittal section, the lower line of which is thick and clear, and the upper is blurred. Computed tomography in patients with secondary PTS often reveals a decrease in tissue density in its cavity, but this sign is also characteristic of endosellar pituitary adenomas and non-neoplastic cysts, so further diagnostics should be directed towards searching for hormone hyperproduction. It is proposed to consider that the volume of the pituitary gland is up to 150 mm³, revealed by computed tomography data is a criterion for PTS [40]. In cases where computed tomography data reveals a zone of reduced echogenicity, it is necessary to perform computed cisternography with amipak. According to the methodology of this study, the contrast agent penetrates the existing arachnoid coele and provides good contrast of PTS, but in 2% of cases this procedure is uninformative. Let us give the following example: a patient with hyperprolactinemia was diagnosed with PTS according to CT data of the brain, and an MRI study revealed a microprolactinoma localized in the lower part of the sella turcica [74]. Moreover, computed tomography is associated with allergic reactions to endolumbar administration of amipak. Computed tomography with contrast and pneumoencephalography are invasive methods and are combined with a significant radiation load. A modern diagnostic method for detecting PTSD is a non-invasive method of intrascopic diagnostics - MRI, based on the phenomenon of nuclear magnetic resonance [66]. The method allows conducting research without the use of ionizing radiation, the introduction of iodine substances, the study can be carried out repeatedly and in 3 mutually perpendicular planes [45]. The state of the pituitary gland and the cerebrospinal fluid-conducting system is most clearly and informatively assessed in the sagittal section. When comparing the MRI picture of the brain in healthy individuals and patients with PTSD, it was found that the relative signal intensity of the deformed pituitary gland is significantly lower, especially on the T-echo image [30]. The MRI picture of PTS looks like this [2]: in the area of the unchanged sella turcica there is a zone of low signal intensity, which has a clear glow when conducting "MR myelography", which is interpreted as the presence of fluid contents in the intrasellar area - cerebrospinal fluid, the pituitary gland is deformed and takes the shape

of a sickle or a crescent 2-4 mm thick and is flattened along the bottom of the sella turcica. Many studies devoted to MRI of the brain in PTS syndrome allow us to conclude that the diagnostic value of MRI in this pathology reaches 100%. Domestic and foreign researchers of the problem of diagnosing PTS syndrome recommend MRI of the brain in patients taking dopamine agonists, thyroid hormones for a long time, as well as in patients diagnosed with hypopituitarism, since these factors lead to the formation of PTS. A patient with hyperprolactinemia was diagnosed with PTS according to CT of the brain, and an MRI study revealed a microprolactinoma localized in the lower part of the sella turcica [74]. Moreover, computed tomography is associated with allergic reactions to endolumbar administration of amipak. Computed tomography with contrast and pneumoencephalography are invasive methods and are combined with significant radiation exposure. A modern diagnostic method for detecting PTS syndrome is a non-invasive method of intrascopic diagnostics - MRI, based on the phenomenon of nuclear magnetic resonance [66]. The method allows conducting studies without the use of ionizing radiation, the introduction of iodine substances, the study can be carried out repeatedly and in 3 mutually perpendicular planes [45]. The state of the pituitary gland and the cerebrospinal fluid-conducting system is most clearly and informatively assessed in a sagittal section. When comparing the MRI pattern of the brain in healthy individuals and patients with PTSD, it was found that the relative signal intensity of the deformed pituitary gland is significantly lower, especially on the T-echo image [30]. The PTSD pattern on MRI looks like this [2]: in the area of the unchanged sella turcica, there is a zone of low signal intensity that has a clear glow when performing "MR myelography", which is interpreted as the presence of fluid contents in the intrasellar area - cerebrospinal fluid, the pituitary gland is deformed and takes the shape of a sickle or crescent 2-4 mm thick and is spread along the bottom of the sella turcica. Many studies devoted to MRI of the brain in PTSD syndrome allow us to conclude that the diagnostic value of MRI in this pathology reaches 100%. Domestic and foreign researchers of the problem of diagnosing PTSD recommend conducting MRI of the brain in patients who have been taking dopamine agonists, thyroid hormones for a long time, as well as in patients diagnosed with hypopituitarism, since these factors lead to the formation of PTSD. A patient with hyperprolactinemia was diagnosed with PTS according to CT of the brain, and an MRI study revealed a microprolactinoma localized in the lower part of the sella turcica [74]. Moreover, computed tomography is associated with allergic reactions to endolumbar administration of amipak. Computed tomography with contrast and pneumoencephalography are invasive methods and are combined with significant radiation exposure. A modern diagnostic method for detecting PTS syndrome is a non-invasive method of intrascopic diagnostics - MRI, based on the phenomenon of nuclear

magnetic resonance [66]. The method allows conducting studies without the use of ionizing radiation, the introduction of iodine substances, the study can be carried out repeatedly and in 3 mutually perpendicular planes [45]. The state of the pituitary gland and the cerebrospinal fluid-conducting system is most clearly and informatively assessed in a sagittal section. When comparing the MRI pattern of the brain in healthy individuals and patients with PTSD, it was found that the relative signal intensity of the deformed pituitary gland is significantly lower, especially on the T-echo image [30]. The PTSD pattern on MRI looks like this [2]: in the area of the unchanged sella turcica, there is a zone of low signal intensity that has a clear glow when performing "MR myelography", which is interpreted as the presence of fluid contents in the intrasellar area - cerebrospinal fluid, the pituitary gland is deformed and takes the shape of a sickle or crescent 2-4 mm thick and is spread along the bottom of the sella turcica. Many studies devoted to MRI of the brain in PTSD syndrome allow us to conclude that the diagnostic value of MRI in this pathology reaches 100%. Domestic and foreign researchers of the problem of diagnosing PTSD recommend conducting MRI of the brain in patients who have been taking dopamine agonists, thyroid hormones for a long time, as well as in patients diagnosed with hypopituitarism, since these factors lead to the formation of PTSD.that the relative signal intensity of the deformed pituitary gland is significantly lower, especially on the T-echo image [30]. The picture of PTS on MRI looks like this [2]: in the area of the unchanged sella turcica there is a zone of low signal intensity, which has a clear glow when conducting "MR myelography", which is interpreted as the presence of fluid contents in the intrasellar area - cerebrospinal fluid, the pituitary gland is deformed and takes the shape of a sickle or crescent 2-4 mm thick and is flattened along the bottom of the sella turcica. Many studies devoted to MRI of the brain in PTS syndrome allow us to conclude that the diagnostic value of MRI in this pathology reaches 100%. Domestic and foreign researchers of the problem of diagnosing PTS syndrome

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Treatment. Treatment of neuroendocrine disorders in PTSD syndrome depends on the clinical picture and hormonal levels. Dehydration and vascular therapy are indicated to improve hemodynamics in the chiasmatic-sellar region. The severity of motivational and psychovegetative disorders determines the introduction of vegetotropic and psychotropic drugs into the spectrum of therapeutic measures. The threat of vision loss is an indication for surgical intervention [8]. Currently, transsphenoidal [79] extradural introduction of a removable balloon [18] filled with silicone [50] is widely used abroad. An alternative approach is tamponade of the sella turcica with fat [59], muscle, cartilage or bone [3] with the possibility of performing simultaneous adenectomy [7]. With the help of the listed methods, the severity of headaches and visual disorders decreases within a few days, which would be difficult to achieve in some cases by therapeutic measures. A method for treating progressive loss of vision in this disease has also been proposed — transsphenoidal chiasmopexy [28], and in patients with intracranial arterial hypertension and PTSD, lumboperitoneal shunting is successfully used. There is an opinion that the combination of spontaneous spinal rhinorrhea and progressive visual impairment in combination with severe intracranial hypertension is an indication for surgical treatment, for example, tamponade of the sella turcica with muscle or cartilage [59]. The prognosis of PTSD syndrome is determined by the degree of endocrine, neurological, and ophthalmological disorders. With adequate symptomatic therapy, a favorable course of the disease can be ensured.

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RAQAMLI VALYUTALARNING MOLIYAVIY INKLYUZIVLIKNI YARATISH VA IQTISODIY O'SISHNI RAG'BATLANTIRISH SALOHİYATI

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ANNOTATSIYA

Raqamli valyutalar (masalan, kriptovalyutalar va markazlashtirilgan raqamli valyutalar) moliyaviy inklyuzivlikni yaratish va iqtisodiy o'sishni rag'batlantirishda katta salohiyatga ega bo'lish. Bu mavzuda aspektlar orqali bu salohiyatni tushuntirish mumkin.

Kalit so'zlar: Moliyaviy inklyuzivlikni oshirish, Iqtisodiy o'sishni rag'batlantirish, global iqtisodiy integratsiya, innovatsion yechimlar va raqamli iqtisodiyot, moliyaviy ta'lim va shaxsiy moliyaviy boshqaruv.

KIRISH

Raqamli valyutalar orqali odamlar bank xizmatlariga kirish imkoniyatiga ega bo'lmalar ham, iqtisodiy tizimga qo'shilishi mumkin. Raqamli valyutalar, ayniqsa, markazlashtirilgan yoki blockchain texnologiyalariga asoslangan tizimlar, banklarga yoki moliyaviy institutlarga murojaat qilmasdan ham global miqyosda operatsiyalarni amalga oshirish imkonini beradi. Bu:

- **Qashshoqlikni kamaytirish:** Bank hisoblari bo'lmagan odamlar uchun oddiy smartfon orqali pul jo'natish va olish imkoniyatlari yaratadi.

- **Xalqaro o'tkazmalarni arzonlashtirish:** Raqamli valyutalar, an'anaviy bank o'tkazmalari bilan solishtirganda, past to'lovlar va tezroq tranzaksiyalarni taqdim etadi, bu esa iqtisodiy integratsiyani osonlashtiradi.

- **Moliyaviy xizmatlar kengaytirish:** Kreditlar, sug'urtalar va investitsiyalar kabi moliyaviy xizmatlarga ham yanada ko'proq odamlar kirish imkoniyatiga ega bo'ladi.

ADABIYOTLAR TAHLILI VA METODLAR

Bu adabiyotlar raqamli valyutalar, ularning moliyaviy inklyuzivlik yaratishdagi roli, va iqtisodiy o'sishni rag'batlantirishda imkoniyatlarni tahlil qilishga yordam beradi. Har bir manba o'zining alohida tadqiqotlari va yondashuvlari bilan mavzuni keng qamrab oladi.

NATIJALAR

Raqamli valyutalar iqtisodiy o'sishning bir nechta muhim jihatlarini rivojlantiradi:

- **Yangi ish o'rinlari yaratish:** Raqamli valyutalar va blockchain texnologiyalarini joriy etish yangi sohalar va ish o'rinlarini yaratadi, masalan, raqamli valyuta treyderlari, texnologik rivojlanish uchun mutaxassislar, va boshqa sohalar.

- **Investitsiyalarni jalb qilish:** Raqamli valyutalar va blockchain texnologiyalari yangi investitsiya imkoniyatlarini taqdim etadi, bu esa innovatsiyalar va startaplarni rag'batlantiradi. Kriptovalyutalar orqali amalga oshiriladigan ICO (Initial Coin Offering) yoki STO (Security Token Offering) lar yangi kapitalni jalb qilish uchun samarali vositalardir.

- **Shaffoflikni oshirish:** Raqamli valyutalar tizimida amalga oshirilgan barcha tranzaksiyalarni blokcheyn orqali shaffof qilish, iqtisodiy tizimda ishonchni oshiradi va korrupsiyani kamaytiradi. Bu iqtisodiy o'sishni rag'batlantiruvchi muhim omildir.

Raqamli valyutalar o'zaro o'zaro bog'liq bo'lgan global moliyaviy tizimni rivojlantiradi. Turli mamlakatlar o'rtasida pul o'tkazmalarining tezligi va samaradorligini oshiradi. Bu esa savdo va xizmat ko'rsatish sohalarini yaxshilaydi.

MUHOKAMA

Raqamli valyutalar bilan bog'liq texnologiyalarni qo'llash, ayniqsa, decentralizatsiya, smart-kontraktlar va yangi iqtisodiy tizimlarni yaratishga imkon beradi. Bu innovatsiyalar, yangi ish o'rinlari va iqtisodiy imkoniyatlarni taqdim etadi.

Raqamli valyutalar foydalanuvchilarni moliyaviy savodxonlikni oshirishga majbur qiladi. Odamlar raqamli valyutalar va ularning ishlash prinsiplari haqida ko'proq ma'lumot olishadi, bu esa shaxsiy moliyaviy boshqaruvni yaxshilashga yordam beradi.

XULOSA

Raqamli valyutalar moliyaviy inklyuzivlikni yaratishda va iqtisodiy o'sishni rag'batlantirishda katta imkoniyatlarga ega. Ular nafaqat yangi moliyaviy imkoniyatlar yaratadi, balki global iqtisodiy tizimning shaffofligi, samaradorligi va barqarorligini ta'minlaydi. Biroq, bunday tizimlarning to'liq potentsialiga erishish uchun, tartibga solish, xavfsizlikni ta'minlash va texnologiyalarni rivojlantirishda ehtiyotkorlik bilan yondashish zarur.

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REDUKTORLAR SILINDRIK TISHLI G'ILDIRAGINING YEYILISH HAJMINING OMILLARINI MATEMATIK MODELLASHTIRISH

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ANNOTATSIYA

Ushbu ilmiy maqolada reduktorlar silindrik tishli g'ildiragining yeyilish hajmining omillariga experimental rejalashtirish va matematik ishlov berish usullari ko'rib chiqilgan. Maqolada kiruvchi omillar sifatida aylanish tezligi, material qattiqligi va ta'sir etuvchi kuchlar (yuklanish) olingan bo'lib, chiquvchi omil sifatida olingan tishchi g'ildirakning ishchi yuzasining yemirilish hajmiga ta'siri o'rganiladi. Ushbu omillar o'rtasidagi bog'lanishlar matrematik model yordamida aniq ko'rsatgichlar bilan tasvirlanadi va maqbul nuqtalar tanlab olinadi. Tadqiqotdan ko'zlangan maqsad tishchi g'ildirakning ishchi yuzasini yemirilishni oldini olish va sharoitga mos ravishda optimal parametrlarni tanlashdir.

***Kalit so'zlar:** reduktor, tishli g'ildirak, matematik modellash, eksperimental rejalashtirish, kiruvchi-chiquvchi omillar.*

АННОТАЦИЯ

В данной научной статье рассмотрены методы экспериментального планирования и математической обработки факторов объема износа

цилиндрических зубчатых колес редукторов. В статье рассматриваются скорость вращения, твердость материала и действующие силы (нагрузка) в качестве входных факторов, а также изучается влияние рабочей поверхности зубчатого колеса, взятого в качестве выходного фактора, на величину износа. Связи между этими факторами описываются точными показателями с помощью матричной модели, и выбираются оптимальные точки. Целью исследования является предотвращение износа рабочей поверхности зубчатого колеса и выбор оптимальных параметров в соответствии с условиями.

Ключевые слова: *редуктор, зубчатое колесо, математическое моделирование, экспериментальное планирование, входные и выходные факторы.*

ABSTRACT

In this scientific article, methods of experimental planning and mathematical processing of the factors of wear volume of the cylindrical gear of reducers are considered. The article examines the influence of rotational speed, material hardness, and acting forces (load) as input factors on the wear volume of the working surface of the gear wheel, taken as the output factor. The relationships between these factors are described by specific indicators using a matrix model, and optimal points are selected. The purpose of the study is to prevent wear of the working surface of the gear and to select optimal parameters in accordance with the conditions.

Keywords: *gearbox, gear wheel, mathematical modeling, experimental planning, input-output factors.*

Reduktorlar mexanik harakatni uzatish va aylanish tezligini o'zgartirish uchun mo'ljallangan qurilmalardir. Ularning tarkibiy qismlaridan biri silindrik tishli g'ildiraklar bo'lib, ular parallel o'qlar orasida aylanish harakatini uzatadi. Ushbu texnologiya mashinasozlikning eng ko'p qo'llaniladigan qismlaridan biri hisoblanadi. Quyida silindrik tishli g'ildiraklarning ishlatilishi, ularning afzalliklari va kamchiliklari haqida batafsil ma'lumot beriladi. Silindrik tishli g'ildiraklar aylanish harakatini va momentni uzatishda, shuningdek, tezlikni oshirish yoki kamaytirishda asosiy vositalardan biri hisoblanadi. Ular yuqori samaradorlik, barqarorlik va aniqlik talab qilinadigan barcha sohalarda keng qo'llaniladi.

Ishlatiladigan sohalar va qurilmalar: 1. Avtomobil sanoati: Avtomobil uzatish qutilari, differensial tizimlari, elektr avtomobillarda moment uzatish mexanizmlari. 2. Energetika: shamol turbinalari uchun kuchli uzatmalar. gidroelektr stansiyalaridagi generatorlar. bug' turbinalarida. 3. Mashinasozlik va sanoat jihozlari: Frezalash, tornalash va burg'ulash stanoklari. Oziq-ovqat ishlab chiqarish uskunalari. Kimyoviy

texnologiyalar uchun mikserlar va aralashtirgichlar. 4. Robototexnika: Yuqori aniqlik talab qilinadigan robot qo'llarining mexanik uzatmalari. Mexatronika va avtomatlashtirish tizimlari. Silindrik tishli g'ildiraklarning turlarib: to'g'ri tishli g'ildiraklar, Qiya tishli g'ildiraklar: ,ichki tishli g'ildiraklar:

Silindrik tishli g'ildiraklarning samaradorligi 95–98% gacha bo'lib, energiya yo'qotish darajasi minimaldir. Aniqlik va ishonchlik: Tishli mexanizmlar aylanish harakatini juda aniq uzatadi, bu esa sanoat uskunolari va robototexnika uchun muhimdir. Kichik hajm va ixchamlik: Konstruksiya ixchamligi va og'irlikni kamaytirish imkoniyati mavjud. Uzoq muddatli ishlash: Tishli g'ildiraklar mustahkam materiallardan ishlab chiqarilgani sababli uzoq xizmat qiladi. Qulay texnik xizmat ko'rsatish: Oddiy yog'lash va muntazam tekshiruv mexanizmning barqaror ishlashini ta'minlaydi. Barqaror ishlash va kam shovqin: Qiya tishli g'ildiraklar kam shovqinli ishlaydi va barqaror uzatma ta'minlaydi.

Reduktorlar silindrik tishli g'ildiragining kamchiliklari : Narx yuqoriligi: Yuqori aniqlikdagi va sifatli materiallardan tayyorlangan tishli g'ildiraklarning ishlab chiqarish narxi baland. - Murakkab ishlab chiqarish jarayoni: Tishlarning aniq shakllanishi uchun zamonaviy texnologiyalar talab etiladi. O'qlar joylashishining cheklanganligi: Silindrik tishli g'ildiraklar faqat parallel o'qlar uchun mos keladi, bu esa universal emasligini ko'rsatadi. Yog'lashga talabchanlik: Mexanizm uzoq muddat ishlashi uchun muntazam yog'lash talab qilinadi. Yog'lashning yo'qligi tishlarning tez yeyilishiga olib keladi. Og'irlik va joy talabi: Ba'zi hollarda tishli mexanizmlar katta hajm va og'irlikka ega bo'lishi mumkin.

Silindrik tishli g'ildiraklar bugungi kunda harakat uzatish tizimlarining eng samarali va ishonchli elementlari hisoblanadi. Ular sanoat, energetika, transport va robototexnika kabi ko'plab sohalarda keng qo'llaniladi. Biroq, yuqori aniqlik va sifatli xizmat ko'rsatish talab etilishi ularning narxini oshiradi. Ammo ularning uzoq muddatli xizmat qilish muddati va samaradorligi bu xarajatlarni oqlaydi.

Tishli g'ildiraklarning yeyilishi mexanizmning ishlash samaradorligi va xizmat muddatiga ta'sir qiluvchi asosiy muammolardan biridir. Yeyilish mexanik stress, ish sharoitlari, materialning xususiyatlari va texnik xizmat ko'rsatish darajasiga bog'liq. Quyida tishli g'ildiraklarning yeyilish sabablari, turlari va oldini olish usullari keltirilgan. Yeyilish sabablari 1. Mexanik yuklanish: Haddan tashqari yuklanish yoki dinamik zarbalar tishlarning tez eskirishiga olib keladi. 2. Yog'lashning yetarli emasligi: Yetarli darajada yog'lanmagan tishlar bir-biriga nisbatan qattiq ishqalanadi, bu esa yeyilishning kuchayishiga sabab bo'ladi. 3. Ishqalanish va aşınma: Tez-tez harakatlanadigan va katta yuk oladigan tishli mexanizmlar yuzasida aşınma yuzaga keladi. 4. Materialning sifatsizligi: Sifatsiz materialdan tayyorlangan tishli g'ildiraklar mexanik stress va ishqalanishga bardosh bera olmaydi. 5. Tashqi omillar: Chang,

namlik va kimyoviy moddalar tishli g'ildiraklarning korroziyaga uchrashiga va yeyilishiga sabab bo'lishi mumkin. 6. Noto'g'ri sozlash: Tishli juftliklarning noto'g'ri o'rnatilishi yoki sozlanishi yuk taqsimotini notekis qilib, tishlarning tez eskirishiga olib keladi.

Tishli g'ildiraklarning yeyilish turlari 1. Ishqalanish (abrasiv) yeyilishi Sabab: Tishlarning ish yuzasida chang, metall zarralari yoki qattiq zarrachalarning mavjudligi. Ko'rinish: Tishlar yuzalana boshlaydi, abraziv izlar paydo bo'ladi.

2. Charchoq yeyilishi Sabab: Tish yuzasiga doimiy ravishda yuklanish va tebranish. Ko'rinish: Tish yuzasida mayda yoriqlar, shikastlangan joylar paydo bo'ladi.

Tishli g'ildiraklarning yeyilishini oldini olish choralari 1. To'g'ri material tanlash Mustahkamligi yuqori bo'lgan qotishmalar yoki issiqlik bilan ishlov berilgan po'latdan foydalanish kerak. 2. Yog'lash tizimi Yaxshi sifatli yog'lash materiallaridan foydalanish va ularni muntazam ravishda yangilash. Yog'lash moslamalarining to'g'ri ishlashini ta'minlash. 3. Yukni me'yorlash Mexanizmni haddan tashqari yuklamaslik. Dinamik yuklarning oldini olish uchun amortizatsiya tizimini qo'llash. 4. Muntazam texnik xizmat Mexanizmning holatini muntazam kuzatib borish va kerakli o'zgartirishlarni kiritish.

Mashinalarda ishlatiladigan tishli g'ildiraklar turli mexanik tizimlar uchun muhim element bo'lib, ularning asosiy vazifalari quyidagilardan iborat:

- harakatni uzatish: tishli g'ildiraklar yordamida bir mexanizmning aylanish harakati boshqa mexanizmga uzatiladi.

- moment va kuch uzatish: katta momentlarni kichik yoki katta tezlikda uzatadi, bu harakatni samarali amalga oshirishni ta'minlaydi.

- tezlikni oshirish yoki kamaytirish: tishli nisbat orqali harakat tezligini o'zgartiradi (reduksiya yoki ko'paytirish).

- yo'nalishni o'zgartirish: harakat yo'nalishini (parallel, perpendikulyar yoki burchak ostida) o'zgartiradi.

- aniq harakat uzatish: tishli g'ildiraklar sinxron va aniqlik talab qilinadigan tizimlarda foydalaniladi, masalan, sanoat mexanizmlari yoki raqamli boshqariladigan dastgohlarda.

- shovqinni pasaytirish: ba'zi hollarda shovqinni kamaytiruvchi xususiyatga ega tishli g'ildiraklar ishlatiladi.

Tishli g'ildiraklar mexanik tizimlarda yuqori yuklanish va doimiy harakat sharoitida ishlaydi, bu esa ularning turli qismlarida shikastlanishlar yuzaga kelishiga sabab bo'ladi. Tishli g'ildiraklarning ishdan chiqadigan joylari quyidagilardir: Tishlar, markaziy teshik va flants.

Tishli g'ildiraklarning ishdan chiqish sabablari quyidagicha bo'ladi:

- Tishning yeyilishi: yetarli darajada moylash bo'lmaganda; harakatlanuvchi qismlarning haddan tashqari yuqori tezlikda ishlashi;

ishqalanish kuchining ortishi:

Natijada tish yuzasida timalish, yuklama ortganda yoki sirpanish natijasida yuzaki qatlamning buzilishi kuzatiladi.

- Korroziya: Namlik, kimyoviy moddalar yoki agressiv muhitda ishlash, himoya qatlami yo'qligi. Natijada metall yuzasining zanglashi va yemirilishi kuzatiladi.

- Sirpanish yoki siljish: Yuqori tezlik va ishqalanishning ortishi, moylash materialining sifatsizligi yoki haddan tashqari qizishi. Natijada tish yuzasining shilinishi va geometrik o'zgarishlarning hosil bo'ladi.

Tishli g'ildiraklarning ishdan chiqishi ko'pincha noto'g'ri ekspluatatsiya, material ishchi yuzasining yetarli darajada qattiq emasligi yoki texnik xizmatning yetishmasligi natijasida yuzaga keladi.

Mashinasozlik va qishloq xo'jaligi texnikalarida tishli g'ildiraklar turli materiallardan tayyorlanadi. Material tanlash g'ildirakning ishlash sharoiti, yuklanish darajasi, yeyilish chidamlilik talablari va iqtisodiy jihatlarni hisobga olgan holda amalga oshiriladi.

Tishli g'ildiraklar tayyorlanadigan materiallar: Po'latlar, cho'yan va kompozit materiallar.

- Po'latlar: Uglerodli po'latlar (Po'lat 40, Po'lat 45X) – o'rtacha yuklangan tishli g'ildiraklar uchun.

- Legirlangan po'latlar (38XH3MΦA, 12XM) – yuqori chidamlilik va yeyilishga chidamlilik talab qilinadigan tishli g'ildiraklar uchun.

Tishli g'ildiraklar uchun materialning yeyilishga bardoshlilikini sementatsiyalash usuli bilan oshirish imkoniyati mavjud.

Sementatsiya – metall sirtini uglerod bilan boyitish orqali uning qattiqligini oshirishga mo'ljallangan kimyoviy-termik ishlov berish usuli. Bu usul tishli g'ildiraklar ishchi yuzalarining yeyilishga bardoshlilikini oshirishning eng samarali yo'llaridan biridir. Sementatsiya jarayonida metall sirtida qattiq qatlam hosil bo'ladi, ichki qismi esa egiluvchanlik va zarba yuklariga chidamliligini saqlab qoladi.

Sementatsiyaning tishli g'ildiraklar uchun ahamiyati:

- Yeyilishga chidamlilikni oshiradi:

Tishli g'ildirakning ishlash jarayonida tishlar yuzasi yuqori yeyilishga uchraydi. Sementatsiya bu yuzani qattiqligini oshirib uning uzoq muddatga ishlashini taminlaydi.

- Charchashga chidamlilikni yaxshilaydi:

Sementatsiya jarayonida metall sirtida yuqori qattiqlikka ega qatlam hosil bo'ladi, bu esa mexanik charchashni kamaytiradi.

- Zarbaga chidamlilikni saqlaydi:

Ichki qatlam elastik bo'lib qoladi, bu esa kuchli zarba va momentlarni bardoshli qilish imkonini beradi.

- Ishlash muddatini oshiradi:

Tishli g'ildiraklar uzoq muddat davomida yuk ostida ishlaydi. Sementatsiya materialni korroziya va termal ta'sirlarga chidamli qiladi.

Sementatsiya odatda kam uglerodli po'latlar uchun qo'llaniladi (masalan,

Po'lat 20, Po'lat 25 va Po'lat 30). Sementatsiyalash jarayoni quyidagi bosqichlardan iborat bo'ladi:

- Uglerod bilan to'yintirish:

Tishli g'ildirak ishchi yuzasi yuqori haroratda uglerod atomlari diffuziya qilinadi.

Uglerod manbalari: Gaz (CH_4 , CO), suyuq (organik moddalar) yoki qattiq (ko'mir kukuni).

- Diffuziya:

Yuqori haroratda ($850\text{--}950^\circ\text{C}$) uglerod atomlari metallga kiradi va uning yuzasida qattiq qatlam hosil qiladi.

- Toblash:

Uglerod bilan boyitilgan tishli g'ildirak tez sovitiladi (masalan, moyda). Bu jarayon sirtini yanada qattiqlashtiradi.

- Bo'shatish:

Metallning ichki qismini mos elastiklikka ega qilish uchun ($350\text{--}500^\circ\text{C}$) issiqlik bilan qayta ishlov beriladi.

Sementatsiya quyidagicha turlari mavjud:

- Gazli sementatsiya:

Uglerod manbai sifatida gazlardan (masalan, CH_4 yoki CO) foydalaniladi.

Zamonaviy texnikada eng keng qo'llaniladigan usul.

Yuqori aniqlik va bir xilda qatlam hosil qilish imkonini beradi.

- Suyuq sementatsiya:

Metall maxsus suyuqlikka (masalan, uglerodga boy eritma) botiriladi.

Oson va tez amalga oshiriladi, lekin ekologik jihatdan xavfli hisoblanadi.

- Qattiq sementatsiya:

Metall qattiq uglerodli materiallar (pista kukuni) orasiga joylashtiriladi.

An'anaviy, lekin kamroq qo'llaniladigan usul hisoblanadi.

Sementatsiya yordamida bardoshlilikni oshirish omillari:

Tishli g'ildiraklarning qattiqligi 58–62 HRC darajasiga yetkaziladi, bu yeyilish va charchashga chidamlilikni sezilarli darajada oshiradi.

Sementatsiyalash jarayoni iqtisodiy jihatdan maqbul bo'lib, uzoq muddat ishlovchi tishli g'ildiraklar yaratishga imkon beradi.

Reduktorlarning silindrik tishli g'ildiraklari mexanik uzatmalar tizimining asosiy elementlaridan biri bo'lib, ularning yeyilishi mexanik samaradorlik va xizmat muddatiga bevosita ta'sir ko'rsatadi. Ushbu tadqiqotda yeyilish hisobi uchun Archard formulasi asos qilib olinadi. Shuningdek, yeyilish jarayoniga ta'sir etuvchi muhim parametrlar, jumladan, aylanishlar soni, material qattiqligi va ta'sir etuvchi kuchlar tahlil qilinadi.

Archard formulasi Archard yeyilish modeliga ko'ra, tishli g'ildiraklar yeyilish miqdori quyidagi tenglama orqali ifodalanadi:

$$W = \frac{KFL}{H}$$

Bu yerda:

W - Yeyilish hajmi (mm³).

K - Yeyilish koeffitsienti (adimension).

F - Tishlarga ta'sir etuvchi kuch (N).

L - Nisbiy siljish masofasi (m).

H - Materialning qattiqligi (MPa).

Archard formulasi tishli g'ildiraklarning yeyilishiga ta'sir etuvchi asosiy omillarni ko'rsatadi. Ushbu parametrlarni tahlil qilish orqali yeyilishning oldini olish choralari ishlab chiqiladi.



1- **rasm. Mexanik uzatmalar qutisi.**

Archard formulasi tishli g'ildiraklarning yeyilishiga ta'sir etuvchi asosiy omillarni ko'rsatadi. Ushbu parametrlarni tahlil qilish orqali yeyilishning oldini olish choralari ishlab chiqiladi.



2-rasm. Silindrik tishli g'ildirakning umumiy ko'rinishi

1. Aylanishlar soni (n).

Tishli g'ildirak aylanishlar soni yeyilish jarayoniga bevosita ta'sir qiladi:

Aylanishlar soni ortishi bilan siljish masofasi (L) oshadi, bu esa yeyilish hajmining ortishiga olib keladi.

Optimal aylanish tezligini tanlash yeyilishni kamaytirish imkonini beradi.

2. Material qattiqligi (H)

Materialning qattiqligi yeyilish hajmini belgilovchi asosiy parametrdir:

Yuqori qattiqlikli materiallardan foydalanish yeyilishni kamaytiradi.

Tishli g'ildirak materiallarining Brinell qattqlik (HB) qiymatlari yeyilishni bashorat qilishda muhim hisoblanadi.

3. Ta'sir etuvchi kuch (F)

Tishlarga ta'sir etuvchi kuch yeyilish jarayonining intensivligiga bevosita ta'sir qiladi:

Kuch ortganda yeyilish miqdori oshadi.

Yuklamalarni bir tekisda taqsimlash va ortiqcha kuchlarni cheklash yeyilishni kamaytirishga yordam beradi.

Silindrik tishli g'ildiraklarning yeyilish modellashtirish usullari:

1. Archard formulasi bo'yicha yeyilish hisobi

Tishli g'ildirakning yeyilishi quyidagicha hisoblanadi:

Siljish masofasini hisoblash:

$$L = \pi \cdot d \cdot n \cdot t$$

d - G'ildirak diametri (m).

n - Aylanishlar soni (1/s).

t - Ishlash vaqti (s).

L – siljish masofasining normallik darajasi: $L = 1000 \text{ m}$

2. Ta'sir etuvchi kuchning aniqlanishi:

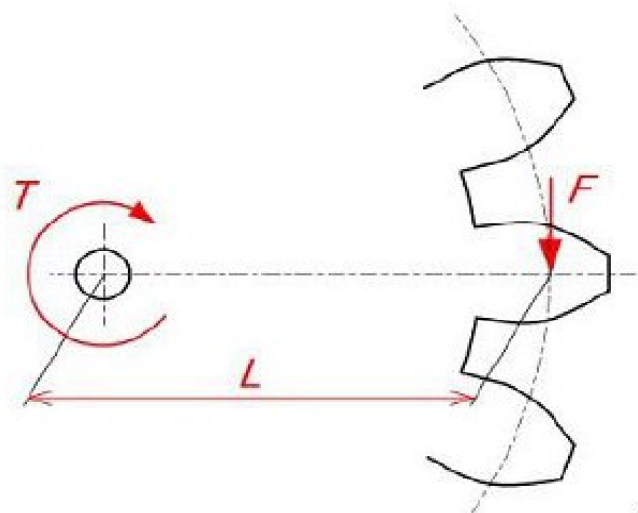
Ta'sir etuvchi kuch (F) moment va tishli uzatma shakliga bog'liq holda hisoblanadi:

$$F = \frac{T}{r}$$

T - Moment (Nm).

r - Radius (m).

$$T = F \times L \quad (\text{N} \cdot \text{mm})$$



3- rasm. Tishli g'ildirakka ta'sir etuvchi kuch .

F – perpendikulyar ta'sir etuvchi kuch;

T – burovchi moment;

L – tish va markaz orasidagi masofa.

Yuqorida keltirilgan tenglamalardan foydalanib, W ni hisoblash mumkin.

Tishli g'ildiraklar yeyilishiga ta'sir etuvchi shakl omillari

1. Tishli uzatma geometriyasi

Tishlarning profili yeyilish jarayonida muhim rol o'ynaydi:

Tish burchagi: Tishlarning ishqalanish maydonini belgilaydi. Katta burchak ko'proq bosim hosil qiladi.

Tish kengligi va balandligi: Yeyilishga bardoshlikni oshiradi

2. Yog'lash va sovutish tizimlari

Tishli g'ildiraklar orasidagi ishqalanishni kamaytirish uchun:

Yog'lash samaradorligini oshirish.

Ish haroratini pasaytirish yeyilish miqdorini sezilarli darajada kamaytiradi.

Tahlil natijalari va modellashtirish natijalari asosida tavsiyalar

1. Optimal aylanish tezligini tanlash:

Yuqori aylanish tezligi ishlash samaradorligini oshirsa-da, ortiqcha tezlik yeyilish jarayonini tezlashtiradi. Shu bois, optimal aylanish tezligini () tanlash kerak.

2. Material tanlovi

Yuqori qattqlikdagi po'latlar (masalan, 40X, 45) yeyilishga chidamli bo'lib, uzatmalarning xizmat muddatini oshiradi.

Ish sharoitiga qarab termik ishlov berish usullaridan foydalanish tavsiya etiladi.

3. Ta'sir etuvchi kuchlarni kamaytirish:

Tishli uzatmalarning geometriyasini optimallashtirish orqali yuklamani kamaytirish.

Dvigatel momentini optimal boshqarish.

4. Yog'lash va sovitish tizimini takomillashtirish:

Yaxshi sifatli moylash materiallaridan foydalanish.

Sovutish tizimini qo'llash harorat va ishqalanishni pasaytiradi.

Archard formulasi asosida silindrik tishli g'ildiraklarning yeyilishi modellashtirilishi tishli uzatmalarning samaradorligi va xizmat muddatini oshirish uchun zarurdir. Ushbu hisob-kitoblarda aylanishlar soni, material qattqligi va ta'sir etuvchi kuchlarning optimal kombinatsiyasi orqali yeyilishni kamaytirish mumkin. Modellashtirish natijalariga asoslanib, dizaynni takomillashtirish va texnik xizmat ko'rsatish rejimini ishlab chiqish reduktorlarning samaradorligini oshiradi va ularning iqtisodiy samaradorligini ta'minlaydi.

Texnologik jarayonlarni modellashtirish fani oliy o'quv yurtlar talabalarini hozirga zamon talablariga javob bera oladigan yuqori malakali, zamonaviy kompyuter texnologiyasini chuqur tadbiq qila oladigan mutaxassislar yetishtirishda katta ahamiyatga egadir. Bu fandan chuqurroq bilimga ega bo'lish, talabalarni oliy o'quv yurtida o'qitiladigan barcha umummatematika, umumta'lim va kasbiy fanlarni bilishni taqoza etadi.

Mashinasozlik , ishlab chiqarish va yengil sanoat texnologik jarayonlari murakkab jarayonlar bo'lib, ular bir-biri bilan bog'langan ko'p faktorlarning o'zgarishlariga bog'liqdir. Shuning uchun bu jarayonlarni ilmiy tadqiqot qilish matematik modellar asosida amalga oshiriladi.

Umumiy holda matematik modellarni quyidagi ko'rinishda ifodalash mumkin:

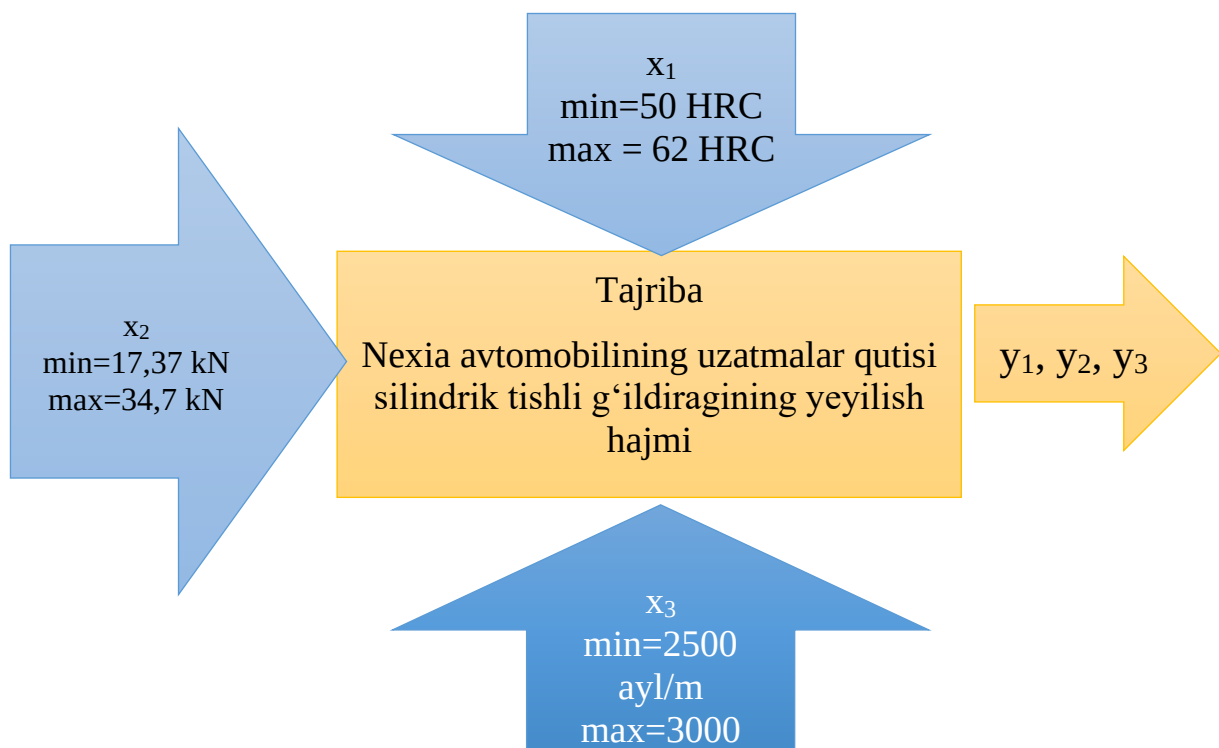
$$Y = F(X) \quad (1)$$

bu yerda:

$Y (y_1, y_2, \dots y_k)$ - chiquvchi faktorlar bo'lib, jarayonning o'rganilayotgan xususiyatlarini,

$X (x_1, x_2, \dots x_k)$ - kiruvchi faktorlar bo'lib, jarayonga ta'sir etuvchi parametrlarni,

F - operator (funksiya) bo'lib chiquvchi faktorni kiruvchi faktorlarga nisbatan bog'lanishini ifodalaydi.



1-sxema. Tajribaning dastlabki ma'lumotlari (batafsil 1-jadvalda)

Ma'lumki matematik modellar nazariy, eksperimental va nazariy-eksperimental usullar yordamida qurilishi mumkin. Nazariy usullar fizika, mexanika qonuniyatlarga asoslansa, eksperimental usul esa tajriba natijalarini bevosita qayta ishlash natijasida amalga oshiriladi.

Silindrik tishli g'ildirakning umumiy parametrlari:

Maksimal aylanish tezligi: $n_{\text{mak}} = 3000$ ayl/m, $n_{\text{min}} = 2500$ ayl/m. $n_{\text{o'r}} = 2750$ ayl/m

Yuklamalar: $P_{\text{mak}} = 10^4$ N, $P_{\text{min}} = 10^3$ N va tasir etuvchi kuchni hisoblasak:

$$F_{\text{mak}} = P_{\text{mak}} \frac{60}{2\pi n} = 10000 * \frac{60}{2 * 3.14 * 2750} = 34.7 \text{ kN}$$

$$F_{\text{min}} = P_{\text{min}} \frac{60}{2\pi n} = 5000 * \frac{60}{2 * 3.14 * 2750} = 17.37 \text{ kN}$$

Tishli g'ildiragimiz uchun optimal qattiqlikka ega bo'lgan material turi va tavsifi:
Po'lat C45 – Qattiqligi 48-50 HRC

Tarkibi: C- 0,17-0,22 % , Mn – 1,1-1,4 % , Cr – 1-1,3 % , Si ≤ 0,4 % , 0,02-0,035 % atrofida Fosfor va Oltingugurt

20MnCr5 – Qattiqligi 60-62 HRC.

Tarkibi: C- 0.42-0,5 % , Mn – 0,6-0,9 % , Si - 0,4 % , 0,02-0,035 % atrofida Fosfor va Oltingugurt.

1-jadval.

Dastlabki ma'lumotlar jadvallashtirilishi

Silindrik tishli g'ildirak	X	Min	Max	Birligi
Material qattiqligi	x ₁	50	62	HRC
Ta'sir etuvchi kuch miqdori	x ₂	17,37	34,7	kN
Aylanish tezligi	x ₃	2500	3000	Ayl/m
Tishli g'ildirakning yeyilish hajmi	y ₁	-	-	mm ³

Ushbu jadvalda keltirilgan y₁, y₂, y₃ natijalarni hisoblash uchun quyidagi formulalardan foydalanamiz:

Tajribadan chiqayotgan mahsulot tezligi aylanishlar soni va radiusi orqali topiladi:

$$v = 2\pi R \cdot \frac{b}{60} \quad (2)$$

bu yerda:

R- parraklar radiusi (0,2 m);

b- aylanishlar soni (rpm);

60-aylanishlarni sonyani minutga aylantirish uchun koeffitsient.

Kompressorda bosim bosim oshishi quyidagi formula orqali topiladi:

$$\Delta P_{ideal} = c \cdot v^2 \quad (3)$$

bu yerda:

c- gaz zichligi (kg/m³);

v- gaz tezligi (m/s).

Samaradorlik parraklar soniga qarab quyidagi formula bilan aniqlanadi:

$$\eta = 0,75 + 0,01 \cdot \frac{a-10}{20} \quad (4)$$

bu yerda:

0,75- bazaviy samaradorlik;

0,01- har bir qo'shimcha parrak uchun samaradorlik oshishi koeffisienti;

a- Parraklar soni.

2-jadval
Tajribaning rejalashtirish sharti

№	Faktorlar nomi belgisi	Kod-lash-tirilgan belgisi	Faktorlarning haqiqiy qiymatlari			O'zgarishlar oralig'i
			-1	0	+1	
1	Material qattiqligi	X ₁	50	54	58	62
2	Tishli g'ildirak aylanish tezligi	X ₂	17	23	29	35
3	Tishga ta'sir qiluvchi perpendikulyar kuch	X ₃	2500	2670	2840	3000

Chiquvchi parametrlar kompressordan chiqayotgan mahsulot tezligi, bosimi va samaradorligiga ta'sirini tajriba asosida o'rganamiz. Buning uchun rejalashtirish matritsasi asosida har bir sharoitda 3 marotaba takroran tajribalar o'tkazamiz. Bu holda tajribalar soni $N = 2^3 = 8$, takrorlanishlar soni $m=3$ ni hisobga olsak umumiy tajribalar soni $N*m=24$ bo'ladi. Chiquvchi parametrning tajribaviy natijalari va dispersinlari 14-jadvalda keltirilgan. Rejalashtirish matritsasi, tajriba va hisobiy natijalar.

3-jadval
Y₁ yeyilish hajmini rejalashtirish matritsasi va tajriba natijalari (a)

u	Faktorlar			$\tilde{y}_{uv}$			$\tilde{y}_u$	$S^2_u \{y\}$
	x_1	x_2	x_3	y_{u1}	y_{u2}	y_{u3}		
1.	-	-	-	18,02	18,4	18,3	18,24	0,0388
2.	+	-	-	19,2	19,8	18,9	19,3	0,21
3.	-	+	-	18,4	18,3	18,8	18,5	0,07
4.	+	+	-	18,9	18,2	18,3	18,4666667	0,143333
5.	-	-	+	19,22	19,1	18,7	19,0066667	0,074133
6.	+	-	+	19,44	18,95	19,55	19,3133333	0,102033
7.	-	+	+	19,1	19,3	19,9	19,4333333	0,173333
8.	+	+	+	19,5	18,4	18,57	18,8233333	0,350633

Tajriba natijalarini qayta ishlash yuqorida keltirilgan bosqichlar asosida amalga oshiriladi. Har bir y_1, y_2, y_3 lar qo'yildi. Keltirilgan tartib asosida hisob ishlarini amalga oshiriladi.

1. Ajralib turgan qiymatlarni statistik usulda chiqarib tashlash 14-jadvaldagi xar bir satr uchun qullanilada. Buning uchun har bir satr uchun o'rta qiymat va dispersiyalar hisoblanada. Bu qiymatlar 14-jadvalda keltirilgan. Masalan, birinchi tajriba uchun:

$$\bar{y}_1 = \frac{18,02 + 18,4 + 18,3}{3} = 18,24$$

$$s_1^2 = \frac{(18,24 - 18,02)^2 + (18,24 - 18,4)^2 + (18,24 - 18,3)^2}{3} = 0,0388$$

tugatilgan dispersiya

so'ng formulalar yordamida kriteriyaning chegaraviy qiymatlari hisoblanadi:

$$V_{Fmax} = 1,2247; \quad V_{Rmin} = 1,2247$$

Ko'rinib turibdiki, bu qiymatlar maxsus jadvaldan olingan U qiymatdan kichik. Shuning uchun yuqoridagi eng katta va eng kichik qiymatlar keyingi statistik qayta ishlashdan chiqarib tashlanmaydi.

Ko'rilayotgan misolda har bir tajriba uchun ajralib turgan qiymatlar yo'q.

2. Dispersiyalarning bir jinsliligini tekshirish uchun (10) formula yordamida hisobiy qiymat hisoblanadi:

$$G_R = \frac{S_{max}^2\{y_j\}}{\sum_{i=1}^N s_u^2\{y\}} = \frac{0,0388}{0,350} = 0,123$$

Kochren kriteriyasining jadvaliy qiymati:

$$G_T(P_D = 0,95; +(S_U^2) = 2,8) = 0,516.$$

Demak, $GR < GT$ bulgani uchun dispersiyalar bir jinsli.

3. Koeffitsiyentlarni hisoblash uchun 5-qiymatlardan foydalanamiz. Ushbu formula samaradorlikni aniqlash uchun:

4-jadval.

Koeffitsiyentlarni hisoblash

Ch. p.	b_0	b_1	b_2	b_3	b_{12}	b_{13}	b_{23}	b_{123}
y_1	18,885417	0,0904166	0,079583	0,25875	0,25125	0,16625	0,06375	0,022083

U holda quyidagi ko'p faktorli regressiya modelini olamiz:

5-jadval:

Ko'p faktorli regressiya modeli

Ch. p.	Ko'p faktorli regressiya modelini
y ₁	Yr= 18,88+0,258*X3-0,25*X1*X2-0,166*X1*X3

Lekin bu modelning oxirgi ko'rinishi emas.

4. Modelning oxirgi ko'rinishini olish uchun koeffitsiyentlarni ahamiyatligini tekshiramiz. Buning uchun Student kriteriyasining formulalaridan foydalanamiz.

$$S^2\{\bar{y}\} = \frac{1}{N} \sum_{u=1}^N S_u^2(y) = \frac{0,0006}{8 \cdot 3} = 0,000025;$$

$$S^2\{b_i\} = \frac{1}{N} S^2(\bar{y}) = \frac{0,03}{8} = 0,005;$$

$$S\{b_i\} = 0,0388.$$

Bular yordamida kriteriyaning hisobiy qiymatlarini hisoblaymiz (Samaradorlik uchun):

$$t_R(b_1) = \frac{|tb_1|}{s\{b_1\}} = \frac{0,2529972827}{0,0058137} = 4,351743$$

6- jadval.

Chiquvchi faktorning tajribaviy va hisobiy qiymatlarini taqqoslash

Y	V _{R max}	V _{R mix}	Gr		Tr
Yeyilish hajmi	0,994832	0,373062	0,123322244	T(b1)	1,162107
	1,336306	-1,06904		T(b2)	-1,02287
	1,38873	-1,38873		T(b3)	3,325662
	-0,86266	0,539164		T(b12)	-3,22927
	-1,37945	1,379448		T(b13)	-2,13678
	0,907427	-0,90743		T(b23)	0,819366
	-0,39223	-1,37281		T(123)	0,283833
	-0,52398	0,523976			

Demak, modeldagi ahamiyatli koeffitsiyentlar soni $N_h = 4$ hisobga olsak:

$$S_{\text{над}}^2\{y\} = \frac{0,001945}{8 - 4} = 0,0388.$$

$2(5) = 0,0002708$ sonidan katta bo'lganligi uchun Bu son teriyaning hisobiy qiymati ushbu formula orqali hisoblanadi:

$$P_R = \frac{0,0388}{0,018} = 2,04$$

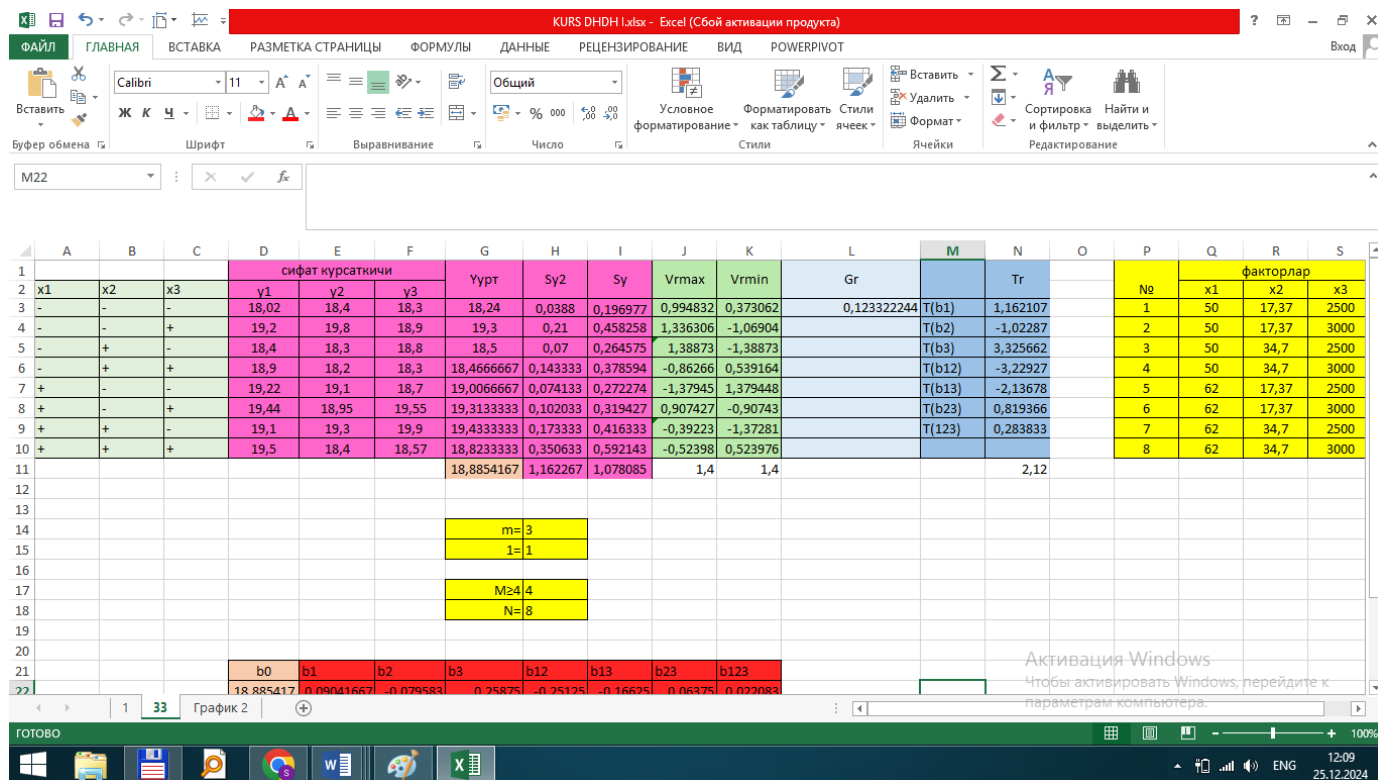
19-formulaga asosan 16-jadvalda ko'rsatilgan paramapetr koeffitsiyentlaridan foydalangan holda yakuniy quyidagi formulalar ya'ni parametrlarni ishlab chiqamiz:

7-jadval.
Qiymatlar dasturda ko‘rinishi

O‘zgaruvchining nomi	Belgisi	Dasturdagi belgisi	Qiymati
Tajribalar soni	N	N	8
Faktorlar soni	M	M	3
Qaytarilishlar soni	m	m	3
Korchen kriteriyasining jadvaliy qiymati	G_T	GKP	0,123
Styudent kriteriyasining jadvaliy qiymati	t_T	TKP	2.12
Fisher kriteriyasining jadvaliy qiymati	F_T	FKP	5.85

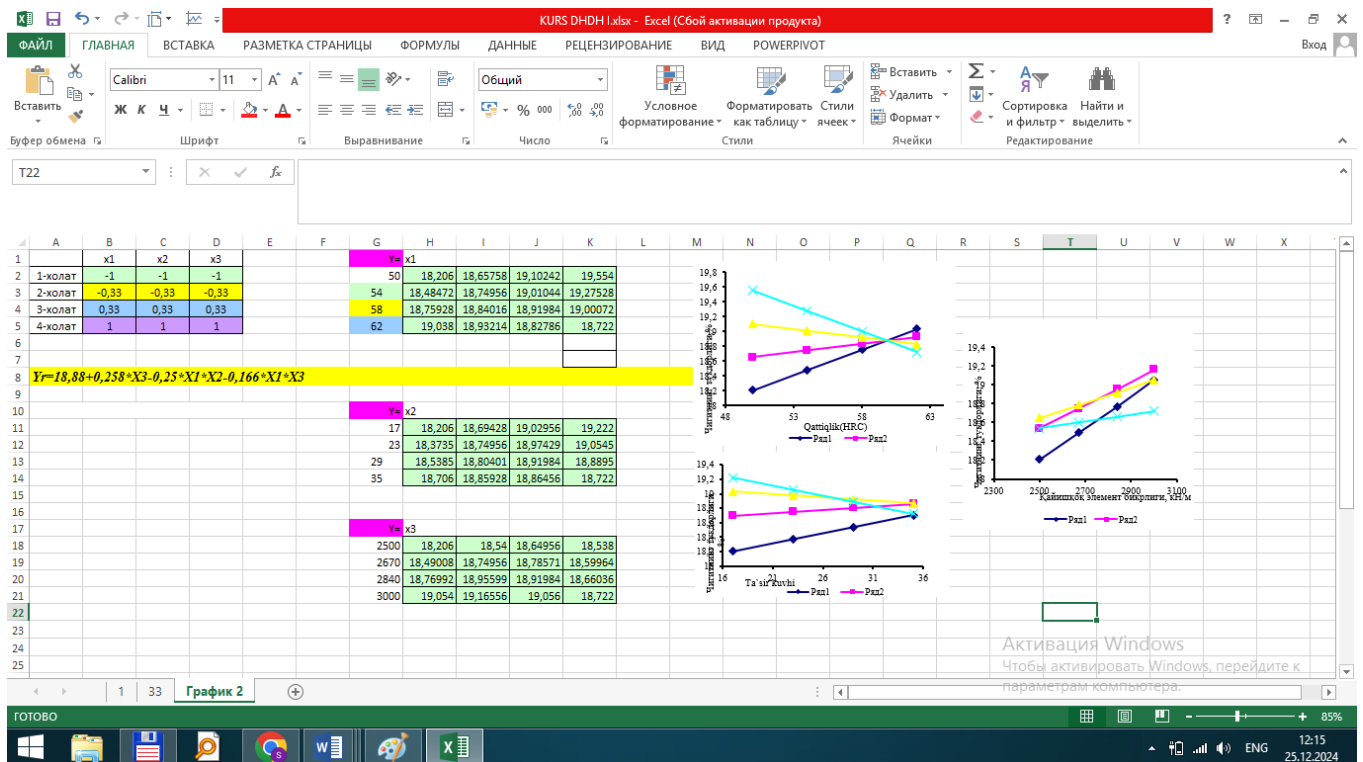
Undan tashqari programmaning tajribaviy qiymatlar satrma-satr yoziladi.

Qurilayotgan misol uchun kompyuter natijalari berilgan bo‘lib, unda qurilgan model haqida barcha ma’lumotlar keltirilgan. Bulardan ko‘rinib turibdiki, hisobiy ishlar bilan kompyuter natijalari ustma-ust tushadi. Bu esa programmalarining to‘g‘ri ekanligini ko‘rsatadi (3-rasm).

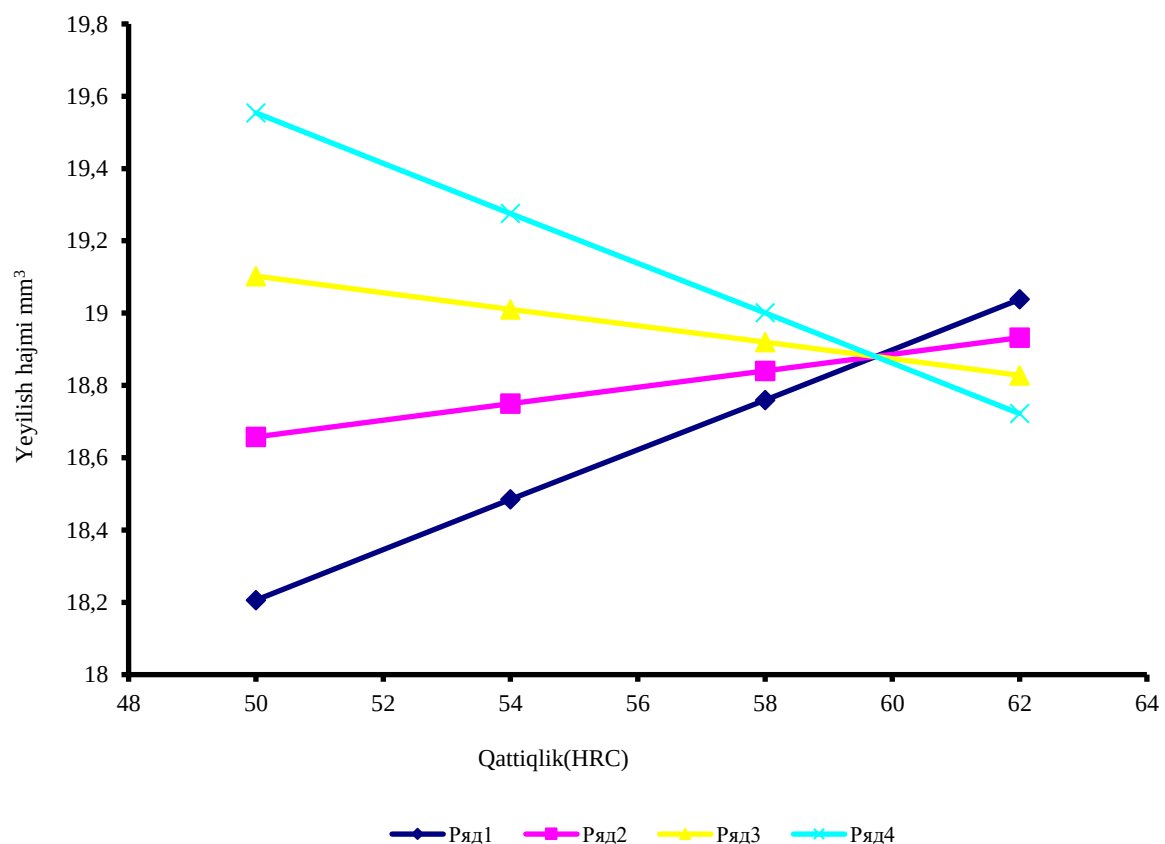


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1																		
2	x1	x2	x3	y1	y2	y3	Угрт	Sy2	Sy	Vrmax	Vrmin	Gr	Tr		№	x1	x2	x3
3	-	-	-	18,02	18,4	18,3	18,24	0,0388	0,196977	0,994832	0,373062	0,123322244	T(b1)	1,162107	1	50	17,37	2500
4	-	-	+	19,2	19,8	18,9	19,3	0,21	0,458258	1,336306	-1,06904		T(b2)	-1,02287	2	50	17,37	3000
5	-	+	-	18,4	18,3	18,8	18,5	0,07	0,264575	1,38873	-1,38873		T(b3)	3,325662	3	50	34,7	2500
6	-	+	+	18,9	18,2	18,3	18,4666667	0,143333	0,378594	-0,86266	0,539164		T(b12)	-3,22927	4	50	34,7	3000
7	+	-	-	19,22	19,1	18,7	19,0066667	0,074133	0,272274	-1,37945	1,379448		T(b13)	-2,13678	5	62	17,37	2500
8	+	-	+	19,44	18,95	19,55	19,3133333	0,102033	0,319427	0,907427	-0,90743		T(b23)	0,819366	6	62	17,37	3000
9	+	+	-	19,1	19,3	19,9	19,4333333	0,173333	0,416333	-0,39223	-1,37281		T(123)	0,283833	7	62	34,7	2500
10	+	+	+	19,5	18,4	18,57	18,8233333	0,350633	0,592143	-0,52398	0,523976				8	62	34,7	3000
11							18,8854167	1,162267	1,078085	1,4	1,4			2,12				
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5-rasm. x_1 , x_2 va x_3 larni y_1 ga ta'siri



6-rasm. Hisob ishlari EXM dasturida ko‘rinishi



2- grafik. Tishli g‘ildirak yeyilish hajmining qattqlikka bo‘g‘liqligi

Y=	x1			
50	18,206	18,65758	19,10242	19,554
54	18,48472	18,74956	19,01044	19,27528
58	18,75928	18,84016	18,91984	19,00072
62	19,038	18,93214	18,82786	18,722

8-jadval. x_1 , x_2 va x_3 larni y_1 ga ta'siri

Bu grafikda silindrik tishli g'ildiraklarning yeyilish ko'rsatkichlari (yo'qotilishi) qat'iylilik (HRC) darajasiga bog'liq tarzda tasvirlangan. Tahlil qilamiz:

Grafikdagi o'qlar: Gorizontal o'q (X o'qi): Qattqlik darajasi (HRC) (50 dan 64 gacha). Vertikal o'q (Y o'qi): Tishli g'ildirakning yeyilish foizi (%) (18,0% dan 19,8% gacha).

Chiziqlar: Grafikda to'rtta chiziq ko'rsatilgan, ularning har biri turli parametr (Par1, Par2, Par3, Par4) uchun yeyilishning qattqlikka bog'liqligini ifodalaydi.

Parametrlar tahlili: 1. Par1 (ko'k chiziq):

Yeyilish qattqlik oshgan sari liniy ravishda kamayadi.

50 HRC da yeyilish ~18,4%, 62 HRC da esa yeyilish ~19,2%.

Ko'tarilish ijobiy trendda.

2. Par2 (pushti chiziq):

Yeyilish oz miqdorda kamayadi.

50 HRC dan 62 HRC gacha yeyilish 19,1% dan 18,6% gacha pasayadi.

Bu chiziq deyarli tekis bo'lib, yeyilish darajasi sezilarli o'zgarish ko'rsatmaydi.

3. Par3 (sariq chiziq):

Yeyilish bir oz oshib, 62 HRC gacha ortadi.

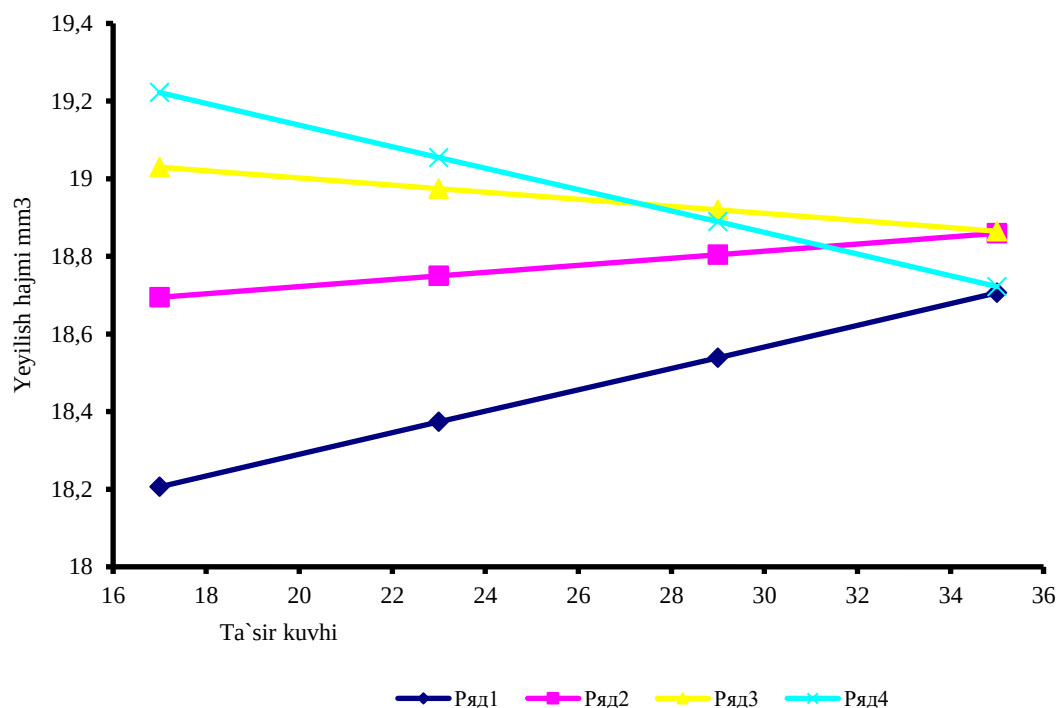
Grafik chiziqning 50 HRC da boshlang'ich nuqtasi ~18,6%, 62 HRC da esa yeyilish ~19,2%.

4. Par4 (moviy chiziq):

Yeyilish ancha yuqori (19,6% bilan boshlanadi) va qattqlik oshgan sari kamayib boradi.

62 HRC ga kelib yeyilish ~18,5% atrofida tugaydi.

Bu trend qattqlik oshgani sari yeyilishning sezilarli kamayishini ko'rsatadi.



3-grafik. Tishli g'ildirak yeyilish hajmining ta'sir etuvchi kuchga bog'liqligi.

Y=	x2			
17	18,206	18,69428	19,02956	19,222
23	18,3735	18,74956	18,97429	19,0545
29	18,5385	18,80401	18,91984	18,8895
35	18,706	18,85928	18,86456	18,722

9-jadval. x_1 , x_2 va x_3 larni y_1 ga ta'siri

Bu grafikda silindrik tishli g'ildirak yeyilishining ta'sir kuchiga bog'liqligi tasvirlangan.

1. Par1 (ko'k chiziq):

Yeyilish ta'sir kuchi oshgani sari past darajada oshadi.

Boshlang'ich nuqta: Ta'sir kuchi yeyilish ~18.2%.

Yakuniy nuqta: Ta'sir kuchi yeyilish ~18.7%.

2. Par2 (pushti chiziq):

Ta'sir kuchi oshgan sari yeyilish nisbatan barqaror, juda oz o'zgaradi.

yeyilish ~18.6%.

yeyilish ~18.8%.

3. Par3 (sariq chiziq):

Yeyilish oz miqdorda oshadi.

yeyilish ~18.8%.

yeyilish ~19.0%.

4. Par4 (moviy chiziq):

Yeyilish pasayadi.

yeyilish ~19.4%.

yeyilish ~18.8%.

Matematik tahlil:

Par1 va Par3: Yeyilish ijobiy trendda ($a > 0$).

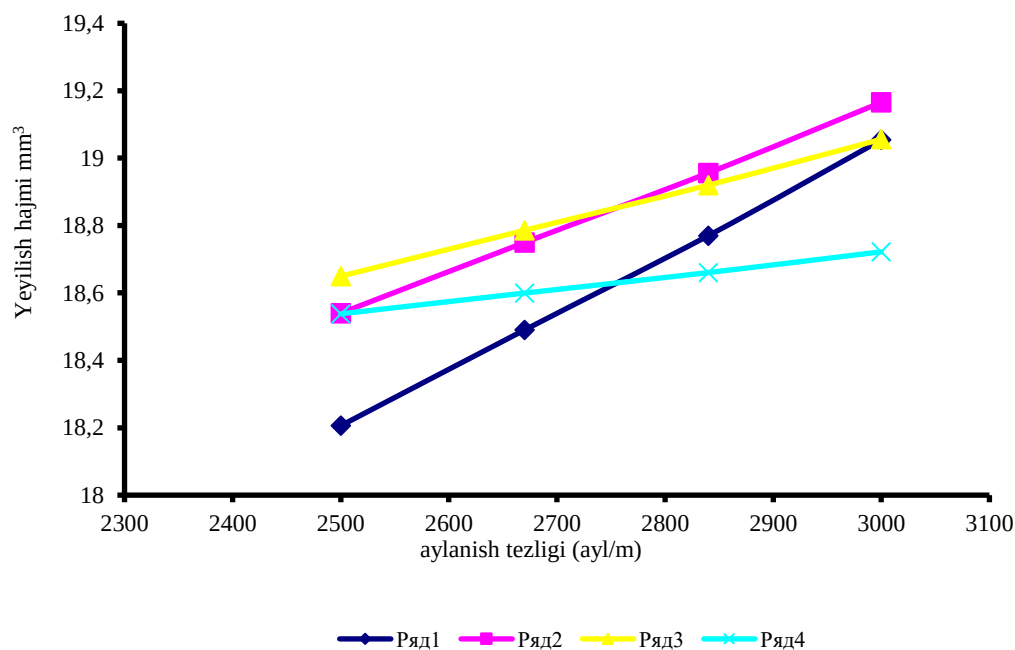
Par2: Barqaror, lekin biroz ijobiy trend ($a \approx 0.05$).

Par4: Salbiy trendda ($a < 0$).

Par1 va Par3: Ta'sir kuchi oshgan sari yeyilish ortadi.

Par4: Ta'sir kuchi oshgan sari yeyilish kamayadi.

Optimal ta'sir kuchi: 28-30 kN oralig'ida, bu yerda ko'p chiziqlar bir-biriga yaqinlashadi.



3- grafik. Tishli g'ildirak yeyilish hajmining

Y=	x3			
2500	18,206	18,54	18,64956	18,538
2670	18,49008	18,74956	18,78571	18,59964
2840	18,76992	18,95599	18,91984	18,66036
3000	19,054	19,16556	19,056	18,722

10-jadval. x_1 , x_2 va x_3 larni y_1 ga ta'siri

Bu grafikda silindrik tishli g'ildirak yeyilishining qayishqoq element birikmasi kuchiga bog'liqligi tasvirlangan.

1. Par1 (ko'k chiziq):

Yeyilish kuch ortishi bilan bir xil ravishda oshadi.

2500 kN/m $\rightarrow$ yeyilish $\sim 18.2\%$.

3000 kN/m $\rightarrow$ yeyilish $\sim 18.7\%$.

2. Par2 (pushti chiziq):

Yeyilish kuch ortishi bilan barqaror oshadi.

2500 kN/m $\rightarrow$ yeyilish $\sim 18.6\%$.

3000 kN/m $\rightarrow$ yeyilish $\sim 19.2\%$.

3. Par3 (sariq chiziq):

Trend Par2 ga o'xshash.

2500 kN/m $\rightarrow$ yeyilish $\sim 18.6\%$.

3000 kN/m $\rightarrow$ yeyilish $\sim 19.2\%$.

4. Par4 (moviy chiziq):

Boshlanishida yuqori, lekin kuch ortishi bilan pasayadi.

2500 kN/m $\rightarrow$ yeyilish $\sim 19.6\%$.

3000 kN/m $\rightarrow$ yeyilish $\sim 18.8\%$.

Matematik tahlil:

Par1, Par2, Par3: Ijobiy trend ($a > 0$), Par2 va Par3 bir-biriga yaqin.

Par4: Salbiy trend ($a < 0$).

Xulosa:

Par2 va Par3: Yeyilish kuch ortishi bilan maksimal ko'rsatkichga yetadi.

Optimal kuch: 2800-2900 kN/m oralig'ida.

Yuqoridagi kiruvchi (x_1, x_2, x_3) va chiquvchi (y_1, y_2, y_3) parametrlar xususan, tishli g'ildirak yeyilish hajmi uchta asosiy parametr (material qattiqligi, ta'sir qiluvchi kuch miqdori va valining aylanish soni) bilan bog'liq ekanligi aniqlandi.

Material qattiqligi: Tishli g'ildirak yeyilish hajmiga material qattiqligining oshishi nisbatan ijobiy ta'sir ko'rsatadi. Qattiqlik ma'lum bir qiymatga yetgach yeyilish hajmi optimal va holatlar bo'yicha bir xil bo'ladi.

Ta'sir qiluvchi kuch miqdori: yeyilish hajmiga nisbatan ta'sir kuchi har bir holatda har xil bo'ladi. Va ta'sir kuchi 28-30kN bo'lganda 4 holat natijasi bir biriga yaqinlashadi.

Val aylanish tezligi: Yeyilish hajmiga nisbatan aylanish tezligi salbiy ta'sir ko'rsatib, tezlik oshgan sari yeyilish hajmi ham oshib boradi. Bu yerda yeyilish hajmi miqdori bir birga yaqin qiymati optimal tezlik 2780 ayl/m dadir.

Grafiklardan aniqlash mumkinki, har bir parametrning tishli g'ildirak yeyilish hajmining eng optimal qiymatiga erishish mumkin bo'lgan holatlar mavjud. Quydagi omillar asosida material qattiqligi, ta'sir kuchi va aylanish tezligi, optimal (maqbul) qiymatlarni aniqlash lozim.

11-jadval.
Grafiklar bo'yicha maqbul nuqtalar

Grafik nomi	Parametrlar (x)	Eng maqbul qiymat (x)	Natija (y)
y_1 ni x_1 ga bog'liqligi	Material qattiqligi (HRC)	60	$\eta \approx 18,86$
y_1 ni x_2 ga bog'liqligi	Ta'sir kuchi (kN)	30,7	$\eta \approx 18,82$
y_1 ni x_3 ga bog'liqligi	Val aylanish tezligi (ayl/m)	2780	$\eta \approx 18,66$

Eng optimal hajmdagi yemirilish hajmi 3 ta holatda ham mavjud ammo qattiqlik darajasi 60 HRC bo'lganda optimal qiymatga erishiladi bunda yeyilish hajmi 18,86 mm³ ni tashkil etadi.

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YUZA VA XAJMNI XISOBLASH UCHUN UNIVERSAL SIMPSON FORMULASINING

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ANNOTATSIYA

Ushbu maqolada geometrik shakllar yuza va hajmlarini xisoblash uchun Simpson formulasini qo'llanilishi haqida yoritilgan. Yagona formulani bilish orqali o'quvchilar maktab geometriya kursidagi shakllar yuza hajmini xisoblay olishlari haqida aytib o'tilgan.

Kalit so'zlar: Simpson formulasi, shar, silindr, xajm, konus, trapetsiya.

АННОТАЦИЯ

В данной статье описано использование формулы Симпсона для расчета поверхности и объема геометрических фигур. Было упомянуто, что, зная единственную формулу, учащиеся могут рассчитать площадь поверхности фигур в школьном курсе геометрии.

Ключевые слова: Формула Симпсона, сфера, цилиндр, объём, конус, трапеция.

ABSTRACT

This article describes the use of Simpson's formula for calculating the surface and volume of geometric shapes. It was mentioned that by knowing a single formula, students can calculate the surface area of shapes in the school geometry course.

Key words: Simpson's formula, sphere, cylinder, volume, cone, trapezium.

Maktab geometriya kursi o'quvchilarda matematik bilimlar fundamentini shakllantiradigan juda qiziq va boy kursdir. Matematik bilimlarni maktabda yaxshi o'zlashtirilishi albatta o'qituvchining mahorati va fan bilimlarini mustaxkam egallaganligiga bog'liq. O'quvchilarda har qanday mavzu bo'yicha bilimlarni shakllantirish uchun o'qituvchi o'rganilayotgan mavzular bo'yicha katta bilimlar bazasiga ega bo'lishi kerak.

Streometriya bo'limiga doir masalalarni yechishda o'quvchilar shar, konus, piramida, silindr, parallelepiped shu va shu kabi eng ko'p uchraydigan shakllar hajmini

aniqlashga doir masalalarga duch kelishadi. Albatta ushbu masalalalarni yechishda o'quvchilar har bir shakl hajmini aniqlashda formulalarga murojaat qilishadi. Formulalar ularning yodida qolmagan bo'lsa, ular matematik ma'lumotnomalardan foydalanishadi.

Hajmni xisoblashga oid masalalarda Simpson formulasining o'rni beqiyosdir. Aslida, bu oliy matematikaga, ya'ni aniq integral orqali hajmni xisoblash usullariga tegishli bo'lsada, soddaligi tufayli ushbu formulani maktab kursida o'qitish, o'rgatish maqsadga muvofiqdir. Birgina Simpson formulasidan foydalanib, biz shakllarning yuzalari hamda turli jismlarning hajmlarini ham hisoblashimiz mumkin.

$$V = \frac{h}{6}(S_{as} + 4S_{o'r} + S_{yuq}) \quad (1)$$

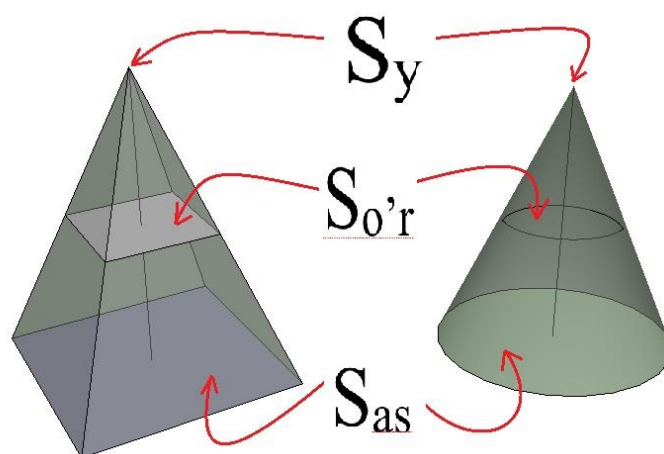
O'quvchilarda bu formula bo'yicha bilimlarni shakllantirish uchun albatta ularda fazoviy jismlar bo'yicha bilimlarini ham tekshirib ko'rish kerak. Mavzuni o'qitishda o'quvchilarga albatta fazoviy shakllarni yasash bilan tushuntirish yaxshi natijalar berishi aniq.

Piramida va konus hajmini ko'rib o'tadigan bo'lsak, ular hajmlari quyidagiga teng.

$$V = \frac{1}{3} S_{as} \cdot h \quad (2)$$

Simpson formulasi bo'yicha ko'rib o'tadigan bo'lsak:

$$V = \frac{h}{6} \cdot (S_{as} + 4S_{o'r} + S_y)$$



1-rasm.

Yuqorida keltirilgan chizmada S_{as} - asos yuzi, $S_{o'r}$ - o'rta kesim yuzi, S_y -yuqori kesim yuzi.

Uchburchak o'xshashligidan o'rta kesim yuzasi asos yuzining to'rtidan bir qismiga tengligi kelib chiqadi. Yuqori yuza nolga tengligidan:

$$V = \frac{h}{6} \cdot \left(S_{as} + 4 \frac{S_{as}}{4} + 0 \right)$$

Bundan (2) formula kelib chiqadi.

Shar hajmini quyidagi formula orqali xisoblaymiz:

$$V = \frac{4}{3} \pi r^3 \quad (3)$$

Shar hajmini Simpson formulasi orqali xisoblaymiz. Yuqori va asos tekisliklari nolga tengligi sababli formula quyidagi ko'rinishga keladi.

$$V = \frac{h}{6} \cdot (0 + 4S_{o'r} + 0)$$

Balandlik diametrga tengligini inobatga olsak

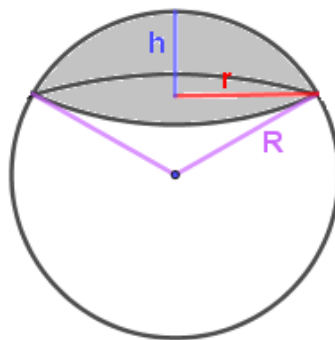
$$V = \frac{2r}{6} \cdot 4\pi r^2 = \frac{4}{3} \pi r^3$$

(3) kelib chiqadi.

Simpson formulasi orqali maktab geometriya kursida uchraydigan fazoviy jismlar kub, parallelepiped, tetraedr kabi shakllar hajmlarini xisoblab ko'rilsa ham, yuqorida keltirilgani kabi to'g'ri yechimga borishimiz mumkin.

Sinf o'quvchilarining bilim darajasi, dunyoqarashi va shunga mos holda o'tilayotgan dars mazmuni qabul qilish imkoniyati ham turlicha bo'ladi. Shularni xisobga olgan holda matematika fani o'qituvchisi har bir dars yuzasidan isbotlashga doir mavzularni turlicha usullarda isbotlash usulini ko'rsatish maqsadga muvofiq xisoblanadi.

Ushbu formulani shar segmenti uchun qo'llab ko'ramiz.



$$S = \frac{h}{6} (a + 4c + b)$$

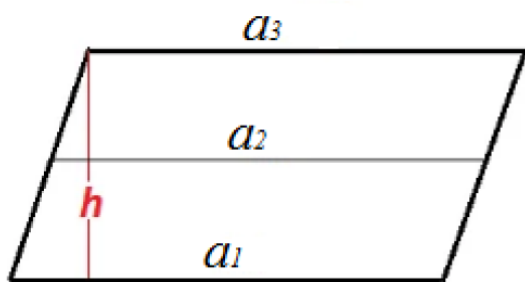
Simpson formulasi orqali segment xajmini xisoblaymiz.

$$V = \frac{h}{6} (2\pi Rh - \pi h^2 + 4\pi Rh - \pi h^2)$$

$$V = \pi Rh^2 - \frac{1}{3} \pi h^3 \text{ kelib chiqadi.}$$

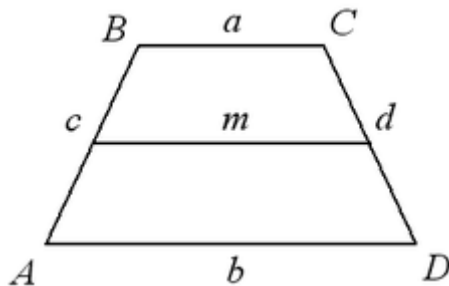
Streometriya bo'limini o'qitishda eng ko'p uchraydigan kub, silindr, konus, parallelepiped hamda tetraedr xajmlarini ushbu formula orqali xisoblanganda o'sha ma'lumotnomalarda keltirilgan formulalarga ega bo'lamiz. Isbotlashga doir masalalarni o'quvchilarga o'qitish davomida, ushbu formula orqali qolgan shakllar formulalarini Simpson formulasi orqali keltirib chiqarishni vazifa qilib berish orqali ularda Simpson formulasini yodda saqlab qolishlarini ta'minlashimiz mumkin.

Simpson formulasining yuzalar uchun ham tadbqiqi mavjud bo'lib u quyidagi ko'rinishga ega:



$$S = \frac{h}{6} (a_1 + 4a_2 + a_3)$$

Ushbu formula orqali trapetsiya va uchburchak yuzalarini xisoblab ko'ramiz.



Berilgan chizmada m trapetsiyaning o'rta chizig'i: $m = (a+b)/2$. Simpson formulasiga ko'ra:

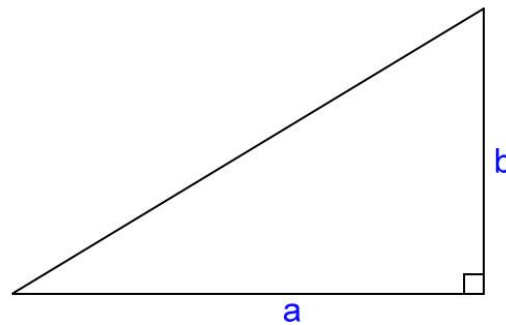
$$S = \frac{h}{6} (a + 4m + b) \text{ dan}$$

$$S = \frac{h}{6} (a + 4 \frac{a+b}{2} + b) \text{ kelib chiqadi.}$$

Ushbu ifodani soddalashtirishdan so'ng trapetsiya yuzasini xisoblash formulasi kelib chiqadi:

$$S = \frac{ab}{2}.$$

Uchburchak yuzasini Simpson formulasi uchun ko'rib chiqamiz:



Uchburchak balandligi yuqoridagi chizmada b ga tengligidan:

$$S = \frac{b}{6} \left(a + 4 \frac{a}{2} + 0 \right) \text{ dan}$$

$$S = \frac{ab}{2} \text{ kelib chiqadi.}$$

Xulosa qilib aytganda Simpson formulasi fazoviy jismlar xajmini va gepmetrik shakllar yuzalarini xisoblashda eng zarur formulalardan biridir. Ushbu formulani bilish orqali o'quvchilar barcha shakllarni yuza va xajmlarini xisoblash uchun universal formulaga ega bo'lishadi.

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GIGIENA FANINI O'QITISHNING USLUBIY ASOSLARI

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Biz yoshlarimiz mustaqil tafakkur, yuksak intellektual va ma'naviy salohiyatga ega bo'lishi, hech bir sohada boshqa mamlakatlardagi tengdoshlaridan kam bo'lmasligi, baxtli va ertangi kunga ishonch bilan yashashi uchun davlatimiz va jamiyatimizning barcha kuch va imkoniyatlarini safarbar etamiz.

Kadrlar tayyorlash milliy dasturi yuqori umumiy va kasbiy madaniyatga, ijodiy va ijtimoiy faollikka, ijtimoiy-siyosiy hayotda mustaqil harakat qila oladigan, istiqboldagi vazifalarni belgilash va hal etishga qodir yangi avlod kadrlarini shakllantirishga qaratilgan.

Xalqning boy intellektual merosi va umuminsoniy qadriyatlar, zamonaviy madaniyat, iqtisodiyot, fan, texnika va texnika yutuqlariga asoslangan mukammal kadrlar tayyorlash tizimini shakllantirish O'zbekiston taraqqiyotining muhim shartidir.

Ta'limni texnologiyalashtirish g'oyasi unchalik yangi emas. Hatto Yan Amos Komenskiy ta'lim berishning shunday umumiy tartibini topishga harakat qildi, unda u inson tabiatining yagona qonunlariga muvofiq amalga oshiriladi. Va keyin, Komenskiy ishondi: "Hamma narsa soatlar to'g'ri muvozanatlangan og'irliklar bilan, xuddi shunday yoqimli va quvonchli avtomatga qarash yoqimli va quvonchli va nihoyat, shunday sodiqlik bilan oldinga siljiydi" kabi mohir asbobda erishish mumkin.

Didaktik mashina uchun, deb yozgan edi u, quyidagilarni topish kerak:

- 1) aniq belgilangan maqsadlar;
- 2) ushbu maqsadlarga erishish uchun aniq moslashtirilgan vositalar;
- 3) maqsadga erishmaslik uchun ushbu vositalardan qanday foydalanish bo'yicha qat'iy qoidalar.

Ta'lim texnologiyasi dastlab pedagogik amaliyotning, keyin esa pedagogikaning yo'nalishi sifatida 30-yillarda AQShda shakllangan va XX asrning 80-yillarida deyarli barcha rivojlangan mamlakatlarni qamrab olgan va YUNESKO tomonidan tan olingan.

Bu vaqt ichida ta'limni texnologiyalashtirishga yondashuvlarda ham, "ta'lim texnologiyasi" tushunchasining o'ziga xos ta'rifida ham evolyutsion o'zgarishlar ro'y berdi.

Hozirgi vaqtda butun o'qitish va tarbiya masalasini pedagogik texnologiya relslariga o'tkazish pedagogik jarayonni qurish va amalga oshirishdagi

o'zboshimchalikdan o'quv amaliyotini keskin burilish demakdir. Uning har bir elementi va bosqichining uyg'un asoslanishiga (o'quv jarayonini algoritmlashtirishda – uni aniq belgilangan va asoslangan, aniq belgilangan elementlarga – o'qitish, muloqot qilish, axborotlashtirish va boshqarish usullari va vositalariga bo'lish yo'li bilan maksimal rasmiylashtirish; berilgan protseduralar ketma-ketligida shakllantirilgan); ob'ektiv tashxis qo'yilgan yakuniy natijaga e'tibor qaratish; o'quv jarayoniga ishlab chiqarish va texnologik jarayonning mukammal, mustahkam yo'lga qo'yilgan, uyg'un, muvozanatli xarakterini berish, belgilangan ta'lim maqsadiga erishishni kafolatlash va berilgan sharoitlarda va belgilangan muddatlarda ijobiy natija olish; ta'lim jarayonining samaradorligini ta'minlash va inson imkoniyatlarini (harakat, vaqt) va texnik resurslarni optimallashtirish maqsadida uning to'liq nazorat qilinishi.

Gigiena fanini o'qitishda motivatsiya darajasi, talabalarning o'qish jarayoni va ularning bilimlarni qabul qilish natijalariga ta'sir etuvchi muhim omil hisoblanadi. Motivatsiya - bu insonning maqsadlariga erishish uchun kuch va intilishni mujassam etuvchi psixologik jarayon. O'quv jarayonida yuqori motivatsiya darajasi talabalar yutuqlarining oshishida muhim rol o'ynaydi.

Gigiena fanini o'qitishda motivatsiyani oshirish uchun bir necha passiv va faol metodlarni qo'llash mumkin. Passiv usullar orasida, masalan, darslar va taqdimotlarning qiziqarli va interaktiv bo'lishi, muhim ma'lumotlarni tushunarli tarzda taqdim etish mavjud. Bu usullar talabalar e'tiborini jalb qiladi va o'zlashtirish jarayonini samarali qiladi.

Faol usullar sifatida esa, amaliy mashg'ulotlar, guruh ishlari va loyiha asosidagi ta'lim metodlarini kiritish mumkin. Talabalar o'z bilimlarini amalda qo'llash imkoniyatiga ega bo'lganda, motivatsiya darajasi oshadi, bu esa o'z navbatida, o'qishga qiziqishni kuchaytiradi. Shuningdek, muvaffaqiyatlarni taqdirlash va rag'batlantirish mexanizmlari, masalan, akademik mukofotlar, o'zaro raqobat yaratish va ilmiy tadqiqotlarga jalb qilish motivatsiyani oshirishga yordam beradi.

O'quv jarayonida muhim jihatlaridan biri, talabalar uchun gigiena fanining ahamiyatini tushuntirishdir. Ushbu fan nafaqat akademik bilimlarni, balki ularning hayotlari va sog'liq xavfsizligini ta'minlashga qaratilgan. Shuning uchun, gigiena fanini o'qitishda real hayotdan misollar keltirish va uni amalda qo'llash imkoniyatlarini ko'rsatish juda muhimdir.

Motivatsiya darajasini oshirish uchun, o'qituvchilarning o'zlari ham doimiy ravishda professional rivojlanish jarayonlarida qatnashishlari, yangi pedagogik usullar va texnologiyalar bilan tanishishlari zarur. Bu esa, o'qituvchilarning o'z faniga bo'lgan qiziqishlarini oshiradi va talabalarni ham qiziqtirish imkonini beradi.

Gigiena fanini o'qitishda samarali motivatsiya strategiyalari quyidagilardan iborat:

1. Amaliy misollar va vaziyatlar: Talabalarga gigiena fanining ahamiyatini tushuntirishda real hayot misollarini keltirish juda muhimdir. Masalan, gigiena qoidalarini bilmaslik natijasida yuzaga keladigan kasalliklarni yoki vaziyatlarni ko'rsatish, talabalarning qiziqishini oshiradi.

2. Interaktiv o'rganish usullari: Amaliy mashg'ulotlar, guruh muhokamalari va seminarlarda ishtirok etish, talabalarni faol ravishda dars jarayoniga jalb qiladi. Bu, ularda o'rganilayotgan materialga qiziqish uyg'otadi hamda bilimlarni kengaytiradi.

3. Maqsadlarni aniqlash: Talabalarga o'z maqsadlarini belgilashda yordam berish. Ular o'z bilimlari va ko'nikmalaridan qanday foydalana olishlarini tushunib olishlari, ularni rag'batlantirishga yordam beradi.

4. Ijobiy muhit yaratish: Darslarda ijobiy va qo'llab-quvvatlovchi muhit yaratilishi kerak. O'qituvchilar talabalarni tajribalarini baham ko'rishga va o'z fikrlarini ifoda etishga rag'batlantirishi lozim.

5. Natijalarni baholash va mukofotlash: Talabalar o'zlari o'rgangan bilim va ko'nikmalarining natijalarini ko'rishlari va uni baholashlari muhimdir. Vaqti-vaqti bilan mukofotlar, sertifikatlar yoki boshqa rag'batlantiruvchi vositalar berish, talabalarni yanada faol bo'lishga undaydi.

6. Ta'limning faoliyati: Talabalarni o'rganish jarayonida faoliyat ko'rsatishga undash. Masalan, talabalar yig'ilgan yerlarda o'zaro savol-javoblar o'tkazish yoki seminarlar tashkil etish orqali ustozlaridan ko'proq o'rganishlari mumkin.

7. O'z-o'zini baholash: Talabalarga o'zlarining o'zgarishlari, o'rganish jarayonidagi muvaffaqiyatlari uchun baholash imkoniyatini berish. Bu, ularning qaror qabul qilish qobiliyatini oshiradi hamda o'z-o'zini boshqarish ko'nikmalarini rivojlantiradi.

Ushbu strategiyalar samarali bo'lib, talabalarni gigiena faniga bo'lgan qiziqishini oshirish va o'quv jarayonini samarali olib borishda muhim rol o'ynaydi.

Gigiena fanida interaktiv o'rganish usullari o'quvchilarning qiziqishini va faol ishtirokini oshirishda samarali hisoblanadi. Quyidagi interaktiv o'rganish usullari eng samarali hisoblanadi:

1. Guruh ishlari: O'quvchilarni kichik guruhlariga bo'lib, muammo yoki vazifalarni baham ko'rish orqali muhokama qilish mumkin. Bu usul o'qituvchining roli pasayadi va o'quvchilar o'z fikrlarini erkin ifoda etish imkoniyatiga ega bo'lishadi.

2. Rol o'ynash: O'quvchilar gigiena bilan bog'liq vaziyatlarni simulyatsiya qilishlari mumkin. Masalan, toza va iflos muhitda qanday xatti-harakatlar qilishni o'rganish uchun rollarni o'zgartirib o'ynash. Bu usul o'quvchilarga nazariy bilimlarini amaliy ko'nikmalarga aylantirish imkonini beradi.

3. Interaktiv taqdimotlar: Raqamli asboblari yoki dasturiy ta'minot yordamida taqdimotlar tayyorlash orqali o'quvchilar o'z bilimlarini ko'rsatishlari mumkin. Masalan, PowerPoint yoki Prezi kabi dasturlarda o'z taqdimotlarini yaratishlari mumkin.

4. Qiziqarli testlar va viktorinalar: O'quvchilarga qiziqarli va interaktiv testlar yordamida gigiena haqidagi bilimlarini baholash imkoniyatini berish. Bunda gratifikatsion tizimlar va ballar ham joriy etilishi mumkin.

5. Video va multimedia materiallar: Gigiyeviy masalalarni o'rganishda video darsliklar va multimedia materiallardan foydalanish o'quvchilarning diqqatini tortadi va mavzuni yanada tushunarli qiladi.

6. Tadbirlar va amaliy mashg'ulotlar: Gigiena bilan bog'liq amaliy mashg'ulotlar, masalan, toza suv manbalarini yaratish yoki sanitariya tadbirlarini o'tkazish kabi tadbirlarda ishtirok etish o'quvchilarni praktika bilan birga ta'lim beruvchi jarayoni kuchaytiradi.

Ushbu interaktiv usullar o'quvchilarning bilimini yanada chuqurlashtirib, qiziqishini oshirib, o'zaro muloqotni rag'batlantiradi. O'qituvchi sifatida bunday usullarni qo'llash, o'quvchilarni faollashtirish va ularga samarali ta'lim berish imkonini beradi.

Xulosa qilib aytganda, gigiena fanini o'qitishda motivatsiya darajasi yuqori bo'lishi, bilimlarni o'zlashtirish, amaliy ko'nikmalarni rivojlantirish va sog'liqni saqlash bilan bog'liq jihatlariga katta ahamiyat beradi. O'qituvchilar buni hisobga olib, o'z darslarini samarali tashkil qilishlari, talabalarning qiziqishini va motivatsiyasini oshirishga intilishlari kerak.

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QO'YLARNI BANITIROVKA QILISH: MAHSULDORLIKNI OSHIRISH VA SOG'LOM PODALARNI SAQLASHNING MUQOBIL USULI

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ANNOTATSIYA

Qo'ylarni banitirovka qilish (tanlab olish va guruhlash) chorvachilikda podaning sog'lig'i va mahsuldorligini oshirishning asosiy usullaridan biridir. Ushbu ilmiy maqolada banitirovka qilishning maqsadi, usullari, mezonlari va ahamiyati yoritiladi. Shuningdek, O'zbekiston sharoitida qo'llaniladigan tajribalar va samarali boshqaruv usullari ko'rib chiqiladi.

Kalit so'zlar: Qo'ychilik, banitirovka, mahsuldorlik, naslchilik, veterinariya, sog'lom podalar, go'sht va jun mahsuldorligi, kasallikka chidamlilik, genetik seleksiya, oziqlanish samaradorligi.

АННОТАЦИЯ

Банитизация (селекция и группировка) овец является одним из основных методов повышения здоровья и продуктивности стада в животноводстве. В данной научной статье раскрыты цель, методы, критерии и значение банитинга. Также рассмотрен опыт и эффективные методы управления, применяемые в условиях Узбекистана.

Ключевые слова: Овцеводство, селекция, продуктивность, селекция, ветеринарная медицина, здоровое стадо, мясная и шерстная продуктивность, устойчивость к болезням, генетическая селекция, эффективность питания.

ABSTRACT

Banitization (selection and grouping) of sheep is one of the main methods of improving the health and productivity of the herd in animal husbandry. This scientific article reveals the purpose, methods, criteria and significance of baniting. Also considered are the experience and effective management methods used in the conditions of Uzbekistan.

Keywords: Sheep breeding, selection, productivity, selection, veterinary medicine, healthy herd, meat and wool productivity, resistance to diseases, genetic selection, nutrition efficiency.

KIRISH

O'zbekiston Respublikasida chorvachilik, jumladan, qo'ychilik sohasini rivojlantirishga qaratilgan bir qator Prezident qarorlari qabul qilingan. Quyida ushbu sohani tartibga soluvchi asosiy hujjatlar keltirilgan:

1. "O'zbekiston Respublikasida chorvachilik sohasi va uning tarmoqlarini rivojlantirish bo'yicha 2022 — 2026-yillarga mo'ljallangan dastur to'g'risida"

Mazkur qaror chorvachilik tarmog'ini jadal rivojlantirish, zamonaviy va innovatsion uslublarni joriy etish, mahsulotlar ishlab chiqarish hajmini oshirish va turlarini kengaytirish, shuningdek, aholini mahalliy sharoitda ishlab chiqarilgan sifatli va arzon chorva mahsulotlari bilan uzluksiz ta'minlashga qaratilgan.

2. "O'zbekiston Respublikasi qishloq xo'jaligini rivojlantirishning 2020 — 2030-yillarga mo'ljallangan strategiyasida belgilangan vazifalarni 2021-yilda amalga oshirish chora-tadbirlari to'g'risida"

Ushbu qaror qishloq xo'jaligi, xususan, chorvachilik tarmog'ini rivojlantirish bo'yicha 2021-yilda amalga oshirilishi lozim bo'lgan chora-tadbirlarni belgilaydi.

3. "Veterinariya va chorvachilik sohasida davlat boshqaruvi tizimini tubdan takomillashtirish chora-tadbirlari to'g'risida"

Mazkur qaror veterinariya va chorvachilikni rivojlantirish davlat qo'mitasining tashkil etilishi, uning vazifalari va faoliyat yo'nalishlarini belgilaydi.

Ushbu qarorlar qo'ychilik sohasini rivojlantirish, mahsuldorlikni oshirish va sog'lom podalarni shakllantirishda muhim ahamiyatga ega.

Chorvachilikning rivojlanishida qo'ylarni to'g'ri boshqarish muhim ahamiyatga ega. Qo'ylar podasining mahsuldorligini oshirish, sog'lom va sifatli avlod yetishtirish uchun chorvadorlar banitirovka (tanlab olish) usullaridan foydalanadi. Banitirovka orqali yaroqsiz yoki past mahsuldor hayvonlar podadan chiqariladi va naslni yaxshilashga imkon beradi.

Mavzuning dolzarbligi. Qo'ylarni banitirovka qilishimizning asosiy maqsadlari: Sog'lom avlod yetishtirish: Genetik nuqsonlarga ega hayvonlarni tanlash orqali nasldagi kamchiliklarni yo'qotish. Mahsuldorlikni oshirish: Ko'p go'sht yoki jun yetishtiradigan hayvonlarni ajratib olish. Iqtisodiy samaradorlikni oshirish: Ozuqa va boshqa resurslarni yuqori mahsuldor hayvonlarga yo'naltirish. Profilaktika: Kasallikka moyil hayvonlarni aniqlab, ulardan podani himoya qilishdan iborat.

Qo'ylarni baholash bir necha asosiy mezonlarga: tashqi ko'rinish sog'lom, proporsional tanaga ega bo'lish. jun qoplami qalinligi va sifatining standartlarga

mosligi. Tishlarning holati (yoshi va sog'lig'ini aniqlash uchun). Naslchilik xususiyatlari Nasl beruvchanlik darajasi (ko'payish qobiliyati). Ota-onalarining mahsuldorligi haqida ma'lumotlari hamda mahsuldorlik: Jun mahsuldorligi, junning qalinligi, uzunligi va sifat ko'rsatkichlari. Go'sht mahsuldorligi: Tana massasi va go'sht sifati. Sut mahsuldorligi: Agar zot sut yo'nalishiga ixtisoslashgan bo'lsa. Kasallik belgilarining mavjudligi (kasallikka moyillik yoki yuqumli kasalliklar). Parazitlardan zararlanish darajasiga qarab amalga oshiriladi:

O'zbekiston sharoitida banitirovkaning ahamiyati

O'zbekistonda qo'ylar go'sht va jun mahsulotlari uchun katta ahamiyatga ega. Mamlakatda mahalliy va chet el zotlarining genetik xususiyatlarini yaxshilash uchun banitirovka muhimdir. Jumladan: Hissori qo'ylari — go'sht va yog' mahsuldorligini oshirish maqsadida banitirovka qilinadi. Merinos qo'ylari — yuqori sifatli jun uchun tanlab olinadi. Kasallikka chidamli mahalliy zotlarni yaratishda banitirovkaning roli katta.

Amaliy tajribalar

O'zbekistonning chorvachilik fermalarida o'tkazilgan tadqiqotlar shuni ko'rsatdiki: Banitirovka orqali podaning mahsuldorligi 15-20% ga oshadi. Nosog'lom va past mahsuldor hayvonlarni chiqarib tashlash ozuqa xarajatlarini 10% gacha kamaytiradi. Genetik xususiyatlarni yaxshilash orqali yuqori sifatli jun va go'sht olish kafolatlanadi.

XULOSA

Qo'ylarni banitirovka qilish chorvachilikda iqtisodiy samaradorlik va mahsuldorlikni oshirishning muhim vositasidir. Quyidagilarni tavsiya etish mumkin: Muntazam banitirovka qilish tizimini yo'lga qo'yish. Veterinariya ko'rigini takomillashtirish. Mahalliy sharoitga mos selektsiya ishlarini kuchaytirish. Ilmiy va texnologik yondashuvlarni tatbiq etish orqali har bir xo'jalik banitirovka yordamida o'zlari ko'zda tutgan natijaga erishishlari va yuqori ko'rsatkichga ega hayvonni olishga muvafaq bo'ladi.

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YOSHLAR ORASIDA YURAK-QON TOMIR KASALLIKLARINING PROFILAKTIKASI

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ANNOTATSIYA

Ushbu maqolada yoshlar orasida yurak-qon tomir kasalliklarining (YQTK) rivojlanish sabablari, xavf omillari va profilaktik chora-tadbirlari tahlil qilinadi. Tadqiqot epidemiologik usullarga asoslanib olib borildi va natijalarga ko'ra, genetik omillar, noto'g'ri ovqatlanish, jismoniy faollik yetishmovchiligi, stress va zararli odatlar YQTK ning asosiy omillari ekanligi aniqlandi. Maqolada profilaktik tadbirlarning samaradorligi va ularni yoshlar orasida keng joriy etish zarurati muhokama qilinadi.

Kalit so'zlar: yurak-qon tomir kasalliklari, yoshlar, profilaktika, sog'lom turmush tarzi, genetik omillar, jismoniy faollik, stress, zararli odatlar.

PREVENTION OF CARDIOVASCULAR DISEASES AMONG YOUTH

ABSTRACT

This article analyzes the causes, risk factors, and preventive measures of cardiovascular diseases (CVDs) among young people. The study was conducted using epidemiological methods, and the results indicate that genetic factors, poor nutrition, lack of physical activity, stress, and harmful habits are the main factors contributing to

the development of CVDs. The article discusses the effectiveness of preventive measures and the necessity of their widespread implementation among youth.

Keywords: cardiovascular diseases, youth, prevention, healthy lifestyle, genetic factors, physical activity, stress, harmful habits.

KIRISH (INTRODUCTION)

Yurak-qon tomir kasalliklari (YQTK) global miqyosda o'lim va nogironlikning asosiy sabablaridan biri hisoblanadi. Jahon sog'liqni saqlash tashkiloti (WHO) ma'lumotlariga ko'ra, 2023-yilda YQTK tufayli 18 milliondan ortiq odam vafot etgan. Ilgari bu kasalliklar asosan 50 yoshdan katta odamlarda uchragan bo'lsa, so'nggi yillarda u yoshlar orasida ham keng tarqalmoqda. Bu jarayonning asosiy sabablari orasida genetik omil, noto'g'ri ovqatlanish, jismoniy faollikning yetishmovchiligi, stress va zararli odatlar kiradi. Profilaktik chora-tadbirlar orqali YQTK rivojlanish xavfini kamaytirish mumkin. Ushbu maqolada yoshlar orasida YQTK profilaktikasi muhimligi, uning asosiy omillari va samarali oldini olish yo'llari muhokama qilinadi.

ADABIYOTLAR TAHLILI VA METODOLOGIYA (LITERATURE REVIEW AND METHODOLOGY)

Orolbo'yi mintaqasi ixtisoslashtirilgan kardiologiya va kardioxirurgiya ilmiy-amaliy tibbiyot markazida 18-35 yosh orasidagi 200 nafar bemor orasida YQTK xavf omillari bo'lgan bemorlarning kasallik tarixi o'rganildi. Bu bemorlarda klinik laborator – umumiy qon analizi, biokimyoviy tahlili va instrumental tekshiruvlar – EKG va ExoKG tahlil qilindi. Tadqiqotda quyidagi usullar ham qo'llanildi:

Epidemiologik tahlil: Xorazm viloyatida YQTK bilan bog'liq statistik ma'lumotlar tahlil qilindi.

Adabiyot sharhi: PubMed, Scopus va Google Scholar bazalaridan 2015-2024 yillar oralig'idagi maqolalar o'rganildi.

So'rovnoma o'tkazish: 18-35 yosh orasidagi 500 nafar respondent orasida YQTK xavf omillari bo'yicha so'rovnoma o'tkazildi.

NATIJALAR (RESULTS)

Tadqiqot natijalari shuni ko'rsatdiki:

Bemorlardan olingan natijalarga ko'ra ushbu kasallikni rivojlanishida genetik omillar muhim ro'l o'ynaydi. Oilaviy tarixida YQTK bo'lgan shaxslar yurak qon tomir kasalliklariga moyil bo'lishadi. Masalan, yaqin qarindoshlarida yurak xuruji yoki insult kabi holatlar kuzatilgan insonlarda YQTK rivojlanish xavfi yuqori bo'ladi. Umumiy tadqiqotlar shuni ko'rsatadiki, genetik moyillik va atrof-muhit omillari qo'shib kasallikni erta rivojlanish xavfini oshiradi. Yoshlar orasida YQTKning oshishiga turmush tarzi omillari, jumladan, noto'g'ri ovqatlanish -yoshlarning 65 foizi tayyor mahsulotlar va yog'li taomlarni muntazam iste'mol qiladi, kam harakatlilik -40 foizi

haftasiga 1 martadan kam jismoniy faollik bilan shug'ullanadi, stress va psixo-emotsional muammolar - yoshlarning 55 foizi yuqori darajada stress holatida ekanligini bildirgan, zararli odatlar - yoshlarning 30 foizi muntazam ravishda chekish yoki alkogol iste'mol qilishini bildirgan.

Ushbu omillar YQTK rivojlanishiga bevosita ta'sir qilishi aniqlangan.

MUHOKAMA (DISCUSSION)

Tadqiqot natijalari xalqaro ma'lumotlar bilan solishtirilganda, yoshlar orasida YQTK rivojlanishining asosiy sabablari o'xshash ekanligi aniqlandi. Masalan, AQShda olib borilgan tadqiqotlarda ham genetik moyillik, noto'g'ri ovqatlanish va kam harakatlilik yetakchi xavf omillari sifatida qayd etilgan.

Profilaktika bo'yicha samarali strategiyalar quyidagilarni o'z ichiga olishi kerak:

Sog'lom ovqatlanish dasturlari: maktab va universitetlarda dietolog maslahati va sog'lom taomlanish madaniyatini shakllantirish. Jismoniy faollikni rag'batlantirish: yoshlar uchun sport to'garaklari va jamoaviy tadbirlarni oshirish. Stressni boshqarish: psixologik maslahatlar va mindfulness texnikalarini joriy etish. Zararli odatlardan voz kechish bo'yicha dasturlar: chekish va alkogol iste'molini kamaytirish uchun targ'ibot ishlari olib borish.

XULOSA (CONCLUSION)

Yoshlar orasida YQTK ning oldini olish uchun kompleks yondashuv talab etiladi. Tadqiqot natijalari shuni ko'rsatdiki, genetik omil, noto'g'ri turmush tarzi va zararli odatlar kasallik rivojlanishining asosiy omillaridan biri hisoblanadi. Agar oilasida yurak qon tomir kasalliklari mavjud bo'lsa va shunga binoan, o'z vaqtida tekshiruvlardan o'tib turilsa kasallikni oldini olishda yoki erta tashxis qo'yishda katta yordam beradi. Undan tashqari sog'lom turmush tarzini shakllantirish va tibbiy profilaktika choralari orqali ushbu kasalliklarning oldini olish mumkin. Natijada jamiyatimizda YQTKga uchrash xavfi birmuncha kamayadi, sog'lom muhit paydo bo'ladi.

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TISHLAR REPLANTATSIYASI: ZAMONAVIY YONDASHUVLAR VA KLINIK TAJRIBALAR

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ANNOTATSIYA

Ushbu maqolada tish replantatsiyasining zamonaviy yondashuvlari, klinik tajribalar va yangi texnologiyalar tahlil qilinadi. Replantatsiya jarayonida qo'llaniladigan biomateriallar, o'sish omillari va regenerativ usullar periodontal to'qimalarning tiklanishiga qanday ta'sir ko'rsatishi muhokama etiladi. Shuningdek, antioksidant eritmalar va antibiotik moddalarning tishning uzoq muddatli saqlanishiga ta'siri ilmiy tadqiqotlar asosida yoritiladi. Klinik misollar va ilg'or texnologiyalar asosida replantatsiya muvaffaqiyatini oshirish yo'llari ko'rib chiqiladi.

Kalit so'zlar: Tish replantatsiyasi, periodontal regeneratsiya, antioksidant eritmalar, o'sish omillari, regenerativ stomatologiya, klinik tajribalar, biomateriallar, tish ankiloziyasi.

TOOTH REPLANTATION: MODERN APPROACHES AND CLINICAL TRIALS

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ABSTRACT

This article analyzes modern approaches, clinical trials, and new technologies in tooth replantation. The impact of biomaterials, growth factors, and regenerative methods used in the replantation process on periodontal tissue regeneration is discussed. In addition, the influence of antioxidant solutions and antibiotic agents on the long-term preservation of the replanted tooth is highlighted based on scientific research. Clinical cases and advanced technologies are reviewed to explore ways to improve replantation success.

Keywords: Tooth replantation, periodontal regeneration, antioxidant solutions, growth factors, regenerative dentistry, clinical trials, biomaterials, dental ankylosis.

KIRISH

Tishlarning replantatsiyasi stomatologiyada o'ta dolzarb muolajalardan biri bo'lib, bu usul 1900-yillardan beri klinik amaliyotda qo'llanib kelinmoqda. Tish jarohatlari, ayniqsa, bolalar va o'smirlar orasida keng tarqalgan bo'lib, tadqiqotlar shuni ko'rsatadiki, 7–14 yosh oralig'idagi bolalar avulsiyaga eng ko'p uchraydigan guruh hisoblanadi. Statistika ma'lumotlariga ko'ra, avulsiyaga uchragan tishlarning 0,5–3% hollarda muvaffaqiyatli replantatsiya qilinishi mumkin.

Replantatsiya muvaffaqiyatli o'tishini ta'minlashda bir qancha muhim omillar mavjud. Tadqiqotlar shuni ko'rsatadiki, tishning og'iz bo'shlig'idan tashqarida bo'lgan vaqti 30 daqiqadan oshmasa, periodontal tolalar va hujayralari yetarlicha tiriklikni saqlab qoladi. Shu sababli, zamonaviy protokollar tishni iloji boricha tezroq qayta joylashtirishni va mos konservatsiya vositalaridan foydalanishni tavsiya qiladi. Masalan, Tadqiqotlar shuni ko'rsatadiki, tishning hayotiyligini saqlab qolish uchun uni fiziologik eritma yoki maxsus eritma (masalan, Hank's Balanced Salt Solution – HBSS) ichida saqlash maqsadga muvofiq. Bu usullar periodontal to'qimalarning sog'lom holatda qolishiga yordam beradi.

So'nggi yillarda regenerativ stomatologiya sohasida o'tkazilgan tajribalar replantatsiya natijalarini sezilarli darajada yaxshilashga yordam bermoqda. Masalan, Masalan, Gulinelli va boshqalar tomonidan 2010-yilda o'tkazilgan tadqiqotlarda, avulsiyaga uchragan tishlarni qayta joylashtirishda antioksidant eritmalar va o'sish omillari qo'llanganda, periodontal regeneratsiyaning yaxshiroq kechishi kuzatilgan. Shuningdek, 2015-yilda Trope tomonidan o'tkazilgan klinik tajribalar shuni ko'rsatadiki, ildiz yuzalariga minosiklin yoki doksisisiklin eritmalarini surtilishi yallig'lanish reaksiyasini kamaytirib, tishning uzoq muddat saqlanish ehtimolini oshiradi.

Replantatsiya qilingan tishlarning uzoq muddatli prognozi asosan ildiz rezorbsiyasi va ankiloziya (tishning suyak bilan bevosita birikishi) bilan bog'liq. Tadqiqotlar shuni ko'rsatadiki, yosh bemorlarda replantatsiya qilingan tishlarda

ankiloziya rivojlanish ehtimoli yuqoriroq bo'lib, bu holat tishning keyinchalik ortodontik harakatlanishini qiyinlashtirishi mumkin. Shu sababli, so'nggi yillarda biomimetik materiallar va ildiz hujayralari himoyalash usullari tobora keng qo'llanilmoqda.

Ushbu tadqiqotning asosiy maqsadi tish replantatsiyasining zamonaviy klinik yondashuvlarini, qo'llanilayotgan ilg'or metodlarni va uzoq muddatli samaradorligini baholashdan iborat. Bundan tashqari, tish replantatsiyasida qo'llanilayotgan yangi texnologiyalar, masalan, to'qima muhandisligi va o'sish faktorlarining ahamiyati ham ushbu tadqiqot doirasida o'rganiladi.

Usullar:

Ushbu tadqiqot retrospektiv va prospektiv usullarni o'z ichiga oladi. Tadqiqot doirasida 12 nafar bemor ishtirok etdi, ularda mexanik jarohatlar natijasida avulsiyaga uchragan tishlar replantatsiya qilindi. Muolajalar xalqaro klinik protokollarga muvofiq amalga oshirildi. Tadqiqot davomida tish replantatsiyasining turli bosqichlari, foydalanilgan konservatsiya eritmalari, immobilizatsiya usullari va antibiotik terapiyaning samaradorligi baholandi.

1. Tishni saqlab qolish va replantatsiya qilish

Tish avulsiyaga uchraganidan keyin uni imkon qadar tezroq saqlab qolish muhim hisoblanadi. Tadqiqot doirasida turli vositalar sinovdan o'tkazildi:

- **Fiziologik eritma (0,9% NaCl):** Periodontal ligament cells (PDL) hujayralarining qisqa muddatli tirikligini saqlashda samarali, ammo uzoq muddatli saqlash uchun yetarli emas.
- **Hank's Balanced Salt Solution (HBSS):** Eng samarali eritma hisoblanadi, chunki u PDL hujayralarining 12-24 soatgacha tirik qolishiga yordam beradi.
- **Tishni quruq holda saqlash:** Replantatsiya natijalarga salbiy tasir ko'rsatadi, chunki PDL hujayralari 15-30 daqiqadan so'ng nobud bo'lishi mumkin.
- **Probiotik eritmalar:** Yangi tadqiqotlarda qo'llanilmoqda va periodontal hujayralarni uzoqroq saqlash imkonini berishi mumkin.

2. Tishni replantatsiya qilish

Tishni replantatsiya qilishda bir necha muhim bosqichlar bajarildi:

A. Antiseptik ishlov berish:

- Tish 0,12% xlorgeksidin yoki povidon-yod((polivinilpirolidon, PVP) eritmasida ishlov berildi.
- Ba'zi hollarda tish yuzasiga minosiklin yoki doksisisiklin eritmasi surtildi (bu usul PDL yallig'lanishini kamaytirishga yordam beradi).
- Ko'p hollarda, replantatsiyadan oldin ildiz yuzalarini eritrotsitlar va qoldiqlardan tozalash uchun fiziologik eritmada yuvish amalga oshirildi.

B. Replantatsiya jarayoni:

- Tish avvalgi alveola ichiga ehtiyotkorlik bilan joylashtirildi.
- Tish joyiga kiritilgach, yengil bosim yordamida mustahkamlash amalga oshirildi.
- Replantatsiyadan so'ng, alveolaning jarohatlanish darajasiga qarab, zarur hollarda choklar bilan mustahkamlash amalga oshirildi.

C. Immobilizatsiya: Tishning joyida mustahkam turishini ta'minlash uchun immobilizatsiya ishlatildi. Tadqiqot davomida turli immobilizatsiya usullari sinovdan o'tkazildi:

- **Yumshoq immobilizatsiya (flexible splinting):** Eng ko'p tavsiya qilinadigan usul bo'lib, 7-14 kun davomida tishni mustahkamlaydi va periodontal tolalarning tiklanishiga imkon yaratadi.

- **Qattiq immobilizatsiya (rigid splinting):** Ba'zi hollarda qo'llanildi, lekin uzoq muddatli qattiq immobilizatsiya ildiz rezorbsiyasini kuchaytirishi mumkinligi aniqlangan.

Immobilizatsiya muddati quyidagicha belgilandi:

- **7-10 kun:** Oddiy avulsiyalar uchun.
- **2-4 hafta:** Alveolaga shikast yetgan yoki suyak sinishi kuzatilgan hollarda.

3. Antibiotik terapiya va kuzatuv

Replantatsiya qilingan tishlarda infeksiya oldini olish uchun antibiotik terapiya muhim rol o'ynaydi. Tadqiqot doirasida quyidagi antibiotiklar sinovdan o'tkazildi:

- **Amoksitsillin (500 mg, kuniga 3 marta, 7 kun):** Bakterial infeksiyani kamaytirish uchun samarali hisoblangan.

- **Doksisiklin (100 mg, kuniga 1 marta, 7 kun):** Antiinflammatuar xususiyatga ega bo'lib, periodontal to'qimalarning tiklanishini yaxshilaydi.

- **Metronidazol kombinatsiyasi:** Anaerob bakteriyalarga qarshi kurashishda qo'llanilgan.

Bundan tashqari, bemorlarga og'iz gigiyenasi bo'yicha quyidagi tavsiyalar berildi:

- **Xlorgeksidin 0,12%** bilan kuniga 2 marta chayqash.
- **Qattiq taomlar tanovvul qilmaslik.**
- **Ortodontik yoki jarrohlik tekshiruvlarini muntazam o'tkazish.**

Kuzatuv jarayonida bemorlar:

- **6 oy va 1 yil davomida muntazam tekshiruvdan o'tkazildi.**
- Har 3 oyda rentgenografik tekshiruvlar o'tkazilib, ildiz rezorbsiyasi yoki ankiloziya belgilari tekshirildi.
- Klinik baholash natijalari tishning rang o'zgarishi, perkussiya sezgirligi va periodontal to'qimalarning holati asosida olib borildi.

Qo'shimcha usullar va yangi texnologiyalar

So'nggi yillarda tish replantatsiyasining samaradorligini oshirish uchun bir qancha innovatsion usullar ham qo'llanilgan:

1. Bioaktiv moddalar bilan ishlov berish:

- **Platelet-Rich Fibrin (PRF):** Alveola ichiga joylashtirilgan va yallig'lanish jarayonini kamaytirishga yordam bergan.

- **Hujayra terapiyasi:** periodontal regeneratsiyada ildiz hujayralarning roli bu regenerativ tibbiyotning zamonaviy yo'nalishlaridan biri bo'lib, **ildiz hujayralaridan** foydalanish orqali shikastlangan to'qimalarni qayta tiklanish jarayonini tezlashtirishni maqsad qiladi.

2. Lazer terapiya:

- Past intensivlikdagi lazer terapiyasi (LLLT) yordamida yallig'lanish kamaytirilib, periodontal hujayralarning faoliyati yaxshilangan.

3. 3D implant materiallari:

- Ba'zi holatlarda, alveolani regeneratsiya qilish uchun bioresorblanuvchi materiallar qo'llanilgan.

NATIJALAR

Tadqiqot natijalariga ko'ra, replantatsiya qilingan tishlarning 75% holatda yaxshi osteointegratsiyasi kuzatildi. 16.7% bemorlarda rezorbsiyaga uchragan tishlarning qayta qimirlashi kuzatildi, qolgan 8.3% bemorlarda esa periodontal yallig'lanish rivojlandi. Tish saqlash muhitining replantatsiya natijalariga ta'siri tahlil qilindi, HBSS muhitida saqlangan tishlarning replantatsiya qilishda yaxshi natijalar olish ehtimoli yuqori bo'lishi aniqlandi.

MUHOKAMA

Tish replantatsiyasining samaradorligi ko'plab omillarga bog'liq: avulsiyadan keyin o'tgan vaqt, tishning saqlash muhiti va bemorning umumiy stomatologik holati. Tadqiqot shuni ko'rsatdiki, imkon qadar tezroq replantatsiya amalga oshirilsa, tishlarning uzoq muddatli saqlanib qolish ehtimoli ortadi. Shuningdek, replantatsiya qilingan tishlarni uzoq muddatli kuzatish va ortodontik qo'llab-quvvatlash muhim ekani aniqlandi.

XULOSA

Tish replantatsiyasi samarali usul bo'lib, tibbiy yondashuvlar va texnologiyalar bilan yaxshilanishda davom etmoqda. Kelajak tadqiqotlari bu sohada yangi biomateriallar va regenerativ stomatologiya usullarining tahliliga yo'naltirilishi kerak. Olingan natijalar stomatologik amaliyotda qo'llaniladigan protokollarni takomillashtirishga yordam beradi

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ВЛИЯНИЕ ЗАГРЯЗНЕНИЯ ВОЗДУХА НА ЗДОРОВЬЕ ЧЕЛОВЕКА

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АННОТАЦИЯ

Данная работа посвящена проблеме атмосферного загрязнения, которая представляет собой одну из самых серьезных экологических угроз для здоровья человека. В статье описываются главные источники загрязнения воздуха, такие как производство электроэнергии, промышленные процессы и транспорт, а также основные загрязнители, включая взвешенные частицы. Проводится сравнительный анализ уровней загрязнения воздуха и связанных с этим показателей здоровья в различных регионах Узбекистана. Рассматриваются успешные примеры политик, направленных на снижение загрязнения, которые могут помочь уменьшить заболеваемость и смертность от связанных с этим заболеваний.

Ключевые слова: Атмосфера, бронхит, эмфизема, астма, слизистая оболочка, голосовые связки, токсическое воздействие, ингаляционный путь.

ABSTRACT

This work is dedicated to the problem of atmospheric pollution, which represents one of the most serious environmental threats to human health. The article describes the main sources of air pollution, such as electricity generation, industrial processes, and transportation, as well as the primary pollutants, including particulate matter. A comparative analysis of air pollution levels and related health indicators in various regions of Uzbekistan is conducted. Successful examples of policies aimed at reducing pollution are considered, which may help decrease morbidity and mortality from related diseases.

Keywords: Atmosphere, pollution, respiratory tract, bronchitis, emphysema, asthma, mucous membrane, vocal cords, health, inhalation route, combustion products.

Атмосферный воздух является одним из основных жизненно важных элементов окружающей нас среды. За сутки человек вдыхает около 12-15 м³ кислорода, а выделяет приблизительно 580 л углекислого газа. Загрязнение воздуха является одной из самых серьезных экологических угроз для здоровья человека. Шесть миллиардов жителей планеты, треть которых – дети, дышат загрязненным воздухом, что создает угрозу их здоровью и даже жизни. Каждый год загрязненный воздух становится причиной преждевременной смерти 7 миллионов человек, что подчеркивает необходимость принятия срочных и эффективных мер для улучшения качества воздуха. Основные источники загрязнения, такие как энергетика, промышленность и транспорт, требуют комплексного подхода к решению проблемы.

Главные причины атмосферного загрязнения воздуха – это производство электроэнергии, промышленные процессы, добыча полезных ископаемых, сельскохозяйственная деятельность, нерациональное удаление отходов и транспорт.

Содержащиеся в атмосфере вредные вещества воздействуют на человеческий организм при контакте с поверхностью кожи или слизистой оболочкой. Происходит это тогда, когда вспотевший человек (с открытыми порами) летом идет по загазованной и запылённой улице. Если, добравшись до дома, он тут же не примет тёплый (не горячий!) душ, вредные вещества имеют шанс проникнуть глубоко в его организм.

Наряду с органами дыхания, загрязнители поражают органы зрения и обоняния, а воздействуя на слизистую оболочку гортани, могут вызвать спазмы голосовых связок. Вдыхаемые твердые и жидкие частицы размерами 0,6-1,0 мкм достигают альвеол и абсорбируются в крови, некоторые накапливаются в лимфатических узлах.

Загрязненный воздух раздражает большей частью дыхательные пути, вызывая бронхит, эмфизему, астму. К раздражителям, вызывающими эти болезни, относятся SO₂ и SO₃, азотистые пары, HCl, HNO₃, H₂SO₄, H₂S, фосфор и его соединения. Исследования, проведенные в Великобритании, показали очень тесную связь между атмосферным загрязнением и смертностью от бронхитов.

Признаки и последствия действий загрязнителей воздуха на организм человека проявляются большей частью в ухудшении общего состояния здоровья:

появляются головные боли, тошнота, чувство слабости, снижается или теряется трудоспособность.

Можно сделать вывод о том, что наибольшее количество загрязнителей попадает в организм человека через лёгкие. И действительно, большинство исследователей подтверждает, что ежедневно с 15 кг вдыхаемого воздуха в организм человека проникает больше вредных веществ, чем с водой, с пищей, с грязных рук, через кожу. При этом ингаляционный путь поступления загрязнителей в организм является ещё и наиболее опасным. В силу того, что:

1. воздух загрязнён широчайшим ассортиментом вредных веществ, некоторые из которых способны усиливать пагубное воздействие друг друга;

2. загрязнения, попадая в организм через дыхательные пути, минуя такой защитный биохимический барьер как печень — в результате их токсическое воздействие оказывается в 100 раз сильнее влияния загрязнителей, проникающих через желудочно-кишечный тракт;

3. усвояемость вредных веществ, поступающих в организм через лёгкие, намного выше, чем загрязнителей, проникающих с пищей и водой;

4. от атмосферных загрязнителей тяжело укрыться: они оказывают влияние на здоровье человека 24 часа в сутки 365 дней в году.

Основные причины смертей, вызванных загрязнением атмосферного воздуха — это рак, врождённые патологии, нарушение работы иммунной системы организма человека.

Вдыхание воздуха, в котором присутствуют продукты горения (разреженный выхлоп дизельного двигателя), даже в течение непродолжительного времени, например, увеличивают риск получить ишемическую болезнь сердца.

Промышленные предприятия и автотранспорт выбрасывают чёрный дым и зеленовато-жёлтый диоксид, которые повышают риск ранней смерти. Даже сравнительно низкая концентрация этих веществ в атмосфере вызывают от 4 до 22 процентов смертей до сорока лет.

Выхлопы автомобильного транспорта, а также выбросы предприятий, сжигающих уголь, насыщают воздух крошечными частицами загрязнений, способных вызывать повышение свёртываемости крови и образование тромбов в кровеносной системе человека. Загрязнённый воздух приводит также к повышению давления. Это вызвано тем, что загрязнение атмосферы вызывает изменение той части нервной системы, которая контролирует уровень кровяного давления. Из-за загрязнения воздуха в крупных городах происходит примерно пять процентов случаев госпитализации. Больше всего страдают уязвимые группы населения, а точнее женщины, дети, меньшинства, коренные народы, а

также бедняки. Женщины и девочки в бедных странах, например, выполняя домашнюю работу, зачастую используют для готовки и отопления уголь и керосин, которые загрязняют воздух. Поскольку мозг и организм детей в процессе развития крайне восприимчивы к токсическим веществам, перенесенное им в детстве вредное воздействие может вызвать хронические проблемы со здоровьем.

Крупные источники атмосферного загрязнения воздуха (электростанции, фабрики, мусоросжигатели и оживленные автотрассы) зачастую находятся на территории бедных районов. Нищета – дополнительный фактор риска еще и потому, что жители, дышащие грязным воздухом, не всегда могут обратиться к врачу, да и зачастую не знают о его последствиях.

Нередко крупные промышленные города накрывает густой туман – смог. Это очень сильное загрязнение воздуха, представляющее собой густой туман с примесями дыма и газовых отходов или пелену едких газов и аэрозолей повышенной концентрации. Такое явление обычно наблюдается в безветренную погоду. Это очень большая проблема крупных городов, которая отрицательно влияет на здоровье человека. Особенно опасен смог для детей и пожилых людей с ослабленным организмом, страдающих сердечно -сосудистыми заболеваниями и заболеваниями дыхательной системы.

Очень опасным симптомом для человечества является то, что загрязнение воздуха повышает вероятность рождения детей с пороками развития. Запредельная концентрация вредных веществ в атмосфере вызывает преждевременные роды, новорождённые имеют малый вес, иногда рождаются мёртвые дети. Если беременная женщина дышит воздухом, содержащим повышенные концентрации озона и окиси углерода, особенно во второй месяц беременности, у неё в три раза повышается возможность родить ребёнка с таким пороком развития, как заячья губа, волчья пасть, дефектами сердечного генеза.

В Узбекистане, как и в других странах мира, большинство заболеваний и преждевременная смертность, связанные с качеством воздуха, вызваны твердыми мелкодисперсными взвешенными частицами диаметром 2,5 микрона (PM_{2,5}). Всемирная организация здравоохранения (ВОЗ) определила их в качестве загрязнителя, вызывающего наибольшую угрозу здоровью населения. По данным портала [IQAir](https://t.me/IQAir), осуществляющего глобальный мониторинг качества воздуха, Ташкент, как и другие города Центральной Азии, часто входит в число городов мира с самым загрязненным воздухом.

По данным гидрометеорологического центра в городах Олмалык, Фергана, Навоий, Коканд и Ташкент наблюдается загрязнение атмосферы различными видами вредных соединений с повышенной ПДК. Установлено, что в

Узбекистане за 2002-2004 гг. отходной выброс промышленных предприятий в атмосферу составил 33%. Из них большую часть составили следующие ингредиенты: углеводы – 21,9%, оксид серы – 41,2%, оксид азота – 9,1%, твердые вещества – 16,5%.

Правительство Узбекистана также признает, что процесс управления качеством воздуха представляет собой серьезный вызов, требующий совместных, комплексных и межсекторальных усилий на местном, национальном и региональном уровнях.

Большинство источников загрязнения атмосферного воздуха не могут контролироваться отдельными людьми, вследствие чего необходимы консолидированные действия со стороны местных, национальных и региональных директивных органов в таких секторах, как энергетика, транспорт, удаление отходов, городское планирование и сельское хозяйство. Также могут быть эффективными следующие меры:

- изучение состава и уровня загрязнений, причины и меры по их устранению;
- опубликование результатов мониторинга в СМИ;
- привлечение лиц, выдавших положительные заключения и разрешения на эксплуатацию к ответственности;
- применение штрафов и наказаний для нарушителей;
- разработка рекомендаций по улучшению качества воздуха.

В заключение, проблема атмосферного загрязнения является одной из наиболее острых экологических угроз, оказывающих негативное влияние на здоровье миллионов людей по всему миру. Успешные примеры политик и инициатив, направленных на сокращение выбросов вредных веществ, демонстрируют, что изменения возможны и необходимы для защиты здоровья населения. Важно продолжать усилия по снижению уровня загрязнения воздуха, чтобы обеспечить безопасную и здоровую среду для будущих поколений. Будущее человечества зависит от чистого воздуха, воды, лесных массивов. Только правильное отношение к природе позволит будущим поколениям быть здоровыми и счастливыми.

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GLUCOCORTICOIDS AND DIABETES

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ABSTRACT

Glucocorticoids (GCs), stress hormones produced by the adrenal cortex, are involved in many physiological and metabolic processes, including glucose homeostasis and inflammation. Excess GC signaling results in Cushing’s syndrome and possibly metabolic syndrome. Diabetes, central adipose tissue, and hyperlipidemia are components of both syndromes. Here, we discuss the mechanisms of GC action, clinical syndromes of GC excess, modulation of glucose homeostasis by GCs, and future GC signaling-based therapies for diabetes.

Keywords: glucocorticoids, insulin resistance, striae, mineralocorticoids, osteoporosis, diabetes mellitus.

INTRODUCTION

Type 2 diabetes mellitus (DM) affects 8.7% of the population of Uzbekistan (WHO 2016) and is associated with multiple microvascular and macrovascular complications. Obesity is a significant risk factor for the development of insulin resistance, which is central to the pathophysiology of type 2 diabetes mellitus (DM). As insulin resistance increases, pancreatic β -cells initially compensate by increasing insulin secretion to maintain normoglycemia. However, over time, β -cells become depleted, leading to insulin deficiency and, subsequently, to the development of diabetes mellitus. The mechanisms underlying insulin resistance remain an active area of research. One of the key factors is adipocyte dysfunction, which occurs in response to chronic nutrient overload. In normal-weight individuals, free fatty acids (FFA) are efficiently sequestered as triglycerides (TG) during periods of caloric excess and released when needed through lipolysis. In obese individuals, adipocytes become dysfunctional, largely due to the inflammatory environment that develops in adipose tissue during prolonged caloric

excess. This condition was first recognized in mouse models of diet-induced obesity and was later confirmed in human studies. As a result, FFA storage is impaired, ectopic lipids accumulate, and serum FFA and inflammatory cytokines are elevated⁶. This leads to systemic insulin resistance. These processes were first recognized in mouse models of diet-induced obesity and were later confirmed in human studies^{4,5}. Glucocorticoids (GCs), also known as stress hormones, play a key role in the regulation of glucose homeostasis, adipocyte development, and inflammatory processes. Glucocorticoid excess, both in clinical settings and in experimental models, is associated with metabolic disorders^{7,8}. Clinical syndromes characterized by elevated glucocorticoid levels are often accompanied by the development of diabetes mellitus and an increase in visceral adipose tissue. Experimental mouse models with localized glucocorticoid excess in adipocytes demonstrate similar metabolic disorders, including the accumulation of visceral adipose tissue and the development of insulin resistance. This review examines the mechanisms regulating glucocorticoid production and metabolism, as well as clinical and basic research supporting their role in the pathogenesis of diabetes mellitus. In addition, the potential of glucocorticoids as a therapeutic target for the treatment of diabetes mellitus is discussed.

REGULATION AND ACTION OF GLUCOCORTICOIDS.

Glucocorticoids (GCs) are steroid hormones produced by the adrenal cortex. Their circulating levels are controlled by the hypothalamic-pituitary-adrenal (HPA) axis, which is a complex neuroendocrine feedback system.

The regulation mechanism includes the following stages:

The hypothalamus produces corticotropin-releasing hormone (CRH), which stimulates the pituitary gland.

The pituitary gland responds by secreting adrenocorticotrophic hormone (ACTH).

ACTH activates the adrenal cortex, stimulating the synthesis and release of cortisol, the main active glucocorticoid in humans.

The HPA axis is activated in response to stress, circadian rhythms, and other acute stimuli. Circulating cortisol exerts negative feedback by suppressing the production of CRH and ACTH, which reduces further cortisol production. Only about 5% of cortisol circulates in a free, biologically active form. The remainder is bound to carrier proteins such as cortisol-binding globulin (CBG) and albumin⁹. These proteins mediate the transport of cortisol within tissues and regulate its availability. The action of glucocorticoids (GCs) is mediated by two types of receptors: glucocorticoid (GR) and mineralocorticoid (MR). Although GCs and mineralocorticoids such as aldosterone bind MRs with equal affinity, circulating GC concentrations are much higher than aldosterone concentrations. This raises the question: how do mineralocorticoid-sensitive tissues

maintain selective sensitivity to aldosterone? A key role in this specific regulation is played by the 11 β -hydroxysteroid dehydrogenase (11 β -HSDH) enzyme system:

11 β -HSDH2 is expressed predominantly in mineralocorticoid-sensitive tissues such as the kidney. This enzyme inactivates cortisol by converting it to cortisone, which cannot activate MR. This prevents excessive activation of MR by glucocorticoids and allows aldosterone to effectively perform its function.

In contrast, 11 β -HSDH1 is expressed in metabolically active tissues such as the liver and adipose tissue. This enzyme catalyzes the reverse reaction, activating cortisone and converting it to cortisol. This activation plays an important role in the pathophysiology of metabolic syndrome.

Most of the metabolic effects of glucocorticoids, including their effects on glucose homeostasis, are mediated through activation of glucocorticoid receptors (GR)^{9,10}.

The glucocorticoid receptor (GR) belongs to a family of nuclear hormone receptors involved in transcription regulation. Binding of glucocorticoids (GC) to GR triggers several key processes:

Dissociation of the cytosolic complex: When GC binds to GR, the receptor is released from its cytosolic complex, which includes heat shock protein (HSP90).

Nuclear translocation: Released GH translocates to the cell nucleus where it interacts with DNA to regulate the transcription of target genes.

In the nucleus, GR regulates transcription in two main ways:

Transcriptional activation: GH binds to glucocorticoid response elements (GREs) in the promoter regions of genes and interacts with transcriptional coactivators to enhance the expression of target genes.

Transcriptional repression: The repressive effect is realized through two mechanisms:

GH binds to ERGH and then interacts with transcriptional corepressors, suppressing the expression of certain genes.

Direct interaction of GR with other transcription factors without the involvement of DNA (DNA-independent mechanism), a process known as "tethering".

These mechanisms allow GH to exert complex effects on gene expression, regulating multiple processes including metabolism, inflammation, and immune response¹¹.

Clinical and subclinical glucocorticoid excess

Chronic glucocorticoid excess is associated with the development of Cushing's syndrome (CS), a serious clinical condition characterized by a wide range of symptoms and complications.

Clinical manifestations of Cushing's syndrome

SC is characterized by the following features:

Metabolic disorders:central obesity, insulin resistance and/or diabetes mellitus.

Muscle and bone changes:muscle atrophy and loss of bone mass (osteoporosis).

Dermatological signs:hyperpigmented abdominal striae, thinning skin, delayed wound healing.

Cardiovascular and neuropsychological disorders:resistant hypertension, as well as depression, anxiety and cognitive impairment.

Diagnosis of Cushing's syndrome

Diagnosis of SC is a complex process that requires a combination of clinical and laboratory methods. The main diagnostic approaches include:

Measuring Salivary Cortisol Levels at Midnight:SC is characterized by the absence of the normal circadian rhythm of cortisol, which normally reaches its minimum values at night.

Overnight dexamethasone test:Administration of exogenous glucocorticoid (dexamethasone) allows one to evaluate the suppression of endogenous cortisol production. The absence of suppression indicates hypercorticism.

Measurement of 24-hour urinary free cortisol:Elevated free cortisol levels confirm hypercortisolism^{12,13}.

Glucocorticoids (GC)are widely used to treat various autoimmune diseases due to their powerful anti-inflammatory properties. However, long-term therapy with exogenous GCs remains the most common cause of Cushing's syndrome (CS).

Types of Cushing's syndrome associated with endogenous GCs

SC caused by hyperproduction of endogenous GC is divided into:

ACTH-dependent SC

The most common cause is a pituitary adenoma that secretes adrenocorticotrophic hormone (ACTH).

Rarely, KS can be caused by neuroendocrine tumors that secrete ACTH, such as:

Small cell lung cancer(classic example).

Other neuroendocrine tumors.

ACTH-independent SC

It is less common and is caused by direct hyperproduction of cortisol by the adrenal glands.

Main reasons:

Adrenal adenoma.

Adrenal cortex hyperplasia.

These differences in the mechanisms of KS development highlight the importance of accurate diagnosis to identify the underlying cause of the disease, since treatment approaches depend on the specific source of hypercortisolism^{12,13}.

The influence of glucocorticoids (GC) on glucose metabolism and diabetes diagnosis

Glucocorticoids significantly increase postprandial glucose excursion, suggesting that diagnostic methods such as hemoglobin A1C testing and oral glucose tolerance testing may be more useful for diagnosing GC therapy-induced diabetes¹⁴.

However, it has been noted that there is a positive correlation between fasting plasma glucose and morning plasma cortisol levels, indicating that abnormal fasting glucose values are more common in individuals with more severe hypercortisolemia¹⁵.

Effect of dose and duration of exogenous GC therapy on the development of diabetes

With long-term use of exogenous GCs, the likelihood of developing diabetes is proportional to the dose and duration of therapy. Case-control studies have shown that after initiation of GC therapy, the likelihood of developing new diabetes increases more than twofold compared with the control group. This effect is dose-dependent:

2 mg dexamethasone:The odds ratio for developing diabetes is 3.06.

4 mg dexamethasone:probability coefficient 5.90.

4.5 mg or more of dexamethasone:probability coefficient 10.35.

For comparison, a healthy person synthesizes the equivalent of 0.55 mg dexamethasone per day^{16,17}.

The increased incidence of diabetes in patients receiving exogenous GCs also has an impact on mortality, which is twice as high in such patients. This highlights the importance of blood sugar control and close monitoring in patients receiving long-term GC therapy¹².

Indeed, exogenous glucocorticoids such as dexamethasone, prednisone or hydrocortisone have a significant effect on carbohydrate metabolism and glycemic control in patients with diabetes, which is associated with increased insulin resistance and elevated blood glucose levels. Your text highlights several important aspects:

Increased insulin requirements: In diabetic patients receiving glucocorticoids, insulin requirements increase, sometimes by 70% or more, depending on the dose and duration of therapy. For example, a study using 60 mg prednisone (equivalent to 240 mg hydrocortisone) showed a 70% increase in insulin requirements. This is important to consider when adjusting insulin doses in these patients to prevent hyperglycemia and improve disease control.²²

Hyperglycemia and relapses: In the hospital setting where patients receive exogenous glucocorticoids, hyperglycemia occurs in more than half of patients, and many experience relapses of hyperglycemia. This highlights the importance of regular glucose monitoring and the possible need for insulin dose adjustments, particularly in patients receiving high doses of steroids.

Circadian changes in glycemic control: Using continuous glucose monitoring helps to identify patterns in glucose levels throughout the day. Hyperglycemia is more common in the afternoon and evening, which may justify the use of higher doses of prandial insulin or the addition of NPH insulin, which is active at peak levels between 6 and 8 a.m. This allows for more accurate control of glucose levels during periods when they are most susceptible to fluctuations^{18,20,21}.

Individualization of therapy: Because of the wide variation in glucocorticoid responses and doses, it is important to individualize insulin therapy taking these factors into account. Patients with type 1 diabetes taking steroids may require significant insulin dose adjustments, including in response to acute conditions or changes in glucocorticoid dose.

In general, therapy of diabetes in patients receiving exogenous glucocorticoids requires careful monitoring and flexible adjustment of insulin doses to prevent hyperglycemia and maintain optimal glucose control.

CS is a rare disease, with an incidence of approximately seven per million people in Uzbekistan. However, the description of metabolic syndrome (MetS),²³ a condition that affects almost a quarter of the adult population and is characterized by obesity, hyperlipidemia, and insulin resistance,²⁴ has led to the suggestion that MetS may represent a subset of patients with CS or subclinical CS (SCS). SCS is most often associated with cortisol-producing adrenal adenomas rather than pituitary Cushing's disease, and is characterized by mild hypercortisolism and metabolic disturbances, including obesity, hypertension, and insulin resistance, without the classic clinical features of CS. Notably, the incidence of clinical hypercortisolism in individuals with diabetes or CVD has been reported to be 3–10% of the total number of subjects examined.²⁵

Strong associations between circulating cortisol levels and features of MetS have been demonstrated. Although some have observed subtle changes in HPA axis activity in patients with MetS, these cannot fully explain the etiology of MetS²⁶. However, the description of tissue-specific conversion of inactive GCs to active GCs by 11 β HSD1 in tissues prone to GC-induced insulin resistance has revived interest in GCs as a primary cause of the etiology of MetS. Indeed, rodent models using targeted overexpression of 11 β HSD1 in adipocytes exhibit a phenotype similar to MetS, characterized by insulin resistance, hyperlipidemia, and visceral fat mass⁸. Furthermore, human studies have shown a correlation between the expression of adipocyte 11 β HSDH1 and intra-abdominal fat levels, as well as worsening insulin sensitivity²⁷. These findings have led to the development of the so-called "dehydrogenase hypothesis" to explain the tissue-specific enhancement of GC action as a mechanism for the development of tissue-specific Cushing's syndrome and systemic metabolic syndrome^{28,29}.

Regulation of glucose metabolism by glucocorticoids

Glucocorticoids affect all aspects of glucose metabolism, interacting with the liver, the endocrine system of the pancreas, skeletal muscle, and adipose tissue. They counteract the action of insulin. The catabolic effects of excess glucocorticoids promote the release of energy reserves. In the short term, such effects play a key role in adaptation to acute stress or illness, helping to maintain circulating glucose levels and ensuring continued brain function.

The long-term consequences of glucocorticoid (GC) excess, as noted, include hyperglycemia and insulin resistance. The effects of GC excess on various tissues will be discussed in the context of glucose utilization, gluconeogenesis, glycogen metabolism, and pancreatic endocrine function 30.

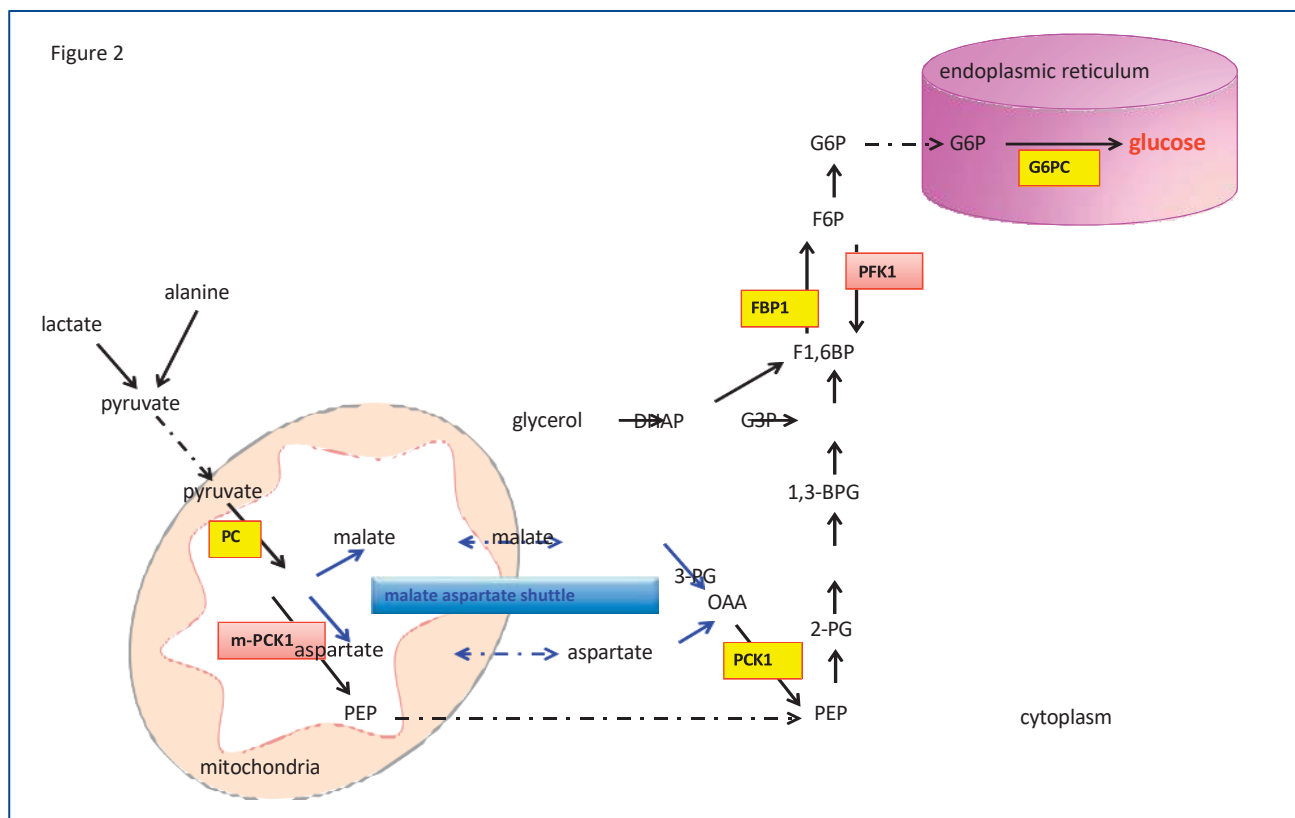


Figure 1

Gluconeogenic pathway in hepatocytes. Gluconeogen precursors (lactate and alanine) are converted to pyruvate, which enters the mitochondria and is converted to oxaloacetate (OAA) by pyruvate carboxylase. OAA exits the mitochondria via the malate-aspartate shuttle to form phosphoenolpyruvate (PEP). OAA can also be converted to PEP directly in the mitochondria. PEP then enters the gluconeogenic pathway. In addition, glycerol is metabolized to dihydroxyacetone phosphate (DHAP), which is then converted

to fructose 1,6-bisphosphate (F1,6BP). The final product, glucose, is formed in the ER by the catalytic subunit of glucose 6-phosphatase (G6PC). Key enzymes are boxed, and major GR targets are shown in yellow. Abbreviations: OAA oxaloacetate, PEP phosphoenolpyruvate, DHAP dihydroxyacetone phosphate, G3P glyceraldehyde 3-phosphate, F1,6BP fructose 1,6-bisphosphate, 2-PG 2-phosphoglycerate, 3-PG 3-phosphoglycerate, 1,3-BPG

1,3-bisphosphoglycerate, G3P glyceraldehyde 3-phosphate, F1,6BP fructose 1,6-bisphosphate, F6P fructose 6-phosphate and G6P glucose 6-phosphate. Enzyme abbreviations: PC pyruvate carboxylase, m-PCK1 mitochondrial phosphoenolpyruvate carboxykinase, PCK1 cytosolic phosphoenolpyruvate carboxykinase, FBP1 fructose-1,6-bisphosphatase 1, PFK1 phosphofructokinase 1, G6PC glucose 6-phosphatase catalytic subunit.

Gluconeogenesis, which occurs primarily in the liver, is the process of synthesizing glucose from non-carbohydrate substrates such as lactate, glycerol, and amino acids. This review does not cover the entire gluconeogenic pathway in detail, but will outline the major steps regulated by glucocorticoids (see Fig. 1). Glucocorticoids play an important role in the formation of gluconeogenic precursors by activating lipolysis in adipose tissue and protein breakdown in muscle, resulting in the formation of glycerol and amino acids required for glucose synthesis^{30,32}. GCs also stimulate gluconeogenesis by activating the binding of glucocorticoid receptors to glucocorticoid response elements in the promoter regions of genes encoding enzymes such as glucose-6-phosphatase and phosphoenolpyruvate carboxykinase, key enzymes in gluconeogenesis^{30,31}.

Regulation of glycogen metabolism differs from gluconeogenesis because it is tissue-specific. In the liver, glucocorticoids stimulate glycogen formation by increasing the activity of glycogen synthase, while in skeletal muscle they decrease glycogen synthesis by decreasing the activity of the same enzyme^{30,33}.

Utilization and oxidation of glucose in white adipose tissue and skeletal muscle is dependent on insulin signaling. Glucocorticoids antagonize insulin signaling in skeletal muscle, in particular by reducing GLUT4 translocation to the cell membrane^{30,34}. In addition, GCs contribute to the development of insulin resistance by regulating several glucocorticoid receptor target genes, which leads to impaired insulin signaling and decreased activity of phosphoinositide 3-kinase and AKT^{35,36}. GCs also stimulate the formation of lipid mediators such as fatty acids from adipocytes and ceramides from the liver, which may contribute to systemic insulin resistance^{6,30,37}.

The mechanisms by which GCs influence glucose utilization in adipocytes are less clear, but likely involve modulation of GLUT4 function and insulin signaling pathways³⁰. Glucocorticoids are also involved in the differentiation and expansion of

adipocyte precursors, which may exacerbate insulin resistance and adipocyte dysfunction^{30,38}.

Glucocorticoids (GCs) have a significant effect on pancreatic β -cells, and their action differs in vivo and in vitro:

In vivo:

Under the influence of GC, secondary hyperplasia of β -cells is observed, which is an adaptive response of the body to maintain normal glucose levels in conditions of peripheral insulin resistance.

In vitro:

In isolated islet experiments, GCs directly induce β -cell apoptosis, which is inconsistent with the adaptive effects observed in vivo³⁰.

Impaired glucose-stimulated insulin secretion (GSIS):

GCs reduce the amount of GLUT2 transporter and glucokinase levels, which slows down the conversion of glucose to glucose-6-phosphate (G6P).

Glucose-6-phosphatase activity increases, which further limits the entry of G6P into the glycolytic cycle.

These changes decrease the ATP/ADP ratio, suppress membrane depolarization, reduce calcium influx, and interfere with insulin exocytosis.

Effect on potassium channels:

GCs enhance the activity of the potassium channel Kv1.5, which promotes repolarization of β -cells, reducing the influx of calcium and inhibiting insulin secretion.

Transgenic mouse models:

Overexpression of glucocorticoid receptors in β -cells leads to deterioration of glucose tolerance and impaired insulin secretion, which confirms the negative effect of GC on β -cells.

Thus, GCs have a complex effect on β -cells, inhibiting key mechanisms of insulin secretion, which explains their association with an increased risk of developing type 2 diabetes.

Summary and Future Directions

Glucocorticoids (GCs) play an important and multifaceted role in the regulation of glucose metabolism. This review examines their mechanisms of action, regulatory features, and clinical and subclinical conditions associated with excess GCs, including their impact on glucose homeostasis.

Short-term and long-term effects:

Increased GC levels during stress play a protective role, but their chronic excess (endogenous or exogenous) is associated with many complications.

Overt GC excess is observed in Cushing's syndrome (CS), whereas subclinical excess is typical for patients with metabolic syndrome.

Research into new therapies:

Selective glucocorticoid receptor modulators (SGRMs) are being developed to treat complications of GC excess, such as insulin resistance and diabetes mellitus (DM).

SMGRs aim to exploit the anti-inflammatory properties of GCs while minimizing their negative metabolic consequences. However, the complexity of development is associated with the intersection of receptor transactivation and transrepression mechanisms.

Modern drugs:

Mifepristone, a GC antagonist, is already used to treat CS in patients with glucose intolerance and diabetes when surgery has failed.

The use of systemic GC antagonists in patients without GC excess is limited due to the risk of developing adrenal insufficiency.

New approaches in diabetes therapy:

Liver-specific GC antagonists coupled to bile acids are being developed to reduce gluconeogenesis without affecting the hypothalamic-pituitary-adrenal (HPA) axis.

Antisense oligonucleotides targeting HA receptor mRNA in the liver are another promising approach.

11 β -hydroxysteroid dehydrogenase 1 (11 β -HSDH1) inhibitors have been shown to be effective in improving insulin sensitivity and lowering blood glucose levels, but their long-term effects on the immune and endocrine systems remain unclear.

Prospects:

The relationship between GC and diabetes remains complex and poorly understood.

GCs influence the regulation of glucose metabolism in various organs, antagonizing the effects of insulin both directly and indirectly.

Increased research into tissue-specific modulation of GC signaling may lead to significant advances in the understanding and treatment of metabolic disorders.

Development of technologies and methods for studying the specific effects of GC in various tissues will likely provide new opportunities for the treatment of diabetes and metabolic syndrome.

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KEY ASPECTS FOR SUCCESSFUL CORRECTION OF PRIMARY HYPOTHYROIDISM IN PREGNANT WOMEN IN THE SAMARKAND REGION

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ABSTRACT

Hypofunction of thyroid secretion in women in the pregravid period and during menstruation is a significant trauma for the development of congenital hypothyroidism in patients, which can lead to fatal changes in the nervous system. Despite the indispensable intake of potassium iodide antibiotics, gestational hypothyroidism often follows in pregnant women, which requires the use of levothyroxine to correct the metabolic background. Many women can suffer from episodic hypofunction of the pancreas even before menstruation, provoked by various aspects. With diagnosed hypothyroidism, metabolic correction is necessary, however, the calculated dosage of levothyroxine, based on the biomass of the client's body, is not always sufficient to achieve long-term concepts of thyroid stimulating hormone (TSH). In addition, pharmaceutical aspects also play a significant role: levothyroxine sodium preparations may differ in bioavailability. Internal aspects such as temperature and temperature, as well as the composition of fillers in different importers, can significantly affect the stability of antibiotics. Therefore, irregular monitoring of the thyroid secretion subsystem and a personal method for treatment are critically important for maintaining the well-being of both mother and child.

Keywords: hypothyroidism, cretinism, myxedema, levothyroxine.

INTRODUCTION

Hypothyroidism is a condition characterized by insufficient production of thyroid hormones by the thyroid gland. It is one of the most common endocrine disorders and can affect people of all ages, but is most common in women and the elderly. Thyroid

hormones, such as thyroxine (T4) and triiodothyronine (T3), play a key role in regulating metabolism, growth, development, and the functioning of various body systems. Their deficiency can lead to a variety of clinical manifestations, including fatigue, weight gain, depression, decreased body temperature, and difficulty concentrating. Although hypothyroidism has well-documented causes, such as autoimmune diseases (such as Hashimoto's disease), surgical removal of the thyroid gland, and iodine deficiency, its diagnosis can be difficult. This is due to the slow progression of symptoms, which can be subtle and mimic other diseases. It is important to note that hypothyroidism was the first endocrine disease for which replacement therapy was introduced, which significantly improved the quality of life of patients and allowed effective control of the symptoms of the disease. Early diagnosis and adequate treatment of hypothyroidism are key to preventing serious complications and maintaining health. The first description of hypothyroidism was made by W. Gall

in 1873 [1]. Later, V. Ordom proposed the term "myxedema" (myxa - mucus, oidema - swelling, edema; Greek) - mucous edema of the skin and subcutaneous tissue. Nowadays, this term is used to characterize the most severe forms of thyroid insufficiency. This is one of the common diseases of the thyroid gland: the prevalence, according to various studies, ranges from 0.2 to 3.7% and depends on age, gender,

iodine intake levels [2, 3]. The annual incidence of primary hypothyroidism is 3.5 per 1,000 women and 0.6 per 1,000 men. The incidence of hypothyroidism increases significantly with age. In the age population over 60 years, taking into account subclinical forms, it can reach 6–12% of cases, more often in women [4, 5]. The Framingham study found hypothyroidism (TSH > 10 mU/L) in 5.9% of women and 2.4% of men over 60 years of age [6].

TARGET. To assess the dependence of the decrease in TSH levels on the method of taking Euthyrox in a population of pregnant women.

MATERIALS AND METHODS

Statistical analysis and prospective study were conducted from 10.06.2024 to 30.10.2024 at the Samarkand State Medical University, 3rd city maternity hospital of Samarkand. Pregnant women diagnosed with primary manifest and subclinical hypothyroidism in the first trimester of pregnancy (n=26) were selected for cohort observation. All pregnant women were prescribed Euthyrox "AcinoPharm". Other levothyroxine preparations were not used in order to exclude distortion of the study results.

RESULTS

Pregnant women with hypothyroidism were divided into two groups by the method of taking Euthyrox: oral (n=14) and sublingual (n=12). After 1 month, normalization of TSH levels was observed in 11 pregnant women in the oral group

(80%) and in 12 pregnant women in the sublingual group (100%). Women who did not achieve compensation for hypothyroidism were recommended sublingual administration without increasing the dose of Euthyrox, provided that the TSH level was no higher than 3.6 μ IU/ml. A TSH study after 1 month showed that all pregnant women who received Euthyrox achieved compensation.

CONCLUSION

Based on the conducted research, it has been shown that it is more rational to prescribe Euthyrox sublingually, since the oral cavity has a slightly alkaline reaction, which does not have such a destructive effect as gastric juice.

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ELEKTROMAGNIT INDUKSIYA VA UNING TAJRIBAVIY ASOSLARI

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ANNOTATSIYA

Maqolada Faradeyning o'z tajribalari asosida yaratgan olamshumul kashfiyoti haqida so'z boradi, shuningdek, induksion tok hosil bo'lishning shartlarini aniqlashga doir tajribalari tahlil qilinib muhokama qilingan. Elektromagnit induksiya hodisasining tatbiqiy masalalari ham ko'rilgan. Mazkur maqolada Faradeyning birinchi qonunining mohiyati, matematik ifodasi, amaliy ahamiyati va uning ilm-fan va texnikada qo'llanilishi batafsil tahlil qilinadi.

Kalit so'zlar: magnit maydon, induksiya, induksion tok, elektr toki, elektroinduksiya qonuni, elektr generator, kuchlanish, magnit oqimi, induktivlik, induktiv g'altak.

ELECTROMAGNETIC INDUCTION AND ITS FUNDAMENTALS OF EXPERIMENTAL

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ABSTRACT

The article talks about Faraday's universal discovery based on his own experiments, as well as analyzing and discussing his experiments on determining the conditions for the formation of an induction current. Applied issues of the electromagnetic induction phenomenon were also considered. This article analyzes the essence of Faraday's first law, its mathematical expression, practical significance and its application in science and technology.

Keywords: magnetic field, induction, induction current, electric current, law of electroinduction, electric generator, voltage, magnetic flux, inductance, inductive spool.

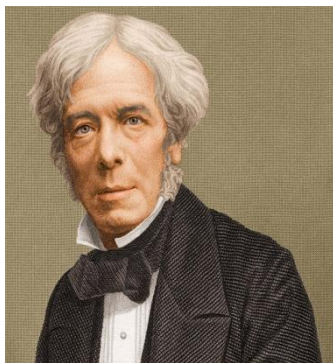
KIRISH (ВВЕДЕНИЕ / INTRODUCTION)

Biz Faradeyning bu qonuni orqali magnit maydon va elektr toki bir-biriga uzviy bog‘liq ekanligini ko‘rishimiz mumkin. Faradey o‘z davrining yetuk olimi hisoblangan. Faradeyning elektroinduksiya qonuni - bu o‘zgaruvchan magnit maydonining elektr tokini hosil qilishiga doir tabiiy qonunlardan biridir. U magnit maydonining vaqt o‘zgarishi elektr maydonini yaratishini isbotladi. Uning matematik ifodasi quyidagicha:

$$\varepsilon = -d\Phi/dt$$

Bu yerda ε – Induksion elektr yurutuvchi kuch (Volt), Φ – magnit oqimi (Veber), t - vaqt (sekund).

Biror doira yoki simli g‘altak orqali o‘tgan magnit oqimi vaqt bo‘yicha o‘zgarganida, bu o‘zgarish elektr kuchlanish (induksiya kuchlanishi) hosil qiladi. Bu kuchlanish, magnit oqimining o‘zgarishiga teskari yo‘nalishda bo‘ladi. Bunga Faradeyning elektromagnit induksiya qonuni deyiladi.



Faradeyning qonunida manfiy belgi Lentz qonuni bilan bog‘liq bo‘lib, bu induksiyalangan kuchlanish, magnit oqimining o‘zgarishiga teskari yo‘nalishda bo‘lishini anglatadi. Ya’ni, induksion tok magnit maydonining o‘zgarishi orqali vujudga keladi.

Faradeyning birinchi qonuni - bu magnit maydonining o‘zgarishi orqali elektr toki induksiyasini yaratish jarayonini tasvirllovchi asosiy fizik qonunlardan biridir. Ushbu qonun 1831-yilda ingliz olimi Maykl Faradey tomonidan kashf etilgan va keyinchalik elektromagnit induksiya hodisasi deb atalgan.

Bu ilmiy kashfiyot, o‘z vaqtida, elektr energiyasini ishlab chiqarish va uzatishda inqilobiy yangilik bo‘lib, keyinchalik zamonaviy elektr energetikasining rivojlanishiga katta ta’sir ko‘rsatdi.

Faradeyning birinchi qonuni, ayniqsa, elektr generatorlari va transformatorlar kabi qurilmalarda magnit oqimi va induksiya jarayonlarini tushunish va ularni samarali ishlatish uchun muhimdir. Ushbu qonun, o‘zining oddiy va kuchli ta’sirlari bilan, magnit maydonining dinamikasini o‘rganishda ilmiy izlanishlar va texnologik yutuqlarning asosini tashkil etadi. Shuningdek, bu qonun energiya saqlanishi tamoyilini ham amalda ko‘rsatadi.

ADABIYOTLAR TAHLILI VA METODOLOGIYA (ЛИТЕРАТУРА И МЕТОДОЛОГИЯ / METHODS)

Faradeyning birinchi qonuni magnit maydonining o‘zgarishi orqali elektr kuchlanishining (induksiya kuchlanishining) hosil bo‘lishini tasvirlaydi. Bu qonun, o‘z vaqtida kashf etilganida, elektromagnit hodisalarning tub o‘zgarishiga olib keldi va

keyinchalik zamonaviy elektroenergetika texnologiyalarining rivojlanishida muhim rol o'ynadi.

Faradeyning birinchi qonuni ko'plab zamonaviy texnologiyalar asosini tashkil etadi. Masalan, elektr generatorlari va transformatorlar bu qonun asosida ishlaydi. Elektr generatorlari magnit maydonining o'zgarishini mexanik energiyaga aylantiradi va elektr tokini hosil qiladi. Bu jarayon elektroi induksiya deb ataladi va Faradeyning qonuniga asoslangan [1, 11,17].

Transformatorlar magnit oqimi yordamida elektr energiyasini uzatish va o'zgartirish jarayonini amalga oshiradi. Faradeyning qonuni bu qurilmalarda kuchlanishning oshishi yoki kamayishini boshqarish uchun ishlatiladi. Masalan, transformatorlarda magnit oqimining o'zgarishiga teskari tarzda elektr kuchlanishi induksiyanadi, bu esa oqimni kerakli darajaga keltirish imkonini beradi.

Bundan tashqari, induktiv elementlar (induktorlar) va elektr energiyasini uzatish tizimlari (masalan, simli to'plamlar) ham Faradeyning qonunidan foydalanadi. Elektromagnit to'lqinlar, induktiv tizimlar, va dinamik magnit maydonlari o'rtasidagi o'zaro ta'sirlar ham ushbu qonun asosida tushuntiriladi [2, 13,16].

NATIJARLAR (PEZYLB'TATY / RESULTS)

Faradeyning birinchi qonuni magnit maydonining o'zgarishiga bog'liq bo'lib, zamonaviy fizika, ayniqsa elektromagnitizmni o'rganishda muhim ahamiyatga ega. Bu qonun, ayniqsa, Maksvellning tenglamalarida o'z ifodasini topadi, chunki Maksvell tenglamalari elektromagnit maydonlarining o'zaro ta'sirini va ularning dinamikasini batafsil tasvirlaydi.

Agar magnit oqimi doimiy bo'lsa, u holda induksiyanlangan kuchlanish hosil bo'lmaydi, ya'ni Faradeyning birinchi qonuni faqat magnit maydonining o'zgarishi bilan bog'liq. Magnit maydoni o'zgarmaganida Faradeyning qonuni o'zining umumiy shaklini yo'qotadi.

Faradeyning birinchi qonuni shuni ta'kidlaydiki, magnit oqimi vaqt bo'yicha o'zgarganda, bu o'zgarish zanjirda induksion elektr tokini hosil qiladi va u quyidagi formula bilan ifodalanadi:

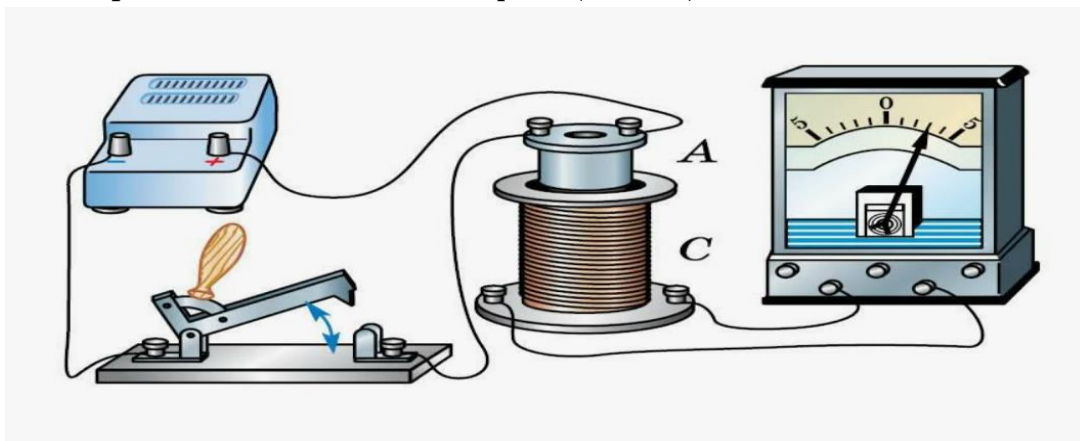
$$\varepsilon = -d\Phi/dt$$

Bu formula shuni ko'rsatadiki, magnit maydonining o'zgarishi vaqt davomida kuchlanish hosil qiladi va bu kuchlanish magnit maydonining o'zgarishiga teskari yo'nalishda bo'ladi (Lens qonuni). Bu hodisa energiyaning saqlanishi tamoyilini tasdiqlaydi, chunki induksiyanlangan kuchlanish magnit maydonining o'zgarishini qarshi oladi, bu esa tizimning energetik muvozanatini saqlashga yordam beradi [4, 14,15].

Eksperimental tasdiqlash: Faradeyning birinchi qonunini tasdiqlash uchun ko'plab eksperimentlar o'tkazilgan. Eng mashhur tajriba shundaki, magnit

maydonining kuchlanishi o'zgarishi orqali elektr toki o'lchandi. Faradey bu hodisani ko'plab tajribalar bilan tasdiqladi va bunda kuchlanishning magnit oqimi o'zgarishiga teskari yo'nalishda bo'lishini ko'rsatdi.

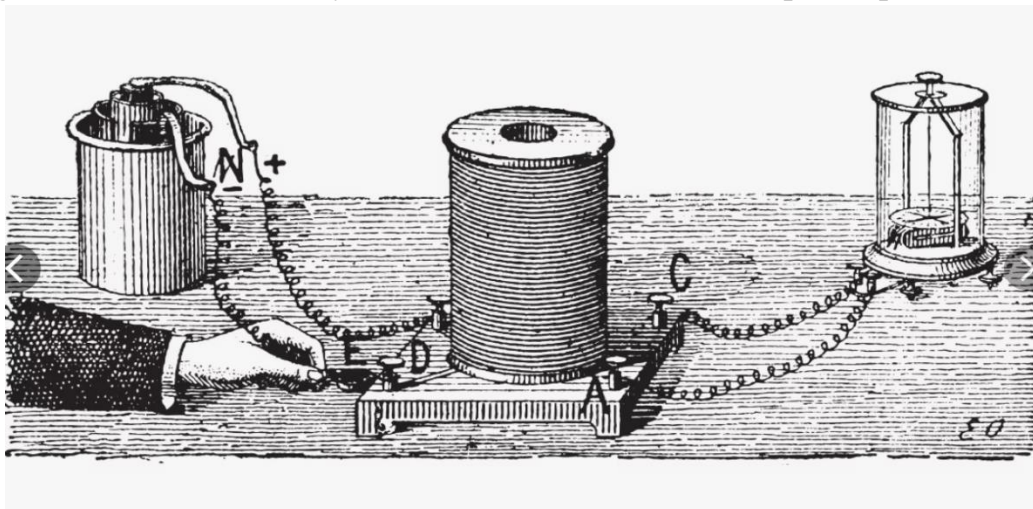
Eksperimentlar yordamida, magnit oqimi va induksiya o'rtasidagi bog'liqlik aniqlandi. Misol uchun, biror simli g'altak yoki spiralga kiritilgan magnit maydonining kuchlanishi o'zgarishi natijasida hosil bo'lgan elektr kuchlanishining o'lchovlari bu qonunni eksperimental ravishda tasdiqladi (1-rasm) [5, 9, 12,].



1-rasm.

МУНОКАМА (ОБСУЖДЕНИЕ / DISCUSSION)

Faradeyning birinchi qonuni, zamonaviy fizikada va texnologiyalarda asosiy ahamiyatga ega. Bu qonun magnit maydonining o'zgarishi orqali elektr toki va kuchlanishining hosil bo'lishi jarayonini tushuntirib beradi. Bugungi kunda bu qonun, ayniqsa, elektr generatorlari, transformatorlar, induktiv tizimlar va boshqa elektromagnit qurilmalarda keng qo'llaniladi. Faradeyning qonuni, shuningdek, energiya saqlanishi tamoyilini ta'minlab, nazariy va amaliy fizika, elektrotexnika va energetika sohalarida asosiy tushunchalardan biri bo'lib qolmoqda.



2-rasm.

Natijada, Faradeyning birinchi qonuni nafaqat ilmiy nazariyada, balki kundalik hayotda foydalaniladigan ko‘plab texnologiyalarni yaratishda va rivojlantirishda muhim o‘rin tutadi. Bu qonun bilan bog‘liq texnologiyalarni yanada takomillashtirish va samaradorligini oshirish uchun yangi ilmiy izlanishlar va eksperimentlar davom etmoqda (2-rasm).

XULOSA (ЗАКЛЮЧЕНИЕ / CONCLUSION)

Mazkur qonun nafaqat nazariy fizikada, balki amaliy texnologiyalar sohasida ham keng qo‘llaniladi. Elektr generatorlari, transformatorlar, induktiv tizimlar va boshqa elektromagnit qurilmalar Faradeyning birinchi qonuniga asoslanadi. Bu qonun magnit maydonining dinamikasini tushunish va uni amaliy energiya ishlab chiqarish jarayonlarida samarali foydalanish imkonini beradi. Faradeyning kashfiyoti, shuningdek, elektromagnit to‘lqinlar, magnit rezonans va boshqa zamonaviy texnologiyalarning rivojlanishiga ham katta ta’sir ko‘rsatdi.

Faradeyning qonuni elektr generatorlari, transformatorlar, induktiv komponentlar va boshqa ko‘plab elektrotexnik qurilmalarda qo‘llaniladi. Faradeyning birinchi qonuni energiya ishlab chiqarish va uzatish, elektrotexnika, fizik tadqiqotlar va ilmiy yutuqlar nuqtai nazaridan jahon ilm-fanida katta ahamiyatga ega. Uning amaliy qo‘llanilishi texnologik sohalarda innovatsiyalarni amalga oshirishda, shu jumladan, elektr energiyasining samarali ishlatilishini ta’minlashda davom etmoqda.

Shu sababli, Faradeyning birinchi qonuni nafaqat ilmiy ahamiyatga ega, balki kundalik hayotda biz foydalanadigan ko‘plab texnologiyalarning asosini tashkil qiladi va uning ahamiyati kelajakda ham o‘z dolzarbligini saqlab qoladi.

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MARKAZDAN QOCHMA NASOS PARRAKLARINING ABRAZIV YEYILISHINI MATEMATIK MODELASHTIRISH

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ANNOTATSIYA

Ushbu ilmiy maqolada, markazdan qochma nasos parraklarining abraziv yeyilishini eksperimental rejalashtirish va matematik ishlov berish usullari ko'rib chiqilgan. Maqolada, markazdan qochma nasos ishining samaradorligini optimallashtirish uchun kiruvchi omillar nasos parragining qattiqligi, aylanish tezligi va suyuqlik tarkibidagi zarrachakar o'lchami tahlil qilinadi. Chiquvchi omillar sifatida esa, nasos parragining abraziv yeyilishini hisobi o'rganiladi. Ushbu omillar o'rtasidagi bog'lanishlar matematik model yordamida aniq ko'rsatkichlar bilan tasvirlanadi va maqbul nuqtalar tanlab olinadi. Tadqiqotning asosiy maqsadi markazdan qochma nasos mashinasining ishlash samaradorligini oshirish va uning ishlash sharoitlariga mos ravishda optimal parametrlarni tanlashdir.

Kalit so'zlar: *markazdan qochma nasos, eksperimental rejalashtirish, matematik ishlov berish, parrak valining aylanish tezligi, mahsulot zichligi, samaradorlik, abraziv yeyilish, optimallashtirish, parametrlar tahlili.*

АННОТАЦИЯ

В научной статье рассматриваются методы экспериментального планирования и математического моделирования абразивного износа рабочих колес центробежных насосов. В статье анализируются факторы, имеющие значение для оптимизации эффективности центробежного насоса: жесткость рабочего колеса насоса, частота вращения и размер частиц жидкости. В качестве выходного фактора рассматривается расчет абразивного износа рабочего колеса насоса. Взаимосвязи между этими факторами описываются конкретными показателями с использованием математической модели и выбираются оптимальные точки. Основной целью исследований является повышение производительности центробежного насосного агрегата и выбор оптимальных параметров в соответствии с условиями его эксплуатации.

Ключевые слова: *центробежный насос, экспериментальное проектирование, математическое моделирование, частота вращения рабочего колеса, плотность продукта, КПД, абразивный износ, оптимизация, параметрический анализ.*

ABSTRACT

This scientific article considers experimental planning and mathematical treatment methods for the abrasive wear of centrifugal pump blades. In the article, the input factors for optimizing the efficiency of the centrifugal pump are analyzed: the hardness of the pump blade, the rotation speed and the particle size in the liquid. As the output factors, the calculation of the abrasive wear of the pump blade is studied. The relationships between these factors are described with specific indicators using a mathematical model and optimal points are selected. The main goal of the study is to improve the efficiency of the centrifugal pump machine and select the optimal parameters in accordance with its operating conditions.

Keywords: *centrifugal pump, experimental planning, mathematical treatment, impeller shaft rotation speed, product density, efficiency, abrasive wear, optimization, parameter analysis.*

Zamonaviy sanoat va muhandislik sohasida markazdan qochma nasoslar ko‘plab tarmoqlarda, jumladan, suv ta’minoti, energetika, neft va gaz sanoati, kimyo va qishloq xo‘jaligida keng qo‘llaniladi. Ushbu uskunarlar yordamida suyuqlik va gazlarni turli sharoitlarda samarali va ishonchli tarzda harakatlantirish imkoniyati mavjud. Nasoslarning uzoq muddat ishlashi va yuqori samaradorligi esa ularning asosiy komponentlari - ayniqsa, parralarning yeyilishga chidamliligiga bevosita bog‘liqdir.

Markazdan qochma nasoslarning ishlash prinsipida parra suyuqlikka kinetik energiya beruvchi asosiy element hisoblanadi. Nasos ishlayotgan paytda parra yuqori tezlikda harakatlanib, suyuqlik oqimiga zarur bo'lgan bosim va oqim yo'nalishini ta'minlaydi. Shu sababli parraning yeyilishi nasosning samaradorligiga va xizmat qilish muddatiga jiddiy ta'sir ko'rsatadi. Ayniqsa, abraziv moddalar (qum, loy, qattiq zarrachalar) bo'lgan muhitda ishlayotgan nasoslar parralarining yeyilishi tezlashadi, bu esa texnik xizmat ko'rsatish xarajatlarini oshiradi, nasosning ishdan chiqishiga olib kelishi va uning samaradorligini pasaytirishi mumkin.

Abraziv yeyilish - bu qattiq zarrachalarning parra yuzasiga mexanik ta'siri natijasida yuzaga keladigan jarayon bo'lib, u materialning qatlami asta-sekin yo'qolishiga sabab bo'ladi. Abraziv yeyilish jarayoni nafaqat materialning mexanik va fizik-kimyoviy xususiyatlariga, balki ish sharoitlariga ham bog'liqdir. Shuning uchun parra uchun qo'llaniladigan materialning yeyilishga bardoshlilikini oshirish, shu bilan birga, uni iqtisodiy jihatdan maqbul darajada saqlash muhim hisoblanadi.

So'nggi yillarda nasos parralari uchun yuqori mustahkamlikka ega materiallar, masalan, maxsus po'latlar, kompozit materiallar va polimerlar keng qo'llanilmoqda. Bu materiallar nafaqat yuqori yeyilishga chidamlilikni, balki korroziyaga qarshilikni ham ta'minlaydi. Shu bilan birga, yangi texnologik yondashuvlar va sirtini mustahkamlash usullari (qoplamalar, issiqlik bilan ishlov berish) yordamida parralarning xizmat muddatini sezilarli darajada uzaytirish mumkin [1].

Ushbu maqolaning dolzarbligi markazdan qochma nasoslarning samaradorligini oshirish va ularning texnik xizmat ko'rsatish xarajatlarini kamaytirish muammolarini hal qilish bilan belgilanadi. Nasos parrasining abraziv yeyilishga bardoshlilikini tadqiq qilish ushbu muammolarning samarali yechimlarini ishlab chiqish uchun muhim ahamiyatga ega. Ushbu maqola quyidagi maqsadlarni ko'zlaydi:

1. Markazdan qochma nasos parrasining abraziv yeyilishga bardoshlilikini tahlil qilish.
2. Parralar uchun qo'llaniladigan materiallarning xususiyatlarini tadqiq qilish va ularning yeyilishga chidamliligini baholash.
3. Abraziv muhit sharoitida parraning ishlash xususiyatlarini tahlil qilish.
4. Parraning yeyilishga chidamliligini oshirish bo'yicha texnologik va konstruktiv takliflar ishlab chiqish.

Ushbu tadqiqotning natijalari sanoatdagi texnologik jarayonlarni optimallashtirishga va markazdan qochma nasoslarning samaradorligini oshirishga yordam beradi. Markazdan qochma nasos parrasining abraziv yeyilishi bo'yicha matematik modellash nasosning samaradorligini oshirish, ishlash muddatini uzaytirish va texnik xizmat ko'rsatish xarajatlarini kamaytirishda muhim ahamiyatga

ega. Quyida ushbu jarayonni matematik modellashtirish bo'yicha asosiy ma'lumotlar keltiriladi.

Abraziv yeyilish - bu nasosning parrak materiali sirtining suyuqlik tarkibidagi qattiq zarrachalar ta'sirida asta-sekin yo'qolishi jarayonidir. Bu jarayon ko'plab texnologik tizimlarda nasosning samaradorligini pasaytiradi va texnik xizmat ko'rsatish xarajatlarini oshiradi. Matematik modellashtirish bu jarayonni chuqurroq tushunish va yeyilishni oldindan baholash uchun muhimdir. Markazdan qochma nasos parragi abraziv yeyilishi quyidagi empirik formula yordamida hisoblanadi.

$$W = k \cdot N \cdot H \cdot C \cdot D_p \quad (1)$$

bu yerda:

k – yeyilish koeffitsienti;

N – aylanish soni;

H – material qattiqligi;

C – zarracha konsentratsiyasi;

D_p – zarracha o'lchami.

Qattiqroq materiallar abraziv yeyilishga nisbatan kamroq sezgir bo'ladi. Yuqori HRC qiymati abraziv zarrachalarning parrak yuzasiga kamroq zarar yetkazishini bildiradi. Quyidagi jadvalda nasos parragining ishlash muhitiga qarab qattiqlik (HRC) qiymatlari keltirilgan (1-jadval).

1-jadval

Nasos Parragi uchun Qattiqlik Jadvali (HRC)

Material nomi	Qo'llanish sohasi	HRC qattiqlik qiymati
Zanglamaydigan po'lat	Korroziyalı muhitlar	40–45
Qotishma po'lat	Yuqori bosimli muhitlar	55–62
Bronza	Oqava suvlar va dengiz suvi	15–20
Cho'yan	Toza suv va oddiy muhitlar	20–30
Keramika/qotishmalar	Agressiv va yuqori aşınuvchi muhitlar	60–70

Ushbu markazdan qochma nasosning afzalliklari:

1. Ishlash muddati prognozi yani modellashtirish yordamida parraga ta'sir qiluvchi abraziv zarralar oqibatida yuzaga keladigan yeyilish tezligini oldindan baholash mumkin.

2. Optimizatsiya yani parraning shakli va materiali optimallashtiriladi, bu esa nasosning uzoq muddatli ishlashini ta'minlaydi.

3. Ekologik samaradorlik yani tejamkor ishlashni ta'minlash orqali energiya va resurslar tejab qoladi.

4. Chiqimlarni kamaytirish yani nasos parchasini almashtirish yoki ta'mirlash talabini kamaytiradi.

5. Turli ish sharoitlarini o'rganish yani nasos turli suyuqliklar va abraziv moddalar bilan ishlaganda qanday ta'sirlanishini aniqlash imkonini beradi.

Kamchiliklari esa quyidagilarni tashkl qiladi:

1. Murakkablik yani abraziv yeyilishning fizik-kimyoviy jarayonlari murakkab va ko'p omilli bo'lib, matematik modelni yaratish uchun keng miqyosdagi ma'lumot talab qilinadi.

2. Anqlik chegaralari yani modellashtirish natijalari doimo laboratoriya va real sharoitlarda sinovdan o'tishi lozim.

3. Dasturiy ta'minotga bog'liqlik yani matematik modelni tuzish uchun maxsus dasturiy ta'minotlar va algoritmlar zarur.

4. Har doim mos bo'lmasligi yani turli abraziv moddalar, ish sharoitlari yoki parraga xos parametrlar uchun model qayta sozlanishi talab qilinadi [2].



1-rasm. Markazdan qochma nasos parraklari

Nasosning aylanish tezligi (rpm – revolutions per minute) suyuqlik va zarrachalarning harakat tezligini belgilaydi.

Yuqori aylanish tezligi zarrachalarning kinetik energiyasini oshiradi, bu esa parrak yuzasiga ko'proq ta'sir qiladi va yeyilish jarayonini tezlashtiradi.

2-jadval
Aylanish sonining ishlashga ta'siri

Aylanish soni (RPM)	Afzalliklar	Kamchiliklar	Qo'llanilish sohasiga mos kelishi
750–1500	Kam energiya sarfi, uzoq muddatli ishlash	Past bosim va oqim	Suv ta'minoti, drenaj tizimlari
1500–3000	Optimal oqim va bosim, samaradorlik yuqori	O'rta darajadagi energiya sarfi	Neft-kimyo, energetika
3000+	Yuqori oqim va bosim, masofaga suyuqlik yetkazish	Kavitatsiya xavfi, yuqori tebranish va shovqin	Yuqori bosimli tizimlar

3-jadval
Samaradorlikni oshirish bo'yicha tavsiyalar

Chora-tadbir	Natija
Chastota o'zgartirgich ishlatish	Optimal RPMda ishlash, energiya samaradorligini oshirish
Muntazam texnik xizmat	Komponentlarning ishlash muddatini uzaytirish
Optimal aylanish sonini tanlash	Nasosning uzoq muddatli ishonchli ishlashini ta'minlash
Bosim va oqimni monitoring qilish	Haddan tashqari yuklanishdan saqlanish

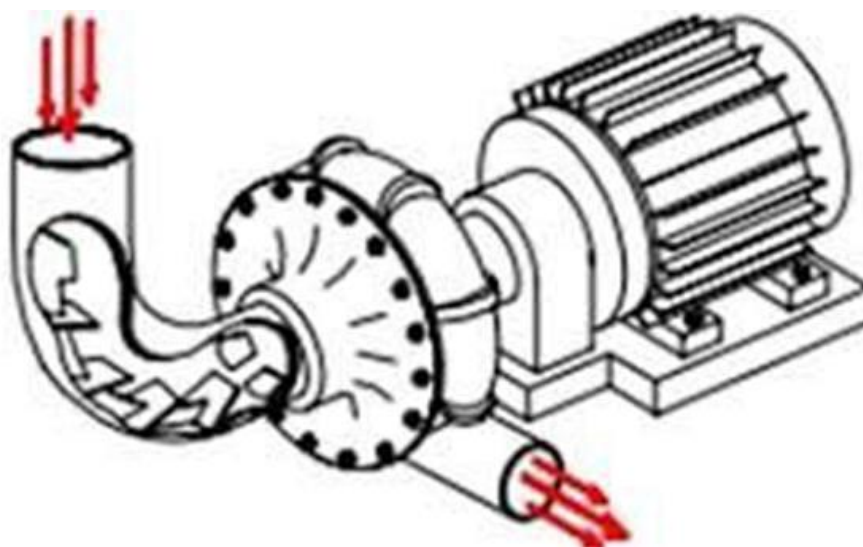
Zarrachalar o'lchami abraziv yeyilishga sezilarli ta'sir ko'rsatadi. Katta zarrachalar yuqori bosim bilan parrak yuzasiga urilib, ko'proq materialni olib tashlaydi. O'lcham birligi odatda mikron yoki millimetrdan o'lchanadi (4-jadval).

4-jadval

Sulzer nasozi parraklari uchun qattiqlik va zarrachalar o'lchami ko'rstailgan

Parrak materiali	Qattiqlik (HRC)	Aylanish tezligi (rpm)	Tavsiya etilgan zarracha o'lchami (μm)	Izoh
Zanglamaydigan po'lat	20–30	1000–2500	10–100	Yuqori korroziyaga chidamli.
Duplex zanglamaydigan po'lat	25–35	1500–3000	10–50	Kuchli mexanik va kimyoviy chidamlik.
Po'lat 4140 zanglamaydigan po'lat	55–62	2000–4000	1–5	Abraziv yeyilishga chidamli.
Chelik (qotishma)	20–45	1500–3000	30–70	O'rtacha yeyilishga chidamli.
Quyma temir	10–25	500–1500	50–100	Arzon, ammo yeyilishga chidamliligi past.

Matematik model abraziv yeyilish jarayonini aniq tavsiflab, nasos komponentlarini optimallashtirishga yordam beradi. Yuqoridagi parametrlarning har biri yeyilish jarayoniga turli darajada ta'sir ko'rsatadi. HRC oshishi va zarracha o'lchamining kamayishi yeyilishni kamaytiradi. Aylanish tezligi oshgani sari yeyilish tezlashadi, shuning uchun optimal parametrlarni tanlash muhimdir.



2-rasm. Markazdan qochma nasos ishlashi

Texnologik jarayonlarni modellashtirish fani oliy o'quv yurtlar talabalarini hozirga zamon talablariga javob bera oladigan yuqori malakali, zamonaviy kompyuter texnologiyasini chuqur tadbqiq qila oladigan mutaxassislar yetishtirishda katta ahamiyatga egadir. Bu fandan chuqurroq bilimga ega bo'lish, talabalarni oliy o'quv yurtida o'qitiladigan barcha umummatematika, umumta'lim va kasbiy fanlarni bilishni taqoza etadi.

Mashinasozlik , ishlab chiqarish va yengil sanoat texnologik jarayonlari murakkab jarayonlar bo'lib, ular bir-biri bilan bog'langan ko'p faktorlarning o'zgarishlariga bog'liqdir. Shuning uchun bu jarayonlarni ilmiy tadqiqot qilish matematik modellar asosida amalga oshiriladi.

Umumiy holda matematik modellarni quyidagi ko'rinishda ifodalash mumkin:

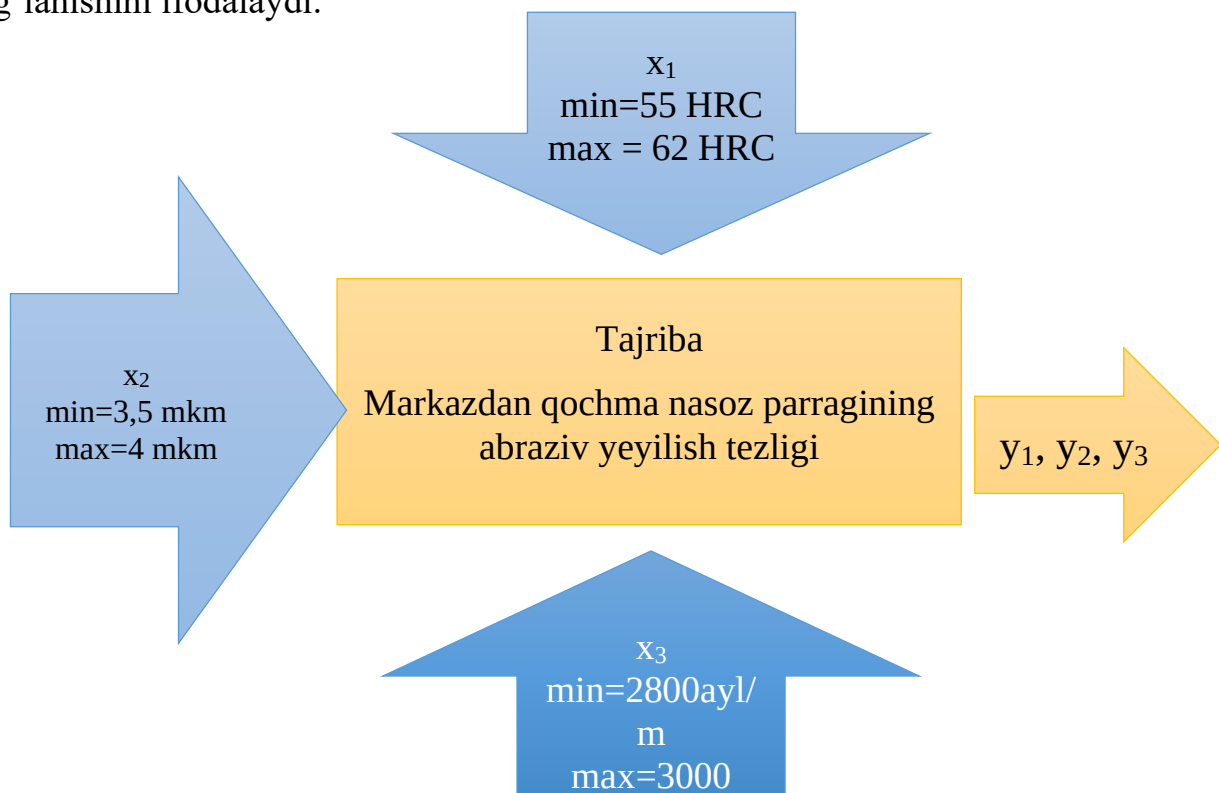
$$Y = F(X) \quad (2)$$

bu yerda:

$Y (y_1, y_2, \dots y_k)$ - chiquvchi faktorlar bo'lib, jarayonning o'rganilayotgan xususiyatlarini,

$X (x_1, x_2, \dots x_k)$ - kiruvchi faktorlar bo'lib, jarayonga ta'sir etuvchi parametrlarni,

F - operator (funksiya) bo'lib chiquvchi faktorni kiruvchi faktorlarga nisbatan bog'lanishini ifodalaydi.



1-sxema. Tajribaning dastlabki ma'lumotlari

Ma'lumki matematik modellar nazariy, eksperimental va nazariy-eksperimental usullar yordamida qurilishi mumkin. Nazariy usullar fizika, mexanika qonuniyatlarga asoslansa, eksperimental usul esa tajriba natijalarini bevosita qayta ishlash natijasida amalga oshiriladi.

5-jadval.

Dastlabki ma'lumotlar jadvashtirilishi

Markazdan qochma Sulzer nasozi	X	Min	Max	Birligi
Material qattiqligi	x_1	50	62	HRC
Parrak aylanish tezligi	x_2	2800	3000	Ayl/m
Zarracha o'lchami	x_3	3,5	4	mkm
Tishli g'ildirakning yeyilish hajmi	y_1	-	-	mm^3/s

Ushbu jadvalda keltirilgan y_1 , y_2 , y_3 natijalarni hisoblash uchun quyidagi formulalardan foydalanamiz:

Tajribadan chiqayotgan mahsulot tezligi aylanishlar soni va radiusi orqali topiladi:

$$v = 2\pi R \cdot \frac{b}{60} \quad (3)$$

bu yerda:

R- parraklar radiusi (0,2 m);

b- aylanishlar soni (rpm);

60-aylanishlarni soniyani minutga aylantirish uchun koeffitsient.

Kompressorda bosim bosim oshishi quyidagi formula orqali topiladi:

$$\Delta P_{\text{ideal}} = c \cdot v^2 \quad (4)$$

bu yerda:

c- gaz zichligi (kg/m^3);

v- gaz tezligi (m/s).

Samaradorlik parraklar soniga qarab quyidagi formula bilan aniqlanadi:

$$\eta = 0,75 + 0,01 \cdot \frac{a-10}{20} \quad (5)$$

bu yerda:

0,75- bazaviy samaradorlik;

0,01- har bir qo'shimcha parrak uchun samaradorlik oshishi koeffisienti;

b- Parraklar soni.

6-jadval
Tajribaning rejalashtirish sharti

№	Faktorlar nomi belgisi	Kod- lash- tirilgan belgisi	Faktorlarning haqiqiy qiymatlari			O'zgarishlar oralig'i
			-1	0	+1	
1	Material qattiqligi	X_1	55	57,33	59,66	62
2	Tishli g'ildirak aylanish tezligi	X_2	2800	2866	2933	3000
3	Tishga ta'sir qiluvchi perpendikulyar kuch	X_3	3,5	3,66	3,83	4

Chiquvchi parametrlar kompressordan chiqayotgan mahsulot tezligi, bosimi va samaradorligiga ta'sirini tajriba asosida o'rganamiz. Buning uchun rejalashtirish matritsasi asosida har bir sharoitda 3 marotaba takroran tajribalar o'tkazamiz. Bu holda tajribalar soni $N = 2^3 = 8$, takrorlanishlar soni $m=3$ ni hisobga olsak umumiy tajribalar soni $N*m=24$ bo'ladi. Chiquvchi parametrlarning tajribaviy natijalari va dispersinlari 14-jadvalda keltirilgan. Rejalashtirish matritsasi, tajriba va hisobiy natijalar.

7-jadval
 Y_1 yeyilish hajmini rejalashtirish matritsasi va tajriba natijalari (a)

u	Faktorlar			$\tilde{y}_{uv}$			$\tilde{y}_u$	$S^2_u \{y\}$
	x_1	x_2	x_3	y_{u1}	y_{u2}	y_{u3}		
1.	-	-	-	2,69	2,71	2,73	2,71	0,0004
2.	+	-	-	2,8	2,79	2,82	2,80333333	0,0002333
3.	-	+	-	2,75	2,77	2,78	2,76666667	0,0002333
4.	+	+	-	2,83	2,82	2,81	2,82	0,0001
5.	-	-	+	2,76	2,77	2,78	2,77	0,0001
6.	+	-	+	2,84	2,82	2,85	2,83666667	0,0002333
7.	-	+	+	2,85	2,88	2,84	2,85666667	0,0004333
8.	+	+	+	2,89	2,90	2,87	2,88666667	0,0002333

Tajriba natijalarini qayta ishlash yuqorida keltirilgan bosqichlar asosida amalga oshiriladi. Har bir y_1, y_2, y_3 lar qo'yildi. Keltirilgan tartib asosida hisob ishlarini amalga oshiriladi.

5. Ajralib turgan qiymatlarni statistik usulda chiqarib tashlash 14-jadvaldagi xar bir satr uchun qullanilada. Buning uchun har bir satr uchun o'rta qiymat va dispersiyalar hisoblanada. Bu qiymatlar 14-jadvalda keltirilgan. Masalan, birinchi tajriba uchun:

$$\bar{y}_1 = (2,69 + 2,7 + 2,73)/3 = 2,71$$

$$S_1^2 = \frac{(2,71 - 2,69)^2 + (2,71 - 2,7)^2 + (2,71 - 2,73)^2}{3} = 0,0004$$

so'ng formulalar yordamida kriteriyaning chegaraviy qiymatlari hisoblanadi:

$$V_{Fmax} = 1,2247; \quad V_{Rmin} = 1,2247$$

Ko'rinib turibdiki, bu qiymatlar maxsus jadvaldan olingan U qiymatdan kichik. Shuning uchun yuqoridagi eng katta va eng kichik qiymatlar keyingi statistik qayta ishlashdan chiqarib tashlanmaydi.

Ko'rilayotgan misolda har bir tajriba uchun ajralib turgan qiymatlar yo'q.

6. Dispersiyalarning bir jinsligini tekshirish uchun (10) formula yordamida hisobiy qiymat hisoblanadi:

$$G_R = \frac{S_{max}^2\{y_j\}}{\sum_{i=1}^N s_u^2\{y\}} = \frac{0,5465}{0,0350} = 0,203$$

Kochren kriteriyasining jadvaliy qiymati:

$$G_T(P_D = 0,95; +(S_U^2) = 2,8) = 0,516.$$

Demak, $G_R < G_T$ bulgani uchun dispersiyalar bir jinsli.

7. Koeffitsiyentlarni hisoblash uchun 5-qiymatlardan foydalanamiz. Ushbu formula samaradorlikni aniqlash uchun:

8-jadval.

Koeffitsiyentlarni hisoblash

Ch. p.	b_0	b_1	b_2	b_3	b_{12}	b_{13}	b_{23}	b_{123}
y_1	18,885417	0,0904166	0,079583	0,25875	0,25125	0,16625	0,06375	0,022083

U holda quyidagi ko'p faktorli regressiya modelini olamiz:

9-jadval:

Ko'p faktorli regressiya modeli

Ch. p.	Ko'p faktorli regressiya modelini
y ₁	2.80+0.03*X1+0.026*X2+0.03*X3-0.009*X1*X2+0.007*X2*X3

Lekin bu modelning oxirgi ko'rinishi emas.

8. Modelning oxirgi ko'rinishini olish uchun koeffitsiyentlarni ahamiyatligini tekshiramiz. Buning uchun Student kriteriyasining formulalaridan foydalanamiz.

$$S^2\{\bar{y}\} = \frac{1}{N \cdot n} \sum_{u=1}^N S_u^2(y) = \frac{0,0006}{8 \cdot 3} = 0,00004;$$

$$S^2\{b_i\} = \frac{1}{N} S^2(\bar{y}) = \frac{0,03}{8} = 0,005;$$

$$S\{b_i\} = 0,0,0388.$$

10- jadval.

Chiquvchi faktorning tajribaviy va hisobiy qiymatlarini taqqoslash

Y	V _{R max}	V _{R mix}	Gr		Tr
Yeyilish hajmi	1,2247449	-1,224745	0,203389831	T(b1)	9,5037905
	-0,267261	-1,336306		T(b2)	8,2019014
	-1,336306	-1,069045		T(b3)	9,7641683
	1,2247449	1,2247449		T(b12)	-2,994345
	-1,224745	-1,224745		T(b13)	-1,952834
	0,2672612	-1,069045		T(b23)	2,4735893
	-0,392232	0,9805807		T(123)	0,1301889
	0,2672612	1,3363062			

Demak, modeldagi ahamiyatli koeffitsiyentlar soni $N_h = 4$ hisobga olsak:

$$S_{\text{nad}}^2\{y\} = \frac{0,001945}{8 - 4} = 0,0004.$$

$2(5) = 0,0002708$ sondan katta bo'lganligi uchun Bu son teriyaning hisobiy qiymati ushbu formula orqali hisoblanadi:

$$P_R = \frac{0,0388}{0,018} = 1,94$$

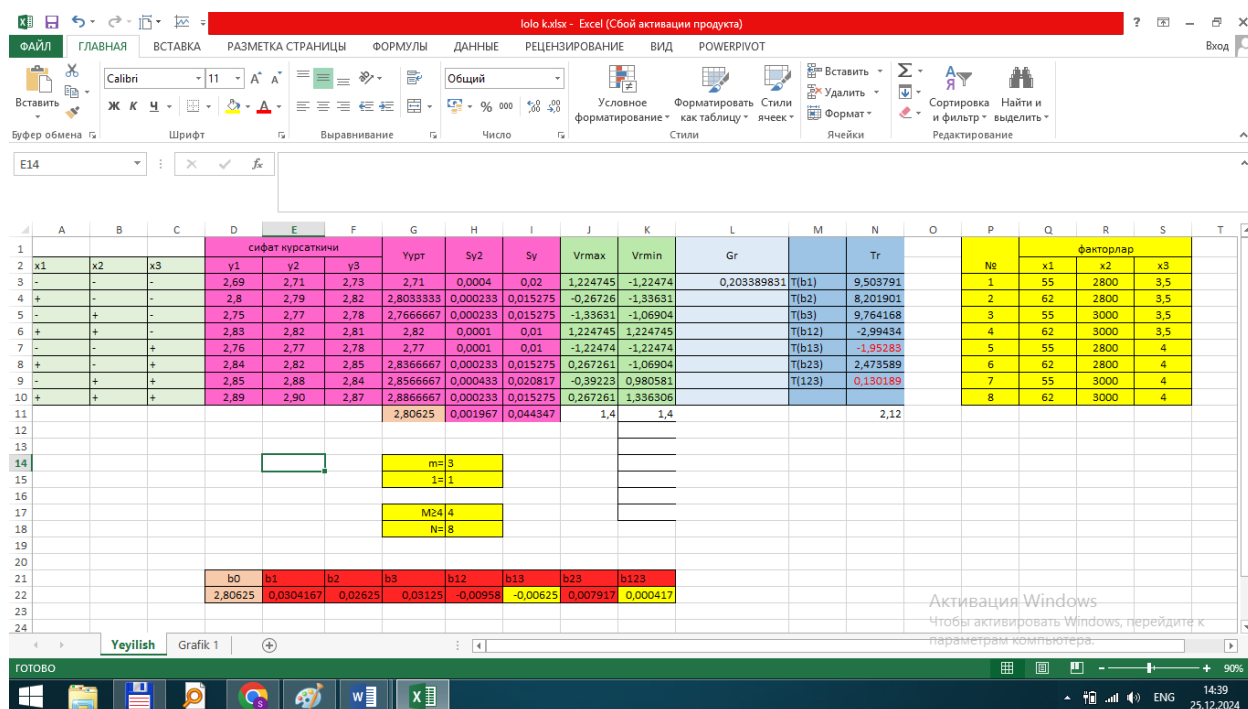
19-formulaga asosan 16-jadvalda ko'rsatilgan paramapetr koefitsiyentlaridan foydalangan holda yakuniy quyidagi formulalar ya'ni parametrlarni ishlab chiqamiz:

11-jadval.
Qiymatlar dasturda ko'rinishi

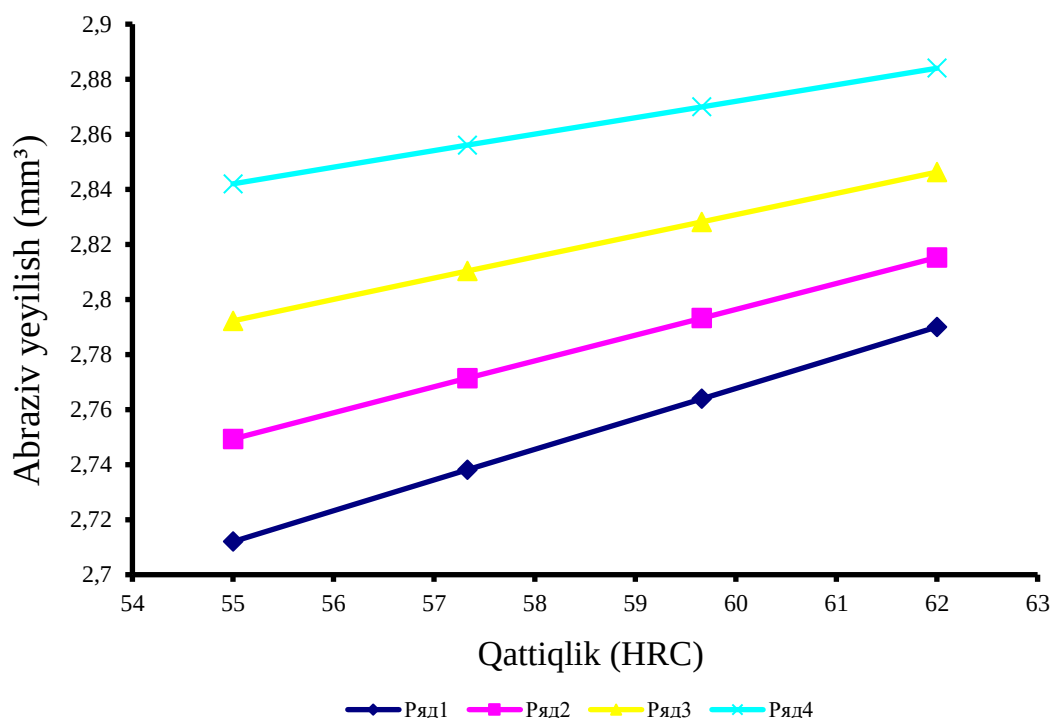
O'zgaruvchining nomi	Belgisi	Dasturdagi belgisi	Qiymati
Tajribalar soni	N	N	8
Faktorlar soni	M	M	3
Qaytarilishlar soni	m	m	3
Korchen kriteriyasining jadvaliy qiymati	G_T	GKP	0,203
Styudent kriteriyasining jadvaliy qiymati	t_T	TKP	2.12
Fisher kriteriyasining jadvaliy qiymati	F_T	FKP	5.85

Undan tashqari programmaning tajribaviy qiymatlar satrma-satr yoziladi.

Qurilayotgan misol uchun kompyuter natijalari berilgan bo'lib, unda qurilgan model haqida barcha ma'lumotlar keltirilgan. Bulardan ko'rinib turibdiki, hisobiy ishlar bilan kompyuter natijalari ustma-ust tushadi. Bu esa programmalarining to'g'ri ekanligini ko'rsatadi (3-rasm).



4- rasm. x_1, x_2 va x_3 larni y_1, y_2, y_3 ga ta'siri.



1-grafik. Parrakning yeyilish tezligining qattqlikka bo'g'liqligi
12-jadval

Chiquvchi faktor natijalari

Y=	x1				
55	2,712	2,749312	2,792212	2,842	
57,33	2,73813	2,771402	2,810322	2,85607	
59,66	2,76387	2,793162	2,828162	2,86993	
62	2,79	2,815252	2,846272	2,884	

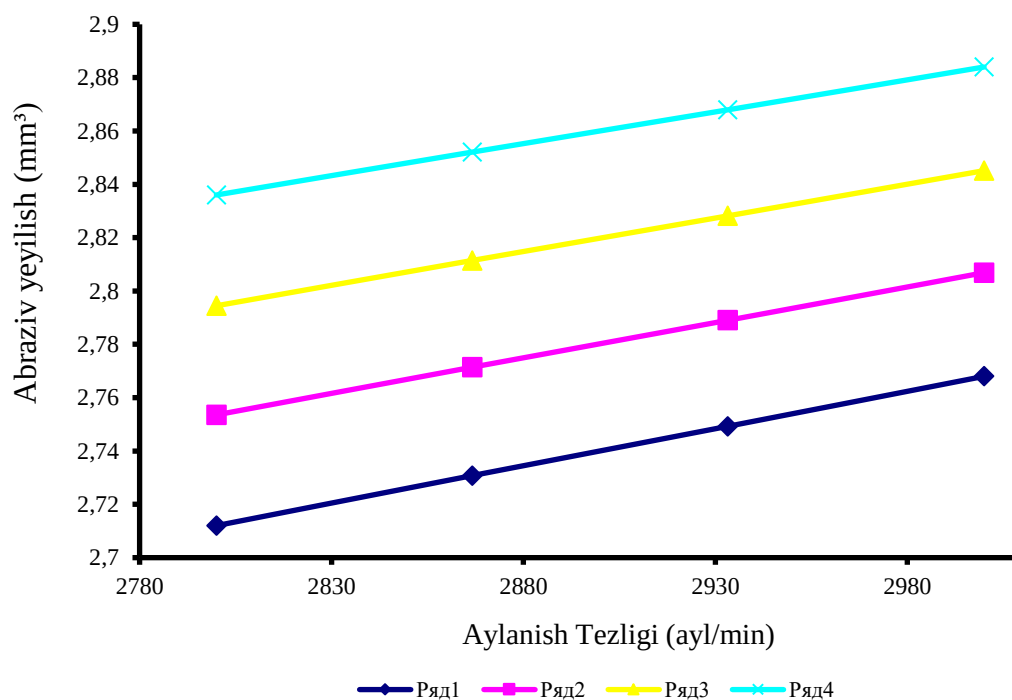
Abraziv yeyilish va parrak qattqligi bog'liqligi. Y o'qi: Abraziv yeyilish (mm), materialning qanchalik yeyilganini ko'rsatadi. X o'qi: Parrak qattqligi (HRC), materialning qattqlik darajasini bildiradi.

Bog'liqlik parrak qattqligi oshgani sari abraziv yeyilish kamayadi. Qattiq materiallar abraziv ta'sirlarga bardoshlilikni oshiradi, shuning uchun abraziv yeyilishning kamayishi kuzatiladi.

1 (eng past chiziq): Abraziv yeyilish minimal va qattqlikka sezgir emas.

4 (eng yuqori chiziq): Abraziv yeyilish ko'proq va qattqlikning oshishiga sezgir.

Bu chiziqlar abraziv yeyilish jarayonida qattqlikning har xil sharoitlarda qanday ta'sir qilishini ko'rsatadi. Qattiqroq materiallardan foydalanish abraziv yeyilishni sezilarli darajada kamaytirishi mumkin. Parametrlar (1-4) abraziv jarayonni nazorat qilishda muhim ro'l o'ynaydi.



2-grafik. Parrakning yeyilish tezligining aylanish tezligiga bog‘liqligi.

13-jadval
Chiquvchi faktor natijalari

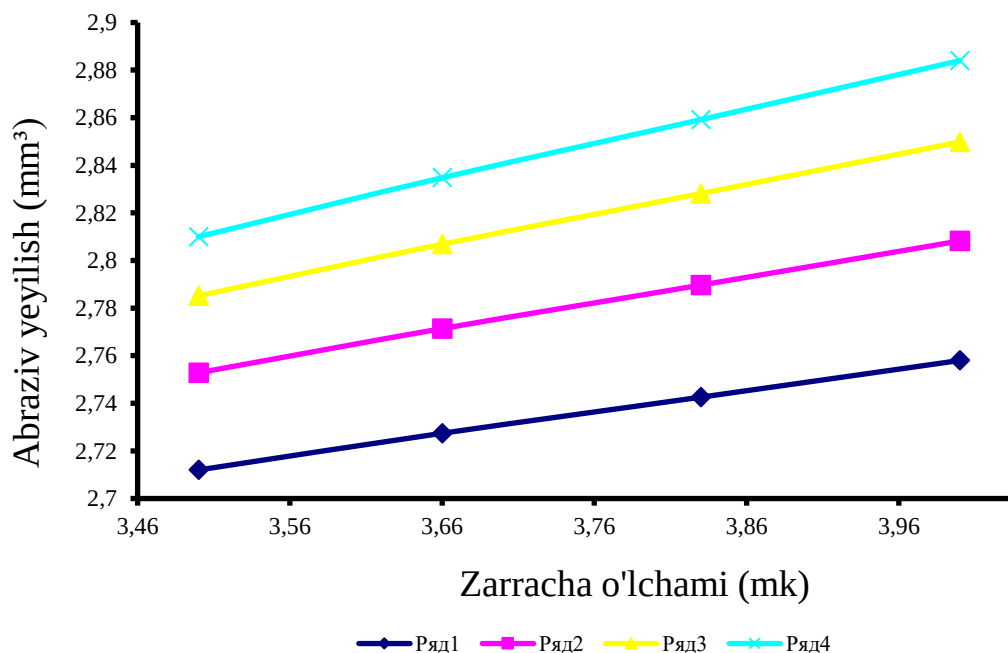
Y=	x2			
2800	2,712	2,75354	2,79446	2,836
2866,6	2,73076	2,7714022	2,8114378	2,85208
2933,2	2,74924	2,7889978	2,8281622	2,86792

Abraziv yeyilish va aylanish tezligi bog‘liqligi quyidagicha: Y o‘qi bu Abraziv yeyilish (mm). X o‘qi bu Parrak aylanish tezligi (ayl/min). Bog‘liqlik aylanish tezligi oshishi abraziv yeyilishning ortishiga sabab bo‘ladi. Bu yuqori tezlikda materialga ko‘proq mexanik ta’sir yetkazilishini anglatadi.

1 (eng past chiziq): Abraziv yeyilish eng past darajada va aylanish tezligiga kam sezgir.

4 (eng yuqori chiziq): Aylanish tezligi oshishi abraziv yeyilishning sezilarli darajada ortishiga olib keladi.

Chiziqlar orasidagi masofalar har xil sharoitlarda abraziv yeyilish darajasini ko‘rsatadi. Tezlikni nazorat qilish abraziv yeyilishni kamaytirishning samarali usuli bo‘lishi mumkin. Yuqori tezlik abraziv materialning ishlash vaqtini qisqartiradi



3-grafik. Parrakning yeyilish tezligining zarracha o'lchamiga bog'liqligi.

14-jadval
Chiquvchi faktor natijalari

Y=	x3				
3,5	2,712	2,7528499	2,7851899	2,81	
3,66	2,72741	2,7714022	2,8068376	2,83479	
3,83	2,74259	2,7896776	2,8281622	2,85921	
4	2,758	2,8082299	2,8498099	2,884	

Yuqoridagi keltirib o'tilgan (x_1, x_2, x_3) va chiquvchi (y_1, y_2, y_3) parametrlar xususan, markazdan qochma nasos parragining abraziv yeyilish tezligi uchta asosiy parametr (parrak materiali qattiqligi, parrakning aylanish tezligi, va suyuqliktarkibidagi zarracha o'lchami) bilan bog'liq ekanligi aniqlandi.

Markazdan qochma nasos parragining abraziv yeyilishiga material qattiqligining oshishi ijobiy ta'sir ko'rsatadi. Ya'ni agarda parrak materiali qattiqligini oshirsak yeyilish ham ma'lum miqdorda oshadi, shuning uchun material tanlaganda iloji boricha qattiqligi past materiallardan foydalangan maqsaga muvofiq hisoblanadil.

Aylanish tezligi va zarracha o'lchamini oshishi ham parrakning abraziv yeyilishi qiymatini o'sishiga sabab bo'ladi. Yeyilishni optimal holatga keltirishimizda biz uch parametrning deyarli eng minimal qiymalarini olshimiz kerak bo'ladi

15-jadval.
Grafiklar bo'yicha maqbul nuqtalar

Grafik nomi	Parametrlar (x)	Eng maqbul qiymat (x)	Natija (y)
y_1 ni x_1 ga bog'liqligi	Material qattiqligi (HRC)	55	$\eta \approx 2,74$
y_1 ni x_2 ga bog'liqligi	Aylanish tezligi (ayl/m)	2800	$\eta \approx 2,77$
y_1 ni x_3 ga bog'liqligi	Zarracha o'lchami (mkm)	3,5	$\eta \approx 2,75$

Eng optimal darajada yemirilish tezligiga 3 ta holat bo'yicha yechim topish uchun, parrak materialining qattiqlik darajasi 55HRC ya'ni minimal bo'lishi kerak, va aylanish tezligi hamda zarrachaning o'lchami ham minimla bo'lishi lozim.

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PSIXOSOMATIK KASALLIKLAR BILAN OG'RIGAN BEMORLARNING PSIXOLOGIK XUSUSIYATLARI

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Annotatsiya: Mazkur maqolada psixosomatik kasalliklar va ularga ta'sir etuvchi psixologik omillar, psixosomatik kasalliklar bilan og'rigan bemorlarning psixologik xususiyatlari tahlil qilinadi. Psixosomatik kasalliklar — bu jismoniy kasalliklar bo'lib, ular ko'pincha ruhiy va emosional holatlarning bevosita ta'siri ostida rivojlanadi. Maqolada psixosomatik kasalliklarning shakllanishiga sabab bo'luvchi psixologik omillar, ularni davolashda psixoterapevtik yondashuvlar, shuningdek, psixosomatik kasalliklar bilan og'rigan bemorlarning psixologik holatini baholash metodlari muhokama qilinadi. Kasallikning jismoniy belgilari bilan bir qatorda, bemorlarning ruhiy ahvoli, o'z-o'zini his etish shakllari va stressga reaksiyasi ham alohida o'rganiladi. Psixosomatik kasalliklarning oldini olish va davolashda psixologik yondashuvlarning o'rni ko'rsatib o'tiladi.

Kalit so'zlar: psixosomatik, psixoterapevtik, tipologik, psixologik, stress, depressiya.

Аннотация: В данной статье анализируются психосоматические заболевания и психологические факторы, влияющие на них, а также психологические особенности пациентов, страдающих психосоматическими расстройствами. Психосоматические заболевания — это физические болезни, которые часто развиваются под непосредственным воздействием психоэмоционального состояния. В статье рассматриваются психологические факторы, способствующие формированию психосоматических заболеваний, психотерапевтические подходы к их лечению, а также методы оценки психологического состояния пациентов с психосоматическими расстройствами. Наряду с физическими проявлениями болезни исследуются психологическое состояние пациентов, их восприятие себя и реакции на стресс. Уделено внимание роли психологических подходов в профилактике и лечении психосоматических заболеваний.

Ключевые слова: психосоматический, психотерапевтический, типологический, психологический, стресс, депрессия.

Annotation: *This article analyzes psychosomatic diseases and the psychological factors influencing them, as well as the psychological characteristics of patients suffering from psychosomatic disorders. Psychosomatic diseases are physical illnesses that often develop under the direct influence of the psychoemotional state. The article discusses psychological factors contributing to the formation of psychosomatic diseases, psychotherapeutic approaches to their treatment, and methods for assessing the psychological condition of patients with psychosomatic disorders. Along with the physical manifestations of the illness, the psychological state of the patients, their self-perception, and stress responses are also examined. Attention is given to the role of psychological approaches in the prevention and treatment of psychosomatic diseases.*

Keywords: *psychosomatic, psychotherapeutic, typological, psychological, stress, depression.*

Bugungi kunga kelib fan texnika tobora rivojlanib taraqqiy etib bormoqda. Boshqa fanlar qatorida psixologiya bo'yicha ham ko'plab ilmiy izlanishlar olib borilyapti. Albatta o'rganilgan psixik holatlar va olingan psixologik bilimlarning barchasini insonlarning hayotida qo'llanilishi uchun yetarli deyolmaymiz. Chunki insonlardagi akseleratsiya hisobiga ayrim o'zgarishlar kutilganidek bo'lmasligi yoki kutilganidan o'zgacharoq holatda ham namoyon bo'lishi mumkin. Shu sabab ham o'rganilgan bilimlarni doimiy takomillashtirib borish zarur hisoblanadi. Psixologiyada turli tarmoqlar va yo'nalishlar bor, ulardan tibbiyot psixologiyasi bo'yicha to'plangan bilimlar ayniqsa juda qimmatlidir. Fan texnikaning rivojlanishi bilan birga insonlarda stress va depressiya holatlari va buning natijasida kelib chiqadigan kasalliklar ham anchagina ortganligini ham e'tirof etish kerak albatta buning natijasida esa psixosomatik kasalliklar paydo bo'lishi nisbatan ko'proq kuzatilmoqda. ¹Xo'sh aslida psixosomatik kasallik o'zi nima? Psixosomatik yunonchadan tarjima qilinganda ruh va tana, ya'ni ruhiyat bilan bog'liq bo'lgan tana kasalliklari degan ma'noni anglatadi. Psixosomatik kasalliklarni yuzaga kelishida ko'pincha psixogen omillar sabab bo'ladi. Ayrim ma'lumotlarga qaraganda 21- asrda yuzaga kelgan psixosomatik kasalliklarga asosiy sabab sifatida psixogen omillar ko'rsatiladi. Psixogen omillar- bu ijtimoiy muhit, stressli vaziyatlar va stressli vaziyatlarning uzoq davom etishi, oiladagi zo'ravonlik holatlari, bolalikdagi psixologik travmalar va insonni toliqtiruvchi uzoq davom etdigan salbiy vaziyatlar, ba'zi holatlarda oila a'zolari va yaqin kishilarining qo'llab-quvvatlamasligi ham bu kabilarga misol bo'lishi mumkin. "Psixosomatika" atamasi birinchi bor 1818-yilda nemis shifokori Iogann-Kristian Geynrot tomonidan

¹ **Karpov, A.V.** (2010). *Psixosomatik kasalliklar: Psixologiya va tibbiyotning o'zaro bog'lanishi.* Moskva

qo‘lanilgan. 1822-yilda esa Germanyalik psixiatr Karl Yakobi “somotopsixik” tushunchasini kiritdi. Ushbu tushuncha psixosomatika tushunchasiga qarama-qarshi va to‘ldiruvchi vazifasini ham bajaradi. O‘z zamonasining eng mashxur tabiblaridan bo‘lgan Gipokrat ham insonning fe‘l atvori uning sog‘ligiga ta’sir ko‘rsatishini aytib o‘tgan.¹

Ba’zan shunday gaplarni eshitib qolamiz, tomoq stress natijasida og‘riydi, saraton birovni kechira olmaslik va adovat saqlash tufayli rivojlanadi, allergiya esa ichda yutilgan g‘azab natijasida tashqariga chiqadi-psixosomatikaga doir ilmiy ishlarda shunday izohlarni ko‘p uchratish mumkin. Bir so‘z bilan aytadigan bo‘lsak, kasalliklarning paydo bo‘lishida g‘am-tashvishlarimiz aybdor. Bu psixosomatika deyiladi. 1920-yilda sil bilan kasallangan Frans Kafka o‘zining holatiga shunday ta’rif bergan: Mening ongim kasal, o‘pkamdagi kasallik esa shunchaki ruhiy kasalligimning aksidir. Yozuvchi Ketrin Mensfild ham shu kasallika chalinib, o‘zining kundaligida shunday yozadi: rasvo kun ...Azobli og‘riq va hokazo. Bu faqat jismoniy zaiflik emas. Sog‘ayib ketish uchun men o‘zimning menimni tuzatishim kerak. Shifo topmayotganimning asl sababi ham shunda. Mening ongim menga bo‘ysunmayapti.²

Shifokorlar depressiya va stressga chidamlilikning past darajasini xavf omili deb hisoblashadi. Ular imunitetni tushiradi, buning natijasida esa sil kasalligi faol shaklga o‘tishi mumkin. Olimlar fikriga ko‘ra, uzoq cho‘zilgan stressning yurak kasalliklari, astma, diabet, Altsgeymer kasalligi va hatto saraton kelib chiqishiga sabab bo‘lishi mumkinligini bildirishmoqda. Gap shundaki, stress – bu yomon fikrlar va boshdagi hissiyotlar to‘plami emas, balki aniq fiziologik jarayon. Bu organizmga ta’sir ko‘rsatmay qolmaydi. Psixosomatika hatto eng og‘ir kasalliklarni ham psixologik holat bilan izohlaydi va ularni psixologik muamolarini hal qilish bilan davolashni taklif qiladi.

Bunday usuldagi davolash muolajalari o‘z-o‘zidan bezarar hatto foydali ham, biroq an’anaviy tibbiyot usullaridan voz kechilganda u katta muammolar bilan xavf soladi.³

Odam o‘ziga o‘zi kasallikni to‘qib chiqarsa ham bu psixosomatikaga taaluqli bo‘ladi. Ba’zan bu haqiqiy kasallikga olib keladi. Nevropatolog Syuzan O’sullivan o‘zining kitobida bir bemor boshida shishni aniqlab, bu saraton ekanligiga qaror qilgan holatini tasvirlaydi. Shundan so‘ng uning o‘ng qo‘li va oyog‘i falaj bo‘ladi.

¹ **Yusufov, S.** (2012). *Psixosomatik kasalliklar va ularga psixoterapevtik yondashuvlar*. Toshkent: Sharq.

² **Dorian, D.** (2005). *The Relationship Between Psychological States and Physical Symptoms*. London: Psychology Press.

³ **Tashkent, Z.** (2018). *Psixosomatik kasalliklarni tibbiy va psixologik davolash*. Toshkent: Universitet nashriyoti.

Psixosomatik kasalliklar – bu jismoniy kasalliklar bo‘lib, ular psixologik faktorlar ta'siri ostida rivojlanadi. Bunday kasalliklarda bemorning ruhiy holati jismoniy alomatlar bilan namoyon bo‘lishi mumkin. Psixosomatik kasalliklar bilan og‘rigan bemorlar ko‘pincha stress, anksiyete (xavotir), depressiya va boshqa ruhiy muammolarni boshdan kechiradilar. Psixosomatik kasalliklar bugungi kunda keng tarqalgan va ular turli xil simptomlar bilan namoyon bo‘ladi. Kasallikning psixologik jihatlarini o‘rganish, bemorning shaxsiy xususiyatlarini va psixologik holatini tahlil qilishni talab qiladi. Shuningdek, bu kasalliklar davolanishida psixoterapevtik yondashuvlarning ahamiyati katta. Psixosomatik kasalliklar, ko‘pincha, ruhiy va hissiy holatlarning ta'siri bilan bog‘liq. Stress, tashvish, depressiya, o‘z-o‘zini past baholash kabi psixologik omillar organizmning jismoniy holatini bevosita o‘zgartirishi mumkin. Misol uchun, odamning doimiy tashvishlari va stressi yurak qon-tomir tizimiga salbiy ta'sir ko‘rsatishi, oshqozon tizimida turli muammolarni yuzaga keltirishi mumkin. Psixosomatik kasalliklar, shuningdek, o‘ziga xos psixologik xususiyatlarga ega bo‘lgan bemorlarda ko‘proq uchraydi. Masalan, yuqori sezgirlik, depressiyaga moyillik, o‘z-o‘zini past baholash va ijtimoiy izolyatsiya psixosomatik kasalliklar xavfini oshirishi mumkin. Psixosomatik kasalliklar bilan og‘rigan bemorlar ko‘pincha o‘z holatini ruhiy jihatdan qabul qilishda qiyinchiliklarga duch keladilar. Ularning psixologik holati odatda stress, bezovtalik, xavotir va ruhiy charchoq kabi alomatlar bilan bog‘liq. Bemorlarning ko‘pchiligi o‘zlarining kasalliklarini psixologik omillar bilan bog‘lamaslikka harakat qiladi, bu esa davolanish jarayonini murakkablashtiradi. Psixosomatik kasalliklar bilan og‘rigan bemorlar ko‘pincha o‘zlarini ruhiy jihatdan zaif va himoyasiz his qilishadi. Ularning psixologik xususiyatlariga quyidagilar kiradi: Psixosomatik kasalliklar bilan og‘rigan bemorlarda doimiy xavotir va tashvish hissi kuzatiladi. Bemorlar ko‘pincha o‘zlarini beqiyos, qo‘rqoq yoki zaif his qiladilar. Kasallik sababli bemorlar o‘zlarini jamiyatdan ajralgan deb his qilishadi va bu holatning rivojlanishi ijtimoiy aloqalarning susayishiga olib kelishi mumkin. Depressiya va stress psixosomatik kasalliklarning asosiy sabablari bo‘lishi mumkin. Bemorlar o‘z holatini ijobiy baholashda qiyinchiliklarga duch keladilar. Psixosomatik kasalliklarning davolanishida psixoterapiya va psixologik yondashuvlar muhim rol o‘ynaydi. Kognitiv-behavyoral terapiya, psixodinamik terapiya, meditasiya va yoga kabi usullar psixosomatik kasalliklarni davolashda samarali bo‘lishi mumkin.¹Psixoterapevtik yondashuvlar bemorning ruhiy holatini yaxshilash va kasallikni yaxshilashga yordam beradi., masalan, bemorning salbiy fikrlarini o‘zgartirishga yordam beradi, stressni kamaytiradi va ijobiy o‘zgarishlar yaratadi.

¹ **Saroyan, T.** (2011). *Stress va psikosomatik kasalliklar*.

Xulosa

Psixosomatik kasalliklar insonning ruhiy holati va jismoniy salomatligi o'rtasidagi murakkab o'zaro aloqalarni anglatadi. Psixosomatik kasalliklarning shakllanishiga turli psixologik omillar, shu jumladan stress, depressiya va o'z-o'zini past baholash sabab bo'ladi. Bunday kasalliklarni davolashda psixoterapevtik yondashuvlar va psixologik yordam muhim ahamiyatga ega. Shuningdek, bemorning psixologik holatini to'g'ri baholash va davolashda individual yondashuvlar zarur.

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TIBBIYOTDA INSONPARVARLIK

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Annotatsiya: Ushbu tezisda tibbiyotda insonparvarlik tamoyillarining bemorlar hayotiga va shifokor ma‘suliyatiga ta‘siri keng yoritilgan. Bemorlarni diqqat bilan tinglash, ruhiy qo‘llab-quvvatlash, yaxshi xulq bilan yondashish, maxfiylikka rioya qilish, tenglik va adolat kabi insonparvarlik tamoyillarining tibbiy xizmat sifatiga, bemorlarning ruhiy holatiga va sog‘ayish jarayoniga ijobiy ta‘siri bayon qilingan. Tezisdá insonparvarlik tamoyillarining shifokor va bemor o‘rtasidagi ishonchli aloqani mustahkamlash, sog‘liqni saqlash tizimining obro‘siní oshirish va davolash jarayonining samaradorligini oshirishdagi o‘rni muhimligini ta‘kidlab o‘tilgan.

Kalit so‘zlar: Tibbiyotda insonparvarlik, bemorlar va shifokorlar o‘rtasidagi aloqa, ruhiy qo‘llab-quvvatlash, tibbiy xizmat sifati, tenglik va adolat tamoyillari, maxfiylik va kasbiy axloq, tibbiy yordam samaradorligi, shifokor ma‘suliyati, sog‘liqni saqlash tizimi.

Tibbiyot inson hayotini saqlash va yaxshilashga qaratilgan, insonparvarlik esa bu jarayonning muhim qismi hisoblanadi. Insonparvarlik tamoyillari nafaqat bemorlarga xizmat ko‘rsatish uslubini, balki ularning umumiy hayot sifatini ham yaxshilaydi. Bunda bemorlarning ruhiy va jismoniy ehtiyojlarini hisobga olish, ularga hurmat va samimiylik bilan yondashish alohida o‘rin tutadi. Tibbiyotda insonparvarlik tamoyillari bemorlarning tibbiy xizmatlardan qoniqishini oshirish, ularning sog‘lig‘ini tiklash jarayonini qulaylashtirish va shifokorlarning jamiyatda obro‘siní mustahkamlashga xizmat qiladi.

Insonparvarlikning asosiy tamoyillari:

1. Diqqat va mehr bilan tinglash: Har bir bemor o‘z holatini, og‘riqlarini va muammolarini shifokorga tushuntirishni xohlaydi. Shifokorning bemorni diqqat bilan tinglashi ularning ruhiy jihatdan yengillashishiga, davolanish jarayonida ishonchli his

qilishlariga yordam beradi. Tinglash orqali bemor va shifokor o'rtasidagi ishonchli aloqa o'rnatilib, bemorning sog'ayishiga ijobiy ta'sir ko'rsatadi.

2. Ruhiy qo'llab-quvvatlash va dalda berish: Ko'plab kasalliklar, ayniqsa uzoq muddatli va surunkali xastaliklar bemorlarning ruhiyatiga jiddiy ta'sir qiladi. Bunday holatlarda shifokorlarning ruhiy qo'llab-quvvatlashi, bemorlarni tushkunlikdan chiqarish va ularga dalda berish kabi insonparvarlik harakatlari katta ahamiyatga ega. Ruhiy yordam bemorlarning sog'ayishga bo'lgan ishonchini mustahkamlaydi, bu esa ularning davolanish jarayonini osonlashtiradi.

3. Yaxshi xulq va hurmat ko'rsatish: Shifokorning bemorga yaxshi xulq bilan yondashishi bemorning shifokorga bo'lgan ishonchini oshiradi. Bu yondashuv bemor va shifokor o'rtasidagi ishonchni kuchaytirib, davolanish jarayonining samaradorligini oshiradi.

Bemorlarning davolash jarayoniga ijobiy munosabatda bo'lishlari va sog'ayishlariga ishonch bilan qarashlari uchun shifokorlarning hurmat ko'rsatishi muhimdir.

4. Kasbiy axloq va maxfiylikka rioya qilish: Shifokorlarning bemor shaxsiy ma'lumotlarini saqlashi va ularni faqat tibbiy maqsadlarda ishlatishi bemorlarning shifokorlarga bo'lgan ishonchini mustahkamlaydi. Kasbiy axloq shifokorning halolligi, adolati va odilona qaror qabul qilishi bilan namoyon bo'ladi. Bemorlar o'zlariga nisbatan adolatli munosabat ko'rishdan umidvor bo'ladilar.

5. Tenglik va adolat tamoyillariga rioya qilish: Tibbiyotda insonparvarlikka asoslangan yondashuv barcha bemorlarga tenglik va adolat tamoyillari asosida xizmat ko'rsatishni talab qiladi. Har bir bemor, ijtimoiy holatidan qat'i nazar, sifatli tibbiy yordam olish huquqiga ega. Bu tamoyil, ayniqsa, kam ta'minlangan va himoyasiz qatlamlar uchun tibbiyot tizimida muhim ahamiyat kasb etadi.

Tibbiyotda insonparvarlikning ahamiyati:

1. Bemorlarning sog'ayish jarayoniga ijobiy ta'siri: Bemorlar shifokorlarning mehribon va hurmatli yondashuvlarini his qilganda, davolanish jarayoniga ko'proq ishonch va motivatsiya bilan yondashadilar. Shifokorning insonparvarlik tamoyillariga rioya qilishi bemorlar ruhiyatiga ijobiy ta'sir ko'rsatib, sog'ayish jarayonini tezlashtiradi.

2. Tibbiyot sohasidagi obro'ni oshirish: Insonparvarlik tamoyillariga asoslangan yondashuv shifokorlar va tibbiyot sohasining obro'sini oshiradi. Bu esa tibbiyot tizimiga bo'lgan ijtimoiy ishonchni mustahkamlaydi va bemorlarning davolanish jarayoniga sadoqatini oshiradi. Shu bilan birga, bemorlarning shifokor va sog'liqni saqlash tizimiga bo'lgan munosabatini yaxshilaydi.

3. Sog'liqni saqlash tizimining samaradorligini oshirish: Tibbiyotda insonparvarlikka asoslangan yondashuv xizmatlar sifatini oshirishga va bemorlarning qoniqishini ta'minlashga xizmat qiladi. Bu esa sog'liqni saqlash tizimining

samaradorligini oshirib, bemorlarning ijtimoiy hayotga tezroq qaytishini ta'minlaydi. Yaxshi va hurmatli munosabat bemorlarning sog'ayish jarayoniga ijobiy ta'sir qiladi va ularni davolash tizimiga qiziqishini oshiradi.

Tibbiyotda insonparvarlik tamoyillari bemorlarning sog'ayish jarayoniga katta ijobiy ta'sir ko'rsatib, ularning davolanishga bo'lgan ishonchini mustahkamlaydi. Shuningdek, shifokorlarning o'z kasbiy vazifalarini yuqori darajada ado etishlarini ta'minlaydi. Insonparvarlik tamoyillariga amal qilgan holda tibbiy yordam ko'rsatish jamiyatda shifokorlarning hurmatini oshiradi, ularni jamiyatning ishonchli va yetuk vakili sifatida qarashga olib keladi. Tibbiyotda insonparvarlikni rivojlantirish bemorlarning hayot sifatini oshirishga, shuningdek, sog'liqni saqlash tizimining yuksalishiga xizmat qiladi. Shu sababli, insonparvarlik tibbiyotning asosiy tamoyillaridan biri sifatida ahamiyatini yo'qotmaydi, balki davolashning samaradorligini oshiradi.

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STUDY OF QUALITY ASSURANCE (QA)

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ABSTRACT:

This work was carried out to study of quality assurance (QA) analysis. For our analysis, we are going to consider information from two parts of the MPD detector: TPC and TOF.

Key words: *MPD and TOF detector, reference multiplicity, pseudorapidity of a particle, ionization loss energy, primary transverse momentum.*

I. Introduction

The Multi-Purpose Detector (MPD) is under construction at the Joint Institute for Nuclear Research (JINR) in Dubna, as part of the Nuclotron-based Ion Collider fAcility (NICA) Accelerator Complex. The MPD Collaboration aims to study the phase diagram of QCD matter at maximum baryonic density, determine the nature of the phase transition between the deconfined and hadronic matter and search for the critical point. The combination of significant luminosity at NICA, collider geometry of the experiment and collision energies $\sqrt{s_{NN}}$ spanning the range of 4 to 11 GeV, where the transition from baryon to meson dominated matter is expected will allow MPD to provide unique insight into these questions. The status of the assembly of the detector in MPD Hall, as well as the progress in the production of MPD subdetectors will be reported on [1].



Figure1. The schematic view of the NICA complex [1].

1.1 Main Objective

The main aim from this work is to learn basic knowledge of C++ programming language and ROOT software framework and use it to process the data, which are taken from Monte Carlo simulation of the MPD detector at NICA.

The TPC is the time projection chamber, it measures the space points of a particle's path as well as the ionization of the gas. The combination of a particle's trajectory and the value of the magnetic field give an opportunity to evaluate the momentum and rigidity of a particle, which, in turn, leads to the discovery of a particle's charge.

TOF is the time-of-flight detector that allows us to find the velocity of a particle. With this knowledge, it is possible to identify a particle's mass.

1.2 Foundation of ROOT

ROOT is a software framework for data analysis and Input/Output: a powerful tool to cope with the demanding tasks typical of state of the art scientific data analysis. It provides all the functionality needed for big data processing, statistical analysis, visualization and storage. Among its prominent features is an advanced graphical user interface, ideal for interactive analysis, an interpreter for the C++ programming language, for rapid and efficient prototyping and a persistency mechanism for C++ objects, used also to write every year petabytes of data recorded by the Large Hadron Collider experiments. This introductory guide illustrates the main features of ROOT which are relevant for the typical problems of data analysis: input and plotting of data

from measurements and fitting of analytical functions. Daily, thousands of physicists use ROOT applications to analyze their data or for modeling [2].

1.3 Multi-Purpose Detector (MPD)

The main physics experiment at NICA is the MPD, which will be operating at the collider. In 2018 an international scientific collaboration of MPD has been established. Currently, it is composed of 42 institutes from 12 countries, as well as JINR as a host institution. The collaboration will be operating the MPD apparatus, which is shown schematically in Fig. 2. Its designated position is the MPD Hall, which is located at the northern straight section of the NICA collider. Since 2020 the building has been available for MPD activities. Its main scientific purpose is to search for novel phenomena in the baryon-rich region of the QCD phase diagram by means of colliding heavy nuclei in the energy range of $4 \text{ GeV} < \sqrt{s_{NN}} < 11 \text{ GeV}$. A wealth of results, obtained by colliding heavy ions at different beam energies, has been gathered by experiments at SIS, AGS, SPS, RHIC and the LHC facilities. The new experimental program at the NICA-MPD will fill a niche in the energy scale, which is not yet fully explored, and the results will bring about a deeper insight into hadron dynamics and multiparticle production in the high baryon density domain.

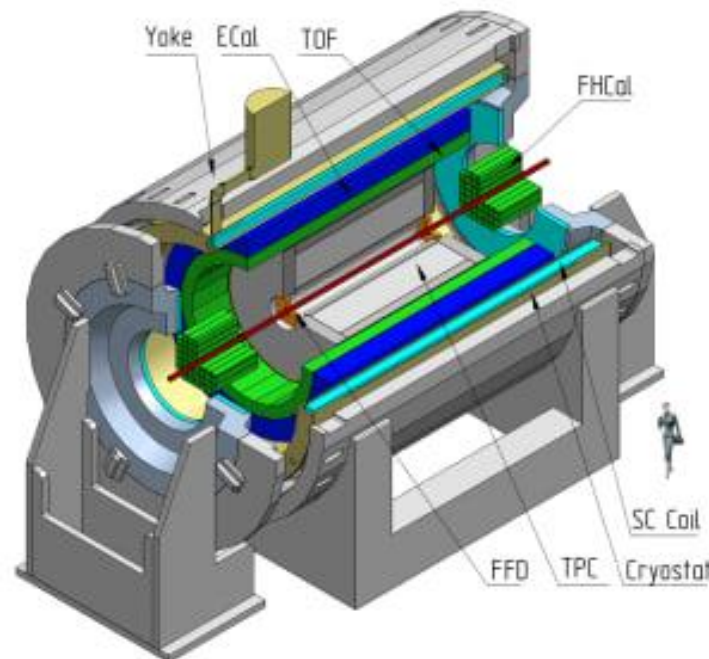


Figure 2. Multi-Purpose Detector [3].

The “central barrel” components have an approximate cylindrical symmetry within $|\eta| < 1.5$. The beam line is surrounded by the large volume Time Projection Chamber (TPC) which is enclosed by the TOF barrel. The TPC is the main tracker, and in conjunction with the TOF they will provide precise momentum measurements and particle identification [3].

1.4 Time Projection Chamber (TPC)

The TPC is the main tracking detector of the MPD central barrel. It is designed to perform three-dimensional precise tracking of charged particles and momentum measurements for transverse momentum $p_t > 50$ MeV/c. The track reconstruction is based on the drift time and R- ϕ cylindrical coordinate measurement of the primary ionization clusters created by a charged particle crossing the TPC. Charged particles traversing this volume ionize the gas mixture of 90% Ar+10% CH₄ along helix-shaped trajectories. The efficient tracking at pseudorapidities up to $|\eta| \leq 1.5$. Two-track resolution of about 1 cm. Hadron and lepton identification by dE/dx measurements made with a resolution better than 8% [4].

Momentum measurements in combination with dE/dx travelled by a particle measurement, dE/dx are used for flow analysis of identified particles. dE/dx traveled by a particle through a specific material is described by the Bethe-Bloch formula [5]:

$$\frac{dE}{dx} = \frac{4\pi}{m_e c^2} \frac{n z^2}{\beta^2} \left(\frac{e^2}{4\pi\epsilon_0} \right)^2 \left[\ln \left(\frac{2m_e c^2 \beta^2}{I(1-\beta^2)} \right) - \beta^2 \right] \quad (1)$$

where β equals v/c , v is velocity of the particle, c is the speed of light, E is the energy of the particle, x is the distance travelled by the particle m_e , m_e is the rest mass of the electron, n is the electron density of the target, z is the particle charge, e is the charge of the electron, ϵ_0 is the vacuum permittivity and I the mean excitation potential of the target. The TPC is calibrated in order to describe dE/dx travelled with a parameterization of the Bethe-Bloch formula. By combining total momentum $\frac{dE}{dx}$ and p_{tot} over primary total momentum measurements the particles can be identified (see Fig. 11).

1.5 Time-Of-Flight (TOF)

The Time-Of-Flight principle is based on measuring the time it takes for a wave to travel from a source (a time-of-flight sensor) to an object and back. The TOF system is intended to perform particle identification for momentum up to 2 GeV/c. The “central barrel” components have an approximate cylindrical symmetry within $|\eta| < 1.5$. The beam line is surrounded by the large volume Time Projection Chamber which is enclosed by the TOF barrel. The TPC is the main tracker, and in conjunction with the TOF they will provide precise momentum measurements and particle identification. The Electromagnetic Calorimeter (ECal) is placed in between the TOF and the MPD magnet. It will be used for detection of electromagnetic showers, and will play the central role in photon and electron measurements. The MPD superconducting solenoid magnet is designed to provide a highly homogeneous magnetic field of up to 0.57 T (with a default operational setting of 0.5 T), uniform along the beam direction, to ensure appropriate transverse momentum resolution for reconstructed particles within the

range of momentum of 0-3 GeV/c. As the average transverse momentum of the particles produced in a collision at NICA energies is below 500 MeV/c, the detector was designed to have a very low material budget. In the forward direction, the Fast Forward Detector (FFD) is located still within the TPC barrel. It will play the role of a wake-up trigger.

Below in Fig. 10.1 and 10.2 give information about distribution of m^2 and p_t with positive and negative charges. In this analysis particle tracks are reconstructed using global tracks, which are tracks reconstructed using both TPC and TOF signals. Particles are also identified by using only the TPCs signal. TOF measure the particle velocity β relative to the speed of light in vacuum, $\beta = v/c$ which allowing the mass square m^2 of the particle to be determined:

$$m^2 = p^2(1/\beta^2 - 1) \quad (2)$$

stop time - start time = τ (time of flight) is associated with reconstructed tracks in the TPC by track extrapolation to the TOF. The TPC provides the momentum p , and total length L , so we can calculate inverse velocity [6].

$$\frac{1}{\beta} = \frac{c\tau}{L} \quad (3)$$

where c is speed of light. From the relativistic particle momentum, we obtain

$$p = m\beta\gamma \Rightarrow p^2 = \beta^2(m^2 + p^2) \quad (4)$$

where m is particle mass.

II. Analysis of the data

In this work we focus on Bi (83/209) + Bi (83/209) collisions at $\sqrt{s_{NN}} = 9.2$ GeV and impact parameter from 0 up to 12 fm within PHQMD model. Total number of events was used around one half million.

2.1 Event

For the analysis, selection of events in the center of the TPC is required, to avoid events that haven't occurred in the center of the TPC. Events required to have a $|V_z| < 150$ cm, where V_z is the z-coordinate of the primary vertex position which is measured by the TPC. Tails of the histogram for primary vertex in z-direction do not contain enough counts and therefore they are not added into analysis. The primary vertex position of an event in the radial direction $|V_r| < 0.1$ (cm).

The loss of formed particles on the edges of the detector is not the only problem that the position of the primary vertex introduces. In the transverse direction, if the primary vertex gets closer to the beam pipe, the collision of nuclei may be disrupted by one of the nuclei interacting with the beam pipe's material.

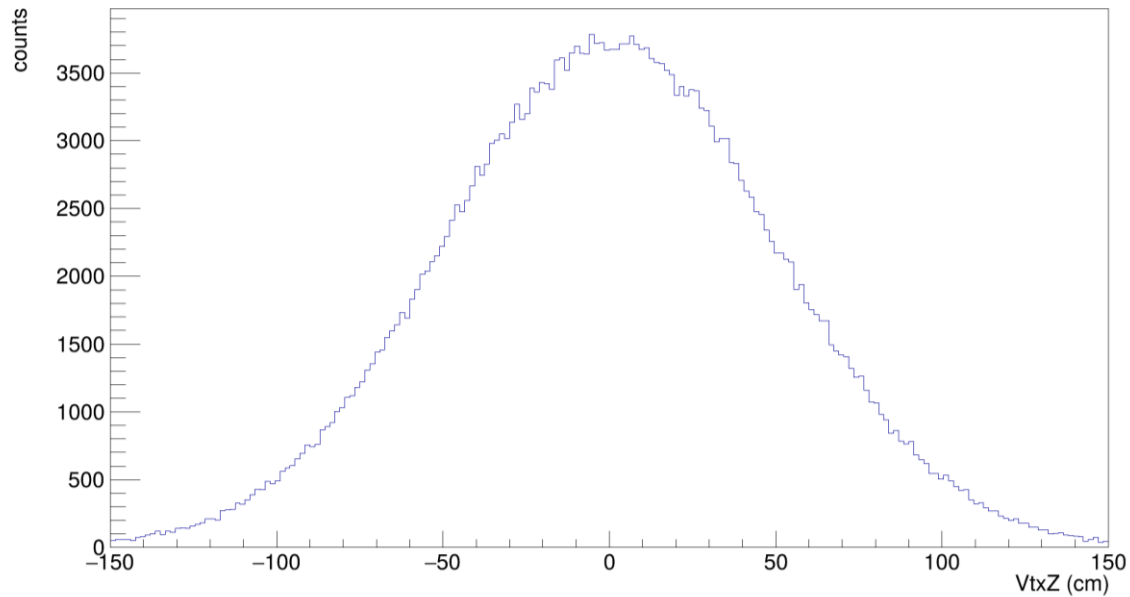


Figure 3. The primary vertex of z-coordinate.

In Fig.3 shows the position of the primary vertex z. In the Cartesian coordinate system, there are x, y, and z coordinates of the vertex. The z-coordinate is a longitudinal component that is responsible for the position of the primary vertex along the beam pipe of the MPD detector.

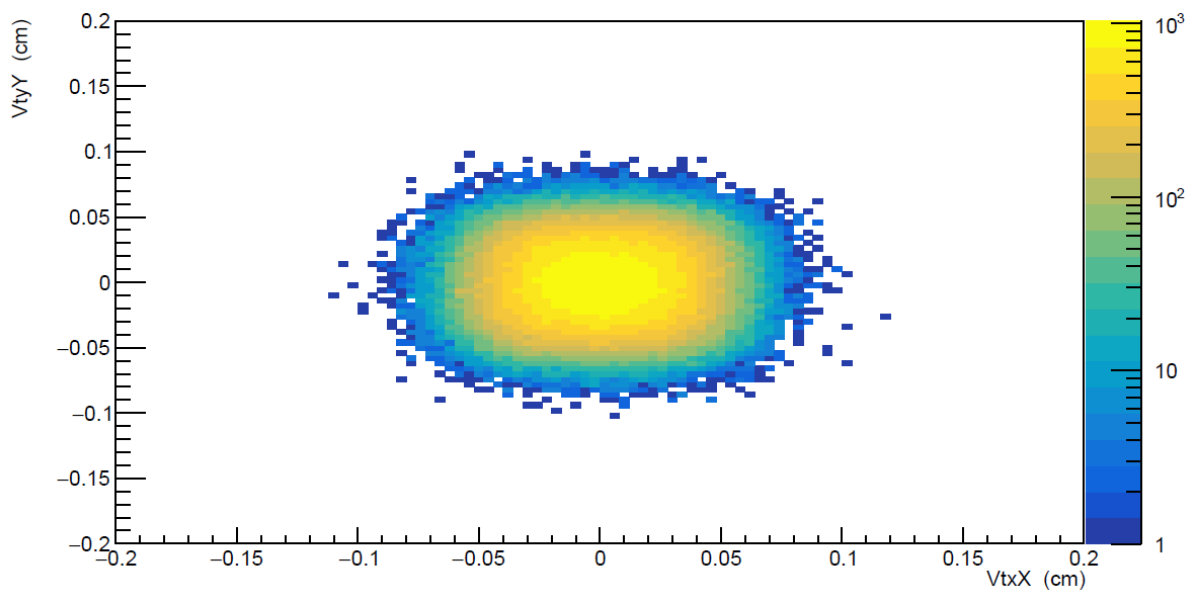
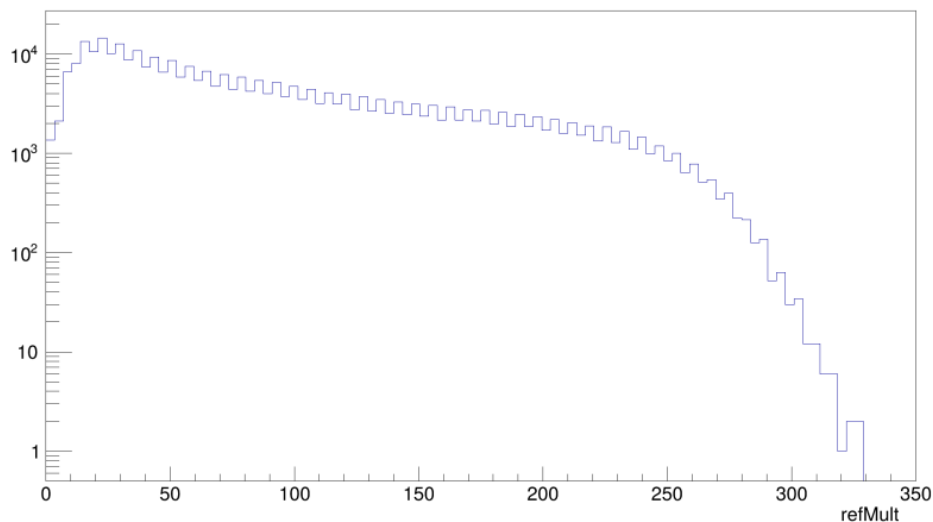


Figure 4. Primary vertex in xy-plane V_r .

The Fig .4 shows a 2D histogram representing the distribution of primary vertices in the XY-plane, specifically in $V_{tx}X$ and $V_{ty}Y$ centimeters. The color gradient indicates the density of events, with yellow representing areas of higher density and blue representing areas of lower density. The concentration of points around the center indicates the typical region where primary vertices are reconstructed in this experiment.



Figure

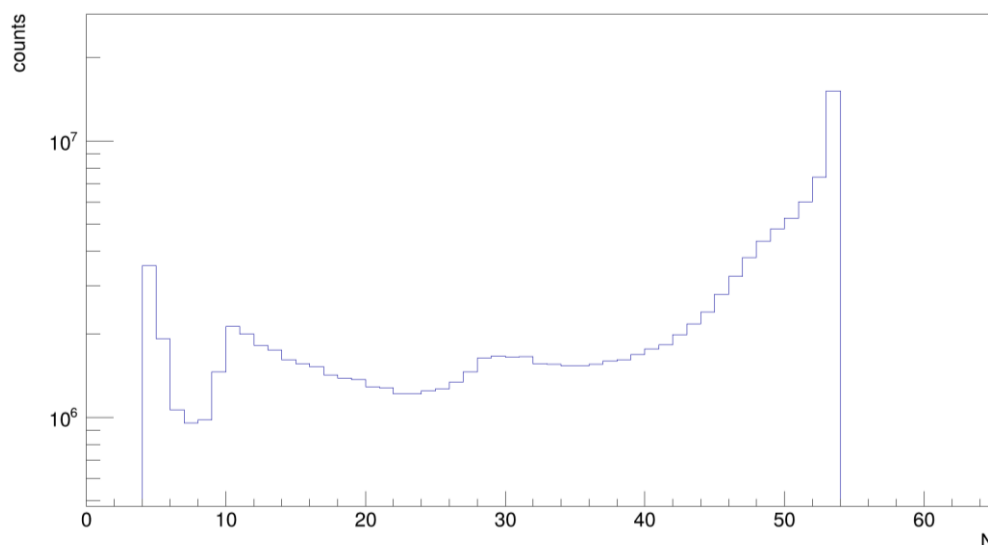
5. Reference multiplicity.

Reference multiplicity is connected to the event's centrality which describes the initial overlap region of the colliding nuclei. According to Fig.5 the distribution shows a peak at lower multiplicities, with a gradual decline as multiplicity increases. The x-axis represents the reference multiplicity, which is a measure of the number of tracks detected in event. The y-axis, on a logarithmic scale, represents the frequency of events corresponding to each multiplicity value.

2.2 Track

After selecting events, desired particles should be selected. As described in 2.1 part particle identification is done in the TPC and TOF detectors. To make sure, that measured particles fall into detector acceptance, only tracks with pseudorapidity $|\eta| < 1.5$ were accepted. Resulting tracks are denoted as global tracks and determine the vertex primary position. These tracks are called primary tracks.

Figure 6. Number of hits produced by a particle's track.



In Fig.6 displays a histogram that represents the distribution of the number of hits produced by a particle's track. The x-axis indicates the number of hits, while the y-axis shows the count of occurrences, on a logarithmic scale.

Pseudorapidity is found, using the following formula:

$$\eta = \frac{1}{2} \ln \left(\frac{|\vec{p}| + p_L}{|\vec{p}| - p_L} \right) \quad (5)$$

where $|\vec{p}|$ total momentum of the global track, p_L transverse momentum of the global track.

Figure 7.1. Distribution pseudorapidity of a particle.

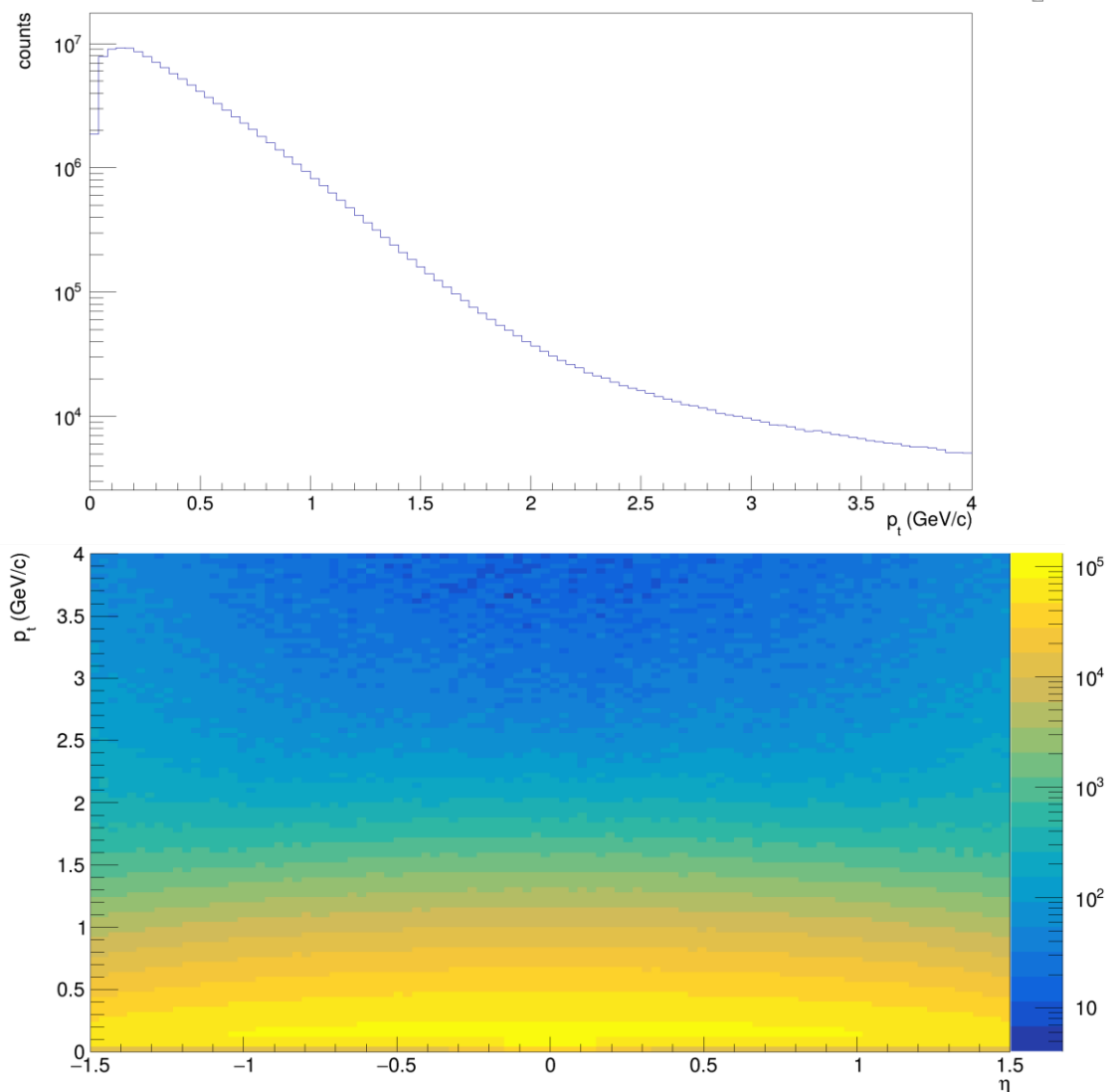


Figure 7.2 Distribution pseudorapidity of a particle.

In Fig.7.1 shows a one-dimensional distribution of particles over p_t , where p_t track primary transverse momentum, while in Fig.7.2 two-dimensional distribution of particles over η and p_t .

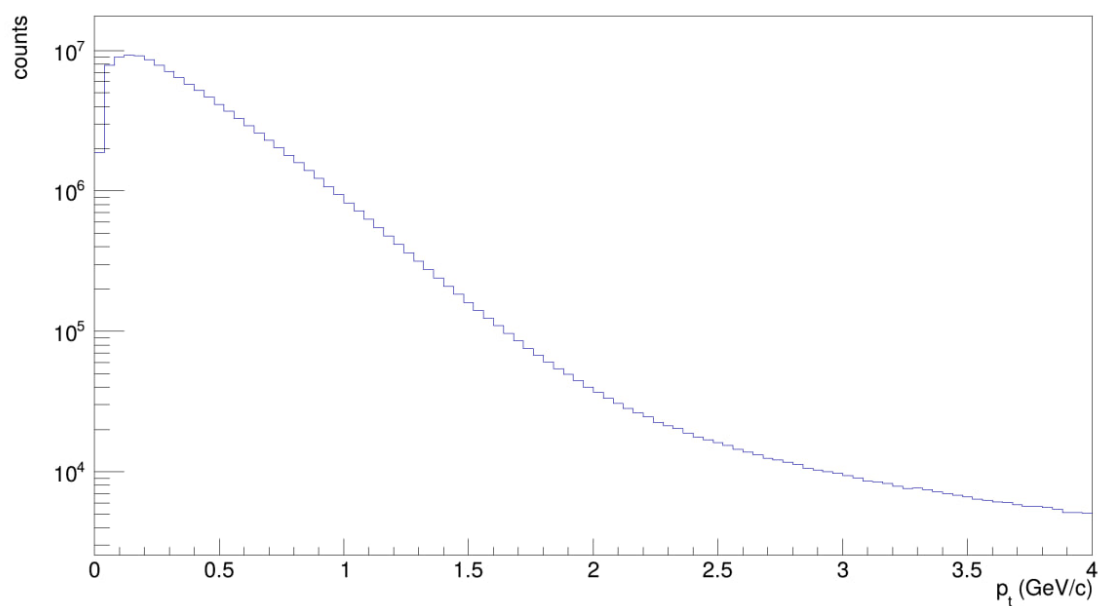


Figure 8.1. Track primary transverse momentum.

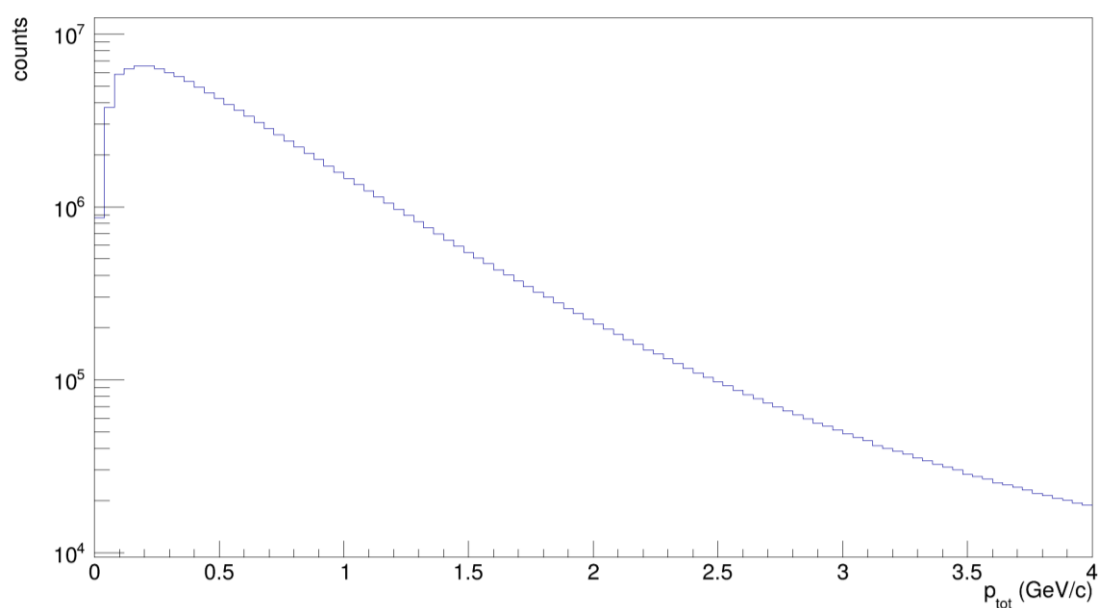


Figure 8.2. Track primary total momentum.

In Fig 8.1 and 8.2 show momentum of particle in track primary transverse and track primary total momentum.

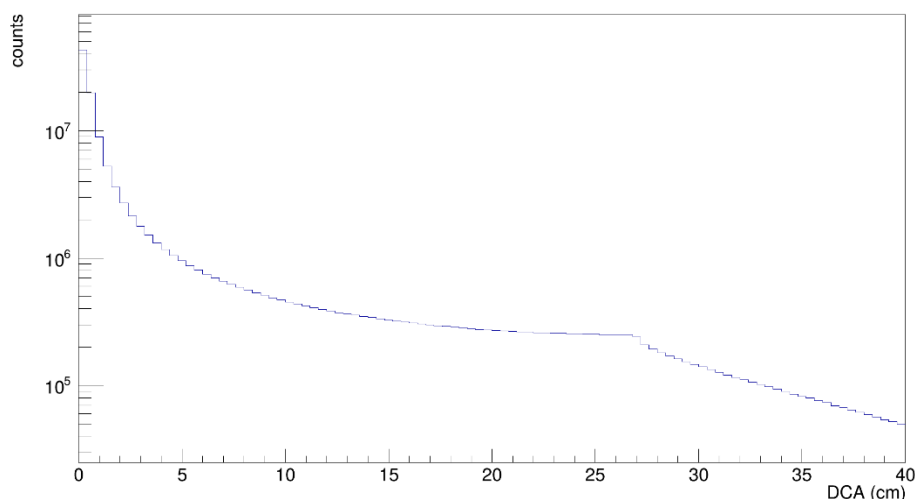


Figure 9. DCA distribution.

In Fig. 9 DCA (Distance of Closest Approach) is the shortest distance between two particles' trajectories in space the trajectories of charged particles are reconstructed using various detector layers. The DCA is calculated to determine how close a particle's trajectory comes to a specific point, such as the origin of the detector or another particle's trajectory.

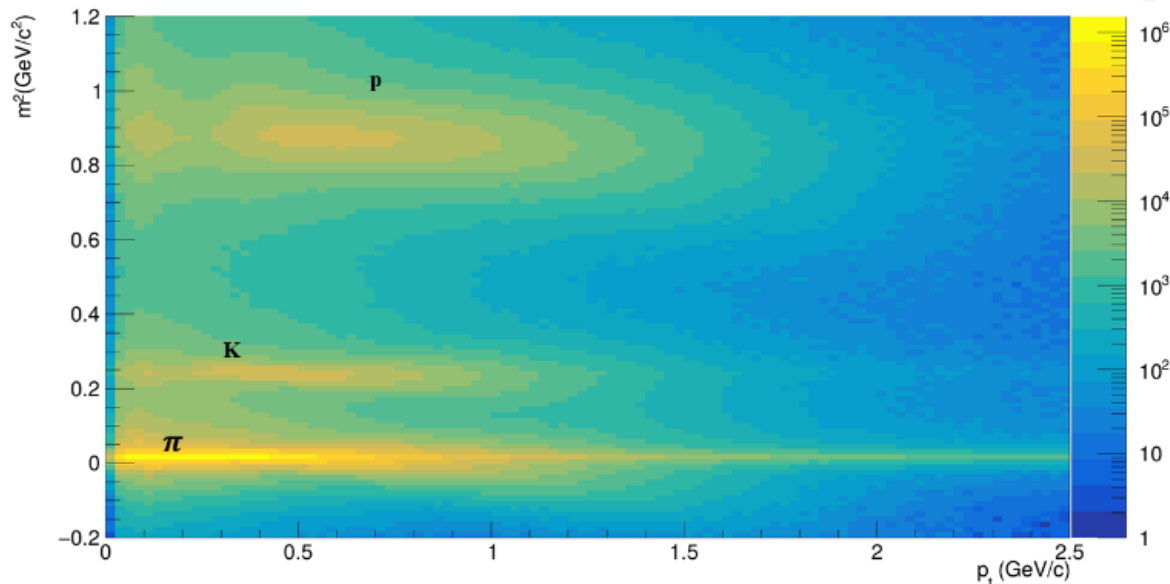


Figure 10.1. Distribution of m^2 a function of p_t for π^+ , K^+ , and p .

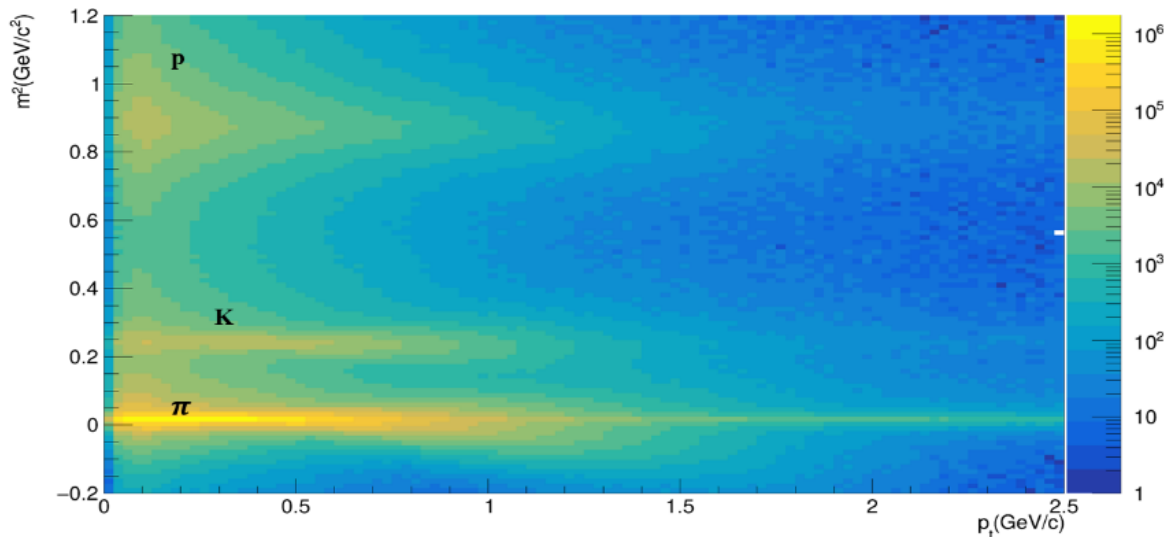


Figure 10.2. Distribution of m^2 as a function of p_t , for π^- , K^- and $\bar{p}$.

In Fig.10.1 and Fig.10.2 show the distribution of squared mass m^2 as a function of transverse momentum p_t for different types of particles. A histogram Fig.10.1 positive charges particles identified, while in Fig.10.2 particles with negative charges. These plots are often used to distinguish different particles based on their mass and momentum, especially in experiments involving particle collisions. The specific curves allow for the identification of particles like π , K , p , and d .

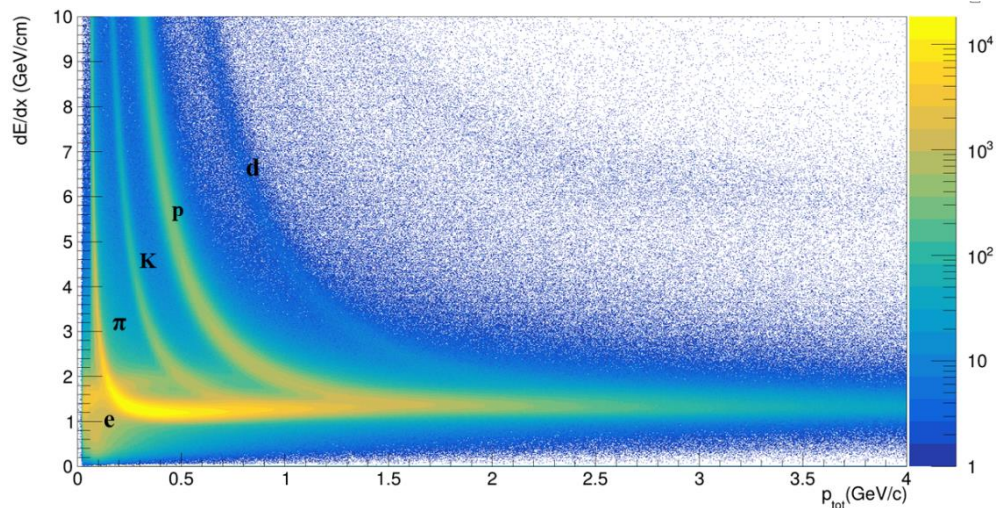


Figure 11. Distribution of ionization loss energy for e , π , K , p and d are identified.

Fig.11 shows a distribution of ionization energy loss (dE/dx) versus momentum (p_{tot}) for different particles (electrons, pions, kaons, protons and deuterons).

This type of plot is typically used in particle detectors, such as the MPD (Multi-Purpose Detector), to identify particles based on their specific energy loss as they pass through a medium. Each particle type follows a distinct curve in the plane, allowing for particle identification.

The color scale on the right indicates the number of detected events, with a higher count shown in warmer colors (yellow) and lower counts in cooler colors (blue).

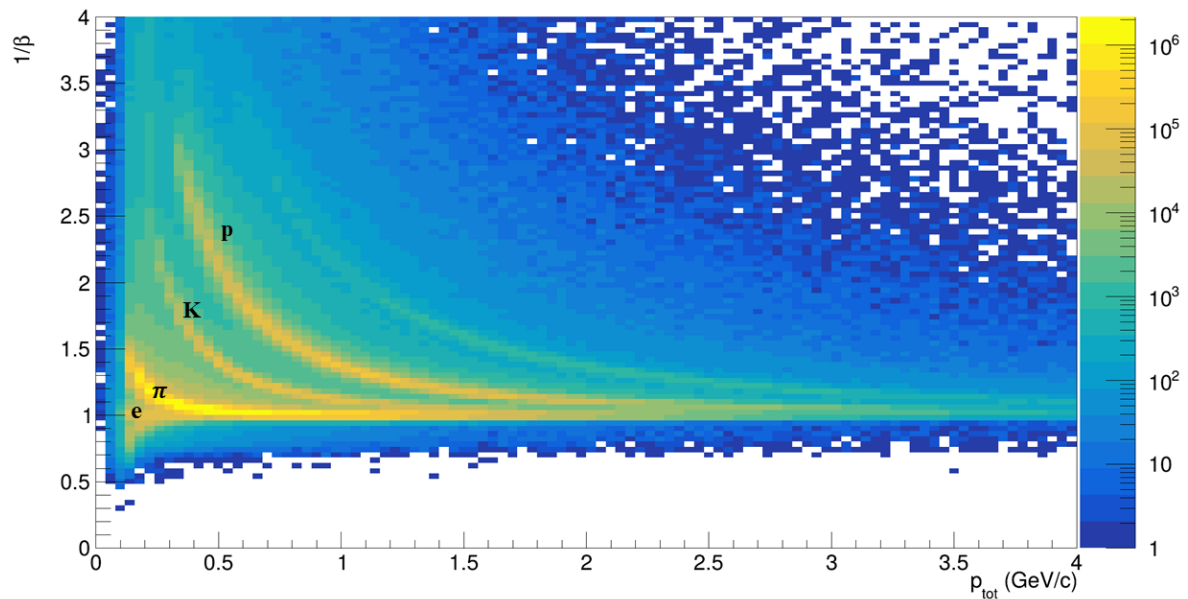
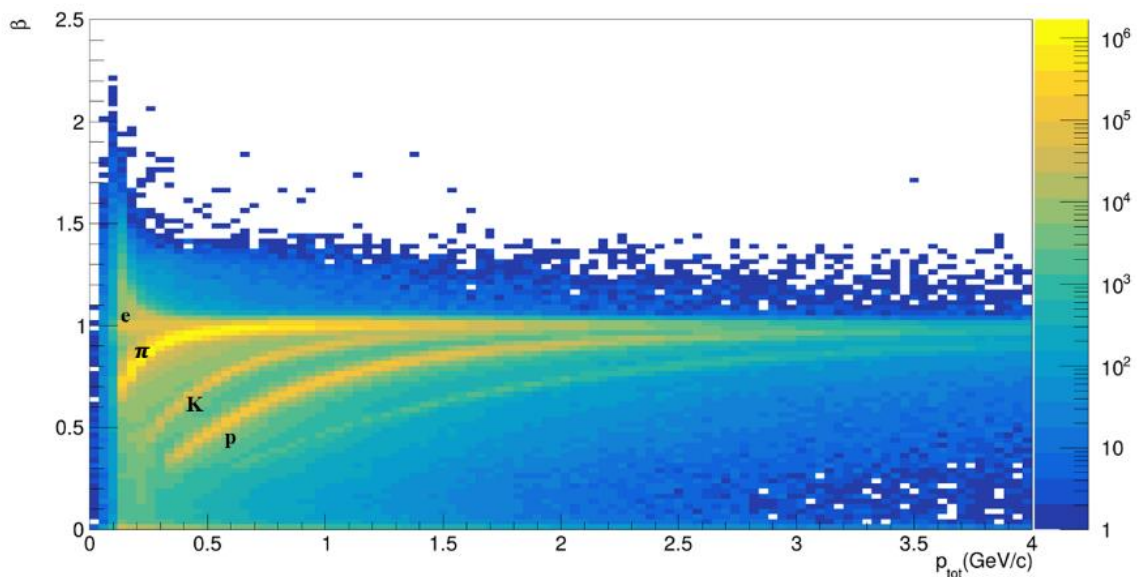


Figure 12.1 The TOF $1/\beta$ versus total momentum p_{tot} of tracks.



Figure

12.2 The TOF β versus total momentum p_{tot} of tracks.

Fig.12.1 is a histogram of the dependence of $1/\beta$ on the total momentum p_{tot} . and Fig.12.2 is a histogram of the dependence of β on p_{tot} . The graph also shows the distribution of different particles as a function of their total velocity. These figures allow distinguishing between particle types based on their velocities and total momentum.

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- [4] <https://lkst.pnpi.nw.ru/projects/nica/tpc/>
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- [6] https://www.star.bnl.gov/public/tof/publications/TOF_20040524.pdf

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SHOLI QOBIG'I ASOSIDA OLINGAN IONITGA Cr^{3+} SORBSIYASI

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ANNOTATSIYA

Mazkur maqolada sholi qobig'i asosida olingan ionit materialining Cr (III) ionlarini yutish jarayoni o'rganilgan. Ionit tayyorlash texnologiyasi, sorbsiya sharoitlari va parametrlariga oid ma'lumotlar keltirilgan. Tadqiqot natijalariga ko'ra, sholi qobig'idan tayyorlangan ionit samarali biosorbent sifatida foydalanilishi mumkinligi tasdiqlandi.

Kalit so'zlar: sholi qobig'i, Cr^{3+} , ionit, sorbsiya, biosorbent, ammoniy persulfat, pH o'lchagich, spektrofotometr.

АБСТРАКТНЫЙ

В данной статье изучается процесс поглощения ионов Cr (III) ионообменным материалом на основе рисовой шелухи. Приведены сведения о технологии приготовления ионообменников, условиях и параметрах сорбции. Результаты исследования подтвердили, что ионит из рисовой шелухи может быть использован в качестве эффективного биосорбента.

Ключевые слова: рисовая шелуха, Cr^{3+} , ионообменник, сорбция, биосорбент, персульфат аммония, pH-метр, спектрофотометр.

ABSTRACT

This article studies the adsorption of Cr (III) ions by ionite material obtained from rice husk. Information on the technology of ionite preparation, sorption conditions and parameters is presented. According to the results of the study, it was confirmed that ionite prepared from rice husk can be used as an effective biosorbent.

Keywords: rice husk, Cr^{3+} , ion exchanger, sorption, biosorbent, ammonium persulfate, pH meter, spectrophotometer.

KIRISH

Atrof-muhitning og'ir metall ionlari bilan ifloslanishi global ekologik muammolardan biri bo'lib, sanoat chiqindilari, konchilik faoliyati, elektroplatlash, bo'yoq va kimyo sanoatlari ushbu ifloslanishning asosiy manbalaridir [1]. Xususan, xrom ionlari (Cr^{3+}) sanoat oqavalarida keng tarqalgan bo'lib, yuqori toksikligi va atrof-muhitda barqarorligi sababli jiddiy ekologik va sog'liq muammolarini keltirib chiqaradi [2]. Cr^{3+} ionlari organizmga tushganda jigar, buyrak, o'pka va immun tizimiga zarar yetkazishi, shuningdek, kanserogen ta'sir ko'rsatishi mumkin [3]. Shu sababli, sanoat oqavalaridan Cr^{3+} ionlarini samarali usullar bilan tozalash masalasi dolzarbdir.

ADABIYOTLAR TAHLILI VA METODOLOGIYA

Hozirgi vaqtda xrom ionlarini ajratib olishda kimyoviy cho'ktirish, membranalik ajratish, ion almashinuv va elektrokoagulyatsiya usullari qo'llanilmoqda [4]. Biroq, bu usullar yuqori xarajatlar, ikkilamchi ifloslanish va murakkab texnologik jarayonlar kabi kamchiliklarga ega. Shu nuqtai nazardan, biosorbentlar yordamida sorbsiya usuli ekologik toza va iqtisodiy jihatdan samarali alternativ usul sifatida katta qiziqish uyg'otmoqda.

Biosorbent sifatida qishloq xo'jaligi chiqindilaridan foydalanish atrof-muhitni muhofaza qilish va chiqindilarni qayta ishlash nuqtai nazaridan muhim ahamiyat kasb etadi. Sholi qobig'i arzonligi, keng tarqalganligi va yuqori uglerod tarkibiga ega bo'lganligi sababli biosorbent sifatida istiqbolli xomashyo manbai hisoblanadi. Tadqiqotlar sholi qobig'i asosida olingan biosorbentlarning og'ir metall ionlarini, jumladan, rux va mis ionlarini samarali yutishini ko'rsatgan.

Shu bilan birga, sholi qobig'ini modifikatsiyalash orqali uning sorbsiya qobiliyatini oshirish mumkin [5]. Ionitlar — kimyoviy modifikatsiya qilingan biosorbentlar bo'lib, ular yuqori selektivlik va sorbsiya quvvatiga ega. Sholi qobig'i asosida olingan ionitlar ekologik xavfsizligi, iqtisodiy samaradorligi va qayta ishlash imkoniyatlari bilan ajralib turadi.

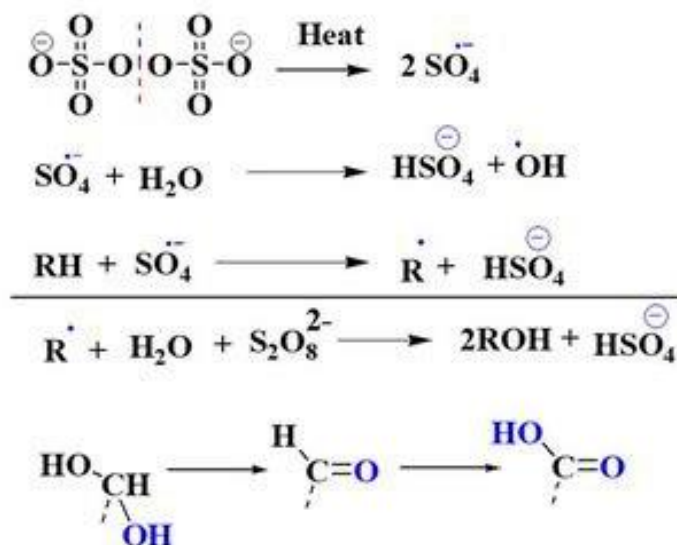
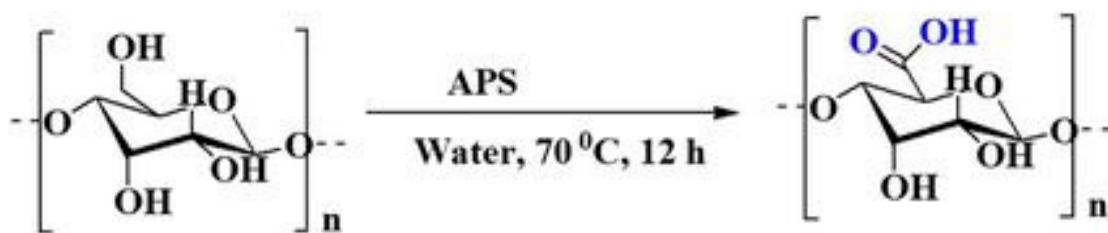
Ushbu maqolada sholi qobig'i asosida olingan ionit yordamida Cr^{3+} ionlarining sorbsiya jarayonlari o'rganiladi. Tadqiqotda sorbsiya kinetikasi, izotermalari va termodinamikasi tahlil qilinib, ionitning samaradorligi baholanadi. Bu ish sanoat oqavalarini tozalashda ekologik toza va arzon texnologiyani joriy etishda ilmiy-amaliy asos bo'lib xizmat qiladi.

Atrof-muhitni og'ir metallar bilan ifloslanishi bugungi kunda dolzarb muammolardan biridir. Xrom ionlari, xususan, Cr(III) va Cr(VI) , sanoat oqava suvlarida keng uchraydi. Ushbu ionlarning yuqori konsentratsiyasi sog'liq uchun xavfli bo'lib, atrof-muhitga zarar yetkazadi. Shu sababli samarali sorbentlar ishlab chiqish va qo'llash masalasi katta ahamiyatga ega.

Materiallar va uskunalar. Tadqiqotda quyidagi materiallar va uskunalardan foydalanildi:

- Ionit tayyorlash. Sholi qobig‘i mexanik aralashmalardan tozalandi, ishqorning 3 % li eritmasida 24 soat qoldirildi. Distillangan suvda neytral holatgacha yuvildi hamda quritildi. 25 g na‘muna 250 ml 20% ammoniy persulfat eritmasida 100°C haroratda 4 soat davomida modifikatsiyalandi. Modifikatsiyadan so‘ng material distillangan suv bilan yuvilib, quritildi va keyingi tajribalar uchun saqlandi.

Modifikatsiya jarayonida quyidagi reaksiya sodir bo‘ldi:



Adsorbsion tajribalari. Adsorbsion qobiliyatni o'rganish uchun modifikatsiyalangan sholi qobig'i CrCl_3 ning turli konsentratsiyadagi eritmalarida sinovdan o'tkazildi. 0.0025 M, 0.005 M, 0.01 M va 0.025 M konsentratsiyadagi CrCl_3 eritmaları tayyorlandi. Har bir tajriba uchun 1 g modifikatsiyalangan sholi qobig'i 100 ml eritmaga qo'shilib, xona haroratida 24 soat davomida qoldirildi.

Eritmalar markazdan qochma usul bilan filtrlab olinganidan so'ng, qoldiq Cr(III) ionlarining konsentratsiyasi atom-adsorbsion spektrofotometr yordamida o'lchandi. Adsorbsion miqdori quyidagi tenglama bo'yicha hisoblandi:

1-formula

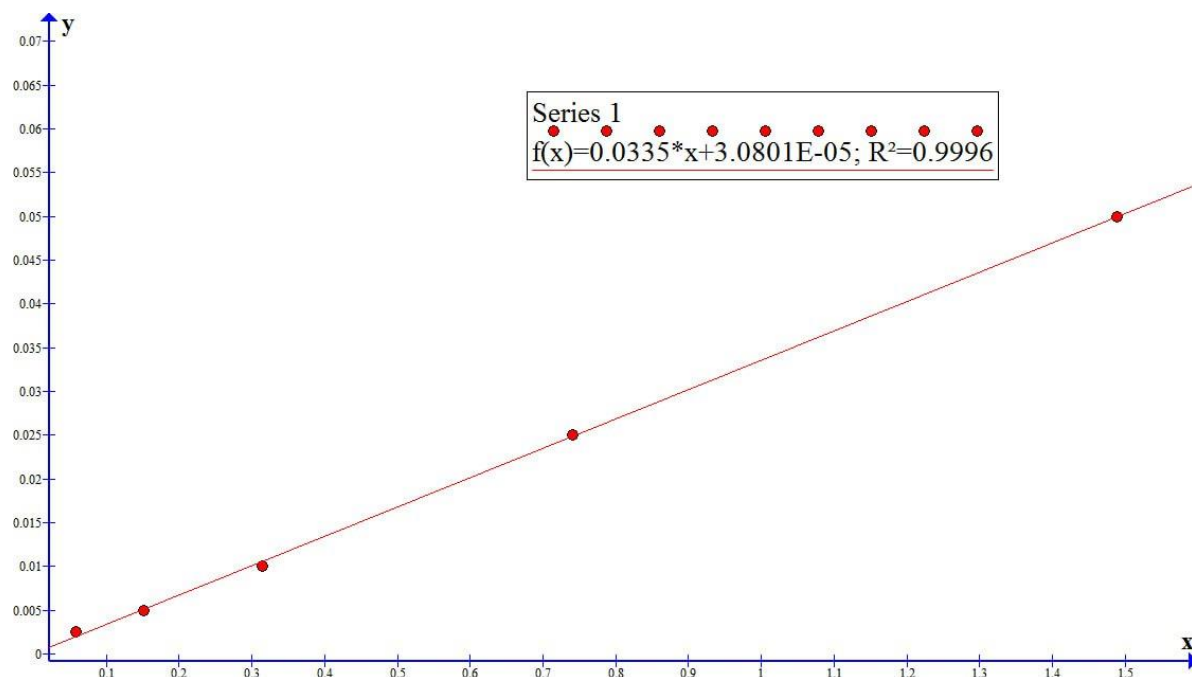
$$q_e = \frac{(C_0 - C_e) \cdot V \cdot Ar}{m}$$

Bu yerda:

- q_e : adsorbsiyalangan Ni(II) ionlarining massasi (mg/g),
- C_0 : boshlang'ich konsentratsiya (mg/ml),
- C_e : qoldiq konsentratsiya (mg/ml),
- V : eritma hajmi (ml),
- m : biosorbentning massasi (g)
- Ar : nikel (II) ionining nisbiy atom massasi

NATIJARLAR VA MUNOZARA

Modifikatsiyalangan sholi qobig'ining Cr(III) ionlarini adsorbsiya qilish qobiliyati yuqori bo'lib, maksimal yutish miqdori 1 g biosorbent uchun 352.56 mg bo'ldi. Adsorbsion natijalar boshlang'ich Cr(III) konsentratsiyasiga bog'liq bo'lib, yuqori konsentratsiyalarda adsorbsion qobiliyat ortgan. Dastlabki va yutilgandan keying eritmalarining konsentratsiyasi kalibrofkalangan grafik yordamida topildi (1-grafik). (1-grafik).



1-grafik. Cr (III) ioni konsentratsiyaning nur sindirish ko'rsatgichiga bog'liqlik grafigi

Turli konsentratsiyalardagi CrCl_3 eritmalari bilan o'tkazilgan tajribalar quyidagilarni ko'rsatdi:

- 0.0025 M: Adsorbsiyalangan ion miqdori pastroq bo'ldi.
- 0.005 M: Adsorbsion samaradorlik sezilarli darajada oshdi.
- 0.01 M va 0.025 M: Adsorbsiyalangan miqdor yuqorilab, maksimal qiymatga yaqinlashdi.

Sorbsiya jarayoni dastlab tez o'sadi va 180 daqiqadan keyin barqarorlashadi. Bu materialning yuqori sorbsiya qobiliyatini tasdiqlaydi

XULOSA

Olingan natijalar shuni ko'rsatadiki, sholi qobig'idan tayyorlangan ionit Cr (III) ionlarini samarali ravishda yuta oladi. Optimal sorbsiya sharoitlari $\text{pH}=7$ va harorat 25°C atrofida bo'ldi. Mazkur biosorbent ekologik toza va iqtisodiy jihatdan samarali bo'lib, sanoat oqava suvlarini tozalashda keng qo'llanilishi mumkin.

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TAQRIBIY HISOBLASHLARNING HISOBLASH MADANIYATINI SHAKLLANTIRISHDAGI AHAMIYATI

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Annotatsiya. Ushbu Taqribiy hisoblashlarning hisoblash madaniyatini shakllantirishdagi ahamiyatini o'rganish haqida bo'lib, hisoblash madaniyati matematika kursining barcha bosqichlarida shakllantiriladi, lekin uning asosi 1-sinf dan 6-sinf gacha yaratiladi. Bu davrda o'quvchilar matematik amallardan ongli foydalanish ko'nikmasini egallaydilar. Keyinchalik olingan ko'nikma va malakalar takomillashadi va boshqa predmetlarni o'rganishda mustahkamlanadi.

Kalit so'zlar: Taqribiy hisoblash qoidalari Ishonchli raqamlar ortiqcha raqam Ko'paytma, bo'linma, darajaning xatoligi Raqamlarni sanash qoidasi va boshqalar.

Oxirgi yillarda hisoblash malakalarini rivojlantirishga alohida e'tibor berilmayapti. Bu ongli va puxta hisoblash malakalarini shakllantirish dolzarb vazifalardan hisoblanadi. Bu hatto kuchli o'quvchining ham hisoblash malakalarining yo'qligi tufayli testlarda o'z bilimlarini to'la qonli namoyish etishga xalaqit beradi.

Agar o'quvchilar natural sonlar, o'nli va oddiy kasrlar bilan matematik amallarni etarlicha tezlikda bajara olishlari hamda turli sonli ifodalarni ayniy almashtirishlarni va taqribiy hisoblashlarni bajara oladigan darajada ko'nikma va malakalarga ega bo'lsa, hisoblash ko'nikma va malakalari shakllangan deb hisoblanadi,.

Ko'pincha tajribasiz o'quvchilar hisoblashlarda foydalanilgan ma'lumotlar aniqligi bilan umuman mos tushmaydigan natijani hosil qiladilar. Bu esa mehnat va vaqtning behuda sarflanishiga olib keladi. Quyidagi holni qaraymiz.

Masalani yechishda biror jismning modda zichligi R ni hisoblash talab qilingan bo'lsin. Jism hajmi $m = 9,38$ g va uning hajmi $V = 4,46$ sm³ berilgan bo'lsin. Berilgan ma'lumotlar uchta ishonchli raqamga ega

Ma'lumot. Ishonchli raqamlar deb, noldan tashqari barcha raqamlarga aytiladi, hamda nol ikki holda: 1) u ishonchli raqamlar orasida joylashgan bo'lsa; u berilgan sonda mos razryad birligi mavjud bo'lmagan holda son oxirida turgan bo'lsa, masalan,

1,57, 0,00507, 3,80 sonlari uchta ishonchli raqamga ega. Izlanayotgan modda zichligini hisoblashga tanqidiy yondashmasdan $\rho = \frac{m}{V} = \frac{9,38}{4,46} = 2,71098 \text{ g/cm}^3$.

natijani olish mumkin. Lekin yozilgan natija ishonchli bo'lib faqat birinchi uchta ishonchli raqam hisoblanadi, bu berilganlar aniqligiga mos keladi. Demak, olingan

natijani yaxlitlash lozim va $\rho = 2,71 \text{ g/cm}^3$ ko'rinishda yozish mumkin. Taqribiy hisoblashlarni quyidagi qoidalarga rioya qilgan holda bajarish lozim.

Taqribiy sonlarni qo'shish va ayirishda oxirgi natijani shunday yaxlitlanadiki, u hech bo'lmaganda bitta taqribiy sonning razryad birliklarida bo'lmagan raqamlarni o'z ichiga olmasin.

Masalan, sonlarni qo'shishda

$$\begin{array}{r} 4,462 \\ 2,38 \\ 1,17273 \\ 1,0262 \\ \hline 9,04093 \end{array}$$

yig'indini yuzdan bir ulushgacha yaxlitlab, uni 9,04 ga teng deb olish lozim.

Ko'paytirishda ko'paytuvchilarni shunday yaxlitlash lozimki, ularning har biri eng kam sondagi raqamlarga ega bo'lgan son qancha ishonchli raqamlarga ega bo'lsa, shuncha ishonchli raqamga ega bo'ladi.

Masalan,

$$\begin{array}{r} 3,723 \cdot 2,4 \cdot 5,1846 \\ \hline \text{ifodani hisoblash o'rniga} \\ 3,7 \cdot 2,4 \cdot 5,2 \end{array}$$

ifodani hisoblash lozim. Oxirgi natijada ko'paytuvchilarda yaxlitlashdan so'ng qancha ishonchli raqam bo'lsa, shuncha raqam qoldirish lozim. Oraliq natijalarda bitta ko'p ishonchli raqam qoldirish lozim. Bunday qoida taqribiy sonlarni hisoblashda ham amal qilinadi.

Kvadrat

ga va kubga ko'tarishda daraja asosida nechta ishonchli raqam bo'lsa, shuncha ishonchli raqam olish kerak.

Masalan,

$$1,32^2 \approx 1,74$$

Kvadrat yoki kub ildiz chiqarishda ildiz ostida qancha ishonchli raqam bo'lsa, shuncha ishonchli raqam olish kerak.

Masalan,

$$\sqrt{1,17 \cdot 10^{-8}} \approx 1,08 \cdot 10^{-4}$$

Murakkab ifodalarni hisoblashda ko'rsatilgan qoidalarni bajarilayotgan amallar turi bilan mos ravishda qo'llash lozim

Masalan,

$$\frac{(3,2 + 17,062)\sqrt{3,7}}{5,1 \cdot 2,007 \cdot 10^3}$$

Ko'paytuvchi 5,1 eng kam ishonchli raqamga ega, ya'ni ikkita. Shuning uchun barcha oraliq hisoblashlar natijalari uchta ishonchli raqamgacha yaxlitlanishi lozim:

$$\frac{(3,2 + 17,062)\sqrt{3,7}}{5,1 \cdot 2,007 \cdot 10^3} \approx \frac{20,3 \cdot 1,92}{10,3 \cdot 10^3} \approx \frac{39,0}{10,3 \cdot 10^3} \approx 3,79 \cdot 10^{-3}$$

Natijani ikkita ishonchli raqamgacha yaxlitlashdan so'ng oxirgi natija $3,8 \cdot 10^{-3}$ natijani olamiz

Bu qoidalarni na faqat masalalar echishda, balki laboratoriya ishlarini bajarishda o'lchashlar natijalarini qayta ishlashda foydalanish mumkin.

1-masala. Kolba va po'kak alohida tortildi, ularning massalari mos ravishda $m_K = 323,1$ g va $m_P = 5,722$ g larga teng bo'ldi (po'kak aniqroq tarozida tortildi). Kolba va po'kakning birgalikdagi massasini topish uchun

$m_{K+P} = 323,1 + 5,722 = 328,822$ g deb olish noto'g'ri bo'lar edi. Haqiqatdan, kolba massasi 0,1 g gacha aniqlikda topilgan va shuning uchun javobdagi yuzdan va mingdan birlar na faqat ortiqcha raqamlar, balki zararli: m_K massa 0,001 gacha aniqlangandek bo'ladi, bu esa noto'g'ri. Shuning uchun qo'shishda m_P ni 2 ta raqamgacha yaxlitlash lozim. Va hisoblashlarni quyidagicha bajarish lozim: $m_{K+P} = 323,1 + 5,7 = 328,8$ g.

Bu javob yuqorida hisoblangan natijani yaxlitlasa ham hosil bo'ladi. Shunday qilib, yig'indida verguldan so'ng eng katta absolyut xatolikka ega hadda qancha raqam bo'lsa shuncha olinadi. Agar qo'shiluvchilar ko'p bo'lsa, ulardagi xatolar qo'shilishi mumkin va yig'indida katta xato berishi mumkin. Bunday hollarda ortiqcha raqam qoidasini qo'llash tavsiya etiladi: bitta ortiqcha raqam qoldirish kerak, javobda esa uni yaxlitlash lozim. Masalan: 132,7; 1,274; 0,06321; 20,96; 46,1521 sonlar yig'indisini topish talab etilgan bo'lsin. Eng katta absolyut xatolik birinchi qo'shiluvchida va u 0,1 ga teng. Shuning uchun qolgan qo'shiluvchilarni 0,01 gacha yaxlitlaymiz:

$$a = 132,7 + 1,27 + 0,06 + 20,96 + 46,15 = 201,14, \text{ ya'ni } a = 201,1.$$

Agar biz ortiqcha raqam qoidasidan foydalanmaganimizda barcha qo'shiluvchilarni 0,1 gacha yaxlitlagan bo'lar edik, u hoda kamroq aniqlikdagi natijani olgan bo'lar edik.:

$$a = 132,7 + 1,3 + 0,1 + 21,0 + 46,2 = 201,3.$$

2-masala. $\sqrt{5} + \sqrt{6} + \sqrt{7} + \sqrt{8}$ yig'indini 0,01 gacha aniqlikda topish talab qilingan bo'lsin, bunda ildiz ostida turgan butun sonlar aniq deb hisoblanadi. Ortiqcha raqam qoidasidan foydalanib ildizlar qiymatlarini 0,001 gacha aniqlikda qo'yamiz:

$$2,236 + 2,449 + 2,646 + 2,828 = 10,159, \quad \bar{a} = 10,16.$$

Agar qo'shiluvchilar soni juda ko'p bo'lsa, ikkita ortiqcha raqamdan foydalanish mumkin. Verguldan so'ng bir xil sondagi raqamlar bilan berilgan bir nechta qo'shiluvchilar yig'indisini hisoblashda yig'indining limitik absolyut xatosi qo'shiluvchilarnikidan kattaroq bo'ladi. Shuning uchun javobni oldingi raqamgacha yaxlitlash maqsadga muvofiq. Masalan: $\bar{a} = 1,38 + 8,71 + 4,48 + 11,96 + 7,33 \bar{a} = 33,86$ ni olamiz. Lekin oxirgi raqam shubhali, shuning uchun javobni $\bar{a} = 33,9$ ko'rinishda yozish lozim.

Bir nechta miqdorlarning yig'indisi yoki ayirmasining limitik absolyut xatosi bu miqdorlarning limitik absolyut xatoliklari yig'indisiga teng. Masalan, agar ikkita miqdor 0,1 gacha aniqlangan bo'lsa, u holda bu miqdorlarning yig'indisi yoki ayirmasi, 0,01 gacha aniqlangan, chunki xatoliklar qo'shilishi mumkin. Agar qo'shiluvchilar juda ko'p bo'lsa, u holda barcha xatolar qo'shilishi ehtimoli kam. Bunday holda yig'indining xatosini aniqlash uchun ehtimollar nazariyasi usullaridan foydalanish lozim. Bundan ko'rinadiki, yig'indida bir raqamni taxminan beshta qo'shiluvchidan boshlab, ikkita raqamni esa taxminan 500 ta qo'shiluvchidan boshlab yaxlitlashni boshlash lozim.

Taqribiy sonlarni ayirishda ham qo'shishdagi qoidalar o'rinli, lekin yaqin sonlarni ayirishda nisbiy aniqlik keskin yomonlashadi. Masalan, 327,48 va 326,91 sonlar ayirmasini topish kerak bo'lsin, ayiriluvchi va kamayuvchida $D = 0,01$, ya'ni $d < 0,004\%$. 0,57 ga teng ayirmada esa limitik absolyut xato 0,02 ga teng, shuning uchun limitik nisbiy xato $d = 3,5\%$. Nisbiy xato 1000 martaga ortdi!

Shuning uchun yaqin sonlar ayirmasini bunday ayirishni bajarmasdan o'lchash yoki hisoblashga harakat qilish lozim. Agar bunday amalsiz bajarish mumkin bo'lmasa o'lchanayotgan ob'ektning mumkin bo'lgan kichigini tanlash va tortishni maksimal mumkin bo'lgan aniqlikda olib borish zarur.

Ko'paytmaning limitik nisbiy xatoligi taqriban ko'paytuvchilar limitik nisbiy qiymatlari yig'indisiga teng. 50 va 20 taqribiy sonlari ko'paytirilayotgan bo'lsin va birinchi ko'paytuvchininng limitik nisbiy qiymati 0,4% ga, ikkinchisniki esa 0,5% ga teng bo'lsin. U holda $50 \times 20 = 1000$ ko'paytmaning nisbiy xatoligi taqriban 0,9% ga teng. Ko'paytmaning nisbiy xatosi hammavaqt ko'paytuvchilar nisbiy xatolari yig'indisidan katta, u bu yig'indidan ko'paytuvchilar nisbiy xatolari ko'paytmasicha ortiq. Bu ortish odatda juda kichik va uni hisobga olib bo'lmaydi. Bizning holda $d = 0,004 + 0,005 + 0,004 \cdot 0,005 = 0,00902$ ga ega bo'lamiz. Bu erdavi ortish $0,00902 - 0,009 = 0,00002$ ni tashkil etadi, ya'ni nisbiy xatoning taqribiy qiymatining 0,2% ini tashkil etadi. Bu ortish shunchalik kichikki, uni hisobga olish ma'noga ega emas.

Bo'linmaning nisbiy xatosi taqriban bo'linuvchi va bo'luvchi nisbiy xatolari yig'indisiga teng.

3-masala. 50,0 taqribiy son 20,0 taqribiy songa bo'linayotgan bo'lsin. Bo'luvchi va bo'linuvchi xatoligi 0,05 ga teng. U holda bo'linuvchining nisbiy xatosi = 0,1%, bo'luvchining nisbiy xatosi = 0,25%. $50,0:20,0 = 2,50$ bo'linmaning nisbiy xatosi taqriban 0,35% ni tashkil etishi lozim.

Nisbiy xatoning aniq miqdori yuqorida qoida bilan hisoblangan ortish taqribiy foyizidan ko'proq bo'ladi va taxminan bo'luvchining nisbiy xatoligiga teng bo'ladi.

(Butun) darajaga ko'tarish takroriy ko'paytirish va shuning uchun unga ham yuqorida aytilganlar taaluqli. Unchalik katta bo'lmagan darajaga ko'tarishda natija olingan son qancha to'g'ri raqamga ega bo'lsa shuncha to'g'ri raqamga ega bo'ladi va oxirgi raqamda unchalik katta bo'lmagan xatoga ega. Agar daraja katta bo'lsa, unchalik katta bo'lmagan xatolar yig'ilmasi yuqori rapzryad yuzligi raqamlarida aks etishi mumkin.

Ixtiyoriy darajali ildizni chiqarishda hech bo'lmaganda ildiz ostidagi qancha to'g'ri raqam bo'lsa, shuncha to'g'ri raqamga ega.

Bu teskari masalaning echimi keltirilgan taqribiy hisoblashlar qoidalariga tayanadi.

O'lchamli kolbaning aniq hajmi suvni tortish bilan hisoblanadi, harorat (taxminan hajmi 100 ml) $20 \pm 2^\circ \text{S}$ gacha saqlanadi. Mumkin bo'lgan maksimal aniqlikka erishish uchun, tortishni qanday aniqlikda o'tkazish lozim qanday qo'shimcha ma'lumotlar sizga zarur?,

Taqribiy hisoblashlarda ko'pincha ham taqribiy, ham aniq sonlarni yaxlitlashga to'g'ri keladi. Ya'ni bitta yoki bir nechta oxirgi raqamni tashlab yuboriladi. Yaxlitlangan sonning eng katta aniqligini ta'minlash uchun quyidagi qoidalariga rioya qilinadi

1-qoida. Agar tashlanadigan raqamlardan birinchisi 5 dan katta bo'lsa, u holda saqlanadigan sonlardan oxirgisit bi birlikka oshiriladi. Bu ortirish tashlanayotgan raqamlardan birinchisi 5 ga teng bo'lsa, undan keyin keladigan bitta yoki bir nechta ishonchl i raqamlar bo'lsa ham amalga oshiriladi.

4-masala. 27,874 sonini uchta raqmgacha yaxlitlab 27,9 ni yozamiz. Uchinchi 8 raqami 9 gacha orttirilgan, chunki birinch tashlanadigan 7 raqami 5dan katta. 27,9 soni berilgan songa orttirilmagan yaxlitlangan 27,8 songa qaraganda yaqin,

5-masala. 36,251 sonini birinchi o'nli raqamgacha yaxlitlab 36,3 ni yozamiz. 2 raqam 3 gacha oshirilgan. Chunki birinchi tashalanuvchi raqm 5 ga teng, undan keyin keluvchi ishonchli raqam 1. 36,3 soni berilgan songa orttirilmagan 36,2 soniga qaraganda yaqin.

2-qoida. Agar tashlanadigan raqamlardan birinchisi 5 dan kichik bo'lsa, ortirish bajarilmaydi.

3-qoida. Agar 5 raqami tashlanayotgan bo'lsa, undan keyin ishonchli raqamlar bo'lmasa, u holda yaxlitlash yaqin juft sonigacha bajariladi, ya'ni oxirgi saqlanuvchi raqm o'zgamasdan qoldiriladi, agar u juft bo'lsa, va u ortiriladi, agar toq bo'lsa .E3-qoidani bir soni yaxlitlashga qo'llab yaxlitlash aniqligini orttirmaymiz. Lekin ko'p sonli yaxlitlashlarda ortiqcha sonlar kami yuilan olingan sonlar kasbi uchraydi. Xatoliklarni o'zaro yo'qolib ketishi natijaning eng katta aniqligini ta'minlaydi. 3-qoidani o'zgartirish mumkin va yaxlitlashni yaqin toq songacha qo'llash ham mumkin. Aniqlik o'shanday bo'laveradi.

7-masala. 0,0465 sonini uchinchi o'nli raqamgacha yaxlitlab 0,046 ni yozamiz.Kuchaytirish amalga oshirmaymiz, chunki oxirgi saqlanuvchi 6 raqami juft. 0,046 soni berilgan songa 0,047 kabi yaqin. .

8-masala. 0,935 sonini ikkinchi o'nli raqamgacha yaxlitlab 0,94.ni yozamiz. Oxirgi saqlanuvchi 3 raqami kuchaytiriladi, chunki u toq son.

9-masala.

6,527; 0,456; 2,195; 1,450; 0,950; 4,851; 0,850; 0,05 sonlarni birinchi o'nli raqamgacha yaxlitlab:

6,5; 0,5; 2,2; 1,4; 1,0; 4,9; 0,8; 0,0

larni olamiz

Xatoliklarni qat'iy hisobga olish va qat'iy hisobga olinmagan taqribiy hisoblashlar farqlanadi. Sodda taqribiy hisoblashlarda ko'pincha raqamlarni sanash qoidalariga asoslangan ikkinchi usuldan foydalaniladi.Bu qoidalarda o'nli raqamlar, ishonchli, aniq va shubhali raqamlar tushunchalari ishlatiladi. Eslatib o'tamiz o'nli raqamlar deb sonning verguldan o'ngda turgan raqamlariga aytiladi. Masalan, 3,5 va 3,05 sonlari mos ravishda bitta va ikkita o'nli raqamga ega. Sonning ishonchli raqamlari deb, chapdan birinchi noldan farqli raqamdan boshlab son yozuvining oxirida yaxlitlashda tashlab yuborilganlari o'rnida turgan noldan tashqari barcha raqamlarga aytiladi. (bu nollar odatda ajratib yoki kichik qilib yoziladi, bunday ishni qo'shilgan noto'g'ri raqamlar bilan ham qilish mumkin).

10-masala. 3,5 sonida —ikkita ishonchli raqam, 0,0307 sonida uchta ishonchli raqam. Mingdan birgacha yaxlitlash natijasida olingan 35000 sonida ikkita ishonchli raqam bor.

Agar taqribiy sonning absolyut xatoligi chegarasi uning oxirgi raqami razryadi birligini yarmiga teng bo'lsa, u holda bu sonning barcha raqamlari aniq deb ataladi. Agar bu chegara sonining oxirgi raqami razryadi birligi yarmidan katta bo'lsa, u holda oxirgi raqam shubhali deb ataladi.

11-masala. $2,06 \pm 0,005$ sonda 2, 0, 6 raqamlari aniq, 6 raqam –shubhali. Mingdan birgacha yaxlitlashda olingan 35000 sonida 3 va 5 raqamlari aniq, barcha uchta nol - shubhali.

Shunday usul bilan yozilgan taqribiy sonlar bilan hisoblashlar quyidagi qoidalariga amal qilib bajariladi .

4-qoida Taqribiy sonlarni qo'shish va ayirishda natijada eng kam sondagi o'nli raqamlarga ega berilgan taqribiy sonda qancha o'nli raqam bo'lsa shuncha raqam qoldiriladi.

Misol. 127,42; 67,3; 0,12 va 3,03 taqribiy sonlarning yig'indisini toping.

$$127,42 + 67,3 + 0,12 + 3,03 = 197,85 \approx 197,9$$

5-qoida Taqribiy sonlarni ko'paytirish va bo'lishda natijada eng kam sondagi ishonchli raqamlarga ega berilgan taqribiy sonda qancha ishonchli raqam bo'lsa shuncha qoldiriladi.

Misol. 3,4 va 12,32 sonlarni ko'paytirish

$$3,4 \cdot 12,32 = 41,888 \approx 42$$

12-masala. Yonish reaksiyasi issiqligi taqriban 7,6 kJ ga, modda miqdori — 0,38 mol ga teng. Yonishning molyar issiqligi nimaga teng?

Yonishning molyar issiqligi 7,6 ni 0,38 ga bo'linmasiga teng. Bo'lish amali quyidagicha bajariladi: agar sonlar butunga bo'linmasa, eng kam sondagi ishonchli raqamlarga ega sondan ko'proq keyingi raqamgacha bo'lish amalga oshiriladi va oxirgi raqamni yaxlitlab bo'lish tugatiladi, agar butun songa bo'linsa, ishonchli raqamdan so'nggi raqam yaxlitlanadi.

5-qoida. Taqribiy sonlarni kvadrat va kubga ko'tarishda natijada ular asosidagi qancha ishonchli raqam bo'lsa, shuncha qoldiriladi.

$$\text{Misollar. } 2,3^2 = 5,29 \approx 5,3; 0,8^3 = 0,512 \approx 0,5.$$

6-qoida. Oraliq hisoblashlarda natijalarda oldingi qoidalar tavsiya etayotgan raqamlardan bitta ko'p raqam olish lozim va yaxlitlashni hisoblash tugagandan so'ng amalga oshirish lozim.

7-qoida. Agar berilgan sonlarni ixtiyoriy aniqlik bilan olish mumkin bo'lsa, n ta raqamli natijani olish uchun raqamlari yuqorida qoidalar bo'yicha olingan natijada $n + 1$ raqamni beradigan sondagi raqamlarga ega taqribiy sonlarni olish lozim.

Bu qoidalar ehtimollik xarakterga ega ular eng ehtimolli, vaholonki bu qoidalarni qanoatlantirmaydigan misollar mavjud. Shuning uchun raqamlarni sanash usuli bilan hisoblash – amallar natijasini xatoligini baholashning eng qo'pol usulidir. Lekin u sodda va qulay va texnik hisoblashlar uchun yetarli. Shuning uchun bu usul hisoblash amaliyotida keng tarqalgan. Murakkab hisoblashlarda chegaralar usuli yoki chegaraviy xatoliklar hamda logarifmik usuldan foydalaniladi.

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AVTOMOBILLARGA YOQILG'I QUYISH SHAXOBCHALARIDA GAZ SARFINI OLDINI OLIISH TEXNOLOGIYASI

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ANNOTATSIYA

Ushbu maqolada avtomobillarga gaz quyish shaxobchalarida joylashgan kolonkalarining shlanglarida qolgan qoldiq gazlarning havoga sarfi o'rganiladi. Havoga isrof bo'layotgan gaz sarfini oldini olish uchun maxsus qurilma taklif qilinadi va qoldiq gazlar saqlanib qolinadi. Maqola davomida taklif qilinayotgan qurilmaning tarkibiy qismlari va ishlash prinsiplari bilan yaqindan tanishtiriladi hamda tegishli formulalar orqali gaz sarfi ko'rsatib beriladi.

Kalit so'zlar: shlang, yoqilg'i quyish shaxobchasi, gaz sarfi, berkitgichlar, fizik-kimyoviy yechimlar.

АННОТАЦИЯ

В данной статье рассмотрен расход остаточных газов, остающихся в шлангах колонок, расположенных на автозаправочных станциях. Предлагается специальное технологическое устройство, позволяющее предотвратить ненужный расход газа в воздух и удержать остаточные газы. В ходе статьи будут подробно рассмотрены компоненты и принципы работы предлагаемого устройства, и расход газа будет показан с помощью соответствующих формул.

Ключевые слова: шланг, топливозаправочная горловина, расход газа, пробки, физико-химические растворы.

ABSTRACT

This article examines the consumption of residual gases remaining in the hoses of columns located at gas stations. A special technological device is proposed that allows preventing unnecessary gas consumption into the air and retaining residual gases. Throughout the article, you will be closely familiarized with the components and operating principles of the proposed device, and gas consumption will be shown through appropriate formulas.

Key words: *hose, fuel filler neck, gas consumption, plugs, physical and chemical solutions.*

Bugungi kunda avtomobillar uchun yoqilg'i sifatida gazdan foydalanish keng tarqalgan. Gaz yoqilg'isi iqtisodiy jihatdan tejamkor va ba'zi yoqilg'ilarga nisbatan ekologik toza hisoblanadi. Ammo gaz quyish jarayonida sarfning samaradorligi va xavfsizligini ta'minlash, ortiqcha yoqilg'i sarfini oldini olish muhim masalalardan biri hisoblanadi. Gaz sarfi va samaradorlik masalalari nafaqat haydovchilarning iqtisodiy manfaatlariga, balki atrof-muhitni muhofaza qilishga ham ta'sir ko'rsatadi. Ushbu maqolada biz avtomobillarga gaz quyish jarayonida sarfni kamaytirishning asosiy usullari, ehtiyot choralarini ko'rish va yoqilg'i tejamkorligini ta'minlash yo'llari haqida so'z yuritamiz.

Yoqilg'i quyish shaxobchlarida avtomobillarga gaz quyishda bir qancha omillar sababli gaz havoga sarf (isrof) bo'ladi, ulardan asosiysi gaz shlangida kuzatiladigan kamchiliklardir. Gaz kalonka shlangida quyidagi kamchiliklar mavjud: a) Yoriqlar, teshiklar yoki sifatsiz shlanglar orqali gaz tashqariga chiqib ketishi mumkin. Bu holat gaz sarfini oshirib, yoqilg'i hisobiga ziyon yetkazadi. Shlangning ichki bosimni ushlab tuturmasligi gaz oqishini kuchaytiradi va foydalanuvchiga qo'shimcha xarajatlar olib keladi; b) Shlanglarda noto'g'ri ulanish yoki eskirish sababli bosim pasayishi mumkin. Bu holatda kallonkadan transport vositasiga gaz yetkazib berish samarasi pasayadi va gaz quyish jarayoni uzoq davom etadi. Natijada transport vositasiga kerakli miqdorda gaz quyilishi uchun ko'proq gaz sarflanadi; d) Shlangdagi muammolar gazning to'g'ri o'tchanmasligiga olib kelishi mumkin. Agar shlang orqali gaz oqimi barqaror bo'lmasa yoki qochqinlar bo'lsa, kallonka noto'g'ri sarf ko'rsatkichlarini namoyish qilishi mumkin. Bu holatda haqiqiy gaz sarfi ko'rsatilmaydi, natijada ortiqcha yoqilg'i sarflanishi ehtimoli oshadi; e) Agar shlang yetarlicha uzun bo'lmasa, transport vositasi kallonkaga yaqin turishga majbur bo'ladi, bu esa ba'zi hollarda noto'g'ri gaz berish holatlarini keltirib chiqarishi mumkin. Shuningdek, qisqa shlanglar orqali gaz yetkazib berish tizimi to'liq ishlamasligi mumkin, bu esa sarfni optimallashtirishga halaqit beradi; f) Shlanglarning eskirishi va zarar ko'rish natijasida ularni tez-tez almashtirish kerak bo'lishi mumkin. Bu esa gaz sarfi barqarorligini saqlash uchun qo'shimcha xizmat ko'rsatish xarajatlarini oshiradi [1].

Yuqorida keltirilgan kamchiliklarning yana biri va eng asosiysi avtomabilga gaz quyib bo‘linganidan keyin an’anaviy shlanglarda shlang ichidagi gaz havoga qasddan chiqarib yuboriladi (1-rasm). Bu amaliyotning esa bir qancha salbiy tomonlari mavjud:

- Atmosferaga chiqarilgan gaz metan kabi issiqxona gazlarini o‘z ichiga oladi, bu esa global isish va iqlim o‘zgarishiga salbiy ta’sir ko‘rsatadi. Metan karbonat angidrididan ko‘ra ancha kuchli issiqxona gazidir, shuning uchun uning atmosferaga chiqishi ekologik zarar yetkazadi;

- Gaz havoga chiqarilganda, u atrof-muhitni ifloslantiradi. Ayniqsa, zich aholiga ega hududlarda havodagi gaz miqdorining oshishi sog‘liq uchun xavf tug‘diradi. Bu esa nafas olish yo‘llari kasalliklari, allergik reaksiyalar va boshqa sog‘liq muammolarini keltirib chiqarishi mumkin;

- Gaz havoga chiqarilganda, u energiya sifatida yo‘qotiladi. Bu resursning noto‘g‘ri sarflanishi bo‘lib, iqtisodiy jihatdan zarar yetkazadi. Gaz qimmatli energiya manbai bo‘lganligi sababli, uning behuda sarflanishi gaz iste’molchilari va davlat uchun ham iqtisodiy yo‘qotishlarni keltirib chiqaradi;

- Gaz havoga chiqarilganida, uning kontsentratsiyasi muayyan darajaga yetganda portlash yoki yong‘in xavfi paydo bo‘lishi mumkin. Bu nafaqat shaxsiy xavfsizlik, balki atrofdagilar va shoxobchaga ham xavf soladi. Ayniqsa, nosoz uskunalar va sifatsiz shlanglar orqali chiqarilgan gaz katta xavf tug‘diradi;

- Ba’zi gazlar inson salomatligi uchun to‘g‘ridan-to‘g‘ri zararli bo‘lishi mumkin. Gaz chiqarilganda, u nafas yo‘llariga kirib, bosh aylanishi, ko‘ngil aynishi, bosh og‘rig‘i yoki hatto zaharlanishga olib kelishi mumkin [2].



1-rasm. An’anaviy kalonka shlangi

Havoga chiqarib yuboriladigan gazning miqdoriga to‘xtalib o‘tadigan bo‘lsak, avvalo shlangning ichki qismiga qancha gaz siqilishi mumkin ekanligini o‘rganishimiz kerak, buning uchun bizga shlang xarakteristikasi kerak bo‘ladi. Odatda yoqilg‘i quyish shaxobchalarida ishlatiladigan shlanglarning uzunligi 5 metr, diametri 1,27 sm bo‘lib o‘rtacha hisobda 200 bar bosim bilan gaz balonlarining ichiga yo‘nalitiriladi.

Biz birinchi navbatda yuqorida keltirilgan ma'lumotlarga asoslangan holda gaz shlangining ichki hajmini (V) hisoblab chiqishimiz kerak, buning uchun bizga quydagi formula kerak bo'ladi:

$$V = \pi \cdot \left(\frac{d}{2}\right)^2 \cdot L$$

bu yerda:

d = shlang diametri (metr);

L = shlang uzunligi (metr).

$$V = \pi \cdot \left(\frac{d}{2}\right)^2 \cdot L = 3,14 \cdot \left(\frac{0,0127}{2}\right)^2 \cdot 5 = 0,000633 \text{ V}$$

Yuqorida ko'rsatilgan natijalarni inobatga oladigan bo'lsak, endi biz O'zbekiston sharoitida va yoqilg'i quyish shaxobchalarida qancha bosim bilan gaz haydalishini va 0,000633 hajmli tuynukka qanchagacha gaz siqilishi mumkin ekanligini hisoblab chiqishimiz mumkin. Hisob-kitoblar davomida biz metan (CH₄) gazidan foydalanamiz. Buning uchun bizga ideal gaz qonuni kerak bo'ladi:

$$PV = nRT$$

bu yerda:

P = bosim (Paskalda 200 bar 20000000 Pa);

V = hajm (m³);

n = mol miqdori (mol);

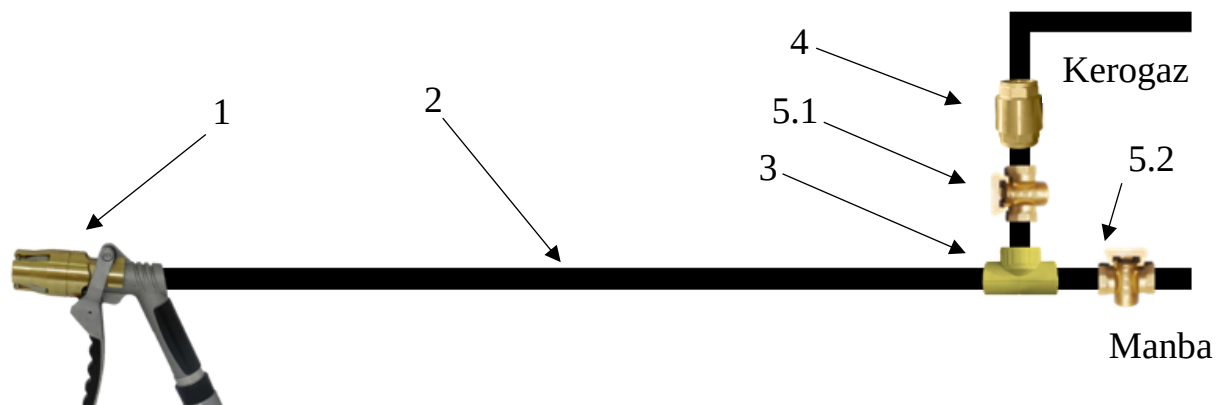
R = gaz konstansasi (8,314 J/mol·K);

T = harorat (Kelvin).

$$n = \frac{PV}{RT} = \frac{20000000 \cdot 0,000633}{8,314 \cdot 298} = 5,11 \text{ mol}$$

bundan kelib chiqadi-ki yoqilg'i quyish shaxobchalarida joylashgan kallonkalarining shlanglari har bir yoqilg'i quyib bo'linganidan so'ng 5,11 mol ya'ni 0,11446 m³ gazni havoga isrof qiladi. Bu birgina holatning o'zi xolos, bir kunda yoqilg'i quyish shaxobchalari taxminan 1000 ta avtomabil qabul qiladigan bo'lsa $\approx 114,46 \text{ m}^3$ gaz havoga isrof bo'ladi [3].

Yuqoridagi kabi isrofni oldini olishmaqsadida biz yoqilg'i quyish shaxobchalarida foydalanilayotgan shlanglarga qo'shimcha texnologik jihozlar qo'shishimiz mumkin (2-rasm).



2-rasm. Taklif qilinayotgan kalonka shlangi

bu yerda:

1- gaz jomragi (сопло); 2- o'tkazuvchi shlang; 3- uzatma (тройник); 4- tekshirish valfi (обратный клапан); 5- berkitish qurilmasi (вентиль).

An'anaviy shlangga biz uch tomonlama uzatma (тройник) orqali qo'shimcha berkitish qurilmasi (вентиль) va tekshirish valfi (обратный клапан) o'rnatiladi. Avtomobilga gaz quyib bo'linganidan so'ng shlang ichida qolgan 0,11446 m³ gaz havoga qo'yib yuborilmaydi, balki o'rnatilgan qo'shimcha berkitish qurilmasi ochiladi va uch tomonlama uzatma orqali gaz zaxira rezervuarlarga yig'iladi. Shlang ichidagi gaz bosim bilan turgani bois unga qo'shimcha kuch kerak emas. Gaz rezervuarga yig'ilganidan so'ng shlangga qaytib bosim bermasligi uchun tekshirish valfi o'rnatiladi, chunonchi 2-rasmdagi chizma bo'yicha ushbu texnologiyani ko'rib chiqadigan bo'lsak, manbadan chiqayotgan gaz berkitish qurilmasi (вентиль) (5.2) va o'tkazuvchi shlang (2) orqali o'tib, gaz jo'mragiga (сопло) (1) yetib boradi so'ngra avtomobilga yoqilg'i quyiladi. Avtomobilga yoqilg'i quyib bo'linganidan so'ng berkitish qurilmasi (вентиль) (5.2) va gaz jo'mragi (сопло) (1) yopiladi hamda berkitish qurilmasi (вентиль) (5.1) ochiladi, o'tkazuvchi shlangga (2) to'planib bosib ustida turgan gaz esa uzatma (тройник) (3) va berkitish qurilmasi (вентиль) (5.1) orqali o'tib, tekshirish valfiga (обратный клапан) (4) yetib boradi. Tekshirish valfidan (обратный клапан) (4) o'tgan gaz ortga qayta olmaydi va kerogazga yig'ilishni boshlaydi. Ushbu texnologiya shu yo'sinda ishlashi orqali gaz sarfi oldi olinadi va maxsus idishlarga saqlanib qolinadi.

Xulosa qilib aytadigan bo'lsak yoqilg'i quyish shoxobchalaridagi kalonka shlanglarida gaz isrof bo'lishining oldini olish maqsadida qo'llanilgan yangi texnologiya energiya tejamliligini oshirishga va atrof-muhitga zarar yetkazishni kamaytirishga qaratilgan. Bu texnologiya orqali gazning shlanglar orqali havoga isrof bo'lishini kamaytirish, resurslardan samarali foydalanish va iqtisodiy foyda olish mumkin. Natijada, gaz yo'qotilishi sezilarli darajada qisqarib, foydalanuvchilar uchun ham qulaylik yaratiladi. Yangi texnologiya nafaqat yoqilg'i sohasida innovatsion yondashuv bo'lib, balki ekologik barqarorlikni ta'minlashga ham katta hissa qo'shadi.

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ОСНОВНЫЕ ПРИНЦИПЫ КОРРЕКТИРОВКИ СОСТОЯНИЯ ПРИ ПЕРВИЧНОМ ГИПОТИРЕОЗЕ У БЕРЕМЕННЫХ

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Аннотация. В статье рассматриваются основные аспекты диагностики и лечения первичного гипотиреоза у беременных женщин, с акцентом на проблему компенсации гормонального дисбаланса. Подчеркивается важность своевременного выявления заболевания, так как гипотиреоз может существенно повлиять на здоровье матери и развитие плода. Обсуждаются основные методы преодоления компенсации состояния, включая корректное назначение дозы тиреоидных гормонов, мониторинг уровня тиреотропного гормона (ТТГ) и свободного тироксина (Т4) в крови, а также необходимость индивидуального подхода к каждой пациентке. Особое внимание уделяется особенностям гормональной терапии в период беременности и постродовом восстановлении. В статье приводятся рекомендации по оптимизации лечения, направленного на минимизацию рисков для матери и ребенка, а также на предотвращение возможных осложнений в поздние сроки беременности. Гипофункция щитовидной железы у женщин на предгравидарном периоде и во время менструации представляет собой существенный травматизм для становления врожденного гипотиреоза у больных, что может привести к фатальным видоизменениям в нервной системе. Несмотря на непрерывный приём антибиотиков калия йодида, у беременных женщин часто следит гестационный гипотиреоз, что просит предназначения левотироксина для коррекции метаболического фона. Многие женщины могут мучиться от

эпизодической гипофункции поджелудочной железы ещё до менструации, спровоцированной различными аспектами. При диагностированном гипотиреозе необходима метаболическая корректировка, впрочем расчетная дозировка левотироксина, основанная на биомассе туловища клиентки, не всегда оказывается достаточной для свершения долгосрочных понятий тиреотропного гормона (ТТГ). Кроме того, фармацевтические аспекты также играют значимую функцию: препараты левотироксина натрия могут различаться по биодоступности. Внутренние аспекты, такие как температура и температура, а также состав наполнителей у различных импортёров, может существенно воздействовать на стабильность антибиотиков. Потому нерегулярный мониторинг подсистемы щитовидной секреции и личностный метод к лечению являются критически значимыми для обслуживания самочувствия как матери, как и ребенка.

Ключевые слова: *первичный гипотиреоз, беременность, компенсация, тиреоидные гормоны, тиреотропный гормон, левотироксин, диагностика гипотиреоза, лечение гипотиреоза, мониторинг гормонов, триместры беременности, риски для плода, гормональная терапия, здоровье матери, осложнения беременности, эндокринные заболевания, гипотиреоз и развитие плода, индивидуализированное лечение.*

Введение. Первичный гипотиреоз — это заболевание, характеризующееся снижением функции щитовидной железы, что приводит к дефициту тиреоидных гормонов в организме. Это состояние имеет важные клинические последствия, особенно в период беременности, когда нормальная функция щитовидной железы играет критическую роль в поддержании гомеостаза матери и правильном развитии плода. У беременных женщин гипотиреоз может оставаться скрытым из-за того, что многие симптомы заболевания схожи с обычными признаками беременности, такими как усталость, изменение массы тела, депрессия или слабость. Это делает диагностику первичного гипотиреоза сложной, а своевременное и адекватное лечение — необходимым для предотвращения развития серьезных осложнений. Одной из основных задач в лечении первичного гипотиреоза у беременных является преодоление компенсации заболевания. Компенсаторные механизмы организма, такие как повышение уровня тиреотропного гормона (ТТГ) и нормализация других параметров, могут скрывать истинную картину болезни и затруднять диагностику. Это состояние требует внимательного мониторинга и точной корректировки дозы тиреоидных гормонов. Важно отметить, что нормализация уровня тиреоидных гормонов у женщин в период беременности имеет ключевое

значение для обеспечения здорового протекания беременности и минимизации рисков для плода, таких как задержка роста, преждевременные роды, и даже умственная отсталость. Особое внимание в данной статье уделяется не только теоретическим аспектам диагностики и терапии гипотиреоза, но и практическим рекомендациям по преодолению компенсации заболевания. Рассматриваются современные подходы к подбору дозы левотироксина, мониторингу уровня ТТГ и свободного тироксина (Т4) в крови, а также особенности лечения в различных триместрах беременности. Важно, что лечение должно быть адаптировано с учетом физиологических изменений, происходящих в организме женщины на каждом этапе беременности, поскольку эти изменения могут влиять на потребность в тиреоидных гормонах. Кроме того, в статье будут рассмотрены возможные риски, связанные с недооценкой гипотиреоза у беременных женщин и возможные последствия, такие как развитие преэклампсии, анемии, осложнений со стороны сердечно-сосудистой системы и депрессии. Разработка эффективной стратегии лечения и мониторинга позволит предотвратить эти риски и улучшить исход беременности как для матери, так и для ребенка. Таким образом, целью данной статьи является представление ключевых аспектов преодоления компенсации при первичном гипотиреозе у беременных женщин, разработка рекомендаций по улучшению диагностики и терапии, а также подчеркивание важности индивидуализированного подхода в лечении с целью достижения наилучших клинических результатов.

ЦЕЛЬ. Оценить зависимость снижения уровня ТТГ от способа приема Эутирокса в популяции беременных женщин.

МАТЕРИАЛЫ И МЕТОДЫ. Статистический анализ и проспективное исследование проводились с 10.06.2024 по 30.10.2024 гг. на базе Самаркандского государственного медицинского университета, 3-городском роддоме г.Самарканд. В когортное наблюдение были отобраны беременные женщины с диагностированным первичным манифестным и субклиническим гипотиреозом в I триместре беременности (n=26). Всем беременным был назначен Эутирокс «AcinoPharm». Другие препараты левотироксина не использовались с целью исключения искажения результатов исследования.

РЕЗУЛЬТАТЫ. Беременные с гипотиреозом были разделены на две группы по способу приема Эутирокса: с пероральным приемом (n=14) и сублингвальным (n=12). Через 1 мес нормализация уровня ТТГ наблюдалась у 11 беременной в группе приема перорально (80%) и у 12 беременных в группе с сублингвальным приемом (100%). Женщинам, у которых не была достигнута

компенсация гипотиреоза, был рекомендован сублингвальный прием без повышения дозы Эутирокса при условии, что уровень ТТГ был не выше 3,6 мкМЕ/мл. Исследование ТТГ через 1 мес показало, что все беременные которые получали Эутирокс достигли компенсации.

ЗАКЛЮЧЕНИЕ. На основании проведенного исследования показано, что более рационально назначение Эутирокса сублингвально, поскольку в полости рта слабощелочная реакция, которая не обладает таким разрушительным действием, как желудочный сок.

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A CASE STUDY AND A CONCISE ACCOUNT OF RIEDEL'S THYROIDITIS

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Annotation. Riedel's thyroiditis (fibroinvasive thyroiditis) is a rare form of chronic inflammatory disease of the thyroid gland, characterized by progressive replacement of glandular tissue with fibrous tissue with spread into the capsule and surrounding tissues. The disease can lead to compression symptoms, such as difficulty breathing, pain when swallowing and compression of blood vessels and trachea. Diagnosis is based on clinical data and the results of instrumental studies, such as ultrasound (hypoechoic areas), scintigraphy, CT and MRI, as well as elastography, showing tissue rigidity. Riedel's thyroiditis is often associated with fibrosis of other organs (orbits, mediastinum, retroperitoneal space) and can be associated with IgG4-mediated inflammation, but an increase in IgG4 levels in the blood is not always observed. Despite the rarity of the disease, it represents a significant diagnostic and therapeutic problem, especially in the case of complications associated with compression of vital structures. The article discusses the clinical features, diagnostic methods and modern approaches to the treatment of Riedel's thyroiditis, as well as possible associations with other fibrosing diseases.

Keywords: Riedel's thyroiditis, fibro-invasive thyroiditis, thyroid gland, fibrosis, compression syndrome, hypothyroidism, ultrasound, scintigraphy, CT, MRI, elastography, IgG4, inflammation, diagnostics, fibrosis, neck organs, multifocal fibrosclerosis.

INTRODUCTION. Riedel's thyroiditis is a rare disease in which inflammation of the thyroid gland leads to the replacement of normal tissue of the gland with fibrous tissue. This process can spread to the capsule of the gland and neighboring organs,

creating risks of compression of blood vessels, trachea and other structures of the neck. This, in turn, can cause symptoms such as difficulty breathing, pain when swallowing and a feeling of pressure in the neck. The disease develops slowly, and in the early stages, symptoms may be barely noticeable. If only one lobe of the thyroid gland is affected, hormonal levels may remain normal, but if fibrosis affects the entire gland, hypothyroidism occurs. Palpation is used to diagnose the disease (the thyroid gland becomes dense and slightly mobile), ultrasound (where areas with low echogenicity and poor blood supply are visible), as well as scintigraphy, CT or MRI, which can show the spread of fibrosis to other tissues and organs. PET scanning may be useful in identifying areas of fibrosis and in monitoring disease dynamics after treatment. In some cases, a decrease in fluorine-18-fluorodeoxyglucose uptake is associated with improvement in symptoms, but this is not always the case. Fine-needle biopsy (FNB) of the thyroid gland in Riedel's thyroiditis is often non-diagnostic, but in some cases, fibrous tissue fragments and signs of inflammation may be found. The diagnosis is usually made after thyroid surgery, when symptoms of compression occur. Histological examination shows dense hyalinized tissue with sparse colloid and a characteristic eosinophilic infiltrate. Morphological and immunohistochemical studies are necessary to confirm the diagnosis. It is important to exclude malignancies, giant cells, lymphoid follicles, oncocytes, and granulomas. The use of blood IgG4 levels and immunohistochemistry for diagnosis remains an open question, since elevated IgG4 is not always present. It is important to differentiate autoimmune thyroiditis (eg, Hashimoto's thyroiditis) and malignancies. Complications of Riedel's thyroiditis may include extension of fibrosis to adjacent organs, tracheal stenosis, occlusion of neck vessels, and involvement of the sympathetic nerve trunk. This may lead to dyspnea, venous thrombosis, and Horner's syndrome. In 14% of cases, the parathyroid glands are involved, causing hypoparathyroidism. Treatment of Riedel's thyroiditis usually includes glucocorticosteroids to reduce inflammation. If these are ineffective, tamoxifen may be prescribed, which helps modulate the inflammatory process. In cases of treatment refractoryness, rituximab or a combination of prednisolone and mycophenolate mofetil may be used. If the symptoms of compression do not go away after drug therapy, surgical intervention is indicated. However, surgery can be difficult due to dense tissue infiltration, and in such cases limited surgeries such as isthmic dissection or hemithyroidectomy are often performed to relieve the symptoms of compression.

CLINICAL CASE. Patient A., 42 years old, was admitted to the Surgery Department of the Sverdlovsk Federal Scientific and Pedagogical Center of Epidemiology and Epidemiology in July 2024 with complaints of a feeling of persistent

suffocation and discomfort in the neck. Upon admission to the department, the patient's condition was satisfactory, blood pressure 120/90 mm Hg, heart rate 80 beats/min, temperature 36.6 °C. Upon examination, the isthmus and left lobe of the thyroid gland are enlarged, dense, painless on palpation. Hereditary history: no thyroid diseases in relatives. Bad habits: smoking - 1 pack of cigarettes per day. It is known from the anamnesis that in September 2023 (at the age of 44), the patient noted an increase in the size of the neck, an increase in body temperature to 38 °C after an infection. She was diagnosed with ARVI, and received symptomatic treatment. During examination at the place of residence (end of September 2023), an ultrasound scan of the thyroid gland revealed a 5 cm nodular formation, the total volume of the thyroid gland was not described. Fine-needle aspiration biopsy was performed, a cytological conclusion was obtained: the preparation is abundantly cellular, fibrin threads, lymphocytes, colloid, groups of thyroid epithelial cells with proliferation, TIRADS II are present. The TSH level at the time of application was 2.3 mIU / l, AT-TPO increased to 528 IU / ml. Then, in December 2023, due to an increase in the feeling of suffocation, hoarseness, and increased discomfort in the neck, a decision was made at the place of residence to perform a subtotal resection of the thyroid gland on the left. According to histology: a morphological picture corresponding to Riedel's fibrous thyroiditis. After the surgery, the patient's condition temporarily improved: the feeling of suffocation and hoarseness decreased. However, due to the progression of the disease (enlargement of the thyroid gland, increasing discomfort, the feeling of suffocation, hoarseness) and the histological examination of TR, prednisolone was prescribed at a dose of 80 mg / day since February 2024. Against the background of the therapy, positive dynamics were noted with a decrease in the feeling of suffocation and discomfort. In April 2024, due to the development of clinical signs of exogenous hypercorticism (manifested by matronism, weight gain, uneven distribution of subcutaneous fat), the dose of prednisolone was reduced to 65 mg / day. In dynamics (end of April 2024) according to ultrasound data: the total volume of the thyroid gland was 50 ml, in the right lobe there was a formation in a calcified capsule measuring 0.7 x 0.6 x 0.7 cm, an isoechoic formation of mixed structure measuring 1.1 x 1.1 x 0.9 cm. In blood tests from April 2024: TSH 1.3 mIU / l, C-reactive protein 0.28 mg / l, ESR 8 mm / h. In all finished preparations, a histological picture corresponding to Riedel's fibrous thyroiditis was found. At the time of admission, she was taking prednisolone 10 mg / day, pantoprazole 80 mg / day, calcium carbonate 1000 mg / day. Results of physical, laboratory and instrumental studies. The following results were obtained during this hospitalization: TSH 0.929 mIU/L, calcitonin less than 1.00 pg/ml (0–4.8), parathyroid hormone 50.6 pg/ml (15–65 pg/ml), total calcium 2.47 mmol/l (2.15–2.55 mmol/l), phosphorus 1.25 mmol/l (0.74–1.52 mmol/l), C-reactive protein 5.8 mg/l. Thyroid ultrasound was

performed: the contours of the gland are smooth, unclear, the gland is low-lying, it embraces the trachea without narrowing it, it deforms the contours of the esophagus, the pretracheal muscles on the left and in the isthmus area are edematous, the border between them and the capsule of the gland is blurred. Vascularization during color Doppler imaging is unchanged. Echogenicity is moderately reduced on the left and in the isthmus area with a transition to the right lobe. Also in the right lobe there were nodular formations: 0.9 cm with calcifications in the capsule, 0.6-0.7 cm of average echogenicity (TIRADS 2). In the left lobe near the isthmus there is a hypoechoic zone of 0.5 cm with small calcifications (TIRADS 4a). The total volume of the thyroid gland is 48.9 cm³. According to CT of the neck it was revealed that the altered left lobe is adjacent to the internal jugular vein without narrowing of its lumen, adjacent to the common carotid artery (fatty tissue between them is preserved). Anteriorly, the gland is adjacent to the sternohyoid/sternothyroid muscles. The muscles are poorly differentiated (their involvement cannot be excluded). Compression syndrome was not revealed. During CT of the neck, attention was drawn to the detection of a partially floating thrombus in the right internal jugular vein, thromboembolism of the left pulmonary artery and its branches. However, given the stable condition, the absence of respiratory failure, and the absence of changes in the lung tissue during chest CT, acute massive PE was excluded. Given the CT picture of the floating thrombus, as well as CT signs of thromboembolism of the left pulmonary artery, the patient was prescribed oral anticoagulant therapy. The presence of a partially floating thrombus in the right internal jugular vein is most likely associated with damage to the intima of the vessel during thyroid surgery in December 2023. An examination was performed for the presence of systemic fibrosing disease. CT of the chest and mediastinal organs did not reveal focal or infiltrative changes. Examination of the abdominal organs did not reveal data for sclerosing cholangitis. Based on the results of the ophthalmologist consultation, no data were received for orbital fibrosis, the diagnosis was: OU - Mild myopia, retinal angiopathy. To exclude IgG4-associated disease, IgG and IgG4 were determined, the results revealed normal levels of these parameters (IgG 6.5 g/l (7.0–16.0), IgG4 0.057 g/l (less than 2.01)), which excluded IgG4-associated disease. Based on laboratory and instrumental research methods, the effectiveness of the glucocorticosteroid therapy was confirmed: a decrease in the goiter size and the absence of compression symptoms were noted. Thus, it was recommended to take prednisolone at a maintenance dose of 10 mg under the control of the patient's well-being, thyroid ultrasound. Outcome and results of follow-up. According to dynamic control data: for another 6 months. The patient continued taking glucocorticosteroids with subsequent gradual withdrawal of the drug. No compression symptoms were noted against the background of withdrawal.

CONCLUSION. There are currently no standard protocols for the treatment of such patients, and in some cases, TR can progress rapidly. However, when conducting imaging studies, it is important to consider the characteristics of fibrotic thyroid disease in TR. One of the key diagnostic steps is to determine the levels of IgG and IgG4 to exclude IgG4-associated disease. Treatment of TR should be individualized and require the participation of several specialists. In this case, the diagnosis was established based on the results of histological examination after surgery. However, after surgery, the patient's condition worsened, and prednisolone was prescribed, which gave a positive effect. At the same time, with this dose of prednisolone, signs of hypercorticism were noted, which required a reduction in the dose of the drug. Subsequently, against the background of long-term use of 10 mg of prednisolone, the condition stabilized.

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КЛИНИЧЕСКИЙ СЛУЧАЙ И КРАТКОЕ ОПИСАНИЕ ТИРЕОИДИТА РИДЕЛЯ

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Аннотация. Тиреоидит Риделя (фиброзно-инвазивный тиреоидит) — редкая форма хронического воспалительного заболевания щитовидной железы, характеризующаяся прогрессирующим замещением железистой ткани на фиброзную с распространением в капсулу и окружающие ткани. Заболевание может приводить к компрессионным симптомам, таким как затруднение дыхания, боли при глотании и сдавление сосудов и трахеи. Диагностика основывается на клинических данных и результатах инструментальных исследований, таких как ультразвуковое исследование (гипоэхогенные участки), сцинтиграфия, КТ и МРТ, а также эластография, показывающая ригидность ткани. Тиреоидит Риделя часто ассоциируется с фиброзом других органов (орбит, средостения, забрюшинного пространства) и может быть связан с IgG4-опосредованным воспалением, однако не всегда наблюдается повышение уровня IgG4 в крови. Несмотря на редкость заболевания, оно представляет собой значительную диагностическую и терапевтическую проблему, особенно в случае осложнений, связанных с компрессией жизненно важных структур. В статье рассмотрены клинические особенности, методы диагностики и современные подходы к лечению тиреоидита Риделя, а также возможные ассоциации с другими фиброзирующими заболеваниями.

Ключевые слова: тиреоидит Риделя, фиброзно-инвазивный тиреоидит, щитовидная железа, фиброз, компрессионный синдром, гипотиреоз, ультразвуковое исследование, сцинтиграфия, КТ, МРТ, эластография, IgG4, воспаление, диагностика, фиброзирование, органы шеи, мультифокальный фибросклероз.

ВВЕДЕНИЕ. Тиреоидит Риделя — это редкое заболевание, при котором воспаление щитовидной железы приводит к замещению нормальной ткани железы на фиброзную. Этот процесс может распространяться на капсулу железы и соседние органы, создавая риски сдавления сосудов, трахеи и других структур шеи. Это, в свою очередь, может вызывать такие симптомы, как трудности с дыханием, боль при глотании и ощущение давления в области шеи. Заболевание развивается медленно, и на ранних стадиях симптомы могут быть малозаметными. Если поражена только одна доля щитовидной железы, гормональные уровни могут оставаться нормальными, но если фиброз затронул всю железу, возникает гипотиреоз. Для диагностики заболевания используют пальпацию (щитовидная железа становится плотной и малоподвижной), ультразвуковое исследование (где видны участки с низкой эхогенностью и слабо кровоснабжающиеся), а также сцинтиграфию, КТ или МРТ, которые могут показать распространение фиброза на другие ткани и органы. ПЭТ-сканирование может быть полезным для выявления участков, пораженных фиброзом, а также для контроля динамики заболевания после лечения. В некоторых случаях снижение поглощения фтор-18-фтордезоксиглюкозы связано с улучшением симптомов, однако такие результаты наблюдаются не всегда. Тонкоигольная биопсия (ТАБ) щитовидной железы при тиреоидите Риделя часто бывает неинформативной, но в некоторых случаях могут быть найдены фрагменты фиброзной ткани и признаки воспаления. Обычно диагноз ставится после оперативного вмешательства на щитовидной железе, когда возникают симптомы компрессии. Гистологическое исследование показывает плотную гиалинизированную ткань с редким коллоидом и характерным инфильтратом эозинофильных клеток. Для подтверждения диагноза необходимы морфологическое и иммуногистохимическое исследование. Важно исключить злокачественные заболевания, гигантские клетки, лимфоидные фолликулы, онкоциты и гранулемы. Вопрос об использовании уровня IgG4 в крови и иммуногистохимии для диагностики остается открытым, поскольку повышение IgG4 встречается не всегда. Важно проводить дифференциальную диагностику с аутоиммунным тиреоидитом (например, тиреоидитом Хашимото) и злокачественными образованиями. Осложнения тиреоидита Риделя могут включать распространение фиброза на соседние органы, сужение трахеи, окклюзию сосудов шеи и вовлечение симпатического нервного ствола. Это может привести к одышке, венозным тромбозам и синдрому Горнера. В 14% случаев происходит вовлечение околощитовидных желез, что вызывает гипопаратиреоз. Лечение тиреоидита Риделя обычно включает глюкокортикостероиды для уменьшения воспаления. Если они неэффективны,

может быть назначен тамоксифен, который помогает модулировать воспалительный процесс. В случаях рефрактерности к лечению возможно применение ритуксимаба или комбинации преднизолона с микофенолатом мофетила. Если симптомы компрессии не проходят после медикаментозной терапии, показано хирургическое вмешательство. Однако операция может быть сложной из-за плотной инфильтрации тканей, и в таких случаях часто проводят ограниченные операции, такие как рассечение перешейка или гемитиреоидэктомия, чтобы облегчить симптомы сдавления.

КЛИНИЧЕСКИЙ СЛУЧАЙ. Пациентка А. 42 лет поступила в июле 2024 г. в отдел хирургии СФРСНПЦЭ с жалобами на чувство сохраняющегося удушья, дискомфорт в области шеи. При поступлении в отделение состояние пациентки удовлетворительное, АД 120/90 мм рт. ст., ЧСС 80 уд/мин, температура 36,6 °С. При осмотре перешеек и левая доля ЩЖ увеличены, плотные, безболезненные при пальпации. Наследственный анамнез: заболевания щитовидной железы у родственников отсутствуют. Вредные привычки: курение – 1 пачка сигарет в день. Из анамнеза известно, что в сентябре 2023 г. (в возрасте 44 лет) пациентка отметила увеличение размеров шеи, повышение температуры тела до 38 °С после перенесенной инфекции. Был выставлен диагноз ОРВИ, получала симптоматическое лечение. При обследовании по месту жительства (конец сентября 2023 г.) на УЗИ щитовидной железы выявлено узловое образование 5 см, общий объем ЩЖ описан не был. Выполнена тонкоигольная аспирационная биопсия, получено цитологическое заключение: препарат обильно клеточный, присутствуют нити фибрина, лимфоциты, коллоид, группы клеток тиреоидного эпителия с пролиферацией, TIRADS II. Уровень ТТГ на момент обращения составил 2,3 мМЕ/л, АТ-ТПО повышены до 528 МЕ/мл. Далее, в декабре 2023 г., в связи с усилением чувства удушья, осиплостью голоса, усилением дискомфорта в области шеи по месту жительства было принято решение о проведении субтотальной резекции щитовидной железы слева. По данным гистологии: морфологическая картина, соответствующая фиброзному тиреоидиту Риделя. После оперативного лечения у пациентки отмечалось временное улучшение состояния: уменьшились чувство удушья, осиплость голоса. Однако в связи с прогрессированием заболевания (увеличение щитовидной железы, нарастание дискомфорта, появление чувства удушья, осиплость голоса) и подтвержденным по данным гистологического исследования ТР с февраля 2024 г. был назначен преднизолон в дозе 80 мг/сут. На фоне проводимой терапии отмечалась положительная динамика с уменьшением чувства удушья и дискомфорта. В апреле 2024 г. в связи с развитием клинических признаков экзогенного гиперкортицизма

(проявлявшийся матронизмом, увеличением массы тела, неравномерным распределением подкожно-жировой клетчатки) доза преднизолона была снижена до 65 мг/сут. В динамике (конец апреля 2024 г.) по данным УЗИ: общий объем ЩЖ составил 50 мл, в правой доле образование в кальцинированной капсуле размерами 0,7 x 0,6 x 0,7 см, изоэхогенное образование смешанной структуры размерами 1,1 x 1,1 x 0,9 см. В анализах крови от апреля 2024 г.: ТТГ 1,3 мМЕ/л, С-реактивный белок 0,28 мг/л, СОЭ 8 мм/ч. Во всех готовых препаратах обнаружена гистологическая картина, соответствующая фиброзу тиреоидиту Риделя. На момент поступления принимала преднизолон 10 мг/сут, пантопразол 80 мг/сут, кальция карбонат 1000 мг/сут. Результаты физикального, лабораторного и инструментального исследований. В рамках данной госпитализации получены следующие результаты: ТТГ 0,929 мМЕ/л, кальцитонин менее 1,00 пг/мл (0–4,8), паратгормон 50,6 пг/мл (15–65 пг/мл), кальций общий 2,47 ммоль/л (2,15–2,55 ммоль/л), фосфор 1,25 ммоль/л (0,74–1,52 ммоль/л), С-реактивный белок 5,8 мг/л. Проведено УЗИ ЩЖ: контуры железы ровные, нечеткие, железа низко расположена, обхватывает трахею, не сужает ее, деформирует контуры пищевода, претрахеальные мышцы слева и в области перешейка отечны, граница между ними и капсулой железы размыта. Васкуляризация при ЦДК не изменена. Эхогенность умеренно понижена слева и в области перешейка с переходом на правую долю. Также в правой доле выявлены узловые образования: 0,9 см с кальцинатами в капсуле, 0,6–0,7 см средней эхогенности (TIRADS 2). В левой доле у перешейка гипоехогенная зона 0,5 см с мелкими кальцинатами (TIRADS 4a). Общий объем щитовидной железы составляет 48,9 см³. По КТ шеи выявлено, что измененная левая доля прилежит к внутренней яремной вене без сужения ее просвета, прилежит к общей сонной артерии (жировая клетчатка между ними сохранена). Кпереди железа прилежит к грудино-подъязычной/грудино-щитовидной мышцам. Мышцы плохо дифференцируются (нельзя исключить их вовлечение). Компрессионный синдром не выявлен. При проведении КТ шеи обратило на себя внимание выявление частично флотирующего тромба в правой внутренней яремной вене, тромбоэмболия левой легочной артерии и ее ветвей. Однако, учитывая стабильное состояние, отсутствие дыхательной недостаточности, а также отсутствие изменений в легочной ткани при выполнении КТ грудной полости, острая массивная ТЭЛА была исключена. Учитывая КТ-картину флотирующего тромба, а также КТ-признаки тромбоэмболии левой легочной артерии, пациентке была назначена терапия оральными антикоагулянтами. Наличие частично флотирующего тромба в правой внутренней яремной вене, скорее

всего, ассоциировано с повреждением интимы сосуда во время операции на щитовидной железе в декабре 2023 г. Проведено обследование на предмет наличия системного фиброзирующего заболевания. При проведении КТ грудной полости и органов средостения очаговых и инфильтративных изменений не выявлено. При обследовании органов брюшной полости данных за склерозирующий холангит не получено. По результатам консультации офтальмолога данных за фиброз орбит не получено, выставлен диагноз: OU – Миопия слабой степени, ангиопатия сетчатки. Для исключения IgG4-ассоциированного заболевания проведено определение IgG и IgG4, по результатам выявлены нормальные уровни данных показателей (IgG 6,5 г/л (7,0–16,0), IgG4 0,057 г/л (менее 2,01)), что исключило IgG4-ассоциированное заболевание. На основании лабораторно-инструментальных методов исследования подтверждена эффективность проводимой терапии глюкокортикостероидами: отмечалось уменьшение размера зоба и отсутствие симптомов компрессии. Таким образом, был рекомендован прием преднизолона в поддерживающей дозе 10 мг под контролем самочувствия пациентки, УЗИ ЩЖ. Исход и результаты последующего наблюдения. По данным динамического контроля: в течение еще 6 мес. пациентка продолжала прием глюкокортикостероидов с дальнейшей постепенной отменой препарата. На фоне отмены симптомов компрессии не отмечает.

ЗАКЛЮЧЕНИЕ. На сегодняшний день не существует стандартных протоколов для лечения таких пациентов, и в некоторых случаях ТР может развиваться быстро. Тем не менее, при проведении визуализирующих исследований важно учитывать особенности фиброзного поражения щитовидной железы при ТР. Одним из ключевых диагностических шагов является определение уровней IgG и IgG4, чтобы исключить IgG4-ассоциированное заболевание. Лечение ТР должно быть индивидуальным и требовать участия нескольких специалистов. В данном случае диагноз был установлен по результатам гистологического исследования после операции. Однако после операции состояние пациентки ухудшилось, и был назначен преднизолон, что дало положительный эффект. В то же время, при такой дозе преднизолона были замечены признаки гиперкортицизма, что потребовало уменьшения дозы препарата. В дальнейшем, на фоне длительного приема 10 мг преднизолона, состояние стабилизировалось.

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ZAMONAVIY KOLORIMETRIYA VA UNING MOHIYATINING TAHLILI

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ANNOTATSIYA

Fotometriyada bir necha turdagi analitik usullar mavjud bo‘lib, ularda kolorimetriya yutilish fotometriyasi ostida bo‘ladi. Kolorimetriya rangni miqdoriy baholashda keng qo‘llaniladigan analitik texnikaga asoslangan, ya‘ni namuna eritmasidagi rangli moddaning kontsentratsiyasini aniqlash uchun ishlatiladi. Masalan suv biologik namunalarda yorug‘likning ko‘rinadigan spektrida 380-780 nm ni qayd etadi. Kolorimetr bugungi kunda ko‘plab kimyoviy analizlarda foydalaniladigan asbobdir. Kolorimetrda tekshiriladigan modda rangli bo‘lishi kerak yoki o‘lchanadigan rang intensivligiga qarab yorug‘likni yutadigan reagentlar qo‘shilishi orqali xromogenlarni hosil qilish xususiyatiga ega bo‘lishi kerak. Rangning intensivligi rangli birikma kontsentratsiyasiga mutanosibdir.

Kalit so‘zlar: kolorimetr, nur, spektr, UF, IQ.

ANALYSIS OF MODERN COLORIMETRY AND ITS ESSENCE

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ANNOTATION

There are several types of analytical methods in photometry, in which colorimetry falls under absorption photometry. Colorimetry is based on an analytical technique widely used in the quantitative assessment of color, that is, it is used to determine the concentration of a colored substance in a sample solution. For example, water records 380-780 nm in the visible spectrum of light in biological samples. A colorimeter is an instrument used in many chemical analyzes today. In a colorimeter, the substance to be examined must be colored or must have the property of forming

chromogens by the addition of light-absorbing reagents, depending on the measured color intensity. The intensity of the color is proportional to the concentration of the colored compound.

Key words: colorimeter, light, spectrum, UV, IR.

АННОТАЦИЯ

В фотометрии существует несколько типов аналитических методов, в которых колориметрия относится к абсорбционной фотометрии. Колориметрия основана на аналитическом методе, широко используемом при количественной оценке цвета, то есть используется для определения концентрации окрашенного вещества в растворе пробы. Например, вода регистрирует 380-780 нм в видимом спектре света в биологических образцах. Колориметр — это прибор, используемый сегодня во многих химических анализах. В колориметре исследуемое вещество должно быть окрашено или обладать свойством образовывать хромогены за счет добавления светопоглощающих реагентов в зависимости от измеряемой интенсивности окраски. Интенсивность цвета пропорциональна концентрации окрашенного соединения.

Ключевые слова: колориметр, свет, спектр, УФ, ИК.

Kirish

Hozirgi vaqtda klinik laboratoriyalarda qo'llaniladigan analitik usullarning aksariyati so'rilgan, uzatilgan yoki chiqarilgan yorug'lik o'lchanadigan ushbu fotometrik printsiplarga asoslanadi. Elektromagnit spektrning butun diapazonida turli to'liq uzunliklarida intensivlik o'lchanganda, u spektrofotometriya deb ataladi.

Kolorimetriya - bu fotometriyaning bir turi bo'lib, u asosan yorug'likni aniqlaydigan va uning intensivligidagi o'zgarishlarni aniqlaydigan usullar sifatida qaraladi. Fotometr - elektromagnit to'liqning energiyasini infraqizil nurlanishdan ultrabinafsha nurlanish oralig'ida, shu jumladan elektromagnit spektrning ko'rinadigan qismini o'lchaydigan mashinadir. Fotoelement yordamida yorug'likni elektr tokiga aylantiradi. Agar o'lchangan yorug'lik elektromagnit nurlanishning ko'rinadigan diapazonida bo'lsa, u kolorimetriya usullari yordamida tekshiriladi. Ushbu usulda yorug'lik manbasidan yorug'lik nuri eritmada tahlil qiluvchi moddani o'z ichiga olgan namuna ushlagich orqali o'tadi. O'tadigan yorug'lik intensivligi kyuvetada namunadan o'tadigan yorug'likdan kamroq bo'ladi. Yutilgan yorug'lik tahlil qiluvchi moddaning konsentratsiyasiga mutanosibdir. Namuna rangi eritmaning o'ziga xos xususiyatidir, agar eritma rangsiz bo'lsa uni mos reagentlar qo'shilishi bilan ishlab chiqish mumkin.

Namuna yutilishi sinov namunasining konsentratsiyasini hisoblash mumkin bo'lgan standartlar bilan taqqoslanadi.

Terminologiyalar: Nur - bu elektromagnit nurlanish. Nurlar Uf nurlari, rentgen nurlari, ultrabinafsha nurlar, ko'rinadigan nurlar, infraqizil nurlar, radio to'lqinlar va mikroto'lqinlardan iborat. Komponentlardan faqat ko'zga ko'rinadiganlar oq yorug'lik deb nomlanadi. Fotonlar: Yorug'lik - bu to'plamlar yoki fotonlar deb ataladigan diskret kvant paketlari shaklida mavjud bo'lgan energiya. Elektromagnitnurlanishning energiyasi (E) uning chastotasi (u) va tezligi (c) ga to'g'ridan-to'g'ri proporsional, lekin to'lqin uzunligiga (l) teskari proporsionaldir.

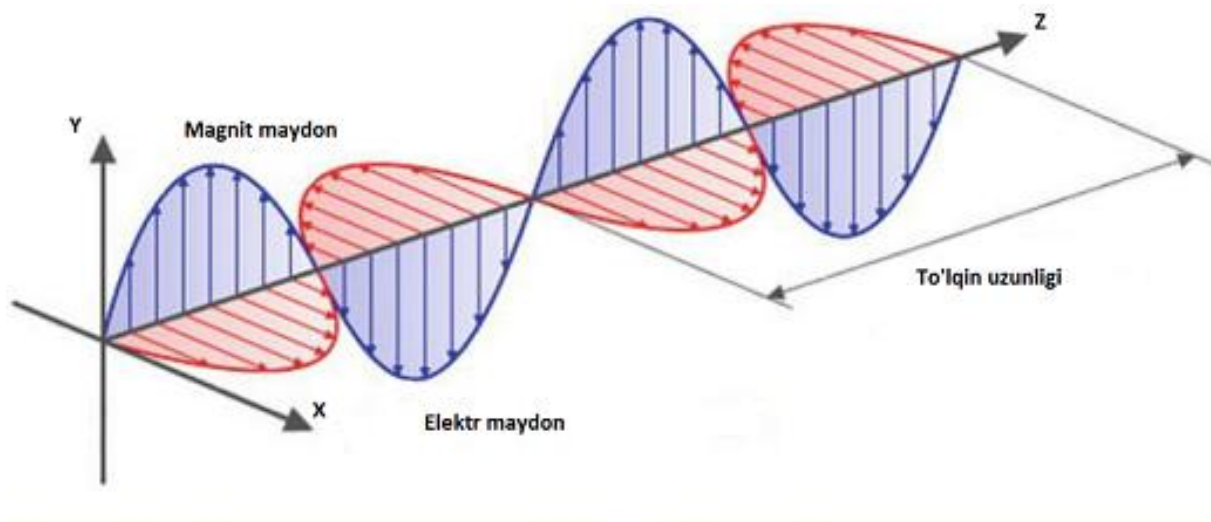
$$E_{\text{foton}} = h \cdot \nu, \quad \nu = c / \lambda, \quad E_{\text{foton}} = h \cdot c / \lambda$$

Bu yerda, h = Plank doimiysi, c - vakuumdagi yorug'lik tezligi, 3×10^8 m / sek.

Elektromagnit nurlanish molekulyar, atom yoki yadro darajasidagi hodisalar natijasida hosil bo'ladi. Elektromagnit nurlanishni keltirib chiqaradigan hodisalardan ba'zilari elektr yoki magnit maydonlarda yadro va elektronlarning tebranishlari, molekulyar egilish va tebranishlar, orbital elektronlarning qo'zg'alishi, ichki orbital elektronning chiqarilishi va boshqa elektronlarning qayta joylashishi, yadro parchalanishi va boshqalar. Ular chiqaradigan nurlanish turli to'lqin uzunliklariga ega bo'ladi, chunki bu hodisalarning har biri jalb qilingan energiya jihatidan farq qiladi (1-jadval).

Obyekt	Rentgen nurlari	Ultrabinafsha nurlari	Ko'rinadigan nurlar	Infraqizil nurlar	Mikroto'lqinli nurlar
To'lqin uzunligi	0,1-100 nm	100-380 nm	380-750 nm	750 nm dan 100 μ m gacha	100 μ m dan 30 cm gacha
Malekulalarga ta'siri	Subvalent elektronlarning qo'zg'alishi	Valentlik elektronlarning qo'zg'alishi	Valentlik elektronlarning qo'zg'alishi	Molekulyar tebranishlar	Molekulyar aylanishlar

Shunday qilib, Elektromagnit nurlanishning to'liq spektri ishlab chiqariladi. Ularning elektr vektori va magnit vektorining kattaligi mos ravishda E va H belgilari bilan belgilanadi. Yorug'lik manbasidan yorug'lik nuri bir xil yo'nalishda tarqaladigan ko'plab tasodifiy yo'naltirilgan tekis polarizatsiyalangan komponentlardan iborat (1-rasm).



1-rasm. XYZ o'qida nurlarning joylashuvi.

Mintaqa rentgen nurlari ultrabinafsha ko'rinadigan infraqizil mikroto'lqinli nurlar. To'lqin uzunligi 0,1–100 nm 100–380 nm 380–750 nm 750 nm dan 100 mkm 100 mkm dan 30 sm gacha, molekulalarga ta'siri subvalent elektronlarning qo'zg'alishi, valentlik elektronlarning qo'zg'alishi, valent elektronlarning qo'zg'alishi molekulyar tebranishlar molekulyar aylanishlar.

Foydalanilgan adabiyotlar.

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