



INTERNATIONAL CONFERENCE ON ADVANCE SCIENCE AND TECHNOLOGY

LONDON

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**INTERNATIONAL CONFERENCE ON ADVANCE SCIENCE AND
TECHNOLOGY**

Volume 03, Issue 04, 2026 (JUNE)

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THE INTERSECTION OF CLIMATE CHANGE AND GIRLS' HOUSEHOLD RESPONSIBILITIES

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Annotation

This article explores the disproportionate impact of climate change on young females in developing regions, specifically focusing on how environmental degradation intensifies traditional household responsibilities. As natural resources become scarce, girls are often pulled from classrooms to assist with water collection, fuel gathering, and domestic labor. This cycle not only jeopardizes their education and health but also reinforces systemic gender inequality. The study emphasizes the need for gender-sensitive climate policies that prioritize educational continuity and sustainable infrastructure.

Keywords: Climate Change, Gender Inequality, Girls' Education, Household Responsibilities, Water Scarcity, Sustainable Development.

Climate change is often discussed in the abstract language of atmospheric carbon parts per million or melting glacial ice. However, for millions of girls across the Global South, climate change is a tangible, daily thief of time and opportunity. While environmental shifts affect all of humanity, they do not affect everyone equally. Existing socio-economic fissures determine how a community absorbs a climate shock, and gender remains one of the most significant predictors of vulnerability.

In many patriarchal societies, the division of labor is strictly gendered. Women and girls are primarily responsible for "reproductive labor"—the unpaid work required to maintain a household. This includes cooking, cleaning, and, most critically, the sourcing of water and fuel. As the planet warms, these tasks become exponentially more difficult. This article examines the intersection of environmental crisis and domestic labor, arguing that climate change is not just an ecological threat, but a direct barrier to gender equity and the empowerment of the next generation of women.

To understand the full scope of this issue, we must look at the specific mechanisms through which environmental shifts translate into domestic burdens. The following sections expand on the core challenges and provide deeper regional context.

1. The "Time Poverty" and Resource Scarcity Loop

The core of the issue lies in **Time Poverty**. When local water tables drop due to drought or land degradation, the task of water collection—traditionally a female responsibility—becomes more arduous. Girls are often tasked with these duties, requiring them to walk significantly longer distances to reach viable water sources.

- **Educational Displacement:** When a girl spends four to six hours daily collecting water or firewood, her time for school attendance and study vanishes.
- **Structural Barriers:** This is not just a temporary disruption; it is a structural barrier that keeps girls from achieving parity with their male peers.
- **Feedback Loops:** As the climate warms, the time burden increases, creating a feedback loop where girls are locked out of the educational opportunities that could eventually help their communities adapt to climate change.

2. Regional Case Studies: Frontlines of Change

Climate impacts are not uniform; they are shaped by specific local topographies and socio-economic histories.

The Aral Sea Crisis: A Lesson in Environmental Gender Inequality

The desiccation of the Aral Sea, once the world's fourth-largest lake, serves as a tragic case study for the region.

- **Economic Collapse:** As the water retreated, the surrounding environment became toxic with salt and dust, and the agricultural economy collapsed.
- **Prioritizing Labor:** In families struggling to survive the loss of their primary livelihoods, girls were the first to be removed from school.
- **Health Management:** The increased burden of household health management—specifically caring for sick family members suffering from respiratory issues caused by toxic dust—fell upon young females, effectively ending their childhoods.

The Sahel and the Fuelwood Crisis

In the Sahel region of Africa, changing rainfall patterns have led to rapid desertification.

- **Increased Risk:** Women and girls must travel deeper into dangerous, arid territories to find wood for fuel.
- **Physical Safety:** This exposes them to increased risk of sexual violence and physical injury.
- **Human Rights Link:** Here, environmental insecurity is directly linked to physical safety, proving that climate policy is also a human rights policy.

3. Climate-Induced Education Attrition and Child Marriage

Economic shocks caused by floods, droughts, and heatwaves push vulnerable families into "survival mode".

- **Economic Buffers:** When income streams are destroyed by climate events, families often treat their daughters as economic buffers.
- **Dependency Ratios:** Daughters are removed from school to assist with increased household chores or to reduce the household's "dependency ratio".
- **Child Marriage:** Tragically, climate change is a documented driver of child marriage. Families facing extreme poverty due to crop failure may marry off young daughters to reduce their domestic burden or in exchange for a dowry to secure the family's survival.
- **Loss of Agency:** This practice, while born of desperation, permanently denies the girl her right to agency and economic independence.

Policy Recommendations for a Gender-Just Future

The solution requires moving beyond "gender-blind" climate policies. Adaptation strategies must prioritize:

- **Infrastructure:** Investments in local solar-powered water infrastructure and clean cooking technologies to directly reduce the labor burden on girls.
- **Education Continuity:** Flexible school schedules and financial incentives (climate-resilient scholarships) that account for the reality of agricultural cycles and seasonal water scarcity.
- **Inclusion:** Mandating the presence of young women in regional and national climate adaptation councils to ensure their lived experiences shape policy.

1. The Water Crisis and the "Time Poverty" Trap

As droughts become more frequent and prolonged, local water sources are drying up. In rural areas of Sub-Saharan Africa and Central Asia, the burden of fetching water falls almost exclusively on girls. When a nearby well fails, a girl who once walked twenty minutes to collect water may now have to trek for hours.

This creates a phenomenon known as **Time Poverty**. There are only a finite number of hours in a day; when six of those hours are spent carrying heavy jerrycans across arid terrain, there is no time left for school, rest, or personal development.

2. Fuel Collection and Environmental Degradation

Similarly, deforestation and changing ecosystems force girls to travel further distances to gather firewood. This task is not only physically exhausting but also dangerous. Girls traveling alone into increasingly remote areas face heightened risks of physical and sexual violence. Furthermore, the use of biomass for cooking in poorly ventilated homes leads to respiratory illnesses, a health burden that girls bear more than their male counterparts who are often working outside the home.

3. Educational Attrition and Child Marriage

The link between climate-induced household labor and education is direct. When a family loses crops to a flood or drought, they face economic "shocks." To survive, they may pull their daughters out of school—either to help with the increased domestic workload or because they can no longer afford school fees.

In extreme cases, climate change drives a rise in "climate-driven child marriages." Families facing total crop failure may see marrying off a daughter as a way to reduce the number of mouths to feed or to gain a dowry (bride price) to survive the season. This effectively ends a girl's childhood and her prospects for financial independence.

4. The Psychological and Physical Toll

The constant pressure of managing a household during environmental instability leads to chronic stress and physical exhaustion. Younger girls are often tasked with caring for siblings while parents search for alternative income, placing adult-sized emotional burdens on children.

The intersection of climate change and girls' household responsibilities reveals a deepening chasm of inequality. We cannot achieve climate justice without gender justice. Protecting the environment is intrinsically linked to protecting a girl's right to an education and a life free from forced domestic servitude.

To mitigate these impacts, global climate strategies must include:

- **Infrastructure Investment:** Building solar-powered water pumps and providing clean cooking technologies to reduce the time spent on resource collection.
- **Gender-Responsive Education:** Implementing flexible school hours and "climate scholarships" to keep girls in school during environmental disasters.
- **Policy Inclusion:** Ensuring women and girls are at the decision-making table when climate adaptation plans are drafted.

If the international community fails to address these gendered domestic burdens, the progress made in girls' education over the last several decades may be washed away by the very same rising tides that threaten our coastlines.

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USING ECONOMIC MECHANISMS TO INCREASE THE COMPETITIVENESS OF TEXTILE INDUSTRY ENTERPRISES

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Abstract. The competitiveness of textile industry enterprises depends not only on production volume, labor cost, or access to raw materials, but also on the quality of economic mechanisms that regulate costs, investment, innovation, market positioning, and value-chain integration. In modern textile markets, enterprises operate under the pressure of global competition, technological modernization, sustainability standards, and changing consumer demand. Therefore, competitiveness must be understood as a systemic economic category that combines productivity, financial stability, product differentiation, export capacity, technological renewal, and responsible supply-chain governance.

Keywords: textile industry, competitiveness, economic mechanisms, value chain, industrial policy, innovation, export potential.

INTRODUCTION

The textile industry remains one of the most important sectors of manufacturing because it connects agriculture, raw-material processing, industrial production, logistics, design, retail, and international trade within a single value chain. According to the WTO sectoral profile, textiles and clothing accounted for 3.7 percent of world merchandise exports in 2022, while the sector's value added was formed not only by textile producers themselves, but also by services, agriculture, chemicals, transport, finance, and other related branches [2]. This evidence confirms that textile competitiveness is no longer determined by sewing capacity alone; it depends on the ability of enterprises to coordinate production, supply, design, branding, logistics, and market access within an integrated economic system.

The relevance of economic mechanisms in textile competitiveness is explained by the structural transformation of global apparel and textile markets. Low-cost labor, once regarded as the principal advantage of developing textile producers, has gradually lost its decisive role. Buyers increasingly require stable quality, short delivery cycles, traceability, ecological standards, social responsibility, digital communication, and flexible production.

MATERIALS AND METHODS

The first major economic mechanism for increasing competitiveness is cost-management and productivity improvement. Textile production is sensitive to the cost of raw materials, energy, labor, machinery maintenance, logistics, and financial resources. Enterprises that lack cost-accounting systems often make decisions based on approximate expenditure rather than precise economic analysis. A modern textile firm must introduce activity-based costing, standard-cost control, lean production principles, and regular productivity measurement. Such mechanisms allow management to identify hidden losses in production downtime, excessive inventory, defective output, inefficient cutting, repeated dyeing, and poor warehouse organization. Cost reduction, however, should not be confused with primitive economy or wage compression. Sustainable competitiveness requires reducing non-productive losses while increasing labor productivity, technological accuracy, and product value. The second mechanism is investment modernization. Textile enterprises cannot remain competitive if they depend on obsolete machinery, high energy consumption, unstable quality, and manual control of processes that can be automated. Investment mechanisms may include preferential credit, leasing of technological equipment, depreciation incentives, reinvestment of profit, public–private partnership in industrial zones, and targeted support for small and medium-sized manufacturers. UNIDO’s Industrial Development Report 2024 stresses the role of modern industrial policy in supporting growth, innovation, employment, and sustainable development [4]. In the textile industry, such policy has practical significance when it directs resources toward spinning, weaving, dyeing, finishing, technical textiles, laboratory certification, and digital production planning rather than only expanding basic garment assembly.

Innovation is another decisive mechanism. In many textile enterprises, innovation is narrowly understood as the purchase of new machines. In reality, innovation includes product design, fabric composition, technical textiles, smart textiles, ecological dyeing, digital pattern development, automated cutting, enterprise-resource planning, e-commerce integration, and the use of data in demand forecasting. The WTO profile notes that finance and business services connected with technology-intensive solutions, including robotics, 3D printing, and computer-aided design, contribute to efficiency in textile and clothing value chains [2]. Therefore, innovation mechanisms should cover both technological and organizational renewal. Enterprises that introduce only equipment without redesigning management, marketing, quality control, and personnel training usually receive limited economic effect.

RESULTS AND DISCUSSION

A separate role belongs to cluster-based mechanisms. Textile clusters increase competitiveness because they reduce transaction costs, improve access to suppliers,

create specialized labor markets, facilitate technological learning, and support cooperation between enterprises, universities, logistics firms, banks, certification bodies, and export agencies. A cluster is economically effective when it does not become a formal administrative grouping, but functions as a network of complementary enterprises. For instance, cotton processing, yarn production, fabric manufacturing, dyeing, garment design, packaging, logistics, and retail can be placed within a coordinated regional production system. Such integration increases domestic value added and reduces dependence on imported intermediate goods. The WTO data show that countries with strong domestic supply-chain capacity, such as China and India, retain a high share of domestic value added in textile and clothing exports [2]. This means that cluster development is not merely a territorial policy; it is a mechanism for capturing a larger part of value inside the national economy.

Export-support mechanisms also have strategic importance. Textile enterprises operating only in the domestic market often face limited demand, weak economies of scale, and unstable profitability. Export orientation encourages enterprises to improve quality, certification, packaging, delivery discipline, and brand positioning. However, export competitiveness cannot be achieved only through customs privileges or short-term subsidies. A rational export mechanism must include market research, participation in international exhibitions, export credit insurance, support for certification under international standards, logistics infrastructure, digital trade platforms, and assistance in negotiating with foreign buyers. The World Bank's analysis of apparel value chains indicates that heightened competition among developing countries and changes in global demand create both risks and new opportunities for textile exporters [5]. Enterprises able to adapt product lines to emerging markets, fast fashion, sustainable fashion, and specialized industrial textiles are more likely to maintain export stability.

Financial mechanisms must be differentiated according to the technological and market position of enterprises. Large vertically integrated textile companies require long-term investment loans, export financing, hedging instruments, and infrastructure support. Small and medium-sized enterprises need accessible working capital, leasing, digital accounting, micro-credit adapted to production cycles, and cooperative purchasing of raw materials. A common problem in textile production is the mismatch between the timing of expenditure and revenue. Enterprises purchase raw materials, pay workers, and finance production before receiving payment from buyers.

CONCLUSION

The competitiveness of textile industry enterprises is formed through a complex interaction of cost efficiency, investment modernization, innovation, cluster

cooperation, export capacity, financial stability, quality management, sustainability, digitalization, and human capital. Price advantage alone is no longer sufficient in the global textile market because buyers increasingly evaluate quality, delivery reliability, traceability, ecological standards, and institutional trust. Therefore, textile enterprises must move from extensive growth based on production volume toward intensive growth based on productivity, value added, technological renewal, and market differentiation.

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ADVANTAGES AND DISADVANTAGES OF FOREIGN EQUIPMENT IN CLEANING COTTON FROM SMALL IMPURITIES

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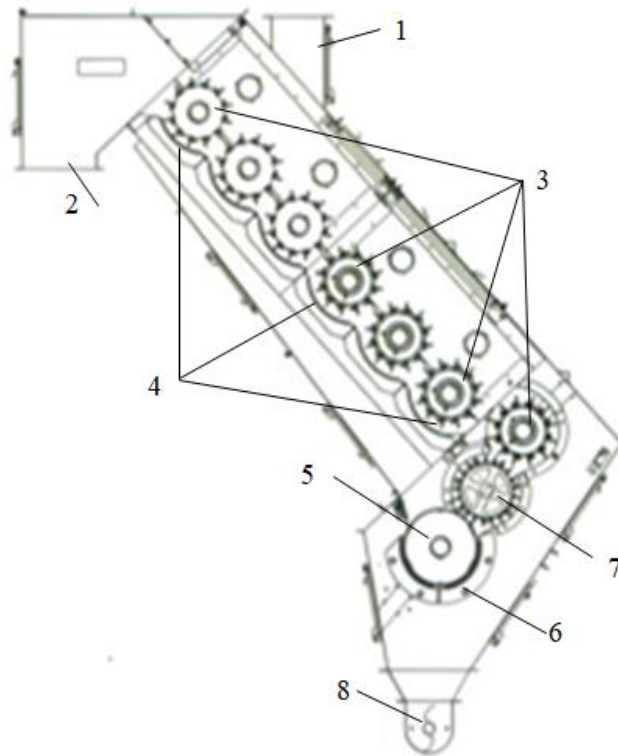
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Abstract: *The cleaning efficiency of cotton of grades I and III in the MQZH-15 type cleaner for cleaning cotton from small impurities was 10.5 (abs)% and 9.6 (abs)% lower than the cleaning efficiency in the technical specifications, depending on the grade, and showed that it could not meet the technological requirements.*

Key words: *Machine, pick drum, regeneration drum, grate, cotton, cleaning effect, small debris, large debris.*

In the developed cotton-producing countries of China, Turkey, India, and the United States, cotton is cleaned of fine impurities during the initial processing of medium-fiber selected cotton varieties to produce high-quality fiber [1]. Therefore, cleaning equipment is produced in these countries to remove fine impurities from cotton.

Cotton gins manufactured in these countries are similar in design and consist of working parts that receive cotton, clean it of small impurities, and regenerate cotton pieces separated as waste during cotton cleaning. In order to study the effectiveness of cotton gins in the initial processing of cotton at cotton ginning enterprises with foreign technological systems, a cotton gin manufactured in the People's Republic of China and currently operating in the Syrdarya region, the "Bek Cluster" Research work was conducted on the MQZH-15 equipment used in the cotton ginning plant's cotton cleaning system for removing small impurities (Figure 1). According to the technical specifications, the equipment's productivity is 15 t/h. The cleaning efficiency is 60-70% for cleaning high and low-grade cotton.



1, 2-intake and discharge manifolds, 3-pile drums, 4-slatted grates, 5-regeneration drum, 6-slatted grate, 7-brush drum, 8-waste auger.

Figure 3. Scheme of the MQZH-15 slope cleaner from Swan cotton machinery

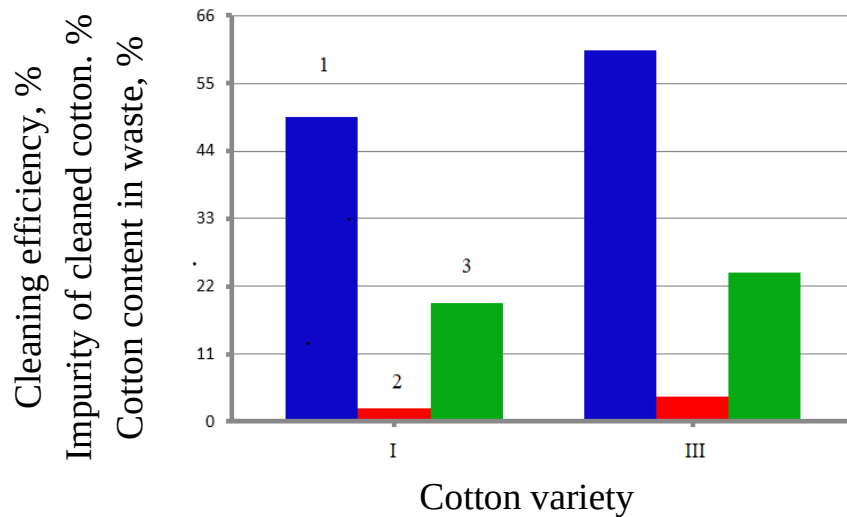
It was studied that the total electrical energy consumption for all rotating working parts of the equipment is 22 kW/h, which is 10 kW/h more than the local 1XK equipment for cleaning cotton from small impurities [2].

The research was conducted on An-Bayavut-2 selected grade I and grade III cotton of class 2 with initial moisture content of 9.2% and 12.4%, impurities of 4.6% and 10.5%. The average moisture content of cotton fed to the cleaner was 7.6% and 8.9% by grade, and the average impurities were 4.2% and 10.1%.

After cleaning cotton of the 1st grade 2nd class on the MQZH-15 equipment, the average moisture content was 7.4%, and the average impurity content was 2.12% [3, 4]. In this case, the cleaning efficiency of the cleaner was 49.5% on average, which was 10.5 (abs)% less than the cleaning efficiency in the technical characteristics (Figure 2). The amount of cotton separated from the cleaner into waste during cleaning was 19.2% on average compared to the waste mass.

Then, research was conducted on cotton of the 2nd grade of the III grade. In this case, cotton with a moisture content of 8.9% and a dirt content of 10.1% was fed to the MQZH-15 equipment. After cleaning the cotton in the cleaner, the moisture content of

the cotton was on average 8.7% and the dirt content was on average 4.0%. In this case, the cleaning efficiency of the cleaner was on average 60.4%, which was on average 9.6 (abs)% less than the cleaning efficiency in the technical specifications.



1-cleaning efficiency, %; 2-pollution of cleaned cotton, %; 3-amount of cotton in waste.

Figure 4. Dependence of equipment efficiency, cotton quality and cotton content in waste on cotton variety

During cotton cleaning, the amount of cotton separated from the cleaner into waste was high, averaging 24.3% of the waste mass. Despite the fact that the equipment was designed to clean cotton from small impurities, the spacing of the grates on the grate grid placed under each pile drum in the equipment was not selected correctly, and a large amount of cotton pieces with small and large impurities were observed during cotton cleaning. Despite the fact that the cotton in the waste was cleaned using the regeneration drum, it was found that a large amount of small impurities remained in the cotton composition and that the addition of this regenerated cotton to the cotton stream fed to the equipment for cleaning increased the level of impurities in the cotton stream, which led to a decrease in the quality of the fiber produced.

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Annotatsiya: Tajribalarni o'tkazishda tozalash filtr barabanining aylanishlar sonining boshlang'ich tezligini aniqlash uchun quyidagi uslub ishlab chiqildi. Tanlangan matoni o'rnatib, changli havoni yuborildi, bu yerda uskunaga kirishdagi chang miqdori va chiqishdagi chang miqdori o'lchandi, bundan tashqari havo tezliklari kirish va chiqishda o'lchanib turildi. Filtrning changda ishlash vaqtining 30 sekunda mato yuzasini tozalab o'tish talab etiladi.

Kalit so'zlar: Paxta, havo, atmosfera, chiqindi, chang, filtr, baraban, organik chang, mato.

Аннотация: Разработана следующая методика определения начальной скорости числа оборотов барабана очищающего фильтра в ходе экспериментов. Устанавливали выбранную ткань и подавали запыленный воздух, где измеряли запыленность на входе и выходе, а также измеряли скорости воздуха на входе и выходе. Для очистки поверхности ткани требуется 30 секунд времени работы фильтра в пыли.

Ключевые слова: Хлопок, воздух, атмосфера, отходы, пыль, фильтр, барабан, органическая пыль, ткань.

Abstract: In the course of the experiments, the following method was developed to determine the initial speed of the number of revolutions of the cleaning filter drum. The selected fabric was installed and dusty air was sent, where the amount of dust at the inlet and outlet of the device was measured, in addition, the air velocities were measured at the inlet and outlet. It is required to clean the fabric surface within 30 seconds of the filter's operation time in dust.

Keywords: Cotton, air, atmosphere, waste, dust, filter, drum, organic dust, fabric.

Paxta tozalash zavodining ishlab chiqarish binolarida havodagi chang miqdori normasi $2-4 \text{ mg/m}^3$ dan oshmaydi, atmosferaga chiqariladigan chiqindi havo esa 150 mg/m^3 ni tashkil qiladi. Darhaqiqat, sexlarda ham, atmosferaga chiqariladigan changning miqdori ham ruxsat etilgan me'yordan bir necha baravar yuqori [1].

Paxta xomashyosidan ajraladigan chang tarkibidan organik va minerall fraksiyalari mavjud.

Texnik jarayonning boshida paxta xomashyosini tashish va aralashmalardan tozalashda undan asosan kelib chiqishi organik bo'lgan mineral chang ajralib chiqadi va havoni ifloslantiradi.

Paxta xomashyosi uchun pnevmatik transport tizimining chiqindi havosidagi organik chang 10 dan 20% gacha va 80-90% esa mineral zarralarni o'z ichiga oladi. Ishlab chiqarish sexlarida texnologik

asbob-uskunalardan chiqarilgan havoning chang miqdori turli navli paxta xom ashyosini qayta ishlashda uning turiga, namligiga va ifloslanishiga bog'liq bo'lib, changning chiqishi kuchli bo'ladi. Chang hosil qiluvchi manbalardan so'rilgan chang va ifloslangan havo, shuningdek, pnevmatik tashish qurilmalaridagi chiqindi havo atmosferaga chiqarilishidan oldin changdan tozalanishi kerak. Shuning uchun atmosferaga siklonlardan chiqayotgan changli havoni tozalashning keyingi bosqichi uchun filtr uskunasi ishlab chiqildi va laboratoriya qurilmasi tayyorlanib tajribalar asosida parametrlar aniqlandi [2].

Tajribalarni tayyorlangan laboratoriya uskunasi yordamida o'tkazildi. Bunda oldindan tayyorlangan 1,2 kg paxta changi miqdorini filtrga uzatilayotgan havo hajmiga nisbatan $1\text{m}^3/\text{s}$ da havoda bo'ladigan chang miqdoriga moslab qo'shib borildi. Ko'pgina izlanishlar [3, 4] asosida jin-linter sexidan ajralayotgan changli havo tarkibida tolali materiallar miqdori yuqori bo'lganligi uchun laboratoriya tajribalarimizda ushbu effektini beramiz. Bunda texnologik tizim bo'yicha siklonda tozalanganidan so'ng atmosferaga chiqayotgan chang konsentratsiyasi, $120\text{-}252\text{ mg/m}^3$ gachani, atmosferaga chiqayotgan tolali material massasi $5\text{-}168\text{ gr.}$ gacha tashkil etadi [3]. Laboratoriya uskunaga uzatilayotgan havo hajmi sekundiga $1,0\text{ m}^3$ ni tashkil etganligi sababli taxminan sekundigi $20\text{-}25\text{ gr.}$ tolali changni bir maromda qo'shib borilsa ishlab chiqarishda chiqayotgan chang konsentratsiyasiga mos keladi.

Filtrlovchi barabanning aylanishlar sonini o'zgarishida filtr matosi ustiga yopishga tolali changlarni tez tozalanishi bilan matoning yuzasi doymu tozaligi ta'minlanadi va havo o'tishi yaxshilanib, qarshilikning oshib ketishini oldi olinadi. Mato yuzasi tolali material bilan to'lib ketadigan bo'lsa matoning havo o'tkazuvchanlik qobiliyati kamayib, uskunaning qarshiligi oshishidan elektr energiya sarfining ortishiga ventilatorning ortiqcha kuchlanishiga va qizishiga olib kelishi mumkin, shuning uchun matoli filtr barabanining aylanishlar chog'ida mato yuzasini tozalovchi sidiruvchi moslama ishlatiladi. Sidirilgan chiqindilarni vakuum-klapan orqali tashqariga chiqariladi.

Tajribalarni o'tkazishda tozalash filtr barabanining aylanishlar sonining boshlang'ich tezligini aniqlash uchun quyidagi uslub ishlab chiqildi. Tanlangan matoni o'rnatib, changli havoni yuborildi, bu yerda uskunaga kirishdagi chang miqdori va chiqishdagi chang miqdori o'lchandi, bundan tashqari havo tezliklari kirish va chiqishda o'lchanib turildi. Bu yerda mato yuzasining changga to'lish va uni tozalash vaqtini quvurlarda havo tezliklarining farqiga qarab aniqlandi. Shunda chiqishdagi so'ruvchi havo tezligi oshib, kirishda kamaya boshlansa, demak shu vaqtni mato yuzasining changga to'lish vaqti sifatida olinadi va mato yuzasini barabannlarni aylantirish bilan tozalanadi. Har 15 sekundda havo tezligi o'lchab borilib, tezliklarning o'zgarishi aniqlanib boriladi. Havo tezligining oshib ketishi filtr matoni tortilishiga va yorilib tez ishdan chiqishiga olib kelishi mumkin. Shuning uchun havoni matodan o'tish tezligini tekislash uchun filtr matoni doymiy tozalanishini barabanning aylanishlar soni bilan boshqariladi. Lekin laboratoriya sharoitida aniqlangan barabanning aylanishlar sonini boshlang'ich ma'lumot sifatida qabul qilinib, ishlab chiqarish sharoitida filtrni siklongan o'rnatib, barabanning aylanishlar sonini tozalash samaradorlikka bog'liq xolda aniqlanadi. Laboratoriya sharoitida o'tkazilgan tajriba natijalari 1-jadvalda keltirilgan.

1-jadval

Filtr barabanining boshlang'ich aylanish tezligini aniqlash bo'yicha tajriba natijalari

No	Ko'rsatkichlar	15 sek	30 sek	45 sek	60 sek
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1	Filtrga kirishda havodagi chang tarkibi, gr	300	300	300	300
2	Filtrdan chiqishdagi havodagi chang tarkibi, gr	8	7	4	4
3	Tozalash samarasi, %	97,4	97,7	98,7	98,7
3	Filtr mato yuzasiga yopishgan chiqindi qalinligi, mm	6	10	18	22
4	Matodan havoni o'tish tezligining farqi, m/sek	4,6/4,5	4,0/4,5	2,5/5,6	1,2/6,8

Izox: suratida kirishda va mahrajida chiqishdagi (so'rish qismida) havo tezliklari.

Yuqoridagi tajriba natijalaridan ko'rinib turibdiki, filtr matodan changli havoni 15 sekund davomida o'tkazilganda filtrdan o'tgan chang miqdori 8 gr.ni tashkil etib, tozalash samarasi 97,4 % ni tashkil etdi. Mato yuzasida yig'ilgan changning qalinligi 6 mm ni tashkil etdi. So'ng yana changni uzatib 15 sekunddan so'ng yana o'lchovlarni o'tkazilganda matodan o'tgan chang miqdori 7 gr.ni tashkil etdi, tozalash samarasi 97,7% ni tashkil etdi. Ja'mi 30 sekunda mato yuzasida yig'ilgan changni qalinligi o'lchanganda 10 mm ni ko'rsatdi. Har 15 sekunda o'lchamlar amalga oshirildi, lekin 45 sekunda so'ng mato yuzasiga yopishgan chang qatlami 18 mmdan oshgandan so'ng havo tezligi so'rish tomonda oshib matodan havo o'tishi qiyinlashib, matoni torta boshladi. Shuning uchun changda ishlash vaqtining 30 sekundida mato yuzasini tozalab o'tish talab etiladi. Mato o'ralgan barabanning aylanishlar sonini shunday tanlash kerakki mato yuzasini 30 sekundlarda tozalab o'tishi kerak. Bunda mato lentasining chiziqli tezligini quyidagi formula orqali aniqlaymiz:

$$V = \Delta S / \Delta t$$

Yetaklovchi barabanning diametri $d = 150$ mm, bu xolda $\Delta S = \Pi * d$ bo'ladi.

$$V = \Pi * d / t.$$

$$V = 3,14 * 0,15 / 30 = 0,0157 \text{ m/s.}$$

Demak, mato lentasining tezligi 0,0157 m/s ni tashkil etadi.

Barabanning aylanishlar sonini aniqlash uchun quyidagi formuladan foydalanamiz. $n = V / (2\Pi * 0,5D) = 0,0157 / (2 * 3,14 * 0,5 * 0,15) = 0,04 \text{ ob/s.}$

Ushbu ko'rsatkichlar laboratoriya stendi uchun bo'lib, tajriba sanoat namunasi uchun tayyorlangan matoni sudrash barabanining aylanishlar sonini tajribalar asosida uskunaning tozalash samarasiga bog'liq xolda aniqlanishi lozim.

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RESULTS OF THEORETICAL AND PRACTICAL STUDY OF THE TECHNOLOGICAL PROCESS OF THE DEVELOPED HEAVY MIXTURE HOLDER

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Abstract. *The article presents the theoretical study results on the effect of a softening long-pinned drum used in the holder of developed heavy mixtures. It analyzes the forces acting on cotton tufts when they strike the long-pinned drum after being transported through a pneumatic pipe. The motion of the cotton tufts and the efficiency of separating heavy mixtures from their composition are shown through equations and graphs. Specifically, considering the operating conditions of equipment used in cotton-cleaning enterprises and the pneumatic transport system—where the flow rate and air velocity at the inlet pipe are approximately 5 m³/s and 40 m/s, respectively—the speed of the transported cotton tufts ranges mainly between 18 and 25 m/s, depending on their size and weight.*

Introduction

According to the developed technical solution, in order to increase the efficiency of pre-softening of cotton raw material in the heavy admixture holder and enhance the effect of its impact on the reflecting wall, it was recommended to place it on the lower guide wall of the chamber, opposite the reflecting wall, so that the cotton raw material first hits the softening drum, thereby ensuring that the cotton is first softened and then hits the reflecting wall. This requires new theoretical and experimental approaches in primary cotton processing¹. Cotton is a key natural fiber in textiles, and its quality is crucial. Fiber quality depends on pre- and post-harvest practices. After harvesting, cotton is ginned to separate fibers from seeds. Quality is also affected by variety, environment, and handling². This article studied the influence of the main input factors on the mass and density of raw material in the process of fiber separation, including the efficiency of the saw fiber separator (X1), the rotation speed of the auxiliary fertilizer device (X2), and the number of hairless seeds coming out of the auxiliary fertilizer device (X3).

Experimental part

The tube (Fig. 1) consists of a chamber 3 consisting of guide 5 and reflective 2 walls and a box 8, to which inlet 7 and outlet 1 manifolds and a small hopper are connected, a vacuum valve 4 is located in the lower part of the chamber. Inside the chamber 3 there is a drum 6 with a long pile, a rotating valve is installed on the hopper wall in the bottom part of the reflecting wall 2 of the chamber 3.

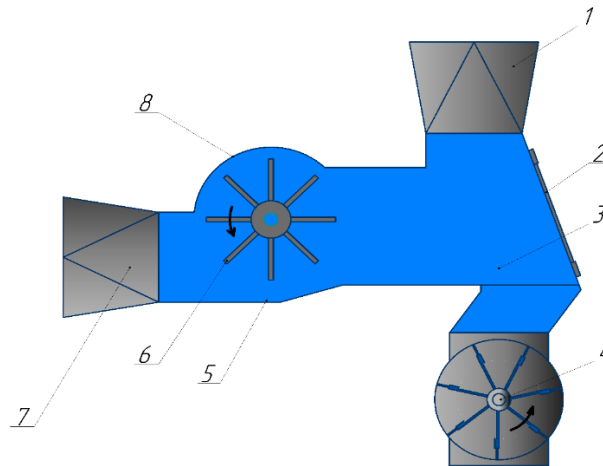


Figure 1. Scheme of the heavy mixture tester according to the proposed technical solution

The operation of the hopper is as follows. The inlet 7 and outlet 1 pipes along the air flow are connected to a pipeline system, the last part of which is connected to a fan through a cotton separator (not shown in the figure), which sucks air from the pipeline system, due to its pressure, the cotton raw material is transported from the pipeline system to the cotton separator through the hopper with heavy impurities. With the operating mode of the equipment used in cotton ginning plants and the pneumatic conveying device, the flow rate and air velocity in the inlet pipe are approximately $5 \text{ m}^3/\text{s}$ and 40 m/s , respectively, and the speed of the transported cotton pieces, depending on their size and weight, is mainly in the range from 18 to 25 m/s . The largest and densest cotton pieces move at a speed lower than these speeds, and individual flaps and small pieces consisting of several pieces move at a higher speed.

Due to the difference between the linear speed of the piles of the long-pile drum 6 and the speed of the cotton pieces transported by air, they are subjected to the impact of the piles, which ensures that almost all the cotton pieces are individually broken into small pieces and heavy impurities are separated from them¹¹.

The reflection of cotton pieces and heavy impurities from the piles of the long-pile drum 6 depends on the height of the impact point on the deflecting wall 5. Basically, the reflection occurs in the direction of the deflecting wall 5, then the cotton pieces and heavy impurities, softened by the piles of the long-pile drum 6, are thrown by the expanding flow onto the reflecting wall 2. After hitting this wall, the pieces of cotton raw material are carried by the air flow to the outlet pipe 1, foreign heavy impurities fall into the hopper and are removed from the holder through the rotary vacuum valve 4.

Separated from the main flow and falling into the lower part of the chamber above the hopper, individual pieces of cotton raw material are removed by the air flow sucked through the holes of the rotary valve and returned to the main flow, which is transported to the outlet pipe 1, which prevents the cotton pieces from mixing with heavy impurities falling into the hopper of the hopper. In the first case, we will consider the action of removing foreign bodies from the composition of cotton raw material due to the installation of a drum with a long pile¹².

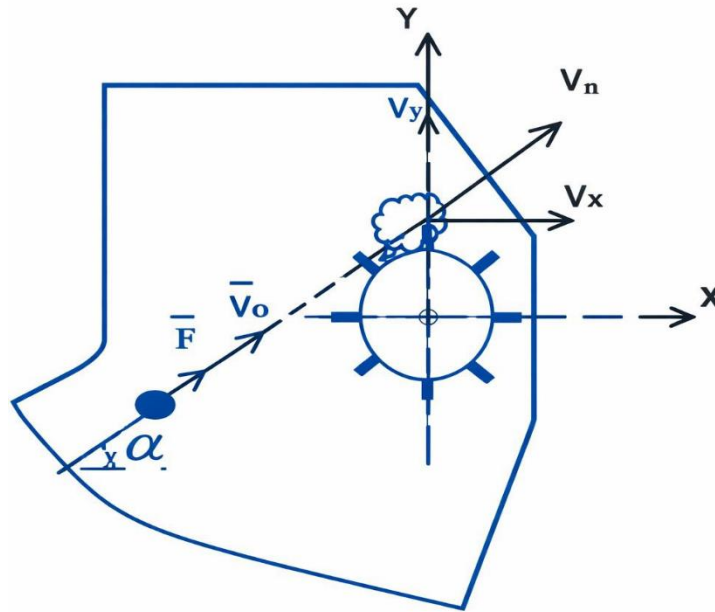


Figure 2. Scheme of the effect of a long-pile drum on the flow of cotton in the holder

Let the coordinate axes be located in the center of the drum with a long pile. Based on the D'alambert principle, we make a formula for balancing a piece of cotton.

$$\begin{aligned} m \cdot \frac{d^2 x}{dt^2} &= R \\ m \cdot \frac{d^2 y}{dt^2} &= -m \cdot g \end{aligned} \quad (1)$$

Here: m is the mass of the cotton ball, v is the velocity, g is the acceleration of gravity,

$R = k \cdot (\mathcal{G}_x - \mathcal{G}_n)$ - aerodynamic force, k - drag coefficient, $\mathcal{G}_x$ - air speed, $\mathcal{G}_n$ - the speed of the cotton ball.

By differentiating the formula (1), we determine the action of separating stones and various mixtures from a piece of cotton.

$$\begin{aligned} \frac{d^2 x}{dt^2} &= \frac{k}{m} \cdot (\mathcal{G}_x - \mathcal{G}_n) \\ \frac{d^2 y}{dt^2} &= -g \end{aligned} \quad (2)$$

(2) by integrating the formula once, we determine the speed of the cotton flow in the axes.

$$\begin{aligned} \frac{dx}{dt} &= \frac{k}{m} \cdot (\mathcal{G}_x - \mathcal{G}_n) \cdot t + C_1 \\ \frac{dy}{dt} &= -g \cdot t + C_2 \end{aligned} \quad (3)$$

C_1 and C_2 we use the initial condition to define the constant values

$t = 0 \quad \vartheta_x = \vartheta_0 \cdot \cos \alpha; \vartheta_y = \vartheta_0 \cdot \sin \alpha \Rightarrow C_1 = \vartheta_0 \cdot \cos \alpha; C_2 = \vartheta_0 \cdot \sin \alpha$ we put the fixed values of the constants in equation (3).

$$\begin{aligned} \frac{dx}{dt} &= \frac{k}{m} \cdot (\vartheta_x - \vartheta_n) \cdot t + \vartheta_0 \cdot \cos \alpha \\ \frac{dx}{dt} &= -g \cdot t + \vartheta_0 \cdot \sin \alpha \end{aligned} \quad (4)$$

(4) we determine the displacement along the coordinate axes when separating stones and various mixtures from the cotton stream.

$$\begin{aligned} x &= \frac{k}{m} \cdot (\vartheta_x - \vartheta_n) \cdot \frac{t^2}{2} + \vartheta_0 \cdot t \cdot \cos \alpha \\ y &= -g \cdot \frac{t^2}{2} + \vartheta_0 \cdot t \cdot \sin \alpha \end{aligned} \quad (5)$$

(5) Equilibrium shift in the separation of cotton particles. The speed of air and cotton particles entering the long pile drum is 400 rpm (8.33 m/s), 600 rpm (12.5 m/s) and 800 rpm (16.6 m/s), respectively. The graphs of the process of separating cotton pieces using equation (5) using the Maple program are presented in Figures 3 and 4.

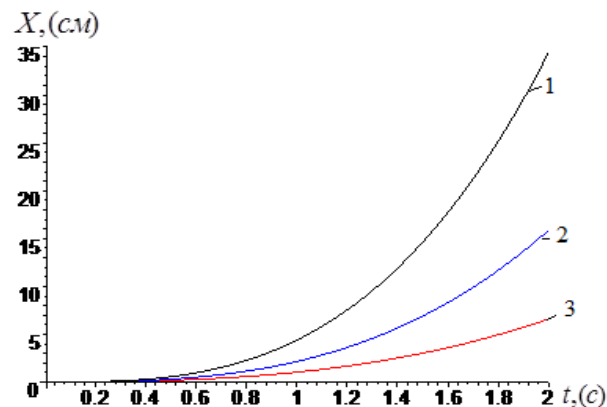


Figure 3. The speed of separation of various mixtures from the cotton stream is different $\vartheta_{n1} = 16.6 \text{ m/s}$, $\vartheta_{n2} = 12.5 \text{ m/s}$, $\vartheta_{n3} = 8.33 \text{ m/s}$ graph of time dependence in values.

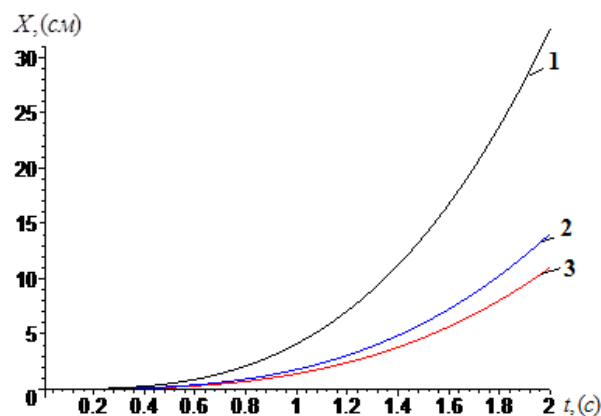


Figure 4. The length of the piles is different when separating different mixtures from the cotton stream $l_1 = 20\text{ sm}$, $l_2 = 15\text{ sm}$, $l_3 = 10\text{ sm}$ graph of dependence on time in values.

As can be seen from the analysis of the graphs in Figures 3 and 4, the air velocity $g_{n3} = 16,6\text{ m/c}$ drum with a long pile of cotton stream $l_1 = 20\text{ cm}$ it is considered sufficient to transfer it to the diverter at the present value, in which it is possible to retain heavy impurities and thereby increase the efficiency of cleaning.

We present the analysis of the impact of external forces on the stone and various impurities separated from the cotton as a result of hitting the drum with a long pile of cotton.

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INVESTIGATION OF THE CONSTRUCTIVE PARAMETERS OF THE SAW INTERMEDIATE INSETS OF THE 5LP MACHINE FOR SEED LINTERING

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Abstract. *The article describes the methodological methods for preparing and conducting experiments with experimental saw spacers prepared for conducting experiments to improve the seed linting process and linting equipment, increase the productivity of the 5LP linter, and achieve energy savings.*

Key words: *lintering, experiment, saw, productivity, gasket, cylinder.*

Login. The increase in the cross-section of the working chamber in 5LP linters, which are currently widely used in the ginning workshops of cotton ginning enterprises, has made it possible to increase the linter's productivity by only 5-8%. The increase in the chamber volume did not accelerate the timely release of lintered seeds from the working chamber. As a result, an increase in the mass and density of the seed roller in the chamber occurred. This, in turn, led to an increase in the load from the seed roller to the saw cylinder. An 18.5 kW electric motor is installed in the saw cylinder to overcome the overload, give the seed roller the required speed, and carry out the linting process without clogging.

Literature analysis and methodology. As a result of theoretical research, researcher E.K. Nuraliev proposes a working chamber for the KL-7 linter, which is enlarged in volume. A mixer with an outer diameter of 240 mm is used in the chamber. At the end of the research work, it was found that the proposed working chamber had a positive effect on the productivity of the linter for seeds and lint due to the good mixing of the mixer seed roller used in it

Research results and discussion. The research process utilizes methodological manuals on theoretical and applied theory of machines and mechanisms, mathematical modeling of technological machine work processes, methods of mathematical statistics, and computational mathematics.

As a result of the analytical analysis, a working hypothesis was developed stating that replacing the inter-saw gaskets in the saw cylinder of the existing 5LP linter with relatively large-diameter ones (the width of the gaskets remains unchanged) positively

affects the processes in the linter's working chamber, relatively reduces seed density in the working chamber, and increases productivity through better mixing.

As a result of the implementation of the proposed working hypothesis, the following is expected: precise fastening of the saw shaft to the linter and the saw discs on it relative to the shaft is ensured, as well as the alignment of each grate section along the gap between the saws, due to which the deviation of one saw from its nominal position in the grate gap is expected to be significantly less than in the existing 5LP linter. Furthermore, the deformation of saws compressed by large-diameter saw spacers can be completely eliminated, thereby eliminating the need for hammer straightening before assembling the saws onto the shaft.

Calculations and measurements showed that up to 85% of the energy consumption of the electric motor rotating the saw cylinder in the existing 5LP linter is spent on friction of the saw cylinder against the seed layer and up to 15% on friction of the saw cylinder against the grate bars. In the developed improved linter, the saw cylinder penetration into the seed layer can be significantly reduced; in the existing 5LP linter, the saw cylinder penetration into the seed layer is 28 mm; therefore, under all other conditions, it is expected that the energy consumption for friction on the lateral surfaces of the saws in the improved linter will be significantly reduced, i.e., by 10-15%.

To implement the developed working hypothesis, a diagram of experimental gaskets for the saw drum of the 5LP linter was developed (Fig. 1).

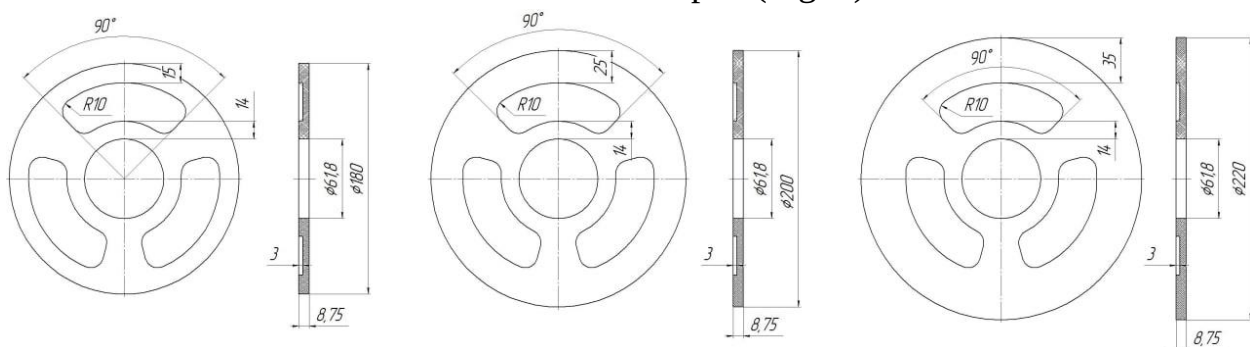


Figure 1. Schematic drawing of the experimental saw spacers

As shown in Figure 1, saw spacers with three diameters were selected for the experiments: 180 mm, 200 mm, and 220 mm.

To simplify the manufacturing process and reduce the cost of the gaskets, they were manufactured from solid DSP material. Thus, 161 saw blades were manufactured for each experimental variant, and 483 were manufactured for the three variants.

It is planned to assemble each variant of the prepared experimental saw spacers in turn in the assembly shop of the 5LP linter saw drum, load the assembled saw drum into the selected linter machine, and conduct the experiments. A cotton ginning enterprise in the Jarkurgan district of the Surkhandarya region was selected for the experiments. The

prepared experimental saw spacers are installed alternately on a single selected linter, and comparative experiments are conducted with the existing 160 mm saw spacer of the 5LP linter. To do this, the selected linter is first adjusted and uniform operating conditions are established. When installing existing and experimental saw spacers, the use of identical new saw blades with a diameter of 320 mm is ensured in all variants. The linter is supplied with ginned seeds of uniform fuzziness; the seed supply of the linter and the position of the seed comb are adjusted identically for all variants. Simultaneously, the prepared experimental saw spacers were delivered to the cotton ginning plant. A linter machine was selected for the experiments. Methodological methods for conducting experiments have been developed.

Conclusion. To implement the selected working hypothesis, the necessary spare parts variants were selected, and the experimental saw spacers were manufactured. A 5LP linter was selected for conducting research at the cotton ginning plant. Methodological methods for conducting the experiments have been developed.

It is expected that the thickness of the seed layer in the linter's working chamber will decrease by an average of 1.4–1.5 times compared to the current 5LP linter, as well as the absolute and relative speed of the seed layers will increase due to the support of large-diameter saw spacers in the rotating saw drum at the bottom of the chamber, their better mixing in the chamber, and accelerated mass transfer, which will increase the productivity of the produced linter by 1.3–1.4 times compared to the current 5LP linter.

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BOJXONA TIZIMIDA INSON OMILI VA TEXNOLOGIYA O'RTASIDAGI MUVOZANAT

Shoymardonov Rustam Sa'dulloyevich

O'zbekiston Respublikasi Davlat bojxona qo'mitasi xodimi

Annotatsiya. Mazkur maqolada bojxona tizimida inson omili va zamonaviy texnologiyalar o'rtasidagi muvozanat masalasi haqida tahlil qilinadi. Unda raqamlashtirish, sun'iy intellekt va avtomatlashtirilgan tizimlarning bojxona jarayonlaridagi o'rni hamda inson nazorati va professional tajribaning ahamiyati yoritilgan bo'lib, shuningdek, samaradorlik, shaffoflik va xavfsizlikni ta'minlashda texnologiya va inson omilining uyg'un ishlashi zarurligi asoslab beriladi.

Kalit so'zlar: bojxona tizimi, samaradorlik, inson omili, raqamlashtirish, sun'iy intellekt, avtomatlashtirish, bojxona nazorati, texnologiya.

O'zbekiston Respublikasi Prezidenti Shavkat Mirziyoyev 2020 yildagi Oliy Majlisga Murojaatnomasida davlat iqtisodiyotini rivojlantirishda raqamli texnologiyalarni joriy etish juda muhim ekanligini alohida ta'kidlab, Mamlakatimizda 2020 yilning "Ilm, ma'rifat va raqamli iqtisodiyotni rivojlantirish yili" deb e'lon qilinishi munosabati bilan raqamli iqtisodiyotni rivojlantirish bo'yicha boshqa sohalar kabi kadastr, qurilish sohalarini ham to'liq raqamlashtirish taklifi berildi.¹

Raqamli texnologiyalarning jadal rivojlanishi global savdoni osonlashtirishda inqilob yasadi. Bojxona rasmiylashtiruvi samaradorligini oshirish, xarajatlarni kamaytirish va shaffofligini oshirish tartib-qoidolari (Jahon savdo tashkiloti, 2025-yil). Rivojlangan iqtisodiyotlar "Yagona darcha" platformalari, avtomatlashtirilgan skanerlash texnologiyalari, va Integratsiyalashgan bojxona boshqaruvi tizimlari (iCMS) orqali yuk rasmiylashtiruvi sezilarli darajada qisqartirildi. va inson aralashuvini minimallashtirish. Masalan, Yevropa Ittifoqining raqamli bojxonalari yechimlar savdoni qayta ishlash vaqtini 40% ga qisqartirdi.

Texnologiyalar bojxona tizimida daromadlar sizib chiqishining oldini olishda ham muhim ahamiyat kasb etmoqda. Jahon bojxona tashkiloti ma'lumotlariga ko'ra (2021), bojxona jarayonlari to'liq avtomatlashtirilgan mamlakatlarda bojxona firibgarligi qariyb 30 foizga kamaygan. Shunga qaramay, raqamli savdoni yengillashtirish borasida rivojlangan va rivojlanayotgan davlatlar o'rtasidagi tafovut hanuz saqlanib qolmoqda.

¹ O'zbekiston Respublikasi Prezidenti Shavkat Mirziyoyevning Oliy Majlisga Murojaatnomasi 2020 yil (manba: <https://uza.uz/oz/politics/zbekiston-respublikasiprezidenti-shavkat-mirziyeevning-oliy-25-01-2020>)

Jahon banki ma'lumotlariga ko'ra (2020), qo'lda amalga oshiriladigan bojxona tartib-taomillari savdo xarajatlarini 15–30 foizgacha oshiradi va bundan ayniqsa past daromadli davlatlar ko'proq zarar ko'radi. Raqamli "Yagona darcha" tizimlari (Single Window System) joriy etilgan rivojlangan mamlakatlarda yuklarni rasmiylashtirishning o'rtacha muddati 24 soatdan kamni tashkil etayotgan bo'lsa, ko'plab rivojlanayotgan hududlarda hanuz qog'oz asosidagi tizimlar saqlanib qolmoqda. Bu esa ortiqcha vaqt yo'qotishlari va samarasizlikka sabab bo'lmoqda.

Shu bois, xalqaro savdoda samaradorlikni oshirish hamda global raqamli tafovutni kamaytirish uchun keng qamrovli va moslashuvchan raqamli yechimlarni joriy etish dolzarb ahamiyatga ega.²

Raqamli bojxona keng siyosiy maqsadlarni qo'llab-quvvatlash uchun texnik vositadir. Raqamli bojxona keng qamrovli, kelajakka qaratilgan tushunchadir, ya'ni bojxonani raqamlashtirish:

- Ilg'or (raqamli) texnologiyalarni qo'llash
- Operatsion jarayonlarni o'zgartirish (bojxona operatsiyalari)
- Biznes jarayonlarini optimallashtirish (bojxona operatsiyalari)
- Biznes modellari - Kengaytirilgan tahlil
- Sun'iy intellekt va boshqalar.

Hozirgi kunda dunyoning deyarli barcha mamlakatlari bojxona xizmatida, jumladan O'zbekiston Respublikasi bojxona organlari faoliyatida ham elektron bojxona, bojxonani raqamlashtirish va avtomatlashtirish tushunchalari keng qo'llanilmoqda. Ushbu jarayonlar bojxona tizimini zamonaviy boshqaruv mexanizmlariga moslashtirish, inson omilini kamaytirish hamda xizmatlar samaradorligini oshirishga xizmat qilmoqda.

Biroq mazkur atamalarning mazmun-mohiyati, ularning o'zaro farqli va bog'liq jihatlari yuzasidan turli ilmiy yondashuvlar va qarashlar mavjud. Xususan, elektron bojxona asosan bojxona xizmatlarini elektron platformalar orqali amalga oshirishni anglatadi, raqamlashtirish bojxona faoliyatidagi barcha ma'lumot va jarayonlarni raqamli muhitga o'tkazishni nazarda tutadi. Avtomatlashtirish esa inson aralashuvini minimallashtirish orqali bojxona operatsiyalarini tezkor va aniq bajarishga qaratilgan texnologik jarayon sifatida namoyon bo'ladi.

Mazkur yo'nalishlarning o'zaro uyg'unligi bojxona tizimida shaffoflikni ta'minlash, korrupsion holatlarni kamaytirish, vaqt va xarajatlarni qisqartirish hamda xalqaro savdo jarayonlarini yengillashtirishda muhim omil bo'lib xizmat qilmoqda. Shu bilan

² William Kitema Jedidah¹, Doris Gitonga², Joel Tenai³ 1,2,3School of Business and Economics, Moi University, Kenya. Effect of Digital Technologies on Trade Facilitation at Nairobi's Customs Stations: Moderating Role of User Competence.

birga, texnologiyalar qanchalik rivojlanmasin, bojxona nazoratida inson omili, xususan, mutaxassislarning tahliliy fikrlashi, tajribasi va mas'uliyati muhim ahamiyatini saqlab qolmoqda. Aynan inson omili va zamonaviy texnologiyalar o'rtasidagi muvozanat bojxona tizimining samarali faoliyat yuritishida asosiy omillardan biri hisoblanadi.

Xulosa qilib aytganda, bojxona tizimini raqamlashtirish va avtomatlashtirish bugungi kunda xalqaro savdoni rivojlantirish, bojxona jarayonlarini tezlashtirish hamda shaffoflikni ta'minlashning muhim omiliga aylanmoqda. Zamonaviy raqamli texnologiyalar bojxona operatsiyalarida inson omilini kamaytirish, korrupsion holatlarning oldini olish, vaqt va xarajatlarni qisqartirish imkonini bermoqda. Shu bilan birga, bojxona tizimida inson omili ham o'z ahamiyatini yo'qotmaydi, chunki murakkab tahliliy qarorlar qabul qilish, xavflarni baholash va nazoratni amalga oshirishda mutaxassislarning bilim va tajribasi muhim o'rin tutadi.

Shu sababli, bojxona tizimini samarali rivojlantirishda texnologik innovatsiyalar va inson salohiyati o'rtasidagi muvozanatni ta'minlash dolzarb vazifa hisoblanadi. Aynan ushbu uyg'unlik bojxona organlari faoliyatining samaradorligi, xavfsizligi va xalqaro standartlarga mosligini ta'minlashga xizmat qiladi.

Foydalanilgan adabiyotlar

1. O'zbekiston Respublikasi Prezidenti Shavkat Mirziyoyevning Oliy Majlisga Murojaatnomasi 2020 yil (manba: <https://uza.uz/oz/politics/zbekiston-respublikasiprezidenti-shavkat-mirziyeevning-oliy-25-01-2020>)
2. William Kitema Jedidah¹, Doris Gitonga², Joel Tenai³ ^{1,2,3}School of Business and Economics, Moi University, Kenya. Effect of Digital Technologies on Trade Facilitation at Nairobi's Customs Stations: Moderating Role of User Competence.
3. F. Usmanaliyev RAQAMLI BOJXONA TUSHUNCHASI VA BOJXONANI RAQAMLI TRANSFORMATSIYA QILISHNING O'ZIGA XOS JIHATLARI. SCIENTIFIC PROGRESS. VOLUME 3 | ISSUE 3 | 2022 ISSN: 2181-1601
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YOSH BASKETBOLCHILARNI TAYYORLASHDA JISMONIY SIFATLARNI RIVOJLANTIRISH

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Annotatsiya: Ushbu maqolada yosh basketbolchilarni tayyorlashda jismoniy sifatlarni rivojlantirishning ahamiyati yoritilgan. Basketbolchilarning tezkorlik, kuch, chidamlilik, chaqqonlik va egiluvchanlik sifatlarini rivojlantirish usullari tahlil qilingan. Shuningdek, basketbol sport turining kelib chiqishi, Olimpiya va Jahon chempionatlari tarixi, yetakchi davlatlar hamda O'zbekistonda basketbolning rivojlanishi haqida ma'lumot berilgan.

Annotatsiya: В данной статье рассматривается значение развития физических качеств у юных баскетболистов. Анализируются методы развития быстроты, силы, выносливости, ловкости и гибкости. Также приведены сведения о происхождении баскетбола, истории Олимпийских игр и чемпионатов мира, ведущих странах и развитии баскетбола в Узбекистане.

Annotatsiya: This article highlights the importance of developing physical qualities in young basketball players. Methods for improving speed, strength, endurance, agility, and flexibility are analyzed. The article also provides information about the origin of basketball, the history of the Olympic Games and World Championships, leading basketball countries, and the development of basketball in Uzbekist

Kalit so'zlar: basketbol, yosh sportchi, jismoniy tayyorgarlik, jismoniy sifatlarni rivojlantirish, savat, maydon, chidamlilik, tezlik, hujum, himoya .

Kirish

Basketbol sport turi 1891-yilda kanadalik pedagog va jismoniy tarbiya o'qituvchisi James Naismith tomonidan Springfield shahrida yaratilgan. Ushbu o'yin dastlab talabalarni qish faslida jismoniy faol saqlash maqsadida tashkil etilgan. Dastlab futbol to'pi va meva savatlaridan foydalanilgan bo'lsa, keyinchalik basketbol qoidalari

takomillashib, zamonaviy sport turiga aylandi. Bugungi kunda basketbol dunyoning eng mashhur sport turlaridan biri bo'lib, millionlab muxlislarga ega. Yosh basketbolchilarni tayyorlash jarayonida ularning jismoniy sifatlarini rivojlantirish muhim ahamiyat kasb etadi. Chunki zamonaviy basketbol yuqori tezlik, kuch va chidamlilikni talab qiluvchi murakkab sport turi hisoblanadi.

Asosiy qism

Yosh basketbolchilarni tayyorlashda tezkorlik, kuch, chidamlilik, egiluvchanlik va chaqqonlik asosiy jismoniy sifatlar hisoblanadi. Mashg'ulotlarda yugurish, sakrash, to'p bilan ishlash, estafeta mashqlari va jamoaviy taktik o'yinlardan foydalaniladi. Ushbu mashqlar yosh sportchilarning texnik va taktik mahoratini oshirishga xizmat qiladi. Basketbol xalqaro sport maydonida ham katta o'rin egallaydi. Erkaklar basketboli 1936-yilda Berlin shahrida o'tkazilgan Olimpiya o'yinlari dasturiga rasman kiritilgan. O'sha yili finalda United States terma jamoasi g'olib bo'lib, ilk Olimpiya chempioniga aylangan. Ayollar basketboli esa 1976-yilda Montreal Olimpiadasida dasturga qo'shilgan va birinchi chempion ham Soviet Union ayollar terma jamoasi bo'lgan. Basketbol bo'yicha Jahon chempionati FIBA tomonidan tashkil etiladi. Erkaklar o'rtasidagi ilk Jahon chempionati 1950-yilda Buenos Aires shahrida o'tkazilgan bo'lib, unda mezbon Argentina terma jamoasi g'oliblikni qo'lga kiritgan. Ayollar o'rtasidagi ilk Jahon chempionati esa 1953-yilda Santiago shahrida o'tkazilgan va United States ayollar terma jamoasi chempion bo'lgan. Hozirgi kunda basketbol bo'yicha dunyodagi eng kuchli davlat sifatida United States tan olinadi. Ushbu davlat basketbol rivojlanganligi, professional ligalarining kuchliligi va ko'plab chempionlari bilan ajralib turadi. Ayniqsa National Basketball Association dunyoning eng kuchli basketbol ligasi hisoblanadi. Amerikaning eng mashhur jamoalaridan biri Los Angeles Lakers bo'lib, u ko'plab chempionliklarni qo'lga kiritgan. Ushbu jamoada faoliyat olib borgan afsonaviy o'yinchilardan biri LeBron James hisoblanadi. U o'zining yuqori texnikasi, kuchli jismoniy tayyorgarligi va rekordlari bilan basketbol tarixidagi eng buyuk sportchilardan biri sifatida tanilgan. Shuningdek, Chicago Bulls jamoasi ham basketbol tarixida alohida o'rin tutadi. Ushbu jamoaning afsonaviy yetakchisi Michael Jordan basketbol tarixidagi eng mashhur sportchilardan biri sanaladi. U basketbolning ommalashishiga juda katta hissa qo'shgan.

O'zbekistonda basketbolga bo'lgan e'tibor

Bugungi kunda Uzbekistonda basketbol sport turiga bo'lgan e'tibor tobora ortib bormoqda. Respublikada yoshlarni sportga jalb qilish, sog'lom turmush tarzini shakllantirish va professional sportchilarni tayyorlash maqsadida ko'plab sport maktablari hamda to'garaklar faoliyat yuritmoqda. Maktablar, akademik litseylar va oliy ta'lim muassasalarida basketbol musobaqalari muntazam o'tkaziladi. Ayniqsa

yoshlar o'rtasidagi "Universiada", "Barkamol avlod" va maktab sport musobaqalari basketbol rivojiga katta hissa qo'shmoqda. Respublikada zamonaviy sport zallari qurilib, yosh basketbolchilar uchun qulay sharoitlar yaratilmoqda. Shuningdek, Uzbekistan Basketball Federation tomonidan turli turnirlar va chempionatlar tashkil etilib, xalqaro hamkorlik yo'lga qo'yilgan. O'zbekiston basketbolchilari Osiyo miqyosidagi musobaqalarda qatnashib, tajriba orttirib bormoqda. Kelajakda mamlakatimiz basketbolining xalqaro maydondagi natijalari yanada yaxshilanishi kutilmoqda.

Xulosa

Xulosa qilib aytganda, yosh basketbolchilarni tayyorlashda jismoniy sifatlarni rivojlantirish muhim ahamiyatga ega. Kuch, tezkorlik, chidamlilik va chaqqonlikni shakllantirish sportchilarning yuqori natijalarga erishishiga yordam beradi. Basketbolning xalqaro maydondagi rivoji hamda O'zbekistonda ushbu sport turiga berilayotgan e'tibor yosh avlodning sportga bo'lgan qiziqishini oshirmoqda.

Foydalanilgan adabiyotlar:

1. Basketbol nazariyasi va metodikasi.
2. Jismoniy tarbiya pedagogikasi.
3. [FIBA rasmiy sayti](https://www.fiba.basketball?utm_source=chatgpt.com)
4. [NBA rasmiy sayti](https://www.nba.com?utm_source=chatgpt.com)
5. Sport mashg'ulotlari nazariyasiga oid ilmiy adabiyotlar.

ОПЫТ ИНТЕГРАТИВНЫХ УЧЕБНЫХ КУРСОВ, НАПРАВЛЕННЫХ НА РАЗВИТИЕ НАВЫКОВ ЯЗЫКА И МЕЖКУЛЬТУРНОГО ОБЩЕНИЯ

УДК 378:316.77

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Аннотация. В статье рассматривается опыт проектирования интегративных учебных курсов, направленных на развитие языковых и межкультурных коммуникативных навыков студентов. Раскрываются структура курса, методические формы работы, возможности проектной деятельности, цифровых инструментов и рефлексивного портфолио. Делается вывод о продуктивности связи языка, культуры и действия.

Ключевые слова: интегративный курс, межкультурное общение, языковое обучение, коммуникативные навыки, проектная деятельность, высшее образование, рефлексия.

Annotation. The article analyzes the experience of designing integrative courses aimed at developing language and intercultural communication skills. It describes course modules, teaching methods, project work, authentic materials, digital tools and reflective assessment. The study argues that the integration of language, culture and action increases the practical value of university language education.

Введение

Актуальность исследования связана с тем, что развитие навыков языка и межкультурного общения невозможно обеспечить только в рамках одной изолированной дисциплины. В современном университете студент включён в сложное пространство учебных предметов, цифровой коммуникации, академической мобильности, профессионального общения и повседневного взаимодействия. Поэтому всё большее значение приобретают интегративные учебные курсы, в которых язык изучается не как набор грамматических правил, а как средство понимания культуры, поведения, ценностей и социальных норм. Интегративный курс в данной статье понимается как учебная модель, объединяющая языковую подготовку, культурологический материал, коммуникативные практики, проектную деятельность и рефлекссию межкультурного опыта. Такой курс позволяет студенту не просто усваивать

лексику и грамматику, но применять язык в ситуациях диалога, презентации, дискуссии, совместного решения проблемы, анализа текста и культурного сравнения. Именно это делает интегративный подход особенно важным для подготовки студентов к жизни и работе в многонациональной среде.

Методы исследования

Интегративный курс строится на принципе содержательной связи языка и культуры. Это означает, что языковой материал подбирается не случайно, а через темы, значимые для межкультурного общения: приветствие и обращение, семейные ценности, нормы вежливости, университетская среда, праздники, национальная кухня, традиции гостеприимства, академическая коммуникация, профессиональный этикет, конфликт и согласие, цифровое общение. Каждая тема раскрывается через лексику, грамматику, текст, диалог, ситуацию и мини-проект.

Опыт интегративных курсов показывает, что особенно эффективны задания, основанные на сравнении без противопоставления. Например, тема «Обращение и вежливость» может включать анализ русских, узбекских и английских речевых формул. Студенты обсуждают, когда уместны официальные обращения, как выражается уважение к старшим, почему прямой отказ в одной культуре может считаться нормальным, а в другой восприниматься как грубость. Такое сравнение помогает увидеть культуру как систему смыслов, а не как набор экзотических фактов.

Таблица 1. Примерная структура интегративного учебного курса

Модуль курса	Содержание	Ожидаемый результат
Языковая база	Речевые формулы, этикет, уточнение, аргументация	Студент корректно строит базовые ситуации общения
Культура общения	Традиции, нормы поведения, невербальные средства	Студент объясняет культурный смысл речевого поведения
Академическое взаимодействие	Дискуссия, презентация, командная работа	Студент участвует в межкультурной учебной группе
Проект и рефлексия	Мини-исследование, портфолио, самооценка	Студент осмысляет личный опыт коммуникации

Результаты исследования

Другой продуктивной формой является анализ критических инцидентов. Студентам предлагается короткая ситуация недопонимания: например, иностранный студент не понял косвенную просьбу преподавателя, студент из другой страны нарушил привычный порядок приветствия, участники проекта по-разному распределяют ответственность. Задача группы – объяснить возможные причины, найти нейтральные формулировки и предложить способ восстановления контакта. М. Беннетт отмечал, что развитие межкультурной чувствительности связано с переходом от отрицания различий к их осознанному принятию [10, с.72].

Интегративный курс должен включать работу с аутентичными текстами. Это могут быть фрагменты художественной литературы, интервью, объявления, университетские правила, письма, посты, видеосюжеты, пословицы и речевые клише. Через текст студент видит, как культура проявляется в словах, образах, интонации, формулах уважения и способах аргументации. При этом важно не перегружать занятие теорией, а связывать каждый текст с конкретной речевой задачей.

Проектная работа является центральным элементом курса. Студенты могут готовить мини-исследование «Культура приветствия», интерактивную карту студенческих традиций, интервью с представителями разных групп, двуязычный словарь речевого этикета, презентацию о национальном празднике, видеоролик о правилах университетского общения. Проект позволяет соединить язык, культуру, цифровые навыки и командное взаимодействие.

Для оценки результатов интегративного курса целесообразно использовать не только тест, но и портфолио. В портфолио могут входить письменные задания, диалоги, записи выступлений, рефлексивные заметки, результаты проекта, самооценка и отзыв преподавателя. А. Фантини подчёркивал: «оценивание межкультурной компетенции должно учитывать процесс, продукт и контекст» [9, с.468]. Такой подход позволяет увидеть развитие студента в динамике.

Использование цифровых инструментов расширяет возможности курса. Онлайн-доски, видеовстречи, электронные словари, форумы, подкасты, виртуальные экскурсии и совместные презентации позволяют студентам общаться за пределами аудитории. UNESCO подчёркивает, что образование может поддерживать диалог, социальную сплочённость и инклюзивную успешность студентов [3, с.18]. В цифровой среде это особенно важно, потому что межкультурное общение всё чаще происходит не только лицом к лицу, но и через экран.

Таблица 2. Методические формы интегративного курса

Методическая форма	Учебная задача	Педагогический эффект
Анализ критического инцидента	Найти причину недопонимания	Развитие интерпретации и эмпатии
Проект	Представить культурную тему через язык	Связь речи, содержания и сотрудничества
Аутентичный текст	Выявить культурные речевые формулы	Понимание языка в контексте
Рефлексивное эссе	Оценить собственный опыт общения	Формирование осознанности

Обсуждение

При внедрении интегративных курсов возникают трудности. Первая трудность связана с подготовкой преподавателя: он должен владеть не только языковым материалом, но и методикой обсуждения культурных различий. Вторая трудность – нехватка времени, поскольку развитие навыков требует регулярной практики. Третья трудность – риск формального подхода, когда культура сводится к праздникам, национальной одежде и кухне. Четвёртая трудность – оценивание, потому что межкультурные навыки нельзя точно измерить одним тестом.

В обсуждении результатов следует подчеркнуть, что интегративный курс не заменяет фундаментальное изучение языка. Напротив, он делает языковую подготовку более живой и функциональной. Без грамматики и словаря межкультурный диалог останется бедным, но без культурного смысла грамматика и словарь превращаются в механическое упражнение. Именно баланс языка, культуры и действия определяет качество курса.

Заключение

Выводы исследования показывают, что интегративные учебные курсы являются эффективной формой развития языковых и межкультурных коммуникативных навыков студентов. Их сила заключается в соединении речевой практики, культурного анализа, проектной деятельности и рефлексии. Такой курс помогает студенту не только узнать о другой культуре, но и научиться взаимодействовать с другим человеком уважительно, понятно и ответственно.

Перспективы дальнейшей работы связаны с созданием типовой программы интегративного курса для разных направлений подготовки, разработкой банка аутентичных материалов, внедрением цифрового портфолио и проведением

сравнительного анализа результатов студентов до и после обучения. В будущем такая модель может стать частью общей стратегии воспитательной и коммуникативной работы в университете.

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**METROPOLITEN ESKALATORLARI XAVFSIZLIGINI TARTIBGA
SOLUVCHI XALQARO STANDARTLAR VA ME'YORIY HUJJATLAR
TAHLILI.**

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Annotatsiya. Tezisdan metropoliten eskalatorlari xavfsizligini tartibga soluvchi xalqaro standartlar (ISO 25745, EN 115, ASME A17) va O'zbekiston me'yoriy hujjatlari qiyosiy tahlil qilingan. Hujjat tahlili metodi orqali standartlarning asosiy talablari, qamrov doirasi va o'zaro farqlari aniqlangan. Tadqiqot natijasida O'zbekiston me'yoriy bazasida mavjud bo'shliqlar aniqlanib, ularni bartaraf etish bo'yicha takliflar ishlab chiqilgan.

Kalit so'zlar: eskalator xavfsizligi, ISO 25745, EN 115, me'yoriy hujjatlar, standartlashtirish, qiyosiy tahlil, metropoliten.

Аннотация. В тезисе проведен сравнительный анализ международных стандартов (ISO 25745, EN 115, ASME A17) и нормативных документов Узбекистана, регулирующих безопасность эскалаторов метрополитена. Методом анализа документов выявлены основные требования стандартов, область их применения и различия между ними. По результатам исследования определены пробелы в нормативной базе Узбекистана и разработаны предложения по их устранению.

Ключевые слова: безопасность эскалаторов, ISO 25745, EN 115, нормативные документы, стандартизация, сравнительный анализ, метрополитен.

Abstract. The thesis presents a comparative analysis of international standards (ISO 25745, EN 115, ASME A17) and Uzbekistan's regulatory documents governing metro escalator safety. Through document analysis, the main requirements, scope, and differences between standards have been identified. The study reveals gaps in Uzbekistan's regulatory framework and proposes recommendations for their elimination.

Keywords: escalator safety, ISO 25745, EN 115, regulatory documents, standardization, comparative analysis, metro.

Kirish.

Metropoliten transporti zamonaviy shaharlarda yo'lovchilar tashishning eng samarali vositasi bo'lib, uning ajralmas qismi sifatida eskalatorlar bekatlar va platformalar

o'rtasidagi harakatni ta'minlaydi. Toshkent metropoliteni eskalatorlarida yiliga millionlab yo'lovchi qatnaydi va ular xavfsizligini ta'minlash davlat ahamiyatiga ega vazifa hisoblanadi [1].

Xalqaro amaliyotda eskalator xavfsizligini tartibga solish maxsus standartlar va me'yoriy hujjatlar tizimi orqali amalga oshiriladi. Asosiy hujjatlar qatoriga ISO 25745 (xalqaro), EN 115 (Yevropa), ASME A17 (AQSh) standartlari va milliy normalar kiradi [2]. Mazkur hujjatlar eskalatorlar konstruksiyasi, montaji, ekspluatatsiyasi va texnik xizmat ko'rsatishga qo'yiladigan talablarni belgilab beradi.

O'zbekiston Respublikasida eskalator xavfsizligi me'yoriy bazasini takomillashtirish hamda xalqaro standartlarga moslashtirish dolzarb masala bo'lib qolmoqda. Tезisning maqsadi — xalqaro va milliy standartlarni qiyosiy tahlil qilish hamda O'zbekiston me'yoriy bazasini takomillashtirish bo'yicha takliflar ishlab chiqishdan iborat.

Metodologiya.

Tadqiqot qiyosiy hujjat tahlili (comparative document analysis) metodi asosida olib borildi. Manbalar sifatida xalqaro standartlashtirish tashkilotlarining rasmiy hujjatlari (ISO, CEN, ASME), O'zbekiston Respublikasi qonun hujjatlari bazasi (lex.uz) hamda xalqaro tashkilotlarning hisobotlari (UITP) o'rganildi.

Tahlil quyidagi mezonlar bo'yicha amalga oshirildi: (1) standartning qamrov doirasi; (2) konstruktiv talablar; (3) xavfsizlik mexanizmlari talablari; (4) ekspluatatsiya va texnik xizmat ko'rsatish talablari; (5) tekshirish va sertifikatlash tartibi. Olingan natijalar O'zbekiston me'yoriy bazasi bilan qiyoslab tahlil qilindi va mavjud bo'shliqlar aniqlandi.

Natijalar va muhokama.

Xalqaro standartlar. Eskalator xavfsizligini tartibga soluvchi asosiy xalqaro hujjat — ISO 25745 standartlar oilasi hisoblanadi [3]. ISO 25745-3:2015 standarti eskalatorlar va harakatlanuvchi yo'laklarning energetik samaradorligini, ekspluatatsiya rejimlarini hamda asosiy texnik parametrlarini belgilaydi. Bundan tashqari, ISO 18738 standarti yo'lovchilar uchun lift va eskalatorlardagi tebranish va shovqin darajalari me'yorlarini, ISO 22201 esa boshqaruv tizimlarining funksional xavfsizligi talablarini tartibga soladi. Mazkur standartlar dunyo bo'ylab eskalator ishlab chiqaruvchilari uchun majburiy mezon hisoblanadi.

Mintaqaviy standartlar. Yevropa Ittifoqida eskalator xavfsizligi EN 115-1:2017 standarti orqali tartibga solinadi [4]. Ushbu standart eskalator va harakatlanuvchi yo'laklar konstruksiyasi va montajiga oid eng batafsil texnik talablarni belgilaydi: harakat tezligi chegaralari (0,5–0,75 m/s), qiyalik burchaklari, xavfsizlik mexanizmlari (avariya to'xtatish tugmalari, qo'l ushlagich tezligi nazorati, monitoring sensorlari). AQShda esa ASME A17.1/CSA B44 kodeksi qo'llaniladi [5], u Shimoliy Amerika va

Kanada eskalatorlari uchun majburiy bo'lib, Yevropa standartlaridan ba'zi texnik parametrlar bo'yicha farqlanadi.

O'zbekiston me'yoriy bazasi. O'zbekiston Respublikasida eskalator xavfsizligi me'yoriy bazasi asosan O'zRSt (O'zbekiston Respublikasi Davlat standartlari) tizimi orqali tartibga solinadi [6]. Yo'lovchi tashish faoliyati Vazirlar Mahkamasining 614-son qarori bilan litsenziyalanadi va davlat nazoratiga olinadi. Biroq olib borilgan tahlil shuni ko'rsatadiki, mahalliy me'yoriy bazada zamonaviy intellektual nazorat tizimlari (vizual monitoring, sun'iy intellekt asosidagi xavfsizlik), avtomatik diagnostika va real vaqtdagi monitoring talablari yetarli darajada aks ettirilmagan. Bu esa eskalator infratuzilmasini zamonaviy talablar darajasida modernizatsiya qilish jarayonini sekinlashtiradi.

Standartlarning asosiy parametrlari qiyosiy tahlili 1-jadvalda keltirilgan.

Standart	Mintaqa	Yil	Asosiy fokus	Maqomi
ISO 25745	Xalqaro	2015	Energetik samaradorlik, ekspluatatsiya rejimlari	Tavsiyaviy
EN 115	Yevropa	2017	Konstruksiya, montaj, xavfsizlik mexanizmlari	Majburiy
ASME A17	AQSh/Kanada	2019	Lift va eskalator xavfsizlik kodeksi	Majburiy
O'zRSt / VM 614	O'zbekiston	2019	Umumiy texnik talablar, litsenziyalash	Majburiy

1-jadval. Eskalator xavfsizligini tartibga soluvchi standartlarning qiyosiy tahlili. Muhokama.

Olib borilgan qiyosiy tahlil shuni ko'rsatadiki, xalqaro standartlar (ISO, EN, ASME) bir-birini to'ldiruvchi xususiyatga ega bo'lib, ular orasidagi farqlar asosan mintaqaviy texnik talablar va sertifikatlash tartibi bilan bog'liq. Yevropa va Amerika standartlari Osiyo davlatlarining milliy normalari shakllanishiga sezilarli ta'sir ko'rsatgan. O'zbekiston me'yoriy bazasi an'anaviy mexanik xavfsizlik talablariga asoslangan bo'lib, zamonaviy raqamli texnologiyalar, jumladan sun'iy intellekt asosidagi vizual nazorat va avtomatik diagnostika tizimlari uchun me'yoriy doirani belgilab bermagan. Mazkur bo'shliqning bartaraf etilishi metropoliten infratuzilmasini modernizatsiya qilish va yo'lovchi xavfsizligini xalqaro talablar darajasiga ko'tarish uchun zarur shartdir.

Xulosa.

Tezida metropoliten eskalatorlari xavfsizligini tartibga soluvchi xalqaro standartlar va O'zbekiston me'yoriy hujjatlari qiyosiy tahlil qilindi. Tadqiqot natijasida quyidagi xulosalar shakllantirildi: **birinchidan**, xalqaro amaliyotda eskalator xavfsizligi ISO 25745, EN 115 va ASME A17 standartlari orqali tartibga solinadi va ular bir-birini to'ldiruvchi tizimni tashkil etadi; **ikkinchidan**, O'zbekiston me'yoriy bazasida zamonaviy intellektual nazorat tizimlari uchun me'yoriy doira aniq belgilanmagan;

uchinchidan, milliy me'yoriy hujjatlarni xalqaro standartlarga moslashtirish va sun'iy intellekt texnologiyalarini qamrab oluvchi yangi normalar ishlab chiqish dolzarb vazifa hisoblanadi.

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CUSTOMER RELATIONSHIP MANAGEMENT STRATEGY AND SERVICE QUALITY IMPROVEMENT AT HILTON SAMARKAND REGENCY AMIR TEMUR

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Abstract: This study analyzes the customer relationship management (CRM) strategy of Hilton Samarkand Regency Amir Temur and evaluates its effectiveness in improving customer satisfaction, loyalty, and operational performance. The research focuses on customer segmentation, targeting, customer journey mapping, complaint management, service quality assessment, and the use of CRM technologies. A qualitative case study approach was used based on secondary data, hotel performance indicators, customer reviews, and strategic analysis tools such as SWOT and PESTEL analysis. Findings indicate that Hilton Samarkand Regency has strong international brand recognition, high service quality standards, and advanced CRM technologies such as OnQ PMS and Salesforce integration. However, challenges remain in customer retention, local customer loyalty, Wi-Fi quality, and technological complexity. The study recommends the implementation of localized loyalty programs, AI-powered customer service systems, stronger cooperation with local businesses, and improved employee training. The research concludes that effective CRM implementation significantly contributes to competitive advantage and customer satisfaction in the hospitality industry of Uzbekistan.

Keywords: CRM, Hilton Samarkand Regency, hospitality management, customer loyalty, tourism, service quality, Uzbekistan

Introduction

Customer Relationship Management (CRM) has become one of the most important strategic tools in the hospitality industry. Hotels increasingly use CRM systems to improve customer satisfaction, enhance loyalty, personalize services, and maintain competitive advantage. In tourism-oriented cities such as Samarkand, where millions of tourists visit annually, CRM strategies are especially important for attracting and retaining international and domestic guests.



Hilton Samarkand Regency Amir Temur is one of the leading five-star hotels in Uzbekistan and operates within the Silk Road Samarkand tourism complex. Due to its international reputation and strategic importance, the hotel provides an excellent case for analyzing CRM strategies in the Uzbek hospitality sector.

The purpose of this study is to evaluate the CRM strategy of Hilton Samarkand Regency Amir Temur and identify opportunities for improving customer relationships, service quality, and customer loyalty. The study also examines the role of modern technologies and ethical data management in hotel operations.

Methods

This research uses a qualitative case study methodology focused on Hilton Samarkand Regency Amir Temur. Data were collected from secondary sources, including hotel performance reports, tourism statistics, customer reviews, industry reports, and academic literature related to CRM and hospitality management.

The study applies several analytical methods:

1. Customer Segmentation and Targeting Analysis – to identify the main customer groups and marketing focus.
2. Customer Journey Mapping – to analyze customer interactions from awareness to post-visit communication.
3. Service Quality Assessment – using SERVQUAL dimensions and Net Promoter Score (NPS).

4. SWOT Analysis – to evaluate strengths, weaknesses, opportunities, and threats.
5. PESTEL Analysis – to assess political, economic, social, technological, environmental, and legal factors affecting hotel operations.

The research also evaluates CRM technologies used by Hilton, including OnQ PMS, Salesforce, Adobe Experience Platform, and ReviewPro.



Results

Customer Segmentation and Targeting. Hilton Samarkand Regency segments its customers based on geographic, demographic, psychographic, and behavioral characteristics.

Geographic Segmentation

Domestic tourists: 15%

CIS countries: 30%

Asian countries: 20%

European countries: 25%

Middle Eastern countries: 10%

Demographic Segmentation

The hotel mainly targets high-income individuals aged 30–65, including businessmen, diplomats, government officials, and luxury travelers.

Psychographic Segmentation

The hotel attracts customers who value prestige, comfort, luxury, and historical tourism experiences.

Behavioral Segmentation

Regular customers: 8%

New visitors: 45%

Non-returning customers: 25%

Passing visitors: 22%

These findings indicate that Hilton primarily focuses on premium international tourism and business travelers.

Customer Journey Analysis. The customer journey at Hilton Samarkand Regency consists of five stages:

1. Awareness and online search
2. Booking process
3. Arrival and check-in
4. Service experience
5. Post-visit communication and loyalty management.

Customers usually discover the hotel through online searches, social media, tourism platforms, or travel agencies. Booking channels include the hotel website, Booking.com, Expedia, and tour operators. Hilton also uses post-visit email communication and loyalty rewards to maintain customer relationships.

Service Quality Assessment. The hotel evaluates service quality through the SERVQUAL model and Net Promoter Score (NPS).

Key findings from the 2025 analysis include:

NPS score: +52

Positive reviews regarding cleanliness: 93%

Positive reviews regarding staff behavior: 89%

Main complaints: Wi-Fi speed, SPA queues, and limited restaurant menu options

These results indicate strong service quality but also highlight operational areas requiring improvement.

Customer Loyalty Program. Hilton uses several loyalty-building strategies:

Late check-out options

Free room upgrades

Hilton Honors points system

Restaurant and excursion discounts

Promotional campaigns such as “2=3” offers

The hotel’s re-engagement campaign increased the customer return rate from 12% to 18%.

Complaint Management System. The complaint management process includes:

1. Complaint registration through OnQ system
2. Classification by urgency level
3. Solution implementation
4. Monitoring and closure

In 2025, the hotel recorded 1,242 complaints, and 89% were resolved within 24 hours. Customer satisfaction with complaint handling reached 84%.

CRM Technologies. Hilton Samarkand Regency uses several technologies:

- OnQ PMS for reservation and billing management
- Salesforce for customer data and marketing automation
- Adobe Experience Platform for customer behavior analysis
- ReviewPro for review monitoring
- The introduction of electronic keys reduced customer queues by 22%.

SWOT Analysis**Strengths**

- ✓ Strong global brand reputation
- ✓ Modern infrastructure
- ✓ Internationally trained staff
- ✓ Five-star service standards

Weaknesses

- ✓ High prices for local residents
- ✓ Complex OnQ system
- ✓ Distance from city center
- ✓ Limited local loyalty programs

Opportunities

- ✓ Growing tourism in Samarkand
- ✓ Expansion of international flights
- ✓ Technological development
- ✓ Cooperation with local businesses

Threats

- ✓ Increasing competition
- ✓ Inflation and rising operational costs
- ✓ Cybersecurity risks

PESTEL Analysis

Political. Government support for tourism and international events positively affects hotel demand.

Economic. Economic growth and currency exchange advantages support foreign tourism.

Social. Strong Uzbek hospitality culture and affordable labor force support service quality.

Technological. AI technologies and digital transformation improve hotel operations.

Environmental. Hilton implements sustainability initiatives through its “Travel with Purpose” program.

Legal. The hotel complies with Uzbek personal data laws and GDPR standards.

Discussion

The findings demonstrate that Hilton Samarkand Regency successfully applies modern CRM strategies to improve customer satisfaction and operational efficiency. The hotel’s strong brand image, advanced technologies, and service quality standards contribute significantly to its competitive advantage in Uzbekistan’s hospitality industry.

However, several challenges remain. The relatively low percentage of repeat customers indicates that customer loyalty strategies require further improvement. Although Hilton Honors and promotional campaigns provide some success, the hotel still depends heavily on first-time visitors.

Technological systems such as OnQ and Salesforce increase operational efficiency but may create difficulties for employees who lack advanced digital skills. Therefore, regular staff training is necessary to improve CRM implementation.

The study also highlights the importance of localization strategies. Since domestic tourism in Uzbekistan is growing, Hilton should develop more affordable and attractive packages for local tourists. Increased cooperation with local restaurants, tour agencies, and transport providers may strengthen customer retention and improve the hotel’s market position.

Artificial intelligence technologies, including multilingual chatbots and automated customer service systems, could further improve communication speed, personalization, and data security.

Conclusion

Hilton Samarkand Regency Amir Temur demonstrates effective use of CRM strategies in the hospitality industry. The hotel benefits from strong international brand recognition, advanced technologies, and high customer satisfaction levels. Service quality indicators and complaint management systems show positive operational performance.

Nevertheless, several issues require attention, including limited local customer loyalty, technological complexity, and service limitations related to Wi-Fi and restaurant

diversity. To strengthen its competitive advantage, Hilton should expand localized loyalty programs, improve employee digital skills, adopt AI-based customer communication systems, and enhance cooperation with local tourism businesses. Overall, the study confirms that effective CRM implementation plays a crucial role in improving customer satisfaction, increasing loyalty, and ensuring long-term success in the tourism and hospitality industry.

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AN'ANAVIY BOSHQARUV TUZILMALARIDA INNOVATSIYAGA TO'SQINLIK QILUVCHI OMILLAR: O'ZBEKISTON KOMPANIYALARI MISOLIDA

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Annotatsiya: Ushbu maqolada an'anaviy boshqaruv tuzilmalarida innovatsion faollikka to'sqinlik qiluvchi tashkiliy, psixologik, moliyaviy va madaniy omillar tahlil qilinadi. O'zbekiston kompaniyalari misolida byurokratik ierarxiya, o'zgarishlarga qarshilik, resurs cheklovlari va qisqa muddatli fikrlash kabi to'siqlarning innovatsion salohiyatga ta'siri ko'rib chiqiladi. Maqolada ushbu to'siqlarni bartaraf etishning amaliy strategiyalari va innovatsion tashkiliy madaniyatni shakllantirishning pedagogik-boshqaruv modeli taklif etiladi.

Kalit so'zlar: innovatsiya, an'anaviy boshqaruv, tashkiliy to'siqlar, byurokratiya, o'zgarishlarga qarshilik, korporativ madaniyat, O'zbekiston, innovatsion menejment.

Abstract: This article analyzes the organizational, psychological, financial, and cultural barriers that hinder innovation in traditional management structures. Using the example of Uzbekistan's companies, the impact of bureaucratic hierarchy, resistance to change, resource constraints, and short-term thinking on innovative potential is examined. The article proposes practical strategies for overcoming these barriers and a pedagogical-managerial model for building an innovative organizational culture.

Keywords: innovation, traditional management, organizational barriers, bureaucracy, resistance to change, corporate culture, Uzbekistan, innovation management.

Аннотация: В данной статье анализируются организационные, психологические, финансовые и культурные барьеры, препятствующие инновационной деятельности в традиционных структурах управления. На примере компаний Узбекистана рассматривается влияние бюрократической иерархии, сопротивления изменениям, ограниченности ресурсов и краткосрочного мышления на инновационный потенциал.

Ключевые слова: инновация, традиционное управление, организационные барьеры, бюрократия, сопротивление изменениям, корпоративная культура, Узбекистан, инновационный менеджмент.

"Biz har doim shunday qilganmiz" — bu ibora ko'pgina tashkilotlarda innovatsiyaning eng xavfli dushmanidir. An'anaviy boshqaruv tuzilmalari o'zining barqarorligi va tartibga solinganlik xususiyatlari bilan qimmatli bo'lsa-da, ular ko'pincha yangilik va ijodkorlikka yon bera olmaydi. Bugungi jadal o'zgaruvchan bozor muhitida innovatsiyasiz kompaniya — harakatlanmaydigan kemaga o'xshaydi: u tez orada oqimdan ortda qoladi.

O'zbekistonda iqtisodiy islohotlar tezlashayotgan, raqamli transformatsiya milliy siyosat darajasiga ko'tarilayotgan hozirgi davrda mahalliy kompaniyalarning innovatsion salohiyati dolzarb masalaga aylandi. Biroq ko'plab tadqiqotlar shuni ko'rsatadiki, tashkilotlardagi innovatsion to'siqlarning 70% dan ortig'i tashqi omillar emas, balki ichki boshqaruv tuzilmalaridan kelib chiqadi [1].

Ushbu maqolada an'anaviy boshqaruv tuzilmalarida innovatsiyaga to'sqinlik qiluvchi asosiy omillar tasniflanib, ularni bartaraf etishning amaliy yo'llari taklif etiladi.

An'anaviy boshqaruv tuzilmasi qat'iy ierarxiya, markazlashgan qaror qabul qilish, rasmiy muloqot kanallari va belgilangan ish tartiblari asosida qurilgan. Bu tuzilma sanoat inqilobi davrida ishlab chiqilgan bo'lib, o'sha zamonning ehtiyojlariga to'liq javob bergan. Biroq XXI asrning tez o'zgaruvchan, raqamli va kreativ iqtisodiyoti sharoitida moslashuvchanlikka asoslangan yangi boshqaruv paradigmalari paydo bo'ldi.

Weber tomonidan ishlab chiqilgan byurokratik boshqaruv modeli samaradorlik, bashoratlilik va nazorat jihatidan afzal bo'lsa-da, u innovatsiya uchun zarur bo'lgan moslashuvchanlik, eksperimentga tayyor bo'lish va tezkor qaror qabul qilishga zid keladi. Buning natijasida ko'plab kompaniyalar "barqarorlik tuzog'i"ga tushib qoladi: ular ishlayotgan tizimni o'zgartirmaslikka harakat qiladilar, ammo bozor ularni chetlab o'tadi [2].

Innovatsiyaga To'sqinlik Qiluvchi Asosiy Omillar

➤ *Birinchi to'siq: Byurokratik ierarxiya va sekin qaror qabul qilish.* An'anaviy tuzilmalarda yangi g'oya ko'pincha bir necha daraja menejerlik tasdig'idan o'tishi kerak. Bu jarayon haftalar, ba'zan oylar davom etadi. Bozor esa shuncha vaqt kutmaydi. Tadqiqotlar ko'rsatishicha, byurokratik kompaniyalarda yangi mahsulotni bozorga chiqarish vaqti tekis tuzilmali kompaniyalarga nisbatan 2-3 baravar ko'p bo'ladi [3].

➤ *Ikkinchi to'siq: O'zgarishlarga psixologik qarshilik.* Insonning miyasi tanish narsalarga moyil bo'lib, yangilik — biologik jihatdan — tahdid sifatida qabul qilinishi mumkin. Kurt Lewinning "Muzlatish — O'zgarish — Qayta muzlatish" modeli ko'rsatishicha, tashkilotdagi o'zgarishga qarshilik kuchlari doimo harakatlanuvchi

kuchlardan ustun turishga harakat qiladi va bu qarshilikni ongli boshqarmasdan innovatsiyani joriy etib bo'lmaydi [4].

➤ *Uchinchi to'siq: Xatoga nisbatan jazo madaniyati.* Innovatsiya mohiyatan eksperiment demakdir, eksperiment esa muvaffaqiyatsizlik ehtimolini o'z ichiga oladi. An'anaviy boshqaruv tuzilmalarida xato ko'pincha jazolanadi, natijada xodimlar g'oyalarini yashiradi va tashabbuskorlikdan voz kechadi. Bu esa innovatsion muhitning asosiy sharti — psixologik xavfsizlikni yo'q qiladi [5].

➤ *To'rtinchi to'siq: Resurs va vaqt cheklovlari.* Ko'pgina kompaniyalar, ayniqsa kichik va o'rta bizneslar, kundalik operatsion ishlar bilan band bo'lib innovatsiya uchun resurs ajrata olmaydi. Christensenning "innovatorning dilemmasi" kontseptsiyasi asosida bu holat tashkilotni "operatsion tuzoq"ga tushiradi: kompaniya bugungi samaradorlik uchun ishlaydi va inqilobiy yangiliklarni ko'ra olmaydi [6].

➤ *Beshinchi to'siq: Qisqa muddatli moliyaviy fikrlash.* An'anaviy boshqaruvda muvaffaqiyat ko'pincha choraklik moliyaviy natijalar bilan o'lchanadi. Drucker ta'kidlaganidek, "qisqa muddatli samaradorlikka e'tibor berish uzoq muddatli raqobatbardoshlikni yo'q qiladi". Natijada menejerlar uzoq muddatli innovatsion investitsiyalardan qochib, tezroq foyda keladigan an'anaviy faoliyatni afzal ko'radilar [7].

1-jadval. Innovatsion to'siqlar, sabablari va oqibatlari

To'siq turi	Asosiy sabab	Tashkilotga ta'siri	Bartaraf etish yo'li
Byurokratiya	Ko'p daraja tasdiqlash	Sekin qaror	Tekis tuzilma
Psixologik qarshilik	O'zgarishdan qo'rqish	G'oya yo'qoladi	O'zgarish menejment
Jazo madaniyati	Xato = jazolash	Tashabbus yo'qoladi	Psixologik xavfsizlik
Resurs cheklovlari	Operatsion yuklanish	Innovatsiyasiz o'sish	Dedikatsiyalangan vaqt
Qisqa muddatli fikr	Choraklik KPI bosimi	Uzoq muddatli zarar	Balansli ko'rsatkichlar

Innovatsion to'siqlarni bartaraf etish uchun quyidagi besh bosqichli "Innovatsion Transformatsiya Modeli" taklif etiladi:

➤ *Birinchi bosqich — Diagnostika: To'siqlarni aniqlash.* Tashkilot ichidagi asosiy innovatsion to'siqlarni xodimlar so'rovnomalari, fokus-guruhlar va boshqaruv auditi orqali aniqlash. Bu bosqichsiz qayerga harakatlanish kerakligini bilish mumkin emas. Anonimlik muhim — xodimlar to'sqinliklar haqida ochiq gapirishi uchun xavfsiz muhit yaratilishi shart.

➤ *Ikkinchi bosqich — Tuzilmaviy o'zgarishlar: Tashkilot tuzilmasini yengillashtirish.* Ortiqcha boshqaruv darajalarini kamaytirish va o'z-o'zini boshqaradigan jamoalar (self-managing teams) tuzish innovatsion salohiyatni sezilarli oshiradi. Laloux tadqiqotlari ko'rsatishicha, bunday "teal" tashkilotlarda xodimlar tashabbuskorligi an'anaviy ierarxik tuzilmalarga nisbatan 3 baravar yuqori bo'ladi [8].

➤ *Uchinchi bosqich — Madaniyat: Xato qilish huquqini legallashtirish.* Rahbariyat o'zi namuna ko'rsatishi kerak — o'z xatolarini ochiq tan olish va muvaffaqiyatsiz bo'lgan lekin qimmatli saboq bergan loyihalarni nishonlash. Amazonning "Fail Forward" va 3M kompaniyasining Post-it kashfiyoti xato muhitidan tug'ilgan muvaffaqiyatning klassik misollaridir.

➤ *To'rtinchi bosqich — Resurs: Innovatsiyaga dedikatsiyalangan vaqt va byudjet.* Har bir bo'lim byudjetining kamida 5-10% ini innovatsiya uchun ajratish, xodimlarga haftasiga bir kun ijodiy ishlarga vaqt berish. Bu sarmoya qisqa muddatda xarajat ko'rinsa-da, uzoq muddatda eng rentabelli investitsiyaga aylanadi.

➤ *Beshinchi bosqich — O'lchov: Innovatsion KPI tizimini joriy etish.* Innovatsion faollikni faqat moliyaviy ko'rsatkichlar bilan emas, balki yangi g'oyalar soni, pilot loyihalar hajmi va xodimlarning ijodiy tashabbuslari bilan ham baholash lozim. Balansli hisob kartasi (Balanced Scorecard) bu maqsadda keng qo'llaniladigan vosita hisoblanadi [9].

XULOSA

An'anaviy boshqaruv tuzilmalari o'zining tarixiy roli va barqarorlikka qo'shgan hissasi bilan qimmatlidir. Biroq tezlik, moslashuvchanlik va doimiy o'rganish talab qiladigan zamonaviy bozorda ular innovatsiyaning asosiy to'sig'iga aylanib qolishi mumkin. Byurokratiya, psixologik qarshilik, jazo madaniyati, resurs cheklovlari va qisqa muddatli fikrlash — bular tashkilotning innovatsion salohiyatini sekin-asta bo'g'ib qo'yuvchi ko'rinmas zanjirlardir.

O'zbekiston kompaniyalari uchun bu to'siqlarni bartaraf etish nafaqat raqobatbardoshlik, balki iqtisodiy yuksalishning zaruriy shartidir. O'zbekiston Respublikasining innovatsion rivojlanish strategiyasi tashkilotlarda innovatsion muhitni shakllantirishni ustuvor vazifa sifatida belgilaydi. Taklif etilgan besh bosqichli model — diagnostika, tuzilmaviy o'zgarish, madaniyat yangilanishi, resurs ajratish va

innovatsion KPI — mahalliy kompaniyalarga an'anaviy tuzilmalar ichida ham innovatsion muhit yaratish imkonini beradi.

Innovatsiya bir martalik loyiha emas — bu doimiy jarayon va tashkiliy madaniyatning ajralmas qismi bo'lishi kerak. Innovatsiyaga to'sqinlik qiluvchi tuzilmani o'zgartirishga qodir bo'lgan rahbar esa o'z kompaniyasini nafaqat bugun, balki ertaga ham yetaklay oladi.

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MORPHOLOGICAL AND ELEMENTAL CHARACTERIZATION OF POLY[ETHYLENEDIAMINETETRAACETATO-AQUA-DISODIUM- NICKEL(II)] BY SEM-EDS ANALYSIS

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Abstract

Poly[ethylenediaminetetraacetato-aqua-disodium-nickel(II)] was synthesized and characterized by scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDS) to investigate its morphology and elemental composition. SEM analysis revealed the formation of highly crystalline elongated prismatic and rod-like crystals with smooth surfaces and well-defined edges. The observed crystal habit indicates anisotropic crystal growth and a high degree of structural organization within the coordination polymer. EDS analysis confirmed the presence of carbon, nitrogen, oxygen, sodium, and nickel as the principal constituents of the synthesized compound. Quantitative elemental analysis showed contents of 49.86 wt.% C, 4.79 wt.% N, 33.01 wt.% O, 3.32 wt.% Na, and 9.02 wt.% Ni. The appearance of characteristic nickel peaks together with the donor atoms of the EDTA ligand confirms successful complex formation. The combined SEM-EDS results demonstrate the formation of a highly crystalline nickel(II)-EDTA coordination polymer with good compositional purity and structural homogeneity.

Keywords: Nickel(II), EDTA, Coordination Polymer, SEM, EDS, Crystal Morphology, Elemental Analysis.

Introduction

Coordination polymers based on transition-metal ions and multidentate organic ligands have attracted considerable attention due to their structural diversity and potential applications in catalysis, ion exchange, environmental remediation, molecular recognition, and advanced functional materials. Among the numerous chelating ligands available, ethylenediaminetetraacetic acid (EDTA) occupies a prominent position because of its strong metal-binding ability arising from four carboxylate oxygen atoms and two amine nitrogen donor atoms. Nickel(II)-EDTA complexes are particularly important because of their remarkable thermodynamic stability and coordination versatility. The incorporation of nickel ions into EDTA-based frameworks leads to the

formation of coordination compounds exhibiting distinct structural, thermal, and physicochemical properties. The performance of such materials is strongly influenced by their crystal morphology, particle size distribution, and elemental composition. Scanning electron microscopy (SEM) is widely used to investigate crystal morphology and surface characteristics, whereas energy-dispersive X-ray spectroscopy (EDS) provides valuable information regarding elemental composition and purity. These techniques are complementary and play a crucial role in confirming the successful synthesis of coordination compounds. Therefore, the present study focuses on the morphological and elemental characterization of poly[ethylenediaminetetraacetato-aqua-disodium-nickel(II)] using SEM and EDS analyses.

Experimental Characterization

The morphology of the synthesized poly[ethylenediaminetetraacetato-aqua-disodium-nickel(II)] was examined using a scanning electron microscope operating at an accelerating voltage of 5.0 kV. Elemental composition was determined using an integrated energy-dispersive X-ray spectroscopy detector. SEM images were recorded at a magnification of $\times 300$, while elemental quantification was performed using standardless EDS fitting procedures.

Results and Discussion

SEM Morphological Analysis

The SEM micrographs of poly[ethylenediaminetetraacetato-aqua-disodium-nickel(II)] reveal a highly crystalline material composed predominantly of elongated rod-like and prismatic particles (Figure 1). The crystals possess smooth surfaces, sharp edges, and well-developed crystal faces, indicating a high degree of crystallinity and structural order.

The dominant morphology consists of rectangular rods with lengths extending up to several tens of micrometers. Such elongated structures suggest preferential crystal growth along specific crystallographic directions. This phenomenon is commonly observed in coordination polymers where directional metal–ligand interactions govern the crystal growth process. The crystal surfaces appear dense and compact without noticeable porosity, indicating efficient packing of molecular units within the crystal lattice. The absence of extensive amorphous regions suggests that the synthesis conditions favored controlled nucleation and subsequent crystal growth. Furthermore, the crystals exhibit clear geometric boundaries and faceted surfaces, characteristic of well-ordered coordination compounds. Some particles are observed to overlap and intergrow, forming larger crystalline aggregates. These observations indicate strong intermolecular interactions and the formation of an extended coordination framework.

The highly developed crystalline morphology observed in the SEM images demonstrates that the nickel(II)-EDTA coordination network forms a stable and structurally organized material.

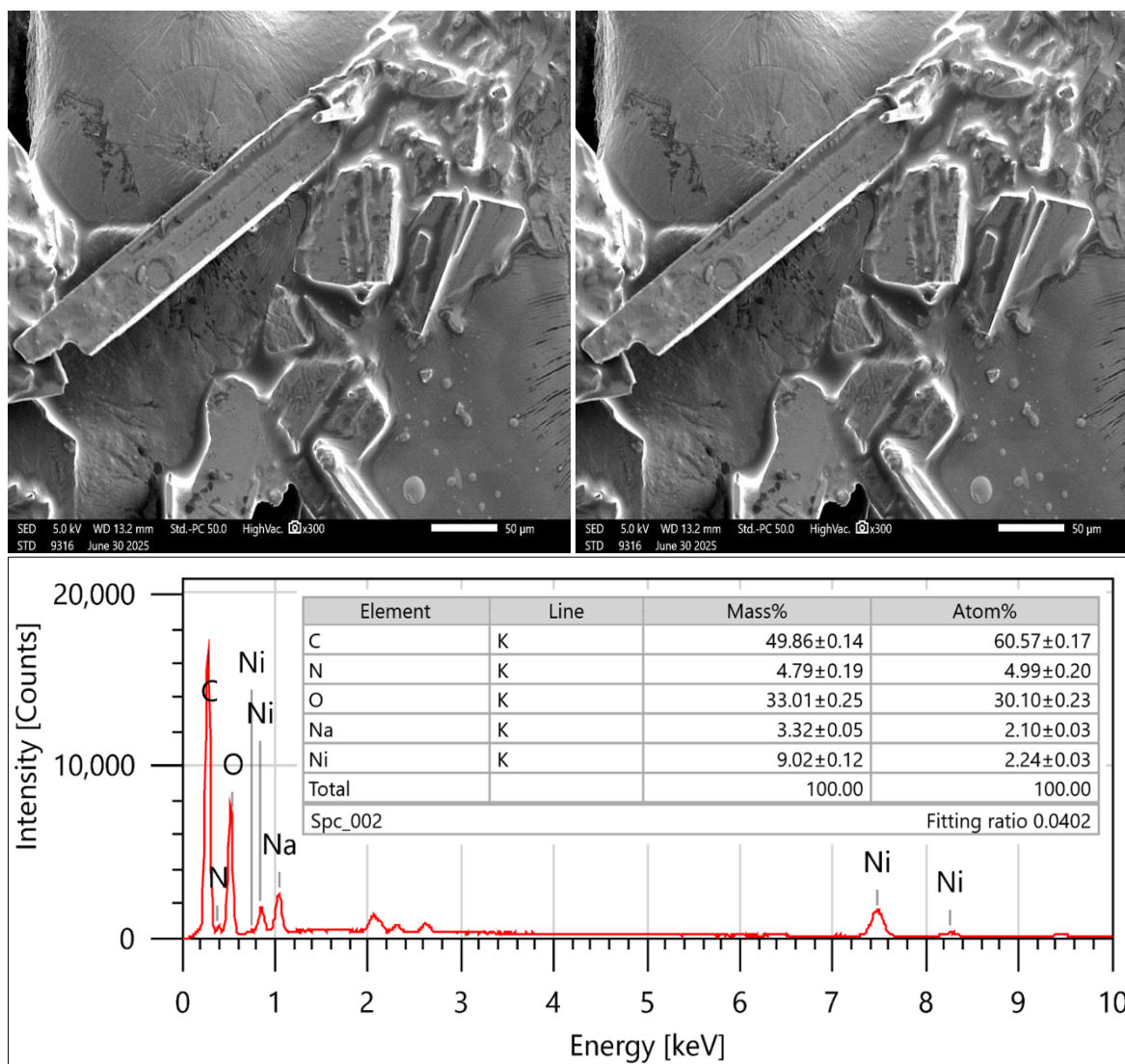


Figure 2. SEM images and EDS elemental analysis of poly[ethylenediaminetetraacetato-aqua-disodium-nickel(II)] showing rod-like crystalline morphology and the presence of C, N, O, Na, and Ni elements.

EDS Elemental Analysis

The elemental composition of the synthesized complex was investigated using EDS spectroscopy. The spectrum displays characteristic peaks corresponding to carbon (C), nitrogen (N), oxygen (O), sodium (Na), and nickel (Ni), confirming the presence of all expected elements in the proposed molecular structure.

Table 1. Elemental Composition of Poly[ethylenediaminetetraacetato-aqua-disodium-nickel(II)]

Element	Mass (%)	Atomic (%)
Carbon (C)	49.86 ± 0.14	60.57 ± 0.17
Nitrogen (N)	4.79 ± 0.19	4.99 ± 0.20
Oxygen (O)	33.01 ± 0.25	30.10 ± 0.23
Sodium (Na)	3.32 ± 0.05	2.10 ± 0.03
Nickel (Ni)	9.02 ± 0.12	2.24 ± 0.03
Total	100.00	100.00

The high carbon content originates from the ethylene backbone and acetate groups of the EDTA ligand. Nitrogen is associated with the amine donor atoms, while oxygen arises from carboxylate groups and coordinated water molecules. Sodium detected in the EDS spectrum confirms the presence of disodium counterions associated with the coordination polymer structure. Most importantly, the strong nickel peaks observed near 7.5 and 8.3 keV correspond to Ni K α and Ni K β emissions, providing direct evidence of nickel incorporation into the coordination framework. The nickel content of approximately 9 wt.% confirms successful metal coordination and is consistent with the proposed nickel-containing EDTA complex. Furthermore, no significant impurity peaks were detected, indicating the high purity of the synthesized material. The agreement between the observed elemental composition and the expected molecular structure strongly supports the successful synthesis of poly[ethylenediaminetetraacetato-aqua-disodium-nickel(II)].

Structural Implications

The combined SEM and EDS results provide important information regarding the structural organization of the synthesized compound. The rod-like morphology observed by SEM suggests directional crystal growth controlled by strong coordination interactions between nickel (II) ions and EDTA ligands. The presence of carbon, nitrogen, oxygen, sodium, and nickel in the EDS spectrum confirms the integrity of the coordination polymer framework. The absence of foreign elements indicates that the synthesized material is chemically homogeneous and free from significant contamination. The coexistence of high crystallinity and compositional purity suggests that the coordination polymer possesses a well-organized crystal lattice in which nickel centers are effectively coordinated by EDTA ligands, resulting in a stable polymeric structure.

Conclusion

Poly[ethylenediaminetetraacetato-aqua-disodium-nickel(II)] was successfully characterized by SEM and EDS techniques. SEM analysis revealed highly crystalline

elongated rod-like and prismatic particles with smooth surfaces, sharp edges, and well-developed crystal faces, indicating excellent structural organization. EDS analysis confirmed the presence of carbon, nitrogen, oxygen, sodium, and nickel as the principal constituent elements of the coordination polymer. The quantitative elemental composition agrees well with the proposed molecular structure and demonstrates the successful incorporation of nickel into the EDTA framework. The absence of significant impurity peaks and the presence of highly ordered crystalline particles indicate the high purity and structural stability of the synthesized material. These findings collectively confirm the successful formation of poly[ethylenediaminetetraacetato-aqua-disodium-nickel(II)] and provide a comprehensive understanding of its morphological and elemental characteristics.

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9.

**KORXONALARDA RAQAMLI LIDERLIKNI SHAKLLANTIRISHNING
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Annotatsiya. Mazkur maqolada korxonalarda raqamli liderlikni shakllantirishning nazariy asoslari hamda tashkiliy-iqtisodiy mexanizmlari tadqiq etilgan. Raqamli transformatsiya sharoitida rahbarlik faoliyatining yangi shakllari, sun'iy intellekt, Big Data, bulutli texnologiyalar va raqamli platformalarning boshqaruv tizimidagi o'rni yoritilgan. Shuningdek, korxonalarda raqamli liderlik kompetensiyalarini rivojlantirish, innovatsion boshqaruv madaniyatini shakllantirish va biznes-jarayonlarni raqamlashtirish bo'yicha ilmiy-amaliy takliflar ishlab chiqilgan.

Kalit so'zlar: raqamli liderlik, raqamli transformatsiya, menejment, innovatsion boshqaruv, sun'iy intellekt, Big Data, korporativ boshqaruv, raqamli iqtisodiyot, tashkiliy mexanizm, iqtisodiy mexanizm.

Kirish

Bugungi kunda jahon iqtisodiyotida raqamli transformatsiya jarayonlarining jadallashuvi korxonalar faoliyatini tashkil etish va boshqarish usullarini tubdan o'zgartirmoqda. Raqamli texnologiyalarning keng joriy etilishi nafaqat ishlab chiqarish jarayonlarini, balki boshqaruv tizimlarini ham yangi bosqichga olib chiqmoqda. Bunday sharoitda tashkilot muvaffaqiyati ko'p jihatdan uning rahbarlarining zamonaviy raqamli texnologiyalardan samarali foydalana olish qobiliyatiga bog'liq bo'lib bormoqda.

Raqamli liderlik – bu rahbarning zamonaviy axborot-kommunikatsiya texnologiyalari, sun'iy intellekt va ma'lumotlarni tahlil qilish vositalaridan foydalangan holda tashkilotni strategik rivojlantirish, innovatsion muhit yaratish va xodimlarni yagona maqsad sari yo'naltirish qobiliyatidir.

O'zbekistonda "Raqamli O'zbekiston – 2030" strategiyasining qabul qilinishi hamda iqtisodiyotning barcha tarmoqlarida raqamli texnologiyalarni joriy etishga qaratilgan islohotlar korxonalarda raqamli liderlikni shakllantirish masalasini dolzarb ilmiy yo'nalishlardan biriga aylantirdi.

Mavzuga oid ilmiy qarashlar tahlili

Xorijiy ilmiy adabiyotlarda raqamli liderlik tushunchasi so'nggi o'n yilliklarda faol o'rganilmoqda. G. Westerman, D. Rogers, T. Davenport, E. Brynjolfsson va K. Schwablarning ilmiy ishlari raqamli transformatsiya va liderlik o'rtasidagi uzviy bog'liqlikni ochib beradi. Ularning tadqiqotlariga ko'ra, zamonaviy rahbar nafaqat boshqaruv funksiyalarini bajaruvchi shaxs, balki texnologik o'zgarishlarni boshqaruvchi strateg sifatida ham faoliyat yuritishi lozim.

Mamlakatimiz olimlari tomonidan ham raqamli iqtisodiyot va innovatsion boshqaruv tizimlarini rivojlantirish masalalari o'rganilib, korxonalarda zamonaviy axborot texnologiyalarini joriy etish, boshqaruv jarayonlarini avtomatlashtirish va raqamli kompetensiyalarni rivojlantirish bo'yicha ilmiy tavsiyalar ishlab chiqilmoqda.

Korxonalarda raqamli liderlikning mazmuni va ahamiyati

Raqamli iqtisodiyot sharoitida korxona rahbari faqatgina boshqaruvchi emas, balki o'zgarishlarni amalga oshiruvchi lider sifatida maydonga chiqadi. Raqamli liderlik quyidagi yo'nalishlarni o'z ichiga oladi:

- strategik fikrlash va innovatsion yondashuv;
- raqamli texnologiyalarni boshqaruv jarayonlariga integratsiyalash;
- ma'lumotlarga asoslangan qarorlar qabul qilish;
- xodimlarning raqamli kompetensiyalarini rivojlantirish;
- korporativ madaniyatni innovatsion muhitga moslashtirish.

Zamonaviy korxonalarda sun'iy intellekt, Big Data, bulutli hisoblash va biznes analitikasi tizimlaridan foydalanish rahbarlarga real vaqt rejimida boshqaruv qarorlarini qabul qilish imkonini bermoqda.

Raqamli liderlikni shakllantirishning tashkiliy-iqtisodiy mexanizmlari

Korxonalarda raqamli liderlikni samarali shakllantirish uchun bir qator tashkiliy va iqtisodiy mexanizmlarni rivojlantirish zarur.

Birinchidan, korxonalarda raqamli transformatsiya strategiyasini ishlab chiqish va uni korporativ rivojlanish dasturlari bilan integratsiyalash lozim.

Ikkinchidan, rahbar va mutaxassislarning raqamli ko'nikmalarini oshirishga qaratilgan uzluksiz malaka oshirish tizimini yo'lga qo'yish zarur. Bunda sun'iy intellekt, ma'lumotlar tahlili, kiberxavfsizlik va raqamli menejment bo'yicha maxsus o'quv dasturlarini joriy etish maqsadga muvofiqdir.

Uchinchidan, korxonalarda biznes-jarayonlarni ERP, CRM va Business Intelligence tizimlari asosida avtomatlashtirish boshqaruv samaradorligini sezilarli darajada oshiradi.

To'rtinchidan, raqamli innovatsiyalarni joriy etayotgan xodimlarni rag'batlantirishning iqtisodiy mexanizmlarini yaratish zarur. Bu innovatsion g'oyalarni qo'llab-quvvatlash va korxonada kreativ muhitni shakllantirishga xizmat qiladi.

Beshinchidan, ichki audit va risk-menejment tizimlarini raqamli texnologiyalar bilan integratsiyalash orqali korxonaning iqtisodiy xavfsizligini ta'minlash mumkin.

O'zbekistonda raqamli liderlikni rivojlantirish istiqbollari

Mamlakatimizda raqamli iqtisodiyotga o'tish jarayonlari jadallashib borayotganligi sababli korxonalarda zamonaviy liderlik modelini shakllantirish zarurati ortib bormoqda. Ayniqsa, sanoat, bank-moliya, logistika va xizmat ko'rsatish tarmoqlarida raqamli boshqaruv texnologiyalaridan foydalanish iqtisodiy samaradorlikni oshirishning muhim omiliga aylanmoqda.

Kelgusida sun'iy intellekt, blokcheyn texnologiyalari va raqamli platformalarni korporativ boshqaruv tizimlariga keng joriy etish orqali korxonalar faoliyatining shaffofligi va raqobatbardoshligini yanada oshirish mumkin.

Xulosa

Raqamli liderlik zamonaviy menejment tizimining ajralmas elementi hisoblanadi. Korxonalarda raqamli liderlikni shakllantirish tashkiliy va iqtisodiy mexanizmlarni takomillashtirish, innovatsion boshqaruv madaniyatini rivojlantirish hamda zamonaviy axborot texnologiyalarini boshqaruv jarayonlariga keng joriy etishni talab etadi.

Shu bois, korxonalarda raqamli transformatsiyani jadallashtirish, rahbarlarning raqamli kompetensiyalarini oshirish va ma'lumotlarga asoslangan boshqaruv tizimlarini rivojlantirish mamlakat iqtisodiyotining barqaror o'sishi va xalqaro raqobatbardoshligini ta'minlashning muhim omillaridan biri hisoblanadi.

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**TABIY FANLARNI O'QITISH JARAYONIDA KREATIVLIK, TANQIDIY
FIKRLASH VA MUAMMOLI TA'LIM TEXNOLOGIYALARI**

(5-sinf misolida)

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Annotatsiya: Mazkur maqolada umumiy o'rta ta'lim maktablarining 5-sinf tabiiy fanlarini o'qitish jarayonida o'quvchilarning kreativlik, tanqidiy fikrlash va muammoni hal etish kompetensiyalarini rivojlantirishning pedagogik imkoniyatlari tahlil qilingan. Tadqiqotda zamonaviy ta'limning kompetensiyaviy yondashuvi, muammoli ta'lim texnologiyalari, so'rovga asoslangan ta'lim (Inquiry-Based Learning) va PISA tadqiqotlari talablari asosida tabiiy fanlarni o'qitishning samarali metodlari yoritilgan. Shuningdek, muammoli vaziyatlar, tadqiqot topshiriqlari, loyiha ishlari va interfaol metodlardan foydalanishning o'quvchilarning ijodiy tafakkuri, tahliliy fikrlashi va ilmiy savodxonligini rivojlantirishga ta'siri asoslab berilgan. Tadqiqot natijalari tabiiy fanlarni o'qitishda kreativ fikrlash, tanqidiy tahlil qilish va muammolarni yechish ko'nikmalarini shakllantirishga yo'naltirilgan innovatsion metodik modelning samaradorligini ko'rsatadi.

Kalit so'zlar: tabiiy fanlar ta'limi, kreativlik, tanqidiy fikrlash, muammoli ta'lim, 5-sinf, kompetensiyaviy yondashuv, ilmiy savodxonlik, Inquiry-Based Learning, PISA, innovatsion pedagogik texnologiyalar.

DEVELOPING CREATIVITY, CRITICAL THINKING, AND PROBLEM-SOLVING SKILLS THROUGH NATURAL SCIENCE TEACHING (evidence from grade 5 education)

Annotation: This article examines the pedagogical opportunities for developing creativity, critical thinking, and problem-solving competencies in the process of teaching natural sciences in grade 5 of general secondary schools. The study highlights effective methods of teaching natural sciences based on competency-based education, problem-based learning technologies, inquiry-based learning, and the requirements of international assessments such as PISA. Furthermore, the paper substantiates the impact of problem situations, research tasks, project-based activities, and interactive

teaching methods on the development of students' creative thinking, analytical reasoning, and scientific literacy. The findings demonstrate the effectiveness of an innovative methodological model aimed at fostering creativity, critical thinking, and problem-solving skills in natural science education.

Keywords: natural science education, creativity, critical thinking, problem-based learning, grade 5, competency-based approach, scientific literacy, inquiry-based learning, PISA, innovative pedagogical technologies.

КРЕАТИВНОСТЬ, КРИТИЧЕСКОЕ МЫШЛЕНИЕ И ТЕХНОЛОГИИ ПРОБЛЕМНОГО ОБУЧЕНИЯ В ПРОЦЕССЕ ПРЕПОДАВАНИЯ ЕСТЕСТВЕННЫХ НАУК

(на примере 5-го класса)

Аннотация: В данной статье рассматриваются педагогические возможности развития креативности, критического мышления и компетенций по решению проблем в процессе преподавания естественных наук в 5-х классах общеобразовательных школ. Исследование основано на компетентностном подходе, технологиях проблемного обучения, исследовательском обучении (Inquiry-Based Learning) и требованиях международных программ оценки качества образования, в частности PISA. Обоснована эффективность использования проблемных ситуаций, исследовательских заданий, проектной деятельности и интерактивных методов обучения для формирования у учащихся творческого мышления, аналитических способностей и естественно-научной грамотности. Результаты исследования показывают, что внедрение инновационной методической модели способствует развитию у школьников навыков критического анализа, творческого поиска и самостоятельного решения учебных и жизненных проблем, что отвечает современным требованиям глобализирующегося образовательного пространства.

Ключевые слова: Естественно-научное образование, креативность, критическое мышление, проблемное обучение, 5 класс, компетентностный подход, естественно-научная грамотность, исследовательское обучение (Inquiry-Based Learning), PISA, инновационные педагогические технологии.

Introduction. In today's globalization environment, the main task facing the education system is not to memorize knowledge, but to form a thinking, creative and problem-solving personality [1; p. 18].

Natural sciences play a leading role in forming a scientific worldview in students. Because these sciences are based on the processes of observation, experimentation, analysis and conclusion. While the traditional education model shapes the student as a passive recipient of knowledge, modern pedagogical technologies aim to transform

him into an active researcher. The student must not only acquire knowledge, but also be able to apply it in real-life situations [2; p. 28]. In particular, natural science education has important pedagogical opportunities for developing cognitive activities in students, such as scientific thinking, observation, experimentation, and identification of cause-and-effect relationships.

It is noted in the scientific literature that when the process of teaching natural sciences is based on research activities, students' interest in knowledge increases and their level of independent thinking significantly develops [3; p. 34]. Modern didactics requires a transition from traditional explanatory and demonstration methods to interactive and problem-based educational technologies.

The concept of critical thinking is interpreted in pedagogy and psychology as a person's ability to analyze information, compare evidence, and draw well-founded conclusions. According to Bloom's taxonomy, the stages of analysis, synthesis, and evaluation constitute a higher level of thinking activity, and it is these processes that serve to form creative thinking [4; p. 155].

In general secondary schools, a reproductive approach still prevails in teaching natural sciences, which leads to insufficient development of students' independent thinking and problem-solving skills. This situation creates the need for the integrated use of creativity, critical thinking, and problem-based educational technologies.

Literature review. In modern pedagogical science, the study of creativity, critical thinking and problem-based learning technologies is one of the important scientific directions for increasing the effectiveness of education. This problem has been studied by domestic and foreign scientists based on various theoretical approaches.

The concept of creativity was initially interpreted in psychology as a person's ability to create new ideas. J. Guilford linking creative thinking with divergent thinking, interprets creativity as the ability to solve a problem in different ways [5; p. 445]. Later E. Torrance scientifically substantiated that the development of creative thinking is an important pedagogical task of the educational process [6; p. 24].

The development of creativity in the educational process is closely related to the constructivist approach. According to the theory of constructivism, knowledge is not given by the teacher ready-made, but is formed in the process of active cognition of the student [7; p. 67]. This idea was put forward by L.S.Vygotsky's theory of sociocultural development also substantiates the fact that the process of knowledge acquisition occurs through collaborative activity [8; p. 86].

The issue of critical thinking has been formed as a separate scientific direction in pedagogy and philosophy of education. R. Paul and L. Elder describe critical thinking as the competence of analyzing information, evaluating evidence, and making logical

decisions [9; p. 17]. In Bloom's taxonomy, higher-level thinking processes - analysis, synthesis, and evaluation - are indicated as the main components of critical thinking [4; p. 207].

Scientific research on the methodology of teaching natural sciences has noted that the development of students' scientific thinking is carried out through experience, observation, and problem situations. J.O.Tolipova emphasizes that involving students in an active research process in teaching natural sciences increases the effectiveness of education [3; p. 35]. Also, the use of innovative pedagogical technologies is scientifically substantiated by R.J. Ishmuhamedov [10; p. 45].

Problem-based learning technology dates back to J. Dewey's pragmatic education concept in the history of pedagogy. Dewey shows the need to organize the educational process based on solving real-life problems [11; p. 53]. Later problem-based learning technology was formed as a method that directs the pedagogical process to research.

Literature analysis shows that creativity, critical thinking, and problem-based learning technologies form an integrated pedagogical system. In particular, science education is the most suitable methodological field for the formation of these competencies.

Science lessons for grades 1-6 in general secondary schools can be organized based on the following stages.

Problem-based learning technology: creating a problem situation; putting forward a hypothesis; conducting an experiment; analysis and reflection.

Research methods: analysis of scientific sources; pedagogical observation; experimental and test work; diagnostic evaluation; comparative analysis.

Theoretical methods: analysis of scientific and pedagogical sources; comparison of competency-based and constructive approaches; modeling of educational technologies.

Empirical methods: pedagogical observation; experimental and test work; diagnostic tests; questionnaire and reflection methods.

Results. During the research, experimental and test work was carried out on creativity, critical thinking and the use of problem-based learning technologies in natural science lessons (grades 1-6). A comparative analysis of students' cognitive activity, creative approach and problem-solving competencies was carried out between the experimental class and the control class.

During the lesson, students' learning activity was assessed based on three main indicators: the level of creative thinking; critical thinking skills; competence in solving problem situations.

The results showed that students' cognitive activity significantly increased in lessons organized on the basis of problem-based learning technologies.

Table 1

№	Indicators	Control group (traditional)	Experimental group (problem-based learning)
1	Creative thinking	41%	79%
2	Critical thinking	44%	82%
3	Problem-solving skills	46%	85%
4	Activity in the lesson	58%	90%
5	Independent judgment	43%	81%

The results show that all indicators were significantly higher in the experimental group. Analysis of the results. The results of the experiment confirmed the high effectiveness of problem-based learning technologies in developing creativity and critical thinking. In particular, students' skills in asking independent questions, putting forward hypotheses, and drawing conclusions based on experience significantly developed.

The analysis showed that lessons organized on the basis of problem situations: increased students' motivation to learn; strengthened group cooperation; formed elements of scientific thinking. In the process of general analysis, the use of problem-based learning technologies in natural science lessons led to the following:

- increased creative thinking by an average of 35–40%;
- increased critical thinking by 30–38%;
- increased problem-solving competence by 35–42%.

This confirms the high scientific and practical effectiveness of this approach.

Discussion. The results of the study show that the integration of creativity, critical thinking and problem-based learning technologies in teaching natural sciences significantly activates the cognitive activity of students. The results obtained are consistent with the basic principles of modern pedagogical approaches and confirm the practical effectiveness of the competency-based education model.

First of all, it was found that the development of creativity is directly related to problem situations. In the process of solving problems that are close to real life, students demonstrated the skills of developing various solutions, putting forward hypotheses and drawing conclusions based on experience. This result is consistent with the theory of divergent thinking put forward by Guilford, that is, finding several solutions to one problem is the main sign of creative thinking.

Also, in the process of developing critical thinking, students were involved in analyzing information, comparing evidence and drawing informed conclusions. Critical thinking is not only the ability to acquire knowledge, but also the ability to analyze and evaluate it.

The effectiveness of problem-based learning technology is particularly noteworthy. Problem situations created during the lesson strengthened students' internal motivation for knowledge and encouraged them to actively search. According to social constructivist theory, knowledge is formed through collaborative activity. Group work, discussion, and collaborative research during the lesson provided students with a high level of cognitive activity.

The results obtained are also consistent with Bloom's taxonomy. In particular, students were able to move from the levels of "knowledge" and "understanding" to the stages of "analysis", "synthesis", and "evaluation". This indicates the effectiveness of problem-based learning technology in developing higher-level thinking operations.

Also an approach based on experience and practical activities in teaching natural sciences plays an important role in developing students' scientific thinking. The results of this article also confirm this idea, since during the lesson, students consolidated their knowledge through observation, experimentation, and analysis.

According to the concept of innovative pedagogical technologies, organizing the educational process based on interactive methods increases the activity of students. Studies have shown that the combination of interactive methods and problem-based learning significantly increases students' interest and participation in the lesson. The highest efficiency is achieved when creativity, critical thinking and problem-based learning technologies are used in an integrated manner. This requires that the role of the teacher in the modern educational process becomes a guide and facilitator rather than a knowledge provider.

Conclusion. Based on the results of the study, the following scientific conclusions were formulated.

First, it was found that the development of creativity in the process of teaching natural sciences is effectively implemented through lessons organized on the basis of problem situations.

Second, Students had the opportunity to develop new ideas, propose alternative solutions, and demonstrate a creative approach in the process of solving real-life problems.

Third, it was confirmed that students' activities to analyze information, compare evidence, and draw informed conclusions are important in the formation of critical thinking.

Fourth, problem-based learning technology serves to transfer students from low-level cognitive activity (knowledge and understanding) to high-level thinking operations (analysis, synthesis, evaluation).

It was also shown that when creativity, critical thinking, and problem-based learning technologies are used in an integrated manner, educational effectiveness increases significantly. Therefore, modern science education should be based on a constructive and competency-based approach that transforms the student from a passive learner to an active researcher.

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MATHEMATICAL ANALYSIS OF BANK DEPOSITS AND INVESTMENT GROWTH USING DIFFERENTIAL EQUATIONS

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Annotatsion: This article investigates the application of differential equations in the mathematical analysis of bank deposits and investment growth. Financial processes such as deposit accumulation, capital investment, and interest generation are dynamic phenomena that evolve continuously over time. Differential equations provide an effective mathematical framework for describing these processes and evaluating their long-term behavior. The study examines the relationship between deposit growth, investment returns, interest rates, and capital accumulation through mathematical models. Particular attention is given to continuous compound interest models and investment growth functions that are widely used in banking and financial analysis. The research demonstrates how differential equations can be employed to forecast future financial outcomes, optimize investment strategies, and assess the impact of changing economic conditions on capital growth. The findings indicate that mathematical modeling based on differential equations is a valuable tool for understanding financial dynamics and supporting informed decision-making in banking and investment management. Furthermore, the study highlights the practical significance of mathematical methods in evaluating long-term financial sustainability and economic development.

Keywords: differential equation, bank deposits, investment growth, compound interest, financial modeling, capital accumulation, interest rate, mathematical analysis, economic forecasting, financial dynamics.

INTRODUCTION

In today's rapidly developing financial environment, banking institutions and investment organizations play a crucial role in promoting economic growth and financial stability. Bank deposits and investments are among the most important financial instruments that contribute to capital formation, wealth accumulation, and sustainable economic development. Understanding the dynamics of deposit growth and investment returns is essential for individuals, businesses, and policymakers who seek to make informed financial decisions. Mathematical modeling has become an

indispensable tool in financial analysis. Among various mathematical methods, differential equations are particularly useful for describing financial processes that change continuously over time. Since the value of deposits and investments is affected by factors such as interest rates, inflation, market conditions, and reinvestment policies, differential equations provide an effective framework for analyzing these dynamic relationships. One of the fundamental applications of differential equations in finance is the modeling of compound interest. Unlike simple interest, compound interest allows earned interest to generate additional returns over time, leading to exponential growth of capital. Differential equations accurately describe this process and help estimate future values of investments and savings accounts. As a result, financial institutions widely use mathematical models to evaluate investment strategies and forecast financial performance. The application of differential equations extends beyond banking activities. They are used in portfolio management, pension fund planning, insurance mathematics, risk assessment, and economic forecasting. Advances in computer technology and financial software have further increased the practical importance of differential equation models by enabling analysts to simulate complex financial scenarios and predict long-term trends. The purpose of this study is to investigate the mathematical analysis of bank deposits and investment growth using differential equations. The research focuses on developing mathematical models that describe capital accumulation, examining the effects of interest rates on financial growth, and demonstrating the practical applications of differential equations in banking and investment management.

The role of differential equations in financial analysis. Financial systems involve continuous changes in capital values over time. The growth of savings accounts, investment portfolios, and business capital can be effectively represented through differential equations. These mathematical tools enable researchers to determine how rapidly financial assets increase or decrease under specific economic conditions. Differential equations are particularly valuable because they allow analysts to model real-world financial situations and predict future outcomes. By understanding the relationship between capital and time, investors can make more informed decisions regarding savings and investment strategies. In financial mathematics, continuous growth models are widely applied because many economic processes operate continuously rather than at discrete intervals. Consequently, differential equations provide a realistic representation of financial behavior.

Mathematical model of bank deposit growth. The growth of a bank deposit under continuous compound interest can be represented by the following differential equation:

$$dD/dt = rD$$

- (D) represents the amount of money deposited in the bank;
- (r) is the annual interest rate;

$$D(t) = D_0 \cdot e^{(rt)}$$

denotes the rate of change of the deposit over time. The solution of this differential equation is:

$$dI/dt = kI$$

where:

- (D_0) is the initial deposit amount;
- (e) is the mathematical constant approximately equal to 2.71828;
- (t) represents time.

This model shows that bank deposits increase exponentially when interest is continuously compounded. The higher the interest rate, the faster the growth of the deposit. For example, if an individual deposits \$10,000 at an annual interest rate of 5%, the value of the deposit will grow significantly over time due to compound interest. The model is widely used by financial institutions to estimate future account balances and determine optimal savings plans for customers.

Mathematical analysis of investment growth. Investment growth can also be modeled using differential equations. When investments generate returns that are reinvested, the capital grows continuously according to the following equation:

$$I(t) = I_0 \cdot e^{(kt)}$$

where:

- (I) represents investment capital;
- (k) denotes the average rate of return;
- ($\frac{dI}{dt}$) is the rate of investment growth.

The solution is:

$$A = P \cdot e^{(rt)}$$

where (I_0) is the initial investment value. This equation demonstrates that investment growth follows an exponential pattern when returns are continuously reinvested. The model helps investors evaluate long-term profitability and compare different investment opportunities. For instance, an investment portfolio with an average annual return of 8% will experience substantial growth over a period of several years. Therefore, mathematical models provide valuable information for financial planning and investment management.

Comparison of deposit and investment growth models. Although both deposits and investments can be described by exponential differential equations, their characteristics differ significantly. Bank deposits generally offer lower risk and stable returns, while

investments often involve higher risks but potentially greater profits. Differential equation models enable analysts to compare these financial instruments quantitatively. By varying interest rates and return rates within the models, it becomes possible to evaluate different financial strategies and identify the most effective approach for capital growth. Financial institutions frequently use such models to design savings products, investment funds, and retirement plans that meet the needs of different customers.

Practical applications in modern banking and finance. The application of differential equations in modern finance extends to various fields, including investment management, pension planning, insurance mathematics, and economic forecasting. Financial analysts use mathematical models to estimate future asset values, evaluate investment risks, and optimize portfolio performance. Technological advancements have further enhanced the usefulness of differential equations. Modern financial software allows analysts to solve complex mathematical models and simulate various economic scenarios. As a result, differential equations have become an essential component of contemporary financial decision-making. The integration of mathematical modeling into banking and investment management contributes to greater accuracy, improved risk assessment, and more effective long-term financial planning.

Growth of bank deposits and investments under different annual rates of return

Initial Capital (USD)	Annual Interest / Return Rate (%)	Period (Years)	Final Deposit Value (USD)	Final Investment Value (USD)
10,000	3	5	11,618	11,593
10,000	5	5	12,840	12,824
10,000	7	5	14,191	14,190
10,000	10	5	16,487	16,487
10,000	12	5	18,221	18,221

Table presents the growth of bank deposits and investments over a five-year period under different annual interest and return rates. The calculations are based on continuous growth models represented by differential equations. The results demonstrate that both bank deposits and investments increase significantly as the interest or return rate rises. At an annual rate of 3%, an initial capital of \$10,000 grows to approximately \$11,618 after five years. When the rate increases to 5%, the final value reaches \$12,840. Higher rates generate even greater growth, with capital reaching more than \$18,000 at a 12% annual return rate. These findings illustrate the exponential nature of financial growth modeled through differential equations. The analysis also

indicates that small increases in interest or return rates can produce substantial differences in accumulated capital over time. This phenomenon highlights the importance of interest rates and investment performance in long-term financial planning. Consequently, differential equation models provide valuable tools for evaluating savings strategies, investment opportunities, and future financial outcomes.

CONCLUSION

This study examined the use of differential equations in analyzing the growth of bank deposits and investments. The findings demonstrate that differential equations provide a powerful mathematical framework for describing continuous financial processes and evaluating the dynamics of capital accumulation. The analysis showed that both deposit growth and investment growth can be effectively modeled through exponential differential equations. These models help explain how interest rates and investment returns influence the value of financial assets over time. Furthermore, mathematical modeling enables financial institutions and investors to forecast future outcomes and develop efficient financial strategies. The study also highlighted the practical significance of differential equations in banking, investment management, and financial planning. Their application supports more accurate forecasting, better risk assessment, and improved decision-making processes. In conclusion, differential equations remain one of the most important mathematical tools in modern finance. Their ability to model financial growth and predict future trends contributes significantly to sustainable economic development and effective capital management.

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**QISHLOQ XO‘JALIGIDA SUG‘ORILADIGAN YERLARNING
UNUMDORLIGINI OSHIRISH BO‘YICHA XORIY TAJRIBAS****Ch.P.Xo‘jageldiyev****Denov tadbirkorlik va pedagogika instituti****Raqamli iqtisodiyot” kafedrasi dotsenti**

So‘nggi yillarda nafaqat mamlakatimizda, balki Markaziy Osiyo davlatlarida suv tanqisligi muammosi yildan-yilga jiddiy tus olmoqda. Transchegaraviy suv resurslaridan foydalanish masalalari bo‘yicha davlatlararo munosabatlarni rivojlantirish, Markaziy Osiyo mamlakatlari manfaatlari o‘rtasidagi muvozanatni ta‘minlaydigan suv resurslarini birgalikda boshqarishning o‘zaro maqbul mexanizmlarini va suvdan samarali foydalanish dasturlarini ishlab chiqish hamda ilgari surish masalasi mamlakatimiz siyosati darajasida o‘rganilmoqda.

Bugungi kunda dunyoning barcha davlatlarida qishloq xo‘jaligida suv tanqisligi muammosi dolzarb ahamiyat kasb etmoqda. Ayniqsa, rivojlangan davlatlarda suvtejamkor texnologiyalaridan samarali foydalanish, tuproq unumdorligini oshirish va sug‘oriladigan yerlarning qishloq xo‘jaligi muomalasidan chiqib ketishini oldini olish muammosi davlat siyosati darajasida katta e‘tibor qaratilmoqda. Darhaqiqat, xorijiy davlatlar tajribalarning ahamiyatli jihatlarini ayrim davlatlar misolida ko‘rib chiqamiz.

Dunyo mamlakatlariga nazar tashlaydigan bo‘lsak, Isroilda sug‘oriladigan maydonlar 100 foiz suvni tejovchi texnologiyalarga o‘tkazilgan. AQShda bu ko‘rsatkich 38,2 foizni, Misrda 36 foizni, Qozog‘istonda 14 foizni, Turkiyada 12 foizni, Xitoy Xalq Respublikasida 11 foizni tashkil etadi. Tadqiqotlardan ko‘rinadiki, yomg‘irlatib sug‘orish usulidan Rossiya, AQSh, Xitoy va Hindiston davlatlarida ko‘proq foydalaniladi, tomchilatib sug‘orish usulidan esa Isroil va Ispaniya davlatlari asosan foydalanishadi. O‘zbekistonda sug‘oriladigan yerlarning 7 foizida, ya‘ni 284 ming gektar maydonda suvni tejovchi texnologiyalar joriy etilgan. Shundan tomchilatib sug‘orish - 114 ming gektar, yomg‘irlatib sug‘orish - 3 ming gektar, diskret sug‘orish (pulsar) - 4 ming gektar hamda egiluvchan quvurlar yordamida sug‘orish 163 ming gektarni tashkil etadi. Suvni tejovchi texnologiyalarga sarmoya kiritish zarurati Isroilni ushbu sohada jahon yetakchisiga aylantirdi. Masalan, Isroilning barcha tuzsizlantirish zavodlarini qurishda ishtirok etgan Isroilning IDE Technologies kompaniyasi o‘z tajribasini 35 davlatga eksport qildi (400 ga yaqin tuzsizlantirish zavodlarini, shu jumladan AQSh va Xitoyda qurgan). Dunyodagi eng yirik kam hajmli sug‘orish kompaniyasi Netafim dunyoning 110 dan ortiq mamlakatlarida taqdim etilgan. Suv resurslarining tanqisligi Isroilni suvni tejovchi

texnologiyalar bo'yicha yetakchiga aylantirdi va endi mamlakat o'z tajribasini butun dunyo bilan baham ko'rishga intilmoqda.

Isroilda 2010-2050 yillar davri uchun suv xo'jaligini rivojlantirish Bosh rejasi qabul qilingan. Unga ko'ra 2050 yilga borib suv taqchilligi oqova suvlarning to'liq tozalanishi va dengiz suvini tuzsizlantiradigan qo'shimcha ob'ektlarni qurish hisobiga qoplanadi¹.

1-jadval

Isroilda hozirgi va istiqbolli suv balansi va suv iste'moli tizimi

Yillar	Qishloq xo'jaligi			Jami
	Ichimlik suvi	Sho'r suvlar	Tozalangan oqova suvlar	
2010	500	144	400	1044
2020	490	120	528	1138
2030	470	110	645	1225
2050	450	100	900	1450

Oqova suvlarining qayta qo'llanilishi Isroil qishloq xo'jaligi uchun muhim suv manbai hisoblanadi. Yiliga ishlangan 530 mln.m³ oqova suvlardan 476 mln.m³ (93%)ga ishlov beriladi va 410 mln.m³ (86%) sug'orishda qayta foydalaniladi. Takidlash joizki, Isroil qishloq xo'jaligi olimlar, maslahatchilar va fermerlar o'rtasidagi yaqin hamkorlikda rivojlanib bormoqda. Suv sarfini kamaytirishning yana bir samarali mexanizmi bu suv narxini belgilashdir. Bu progressiv xarakterga ega, ya'ni yakuniy iste'molchilar uchun narx faqat iste'mol qilinadigan suvning ma'lum bir hajmida o'zgarmaydi, undan oshib ketganda har kub metr suv narxi ortiqcha qancha ko'p bo'lsa, narx ham shunchalik yuqori bo'ladi. Suv narxi blokli tizimda o'rnatildi. Har bir iste'molchi uchun ham shahar suv iste'molchilari, ham sanoat va qishloq xo'jaligi uchun kvotalar belgilangan.

2-jadval

Isroil davlatining suv va yer resurslaridan foydalanish ko'rsatkichlari (2024y.)

№	Ko'satgichlar	O'lch.birl.	Miqdori
1.	Jami foydalanilgan yer resurslari	ming ga	440
2.	Shundan sug'oriladigan yerlar	ming ga	182
3.	Jami suv resurslari	mln. m ³ /yil	2000
4.	Shu jumla qishloq xo'jaligida foydalanilgan suv resurslari (60-70%)	mln. m ³ /yil	1300

¹ <https://talqinvatadqiqotlar.uz/index.php/tvt/article/download/153/299>

5.	Bir yilda bir gektarga sarflangan suv miqdori	m ³	7143
6.	1 m ³ suvning samaradorligi, AQSh doll.	\$/ m ³	3,93
7.	1 ga yerning samaradorligi, AQSh doll.	\$/ga	18182
8.	Sug'orishda 1 m ³ suvning o'rtacha narxi	dollar	0,57
9.	Suv resurslarining aholi jon boshiga to'g'ri kelishi	m ³	285
10.	Yer resurslarining aholi jon boshiga to'g'ri kelishi	ga	0,06
11.	Paxta hosildorligi	s/ga	60-70
12.	Bug'doy hosildorligi	s/ga	60

Xitoyning o'rtacha yillik suv resurslari 2711,5 mlrd.m³ daryo oqimi va 828,8 mlrd.m³ yer usti suvli qatlamlardan olinadi. Suv quyish daryolar oqimini kamaytirilganligi sababli, umumiy suv resurslari 2821,4 mlrd.m³ ni tashkil qiladi. Bunday muvaffaqiyat omillaridan biri suv xo'jaligi sohasidagi ilg'or texnologiyalar va bilimdir. Bugungi kunda Xitoyda suv resurslari sohasidagi ilmiy va texnologik ishlanmalar odatda ilg'or xalqaro standartlarga mos keladi.

Mamlakatda bugungi kunda tuproq va suv unumdorligini saqlash, sug'orish usullari va ularni suv tanqis hududlarida qo'llash, monitoring va baholash, agronomiya, yer va suv xo'jaligi, turli tabiiy-iqlim sharoitlariga ega daryolar havzalarida suvni boshqarish, suv ta'minotining oldini olish va nazorat qilish, ifloslanish, suv muhitini tiklash, iqlim o'zgarishiga moslashish bo'yicha muvaffaqiyatli modellar ishlab chiqilgan. Shuningdek, mamlakatda yangi texnologiyalarni muvaffaqiyatli qo'llash va kengroq tarqatish uchun zarur bo'lgan suv resurslarini boshqarish bo'yicha institutsional bazaviy salohiyat amalga oshirildi.

Xitoydagi BMTTD (Birlashgan Millatlar Tashkiloti Taraqqiyot Dasturi) suv resurslarini boshqarishni yanada takomillashtirish bo'yicha hukumatni qo'llabquvvatlashga katta yordam qilmoqda. Shinjon avtonom tumanida suvni tejaydigan sug'orish texnologiyalari muvaffaqiyatli tatbiq etilib, bu esa suvni oqilona, chegaralangan holda boshqarishga yordam berdi. Tyantszinda BMTTD toshqin suvlaridan foydalanish va ularni turli sektorlar o'rtasida taqsimlashni optimallashtirishga yordam berdi. Suvdan foydalanish samaradorligini yaxshilash maqsadida purkalab va tomchilatib sug'orish kabi usullar keng joriy etildi.

Suvdan foydalanish samaradorligi purkalab sug'orishda 0,7-0,8 tomchilatib sug'orishda esa - 0,9ga teng bo'lib, ammo ular qimmat bo'lganligi sababli, ularni amalga oshirishni rag'batlantirish uchun Xitoy hukumati bir qator chora-tadbirlar

ishlab chiqdi. Hukumat gidravlika uskunalari sotib olish xarajatlarining bir qismini qoplab berdi.

Xitoy Fanlar akademiyasi tomonidan “Xitoyda barqaror rivojlanish strategiyalari” tayyorlangan suv bo'yicha hisobotga ko'ra resurslar, 2030 yilga borib suvga bo'lgan talab 140 mlrd. m³ ga oshadi, oqava suvlarni oqizish esa 85 dan 106 mlrd.m³ ga oshishi prognoz qilingan. Qishloq xo'jaligining suvni tejash bo'yicha davlat dasturida belgilangan vazifalari 2030-yilda suv iste'molini bir xil darajada saqlab qolgan holda foydali sug'orish koeffitsientini 55 foizga oshirishni nazarda tutadi. So'nggi yillarda Xitoyda suvni tejaydigan ko'rgazmali qishloq xo'jaligi ob'ektlarini yaratish bo'yicha ko'plab ishlar amalga oshirildi, davlat ahamiyatiga ega suvni tejaydigan qishloq xo'jaligi texnologiyalarni rivojlantirish uchun ko'rgazmali sanoat parklari, yuqori mahsuldorlikni namoyish etish bo'yicha esa ko'plab ishlar amalga oshirildi. Bunda texnik jixozlar majmuasi va suvni tejaydigan qishloq xo'jaligini rivojlantirish modellari ishlab chiqildi. Xukumat tashabbusi bilan suvni tejovchi qishloq xo'jaligi texnologiyalari, sug'orish kanallari tubining suv o'tkazuvchanligini pasaytirish, past bosimli quvurli suv ta'minoti tizimi va tomchilatib sug'orish texnologiyasi keng joriy etilmoqda. Shu bilan birga namlikni saqlaydigan turli xil texnologiyalar qo'llaniladi jumladan somon yoki plyonka bilan qoplash, namlikni saqlaydigan preparatlar va boshqalardan foydalanish kabilar. Qishloq xo'jaligi ekinlarining qurg'oqchilikka chidamli navlari intensiv ravishda yetishtiriladi.

So'nggi yillarda suvsiz mamlakatlar o'zlarining qishloq xo'jaligi infratuzilmasini rivojlantirmoqda, suvdan oqilona foydalanish yo'llarini qidirishmoqda. Masalan, Isroil bu borada eng yaxshi namunalardan biri va Yaqin Sharq mamlakatlarining eng qurg'oqchil davlatidir. Isroilda suvni boshqarish bo'yicha xususiy kompaniya mavjud. Xususan, yuqori texnologiyalarga asoslangan Mekorot kompaniyasi Isroilning 90 foiz ichimlik suvini yetkazib beradi va taxminan 80 foiz suv ta'minotini boshqaradi. Uning shu'ba korxonasi EMS Mekorot Projects suv ishlarini rejalashtirish, o'rnatish, sinovdan o'tkazish, oqova suvlarni tozalash, sho'rsizlantirish, yomg'ir suvini yaxshilash va boshqa masalalarda yechimlarni taqdim etadi. Mekorotning ikkinchi shu'ba korxonasi Mekorot Development and Enterprise loyihalash, texnik-iqtisodiy asoslar, loyihalarni boshqarish va tozalash inshootlarini qurish, ulardan foydalanish va ularga xizmat ko'rsatish ishlarini tashkil etadi.

Mekorot kompaniyasining suv sohasida erishgan yutuqlari jahon yetakchisiga aylantirdi va Isroilning OECD (Iqtisodiy hamkorlik va taraqqiyot tashkiloti)dagi suv qudrati sifatidagi mavqeini mustahkamladi. Yangi reyting GWI (Global Water Intelligence) 2020 reytingidan keyin tuzilgan bo'lib, u Isroilni dunyodagi eng ilg'or to'rtta suv sektoridan biri sifatida baholadi. 2020 yilgi reytingda Mekorot dunyodagi

eng yaxshi korxonalardan biri bo'lib, OECD mamlakatlaridagi suv manbalaridan o'rtacha 15 %ga nisbatan 3 %dan kam suv yo'qotish darajasi qayd etildi va kompaniyaning infratuzilmasi, ilmiy izlanishlari, professional nou-xausi va suvni yo'qotish darajasi yuqori baholanadi.

Xulosa. Xulosa qiladigan bo'lsak, suv tejovchi texnologiyalardan foydalanish bo'yicha xorijiy tajribalar o'rganilganda iqtisodiyoti rivojlangan davlatlar sug'orma dehqonchiliklarida, ya'ni AQShda 38,2 foiz, Misrda 36 foiz, Qozog'istonda 14 foiz, Turkiyada 12 foiz, Xitoy Xalq Respublikasida 11 foiz sug'orishning progressiv texnologiyalari qo'llanilib kelinmoqda. Ayniqsa Isroilda dengiz suvini tuzsizlantirish hisobiga suvdan samarali foydalanish bo'yicha 2050 yilga mo'ljallangan dasturlar tuzilganligi ayni bizni mamlakatimizda ham ushbu loyiha doirasida suvdan samarali foydalanishni yo'lga qo'yishga qaratilgan dasturlar ishlab chiqilishi maqsadga muvofiq, deb hisoblaymiz. Xorijiy davlatlar tajribasini o'rgangan holda mamlakatimiz, qolaversa Qashqadaryo viloyati sug'orma dehqonchiligida sug'orishning suv tejamkor usullarini qo'llash orqali suvdan tejimli va oqilona foydalanishga hamda ekinlar hosildorligini oshishiga zamin yaratiladi.

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TYPES OF WINTER WHEAT

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Abstract: his article provides information about wheat (*Triticum aestivum* L.), including its types, particularly hard and soft wheat varieties.

Keywords: Soft wheat, common wheat, hard wheat, soft and hard wheat varieties.

Types of Wheat Wheat belongs to the genus *Triticum*. The most widespread and economically important species are soft wheat and hard wheat. These two species differ mainly in the protein content of their grains. Hard wheat flour is primarily used for pasta production. In Uzbekistan, hard wheat is less common than soft wheat. These species also differ significantly in their morphological characteristics. Soft Wheat or Common Wheat (*Triticum aestivum*) The spike is long and loose, with a relatively broad front side. It may be either awned or awnless. The awns are usually shorter than the spike and spread outward in a fan-like shape. The grain has a tuft at its tip. Its surface is floury or semi-vitreous. Soft wheat includes both spring and winter forms. Soft wheat flour is highly valued and widely used in the baking industry due to its excellent bread-making qualities.

Hard Wheat (*Triticum durum*) Hard wheat ranks second in terms of cultivated area. Its spike is large, and the grains are densely arranged. Only awned forms exist. The awns are long, thick, and oriented parallel to the spike. The grains are large, elongated, and taper downward. In cross-section, the grain is angular, whereas soft wheat grains are generally round. The grain surface is vitreous and glossy. The tuft at the grain tip is either very small or absent. Hard wheat flour is mainly used for producing high-quality pasta, vermicelli, and wheat groats. Compared to soft wheat flour, it produces bread of lower quality with less porous texture. Hard wheat is mainly cultivated as a spring crop. Classification of Wheat Based on morphological and economic characteristics, all cultivated wheat species are divided into two groups:

1. True or Naked Wheat True wheat has a strong rachis, and when the spike matures, it does not break into separate spikelets. The grain is naked and can be easily threshed. This group includes ten species, such as hard wheat, Mesopotamian wheat, Polonicum, Turgidum, round-grained wheat, soft wheat, Van wheat, and several others.
2. Spelt-like or Hulled Wheat Spelt-like wheat differs in that its spike rachis is brittle and breaks into separate spikelets when mature. During threshing, the grain remains enclosed within the glumes and does not separate easily. This group includes the

remaining fourteen wheat species, such as wild einkorn wheat, cultivated einkorn wheat, spelt wheat, zanduri wheat, emmer wheat, and others.

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ARTIFICIAL INTELLIGENCE IN OPTIMIZING SUPPLY CHAINS AND LOGISTICS

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Annotation: This article analyzes the role of artificial intelligence (AI) in managing and optimizing global supply chains and logistics. It substantiates the effectiveness of AI in demand forecasting, inventory management, route optimization, and warehouse automation, and examines how AI increases supply chain resilience and risk detection. The novelty of the article lies in demonstrating that AI is becoming a strategic tool for supply chain efficiency and resilience, with recommendations developed for implementing these technologies in Uzbekistan's developing economy.

Keywords: Artificial Intelligence, supply chain, logistics, demand forecasting, inventory management, route optimization, warehouse automation, machine learning, predictive analytics, resilience.

Introduction

Supply chains form the backbone of the modern global economy, spanning suppliers, manufacturers, warehouses, and retailers across many countries. Managing such complex systems is extremely difficult, and the COVID-19 pandemic exposed how vulnerable global supply chains can be. Artificial intelligence (AI) has emerged as a powerful tool for managing this complexity. AI improves demand forecasting by analyzing historical data and external factors, optimizes inventory to avoid both shortages and excess, finds the most efficient transport routes, and detects potential disruptions in advance. Given that Uzbekistan occupies an important position on transit routes between Europe and Asia, AI-driven logistics optimization carries significant economic relevance for the country.

Discussion

The application of AI in supply chain management raises three central debates. First, the accuracy of demand forecasting: AI learns complex relationships among seasonality, economic conditions, and trends, but unexpected events such as pandemics or natural disasters can reduce forecast accuracy. Second, the balance between efficiency and resilience: supply chains long optimized purely for minimal cost became vulnerable to disruption, and AI is now used to strengthen resilience as well as

efficiency. Third, data quality and integration: effective AI requires accurate, complete data from all links of the chain, yet data from different companies and systems is often incompatible and fragmented, making integration a central challenge.

Main Part

1. Demand forecasting. AI analyzes historical sales, seasonal trends, economic indicators, weather, and even social media data to predict future demand more accurately than traditional methods, preventing both lost sales and excess inventory costs.

2. Inventory management. AI continuously analyzes demand forecasts, delivery times, and costs to determine the optimal inventory level for each product, freeing up capital and reducing storage costs while preventing shortages.

3. Route and transport optimization. AI identifies the most efficient transport routes by accounting for distance, traffic, weather, and fuel costs, saving time, reducing costs, and lowering harmful emissions.

4. Warehouse automation. AI and robotics optimize product placement, direct robots in order picking, and predict workload, accelerating warehouse operations and reducing errors, particularly in large e-commerce facilities.

5. Risk management and prospects for Uzbekistan. AI detects potential disruptions in advance, increasing supply chain resilience. For Uzbekistan, positioned on key Europe–Asia transit routes, training specialists, deploying AI-based logistics systems, and developing digital infrastructure are essential next steps.

Conclusion

AI-based supply chain and logistics optimization is becoming a strategic tool for the efficiency and resilience of the modern economy. Through demand forecasting, inventory management, route optimization, and warehouse automation, AI significantly reduces costs while increasing efficiency. Challenges remain in forecasting accuracy during unexpected events and in data quality and integration. For Uzbekistan, leveraging AI in logistics is key to economic competitiveness, supported by specialist training and digital infrastructure development.

FIZIK KIMYOVIY TAHLIL USULLARI ASOSINDA NAMLIKNI ADSORTSIYA QILISH UCHUN SINTEZLANGAN SILIKA GELINING XARAKTERISTIKALARI

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ANNOTATSIYA

Ushbu maqola suyuq shisha (Na_2SiO_3) va sulfat kislota (H_2SO_4) asosidagi sol-gel usuli yordamida laboratoriya sharoitida silika gelining sintezi, shuningdek, uning fizik-kimyoviy xususiyatlarini har tomonlama o'rganish haqida bo'lib, sintez jarayoni material xususiyatlariga ta'sirini baholash uchun turli rejimlarda gel hosil bo'lishi, qarish, yuvish va nazorat ostida quritishni o'z ichiga oladi.

Olingan namunalarning issiqlik xususiyati va barqarorligi DTA–TGA usullari yordamida tahlil qilindi. Natijalar shuni ko'rsatdiki, 40–150 °C harorat oralig'ida massa yo'qotilishi fizik adsorbsiyalangan suvning olib tashlanishiga to'g'ri keladi. 2.2 Y namunasi yuqori namlik adsorbsiyasi qobiliyatini (14.49%) va rivojlangan g'ovakli tuzilishni namoyish etdi, 2.1 Y namunasi esa strukturaviy bog'langan gidroksil guruhlari mavjudligi sababli yuqori issiqlik barqarorligini namoyish etdi.

BET tahlili shuni ko'rsatdiki, sintezlangan silika gelining o'ziga xos sirt maydoni 203,7 m^2/g va umumiy g'ovak hajmi 0,21 sm^3/g ni tashkil qiladi. G'ovak o'lchamlarining taqsimoti asosan 1,7–2,0 nm oralig'ida bo'lib, bu mezoporal tuzilishni ko'rsatadi. Bundan tashqari, mikrog'ovaklarning mavjudligi t -usuli va HK tahlili bilan tasdiqlandi, bu esa adsorbsiya xususiyatlarining yaxshilanishiga hissa qo'shdi.

Olingan natijalar shuni ko'rsatadiki, sintezlangan silika geli yaxshi rivojlangan g'ovakli tuzilishga ega va turli sanoat jarayonlarida adsorbent va qurituvchi material sifatida samarali qo'llanilishi mumkin.

KALIT SO'ZLAR:

Silika geli; Sol-gel sintezi; BET tahlili; Mezoporoz struktura; Adsorbsiya; DTA–TGA; G'ovakli materiallar; Quritgich

Kirish .

Silikagel - bu sol-gel usuli bilan olingan yuqori darajada g'ovakli amorf kremniy dioksidi bo'lib, u fizik adsorbsiya orqali namlikni yutadi. Bu turli sohalarda namlikni nazorat qilish uchun keng qo'llaniladigan barqaror, yangilanadigan va samarali qurituvchi materialdir.[1]

Silikagel A, B va C guruhlariga bo'linadi. A turi asosan gazlarni quritish va mahsulotlarni namlikdan himoya qilish uchun ishlatiladi. B turi suyuqliklarni adsorblash, namlikni nazorat qilish va katalizator tashuvchisi sifatida ishlatiladi. C turi sanoat gazlarini quritish, moyni tozalash, farmatsevtika jarayonlari va boshqa texnologik jarayonlarda keng qo'llaniladi [2].

Silika gel turlari aminlar bilan modifikatsiyalanganda, ularning CO₂ ga nisbatan sorbsiya qobiliyati oshadi. Hidroksietil karbamat bilan modifikatsiyalangan silika gellari aminokislotalarning mavjudligi tufayli CO₂ sorbsiyasini sezilarli darajada oshiradi. 30% HEC da optimal modifikatsiya sorbsiya qobiliyatini ikki baravar oshiradi, bu yuqori samaradorlik va barqarorlikni namoyish etadi, bu esa bu sorbentlarni CO₂ ni ushlash uchun istiqbolli qiladi [3].

Nanokremniy qo'shilishi putzolanik reaksiyalarni kuchaytirish va C-S-H gel hosil bo'lishini oshirish orqali betonning mustahkamligi va chidamliligini sezilarli darajada oshiradi. Optimal nanokremniy miqdori mexanik ish faoliyatini yaxshilaydi, shu bilan birga tsement sarfini kamaytiradi, bu esa uning ilg'or beton qo'llanilishi uchun kuchli salohiyatini namoyish etadi [4].

Sol-gel usullari SBA-15 kabi gibrid va mezoporoz materiallarni tayyorlashda muhim ahamiyatga ega. Bunday materiallar yuqori sirt maydoni va funksionalizatsiya salohiyati tufayli adsorbsiya va atrof-muhit qo'llanilishi uchun istiqbolli hisoblanadi. Biroq, ularni sintez qilish uchun oddiy va arzon laboratoriya protokollarini ishlab chiqish dolzarb muammo hisoblanadi [5].

Siklotidlarni ajratish uchun silika geli-C18 dan foydalangan holda mikrofluidik HPLC-mimik tizimi muvaffaqiyatli qo'llanildi. Ushbu usul siklotidlarni tez, arzon va samarali ajratish imkonini beradi, bu esa dori vositalarini kashf etishda katta salohiyatni namoyish etadi [6].

Silika geli (SiO₂) sorbent, quritgich va katalizator tayanchi sifatida keng qo'llaniladi. Rossiyada unga talab yuqori va mahalliy ishlab chiqarish yetarli emas, shuning uchun u ko'p miqdorda import qilinadi. Shuning uchun mahalliy xom ashyo asosida yuqori sifatli silika geli ishlab chiqarishni rivojlantirish muhimdir [7].

Eksperimental qism.

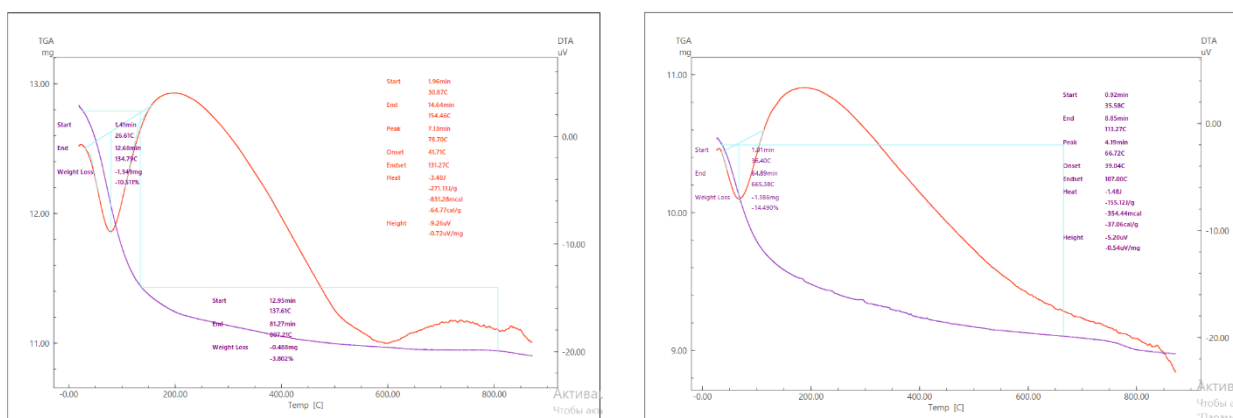
Laboratoriya sharoitida suyuq shisha va sulfat kislotaning o'zaro ta'siri natijasida jellanish kuzatildi va hosil bo'lgan gel ma'lum vaqtdan keyin yuvilib quritildi.

Bu holda, natriy silikat va suv 1:4, 1:6 nisbatda eritildi va tizim doimiy ravishda aralashtirildi. Keyin, unga suyultirilgan sulfat kislota eritmasi tomchilab asta-sekin qo'shildi, kuchsiz kislotali muhit hosil bo'lguncha. Gel hosil bo'lgandan so'ng, aralashtirish to'xtatildi va gel 12-24 soat dam olishga qoldirildi. Vaqt tugagandan so'ng, tizimda hosil bo'lgan natriy sulfat tuzini olib tashlash uchun gel bir necha marta yuvildi va filtrlandi. Olingan gel 180-200 ° C haroratda 2 soat davomida suvsizlantirildi.

Quritish jarayoni .

Namunalar 2.1 Y va 2.2 Y deb belgilandi. Quritish jarayonida ikkala namuna ham turli usullar bilan quritildi. Quritish uchun ikkala namunaning harorati 180-200 ° C gacha ko'tarildi va 2.1 Y namunasi shu haroratda 2 soat davomida ushlab turildi va keyin sekin sovutildi. 2.2 Y namunasi shu haroratda 180-200 ° C da 2 soat davomida ushlab turildi va keyin to'satdan sovutildi va olingan namunalar sinov uchun yuborildi.

Olingan namunalarni DTA–TGA tahlili orqali tekshirganimizda, quyidagi natijalar olindi.



1-rasm. Silika geli namunasi uchun TGA–DTA natijalari (2.1 Y va 2.2 Y).

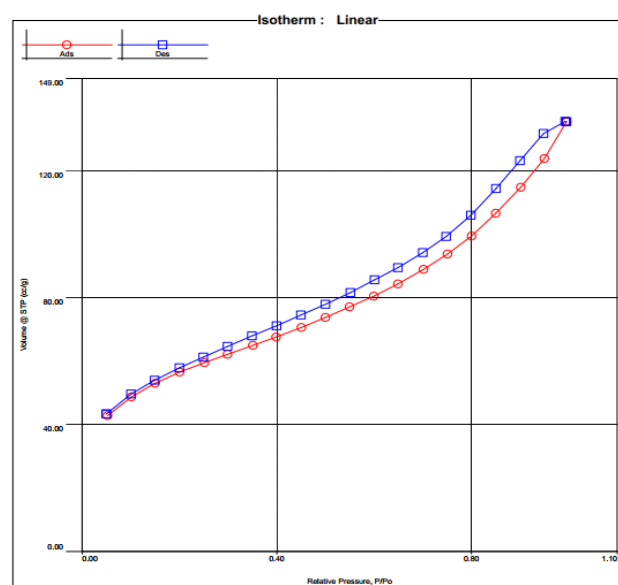
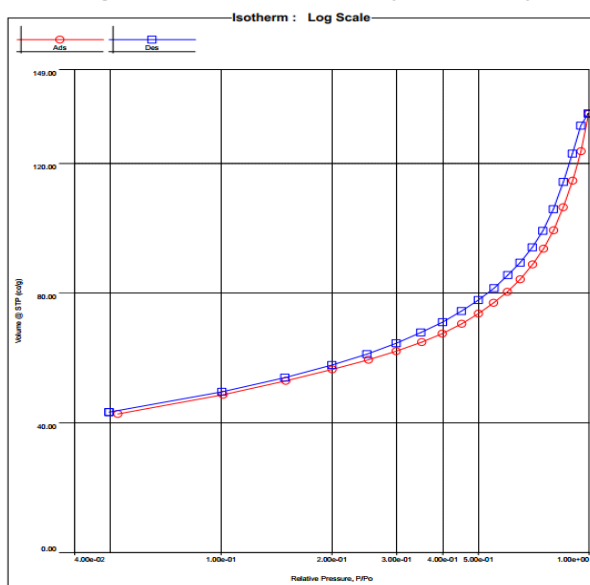
Sintezlangan silika geli namunalarning TGA-DTA tahlili shuni ko'rsatdiki, 40–150 °C oralig'ida massa yo'qotilishi adsorblangan suvning ajralib chiqishi bilan bog'liq. 2.2 Y namunasi yuqori namlikni yutish qobiliyatiga (14.49%) ega edi va rivojlangan g'ovakli tuzilishga ega edi. 2.1 Y namunasida qo'shimcha bosqichda strukturaviy gidroksil guruhlarining parchalanishi kuzatildi, bu uning yuqori issiqlik barqarorligini ko'rsatdi. Olingan natijalar silika gellarining adsorbentlar sifatida yuqori samaradorligini tasdiqlaydi.

1-jadval. Namunalarning qiyosiy tahlili

Parametr	2.2 Y	2.1 Y
Namlik yo'qotish	Yuqori (14.49%)	O'rtacha (10,5%)
Cho'qqi harorat	66,7 °C	78,7 °C
Strukturaviy barqarorlik	Pastroq	Yuqori

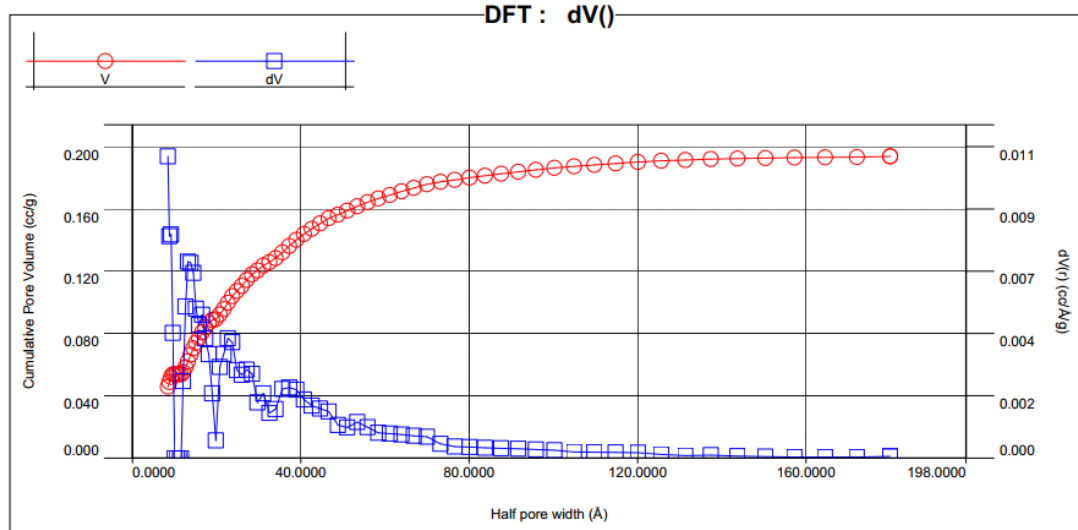
G'ovaklik	Juda yaxshi	Yaxshi
Adsorbsiya sig'im	Juda yuqori	Yuqori

Sintezlangan silika geli namunasining BET tahlil natijalari quyidagicha. BET tahlili natijalariga ko'ra, sintezlangan silika geli namunasining solishtirma sirt maydoni 203,7 m²/g ni tashkil etadi, bu uning yaxshi rivojlangan g'ovak tuzilishini ko'rsatadi. Umumiy g'ovak hajmi 0,21 sm³/g ni tashkil qiladi. G'ovak o'lchamlari asosan 1,7–2,0 nm oralig'ida bo'lib, bu materialning mezog'ovak tuzilishga ega ekanligini ko'rsatadi. t-usuli va HK usullari natijalariga ko'ra, namunada mikrog'ovaklar ham mavjud bo'lib, bu uning adsorbsion xususiyatlarini yanada oshiradi.



a) b)

DFT : dV()



c)

2-rasm. a), b) va c) - Sintezlangan silika gelining BET tahlil natijalari.

BET va g'ovak tuzilishi tahlili klassik BET nazariyasi va IUPAC tavsiyalariga [8–10] muvofiq amalga oshirildi va g'ovak materiallar uchun zamonaviy yondashuvlar yordamida talqin qilindi [11–13].

XULOSA .

Ushbu tadqiqotda silika geli nazorat ostida laboratoriya sharoitida natriy silikat va sulfat kislota yordamida sol-gel usuli orqali muvaffaqiyatli sintez qilindi. Quritish rejimlarining materialning strukturaviy va adsorbsion xususiyatlariga ta'siri aniq ko'rsatildi.

Termik tahlil sintezlangan namunalarda odatiy suvsizlanish xususiyatiga ega ekanligini, past haroratlarda fizik adsorbsiyalangan suv olib tashlanishini tasdiqladi. Namunalarni taqqoslash shuni ko'rsatdiki, tez sovutish g'ovaklik va adsorbsiya qobiliyatini oshiradi, sekin sovutish esa termal barqarorlikni yaxshilaydi.

mezoporalar va mikroporalar bilan yaxshi rivojlangan g'ovak tuzilishga ega . 1,7–2,0 nm oralig'idagi dominant g'ovak o'lchami materialning mezoporal xususiyatini tasdiqlaydi, bu esa adsorbsiya qo'llanilishi uchun qulaydir.

Umuman olganda, sintezlangan silika geli gazni quritish, namlikni nazorat qilish va atrof-muhitni muhofaza qilishda samarali adsorbent sifatida foydalanish uchun istiqbolli xususiyatlarni namoyish etadi. Keyingi modifikatsiya (masalan, amin funksionalizatsiyasi) uning selektiv gaz adsorbsiyasi, xususan, CO₂ ni ushlash samaradorligini sezilarli darajada oshirishi mumkin.

Foydalanilgan adabiyotlar ro'yxati.

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**O‘ZBEKISTON MOLIYA TIZIMINING XALQARO MOLIYA
BOZORLARIGA INTEGRATSIYALASHUVI VA RIVOJLANISH
ISTIQBOLLARI**

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ANNOTATSIYA

Ushbu tezisda O‘zbekiston moliya tizimining **xalqaro moliya bozorlariga integratsiyalashuvi**, uning iqtisodiy zarurati, institutsional omillari, mavjud imkoniyatlari va ehtimoliy risklari tahlil qilinadi. Integratsiya jarayoni xalqaro kapital bozorlariga chiqish, suveren va korporativ obligatsiyalar joylashtirish, **xalqaro moliya institutlari** bilan hamkorlikni kengaytirish, bank tizimida xalqaro standartlarni joriy etish, **kapital bozorini** chuqurlashtirish, xorijiy investorlar uchun huquqiy kafolatlarni mustahkamlash va moliyaviy infratuzilmani modernizatsiya qilish bilan bog‘liq. Tadqiqotda O‘zbekistonning makroiqtisodiy barqarorligi, xalqaro zaxiralari, bank sektoridagi islohotlar, **kapital bozori** salohiyati va **Tashkent International Financial Centre** kabi tashabbuslar xalqaro integratsiyaning muhim omillari sifatida baholanadi. Shu bilan birga, tashqi qarz, **valuta riski**, global foiz stavkalari, **korporativ boshqaruv** sifati va ichki **kapital bozori** likvidligining pastligi kabi cheklovlar ham yoritiladi.

KALIT SO‘ZLAR

xalqaro moliya bozorlar, moliyaviy integratsiya, kapital bozori, suveren obligatsiyalar, investitsiya, bank islohotlari, valuta riski, xalqaro moliya institutlari, moliyaviy barqarorlik, O‘zbekiston.

KIRISH

O‘zbekiston iqtisodiyotining ochiqlik darajasi ortib borayotgani milliy moliya tizimini xalqaro moliya bozorlariga bosqichma-bosqich integratsiya qilish zaruratini kuchaytirmoqda. Moliya tizimining xalqaro integratsiyasi deganda mamlakat banklari, davlat moliyasi, **kapital bozori**, sug‘urta bozori, to‘lov infratuzilmasi va investitsiya institutlarining global moliyaviy oqimlar, xalqaro standartlar va transhegaraviy kapital harakati bilan bog‘lanishi tushuniladi. Bu jarayon iqtisodiyotga uzoq muddatli investitsiyalar jalb qilish, moliyalashtirish manbalarini diversifikatsiya qilish, bank sektorida raqobatni kuchaytirish va **kapital bozori** chuqurligini oshirish imkonini beradi.

O‘zbekiston uchun xalqaro moliya bozorlariga integratsiya faqat tashqi qarz olish yoki chet el investorini jalb qilish masalasi emas. Bu jarayon moliya tizimining ichki sifatini

o'zgartiradi. Xalqaro investor milliy bozorga kirishi uchun ishonchli statistik ma'lumotlar, barqaror makroiqtisodiy siyosat, shaffof budjet boshqaruvi, xalqaro moliyaviy hisobot standartlari, mustaqil audit, investor huquqlarini himoya qiluvchi sud va regulativ tizim, likvid bozor infratuzilmasi zarur. Demak, integratsiya tashqi kapital oqimidan oldin ichki institutsional islohotlarni talab qiladi.

So'nggi yillarda O'zbekiston iqtisodiyoti **xalqaro moliya institutlari** va investorlar e'tiborini ko'proq jalb qilmoqda. Xalqaro valyuta jamg'armasi 2025-yilgi IV modda maslahatlashuvida O'zbekiston iqtisodiy ko'rsatkichlari kuchli saqlanib qolganini, konsolidatsiyalashgan fiskal va joriy hisob taqchilliklari torayganini hamda xalqaro zaxiralar yetarli darajada ekanini qayd etgan. Bunday baholar mamlakatning xalqaro moliya bozoridagi ishonchliligini oshiradi. Shu bilan birga, ishonch avtomatik ravishda shakllanmaydi. U davlat qarzini ehtiyotkor boshqarish, inflyatsiyani pasaytirish, bank tizimini xususiylashtirish, **kapital bozorida** oshkoralikni kuchaytirish va investorlar uchun teng sharoit yaratish orqali mustahkamlanadi.

ASOSIY QISM

Xalqaro moliya bozorlariga integratsiyalashuvning asosiy yo'nalishlaridan biri davlat va korporativ qimmatli qog'ozlarni global bozorlarda joylashtirishdir. O'zbekiston 2019-yildan boshlab xalqaro obligatsiyalar bozorida faol qatnasha boshladi. Keyingi yillarda milliy valuta va xorijiy valutadagi **suveren obligatsiyalar** joylashtirilishi mamlakatning xalqaro investorlar bilan moliyaviy aloqasini kengaytirdi. 2023-yilda O'zbekiston 660 mln AQSh dollari miqdoridagi obligatsiyalarni va 4,25 trln so'mlik ilk yashil **suveren obligatsiyalarni** London fond birjasida joylashtirgani ekologik va ijtimoiy yo'naltirilgan moliyalashtirish imkoniyatini ochdi. 2025-yilda esa O'zbekistonning so'm, AQSh dollari va yevrodagi suveren yevroobligatsiyalari umumiy qiymati qariyb 1,49 mlrd AQSh dollariga teng hajmda joylashtirilgani xalqaro **kapital bozoridagi** ishtirokni chuqurlashtirdi.

Suveren obligatsiyalar xalqaro moliya bozoriga chiqishning muhim vositasi bo'lsa-da, u yagona maqsad bo'lmasligi kerak. Tashqi qarz orqali jalb qilingan mablag'lar iqtisodiy o'sishga xizmat qiladigan infratuzilma, energetika, transport, ta'lim, sog'liqni saqlash va yashil iqtisodiyot loyihalariga yo'naltirilsa, qarz yuki kelajakda qo'shimcha qiymat yaratadi. Agar mablag'lar joriy xarajatlarni yopish yoki past samarali loyihalarni moliyalashtirishga sarflansa, integratsiya **moliyaviy barqarorlik** uchun xavfga aylanadi. Shu sababli xalqaro moliya bozorlariga chiqish qarzning miqdori bilan emas, uning iqtisodiy samaradorligi, valuta tarkibi, foiz stavkasi, qaytarish muddati va loyiha natijadorligi bilan baholanishi zarur.

Milliy **kapital bozorining** rivojlanishi xalqaro integratsiyaning ichki tayanchidir. Agar mamlakatda aksiyalar, korporativ obligatsiyalar, investitsiya fondlari, davlat qimmatli

qog'ozlari va derivativlar bozori yetarlicha rivojlanmagan bo'lsa, tashqi kapital oqimi tor doirada qoladi. Prezident administratsiyasi tomonidan 2025-yilda e'lon qilingan ma'lumotlarga ko'ra, O'zbekistonda muomaladagi qimmatli qog'ozlar bozor qiymati 275 trln so'mni tashkil etgan, erkin birja savdolaridagi qimmatli qog'ozlar hajmi esa 4 trln so'mga yetgan. Bozorda 717 emitent va 77 professional ishtirokchi faoliyat yuritmoqda. Shu bilan birga, **kapital bozori** kapitallashuvi yalpi ichki mahsulotga nisbatan 20 foiz atrofida ekani, global ko'rsatkichlar bilan taqqoslaganda, bozor chuqurligi hali yetarli emasligini ko'rsatadi.

Kapital bozorini xalqaro moliya tizimiga bog'lash uchun **dual listing**, global depozitar tilxatlar, valuta obligatsiyalari, birja savdo fondlari va xorijiy qimmatli qog'ozlar savdosini joriy etish muhim. Dual listing mahalliy kompaniya qimmatli qog'ozlarini bir vaqtning o'zida O'zbekiston va xorijiy fond birjalarida joylashtirish imkonini beradi. Bu korxonalar uchun investitsiya bazasini kengaytiradi, investorlar uchun likvidlikni oshiradi, kompaniyalarni xalqaro hisobot va **korporativ boshqaruv** talablariga yaqinlashtiradi. Valuta obligatsiyalari esa mahalliy kompaniyalarga tashqi bozorga chiqmasdan xorijiy valuta resurslarini jalb qilish imkonini berishi mumkin. Biroq bunday instrumentlar **valuta riskini** kuchaytiradi. Shuning uchun risklarni xedj qilish, daromadlar valuta tarkibini baholash va obligatsiya emitentlari uchun oshkorlik talablarini kuchaytirish shart.

Bank tizimining xalqaro standartlarga moslashuvi ham integratsiyaning asosiy shartidir. O'zbekiston bank sektorida davlat ulushining yuqoriligi, ayrim banklarda **korporativ boshqaruv**ning sustligi va kredit portfeli sifatiga oid muammolar xalqaro investorlar uchun risk sifatida baholanadi. Jahon bankining moliya sektorini isloh qilish loyihasi bank sektorini modernizatsiya qilish, davlat banklarini transformatsiya qilish va xususiy sektor rolini oshirishga qaratilgan. Bu yo'nalish xalqaro moliya bozorlariga integratsiya bilan bevosita bog'liq, chunki raqobatbardosh banklar xalqaro kredit liniyalari, savdo moliyasi, sindikatlashgan kreditlar va investitsiya xizmatlarini jalb qilishda faolroq qatnashadi.

Xalqaro moliya institutlari bilan hamkorlik O'zbekiston integratsiyasining xavfsiz va bilimga asoslangan shaklidir. Jahon banki, Xalqaro moliya korporatsiyasi, Osiyo taraqqiyot banki, Yevropa tiklanish va taraqqiyot banki va Xalqaro valyuta jamg'armasi bilan hamkorlik nafaqat mablag' jalb qilish, balki texnik yordam, institutsional diagnostika, **korporativ boshqaruv**, **moliyaviy inklyuziya**, garov reyestri, pul bozori infratuzilmasi va bank nazorati kabi yo'nalishlarda tajriba olish imkonini beradi. Markaziy bankning 2024-yilgi hisobotida Jahon banki, Xalqaro moliya korporatsiyasi, Yevropa tiklanish va taraqqiyot banki hamda Osiyo taraqqiyot

banki bilan hamkorlik garov reyestri, pul bozori, **moliyaviy inklyuziya** va bank xizmatlari iste'molchilari himoyasi yo'nalishlarida olib borilgani qayd etilgan.

Integratsiyaning yangi institutsional yo'nalishi **Tashkent International Financial Centre** tashabbusi bilan bog'liq. 2026-yilda ushbu markazni ingliz umumiy huquqi tamoyillariga asoslangan maxsus huquqiy rejim, soliq va bojxona imtiyozlari, erkin kapital harakati, istalgan valutada hisob-kitob qilish, **fintech**, raqamli aktivlar va **yashil moliya** xizmatlarini rivojlantirish maydoni sifatida shakllantirish rejalari e'lon qilindi. Bunday markaz O'zbekistonni mintaqaviy moliyaviy hub sifatida ko'rsatishi mumkin. Ammo bu tashabbus real natija berishi uchun mustaqil regulyator, professional sudlov mexanizmi, investorlar nizolarini tez hal qilish, xalqaro auditorlar va yuridik maslahatchilar bozori, malakali kadrlar hamda pul yuvishga qarshi nazorat tizimi bir vaqtda ishlashi kerak.

Xalqaro integratsiyaning eng muhim xavfi tashqi shoklarga sezgirlikning ortishidir. Global foiz stavkalari ko'tarilganda tashqi qarzga xizmat ko'rsatish qimmatlashadi. AQSh dollari yoki yevro mustahkamlanganda valuta qarzi bo'lgan emitentlar uchun yuk oshadi. Investorlar riskdan qochish rejimiga o'tganda rivojlanayotgan bozorlar aktivlaridan kapital chiqishi mumkin. Shu sababli O'zbekiston integratsiyaning ehtiyotkorlik bilan boshqarishi kerak. Ichki **kapital bozori**ni chuqurlashtirish, so'mdagi uzoq muddatli instrumentlarni ko'paytirish, davlat qarzi bo'yicha ochiq ma'lumotlarni kengaytirish, **valuta riskini** xedj qilish instrumentlarini rivojlantirish va makroprudensial nazoratni kuchaytirish bu jarayonda zarur himoya mexanizmlaridir. Integratsiya jarayonida mahalliy biznesning xalqaro moliya resurslariga kirish imkoniyati alohida ahamiyatga ega. O'zbekistonda ko'plab korxonalar uzoq muddatli investitsiya uchun asosan bank kreditlariga tayanadi. Bu holat bank tizimiga ortiqcha bosim beradi va korporativ sektor uchun moliyalashtirish narxini oshiradi. Xalqaro moliya bozorlariga bog'langan **kapital bozori** esa sanoat, energetika, logistika, qishloq xo'jaligi va xizmatlar sohasidagi kompaniyalarga obligatsiya chiqarish, aksiyalarni joylashtirish yoki strategik investor jalb qilish imkonini beradi. Bunday mexanizm korxonalar balansini sog'lomlashtiradi, qarz va kapital nisbatini muvozanatlashtiradi hamda innovatsion loyihalarga uzoq muddatli resurs yetkazadi.

Moliyaviy integratsiyaning yana bir muhim jihati xalqaro reytinglar va mamlakat imiji bilan bog'liq. Suveren kredit reytingi, banklarning xalqaro reytinglari, korporativ emitentlarning moliyaviy shaffofligi va davlat qarzi boshqaruvi sifati investorlar qaroriga bevosita ta'sir qiladi. Reyting yaxshilanishi qarz olish xarajatlarini kamaytirishi mumkin, ammo reytingni sun'iy ravishda emas, makroiqtisodiy barqarorlik, fiskal intizom, mustaqil monetar siyosat va institutsional ishonch orqali

oshirish mumkin. Shu bois xalqaro integratsiya tashqi aloqalar siyosati emas, balki ichki iqtisodiy boshqaruv sifatining ko'zgusi hisoblanadi.

Xalqaro investorlar uchun moliya tizimining shaffofligi hal qiluvchi omil hisoblanadi. Investorga qimmatli qog'ozning nominal daromadliligi emas, balki kompaniyaning real moliyaviy holati, aksiyadorlar huquqi, dividend siyosati, audit sifati, sud tizimiga ishonch, soliq barqarorligi va pulni erkin olib chiqish imkoniyati muhim. Shu sababli O'zbekiston **kapital bozorini** rivojlantirishda faqat yangi instrumentlar chiqarish bilan cheklanmasligi kerak. Emitentlar moliyaviy hisobotini xalqaro standartlarga moslashtirish, mustaqil direktorlar institutini kuchaytirish, minoritar aksiyadorlar huquqlarini himoya qilish, insayderlik savdolari va bozor manipulyatsiyasiga qarshi nazoratni kuchaytirish talab etiladi.

Rivojlanish istiqbollari, avvalo, xalqaro integratsiyani real sektor ehtiyojlari bilan bog'lashga tayanadi. Eksportchi korxonalar, logistika kompaniyalari, energiya loyihalari va hududiy sanoat klasterlari xalqaro moliya resurslaridan foydalanish orqali ishlab chiqarish quvvatini oshirishi mumkin. Biroq bunday resurslar faqat yirik davlat korxonalari atrofida jamlanib qolsa, integratsiya iqtisodiyot bo'yicha keng ta'sir bermaydi. Shu bois kichik va o'rta biznes uchun savdo moliyasi, kafolatlar, eksport sug'urtasi, lizing va mahalliy korporativ obligatsiyalar bozorini rivojlantirish xalqaro moliya bozorlariga ulanishning amaliy natijasini kuchaytiradi. Integratsiyaning sifati kapital kelishi bilan emas, uning qaysi tarmoqlarda mahsuldorlik, eksport va bandlik yaratishi bilan baholanishi kerak.

XULOSA

O'zbekiston moliya tizimining **xalqaro moliya bozorlariga integratsiyalashuvi** mamlakat iqtisodiy o'sishini moliyaviy jihatdan qo'llab-quvvatlaydigan muhim jarayondir. U tashqi kapitalni jalb qilish, investitsiya manbalarini diversifikatsiya qilish, bank tizimini raqobatbardosh qilish, **kapital bozorini** chuqurlashtirish va xalqaro standartlarni joriy etish imkonini beradi. Shu bilan birga, integratsiya o'z-o'zidan samaradorlik bermaydi. Uning natijasi ichki moliyaviy institutlar sifati, fiskal intizom, valuta risklarini boshqarish, davlat qarzi shaffofligi, **korporativ boshqaruv** va **investorlar huquqlarini** himoya qilish darajasiga bog'liq. O'zbekiston uchun eng maqbul yo'l tashqi bozorga faqat qarz oluvchi sifatida emas, balki ishonchli emitent, ochiq **kapital bozori**, raqobatbardosh bank tizimi va mintaqaviy moliyaviy xizmatlar markazi sifatida chiqishdir. Buning uchun xalqaro integratsiya ichki islohotlar bilan bir vaqtda olib borilishi, moliyaviy ochiqlik, regulativ barqarorlik va real sektor samaradorligi bilan mustahkamlanishi zarur. Ana shunda xalqaro moliya bozorlariga integratsiya O'zbekiston uchun tashqi qaramlik manbai emas, balki moliya tizimini modernizatsiya qilish va iqtisodiy taraqqiyotni jadallashtirish vositasiga aylanadi.

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**UGLEROD NANO NUQTACHALARI ASOSIDA YUQORI INTENSIV
YORUG‘LIK CHIQUYUVCHI INNOVATSION BO‘YOQLAR YARATISH
VA ULARNING OPTIK XOSSALARINI TADQIQ ETISH**

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Annotatsiya: Ushbu maqolada uglerod nano nuqtachalari (carbon quantum dots, CQDs) asosida yuqori intensiv yorug‘lik chiqaruvchi innovatsion bo‘yoqlarni yaratish va ularning optik xossalarini tadqiq etish masalalari yoritiladi. Tadqiqotda CQDs ning fotolyuminesans mexanizmi, elektron tuzilishi va sirt holatlari asosida yorug‘lik emissiya jarayonlari ilmiy jihatdan tahlil qilinadi. Shuningdek, ularni turli sintez usullari orqali olish hamda polimer matritsalar bilan kompozit holatda qo‘llash imkoniyatlari ko‘rib chiqiladi. Optik xossalar emissiya spektri, kvant chiqish samaradorligi va yorug‘lik barqarorligi asosida baholanadi. Natijalar CQDs asosidagi bo‘yoqlar ekologik xavfsiz va yuqori samarali luminescent materiallar sifatida keng amaliy qo‘llanilish salohiyatiga ega ekanligini ko‘rsatadi.

Kalit so‘zlar: uglerod nano nuqtachalari, fotolyuminesans, kvant nuqtalar, innovatsion bo‘yoqlar, optik xossalar, nano materiallar, emissiya spektri, kvant samaradorlik

Abstract: This article addresses the development of innovative high-intensity light-emitting paints based on carbon quantum dots (CQDs) and the study of their optical properties. The research provides a scientific analysis of the photoluminescence mechanism of CQDs, focusing on their electronic structure and surface states that govern light emission processes. In addition, various synthesis methods for obtaining CQDs and their application in composite form with polymer

matrices are discussed. The optical properties are evaluated based on emission spectra, quantum yield efficiency, and photostability. The results demonstrate that CQD-based paints have significant potential for wide practical applications as environmentally friendly and highly efficient luminescent materials.

Keywords: carbon quantum dots, photoluminescence, quantum dots, innovative paints, optical properties, nanomaterials, emission spectrum, quantum efficiency.

Аннотация: В данной статье рассматриваются вопросы создания инновационных красок с высокой интенсивностью свечения на основе углеродных квантовых точек (carbon quantum dots, CQDs) и исследования их оптических свойств. В работе проводится научный анализ механизма фотолюминесценции CQDs с акцентом на их электронную структуру и поверхностные состояния, определяющие процессы излучения света. Также рассматриваются различные методы синтеза CQDs и возможности их применения в составе композитов с полимерными матрицами. Оптические свойства оцениваются на основе спектра излучения, квантового выхода и фотостабильности. Полученные результаты показывают, что краски на основе CQDs обладают высоким потенциалом практического применения как экологически безопасные и высокоэффективные люминесцентные материалы.

Ключевые слова: углеродные квантовые точки, фотолюминесценция, квантовые точки, инновационные краски, оптические свойства, наноматериалы, спектр излучения, квантовая эффективность.

Kirish: So‘nggi o‘n yilliklarda nanofizika va nanomateriallar kimyosi jadal rivojlanib, yangi avlod funksional materiallarni yaratishga keng imkoniyatlar ochib

bermoqda. Ayniqsa, uglerod asosidagi nanostrukturalar — grafen, fullerenlar va uglerod nano nuqtachalari (carbon quantum dots, CQDs) — o‘zining noyob fizik-kimyoviy va optik xossalari bilan ilmiy jamoatchilik e’tiborini tortib kelmoqda. CQDs nanometr o‘lchamdagi, kuchli fotolyuminesans xususiyatiga ega bo‘lgan uglerod zarrachalari bo‘lib, ular yuqori barqarorlik, past toksiklik, suvda yaxshi eruvchanlik hamda ekologik xavfsizlik kabi afzalliklari bilan ajralib turadi. Ushbu xususiyatlar ularni an’anaviy yarimo‘tkazgich kvant nuqtalariga nisbatan istiqbolli muqobil material sifatida ko‘rsatadi. CQDs ning optik xossalari ularning kvant o‘lcham effekti, sirt holatlari, funksional guruhlar tarkibi hamda elektron tuzilishidagi o‘ziga xosliklar bilan bevosita bog‘liqdir. Ushbu omillar fotolyuminesans jarayonining mexanizmini belgilab beradi va emissiya spektrining keng diapazonda boshqarilishini ta’minlaydi. Shu sababli CQDs asosidagi materiallar optoelektronika, bioimaging, kimyoviy sensorlar, yorug‘lik chiqaruvchi qurilmalar hamda innovatsion qoplama materiallar yaratishda keng qo‘llanilmoqda. Hozirgi vaqtda yuqori intensiv yorug‘lik chiqaruvchi innovatsion bo‘yoqlarni ishlab chiqish muhim ilmiy-amaliy yo‘nalishlardan biri hisoblanadi. Bunday bo‘yoqlar nafaqat vizual effekt yaratish, balki xavfsizlik belgilari, optik kodlash, yorug‘likka sezgir qoplamalar hamda zamonaviy dizayn yechimlarida ham katta ahamiyat kasb etadi. Ushbu yo‘nalishda CQDs asosidagi luminescent bo‘yoqlar alohida o‘rin tutadi, chunki ular yuqori yorug‘lik intensivligi, barqaror emissiya va ekologik tozaligi bilan ajralib turadi. CQDs ni olishning turli usullari — “top-down” va “bottom-up” yondashuvlar — ularning fizik-kimyoviy xossalarini boshqarishda muhim rol o‘ynaydi. Shuningdek, ularni polimer matritsalar bilan kompozit tizimlarda qo‘llash yorug‘lik emissiya samaradorligini oshirish va materialning mexanik barqarorligini ta’minlash imkonini beradi. Natijada, CQDs asosidagi bo‘yoqlarning optik parametrlarini, jumladan emissiya spektri, kvant chiqish samaradorligi va fotostabillik darajasini chuqur o‘rganish

ilmiy jihatdan dolzarb hisoblanadi. Mazkur ilmiy ishning asosiy maqsadi uglerod nano nuqtachalari asosida yuqori intensiv yorug'lik chiqaruvchi innovatsion bo'yoqlarni yaratish va ularning optik xossalarini tizimli ravishda tadqiq etishdan iboratdir. Tadqiqot jarayonida CQDs ning fotolyuminesans mexanizmi, sintez usullari hamda ularning polimer kompozitlar tarkibidagi xatti-harakati tahlil qilinadi. Olingan natijalar CQDs asosidagi materiallarning yuqori samarador, ekologik xavfsiz va istiqbolli optik material sifatida sanoat va ilmiy tadqiqotlarda keng qo'llanilish imkoniyatiga ega ekanligini ko'rsatadi.

Asosiy qism: Uglerod nano nuqtachalari (CQDs) nanometr o'lchamdagi uglerod asosli yorug'lik chiqaruvchi zarrachalar bo'lib, ularning diametri odatda 1–10 nm oralig'ida bo'ladi. Ular sp^2 va sp^3 gibridlangan uglerod atomlaridan tashkil topgan murakkab tuzilishga ega bo'lib, yuzasida turli funksional guruhlar ($-OH$, $-COOH$, $-NH_2$ va boshqalar) mavjudligi bilan tavsiflanadi. Aynan ushbu sirt guruhlari CQDs ning suvda eruvchanligi, kimyoviy barqarorligi hamda optik xossalarini belgilashda muhim rol o'ynaydi. CQDs ning eng muhim xususiyatlaridan biri ularning fotolyuminesans (PL) hodisasidir. Bu jarayon tashqi energiya (odatda ultrabinafsha yoki ko'k nurlanish) ta'sirida elektronlarning yuqori energiya holatiga o'tishi va keyinchalik past energiya holatiga qaytishi natijasida yorug'lik emissiyasi yuzaga kelishi bilan izohlanadi. Fotolyuminesans mexanizmi asosan uchta omil bilan bog'liq: kvant o'lcham effekti, sirt holatlari va molekulyar floresans markazlari. Ushbu omillar emissiya spektrining keng diapazonda (ko'kdan qizilgacha) sozlanishiga imkon beradi. CQDs ni sintez qilish usullari ikki asosiy guruhga bo'linadi: "top-down" va "bottom-up" yondashuvlar. Top-down usullarida katta uglerod manbalari (grafit, grafen, karbon nanotrubkalar) fizik yoki kimyoviy yo'llar bilan mayda nanobosqichlarga ajratiladi. Bottom-up usullarida esa kichik organik molekulalar (limon kislotasi, glyukoza, aminokislotalar) termik

parchalanish, gidrotermal yoki solvotermal jarayonlar orqali CQDs ga aylantiriladi. Bottom-up usuli odatda yuqori kvant chiqish samaradorligi va yaxshi nazorat qilinadigan sirt tuzilmasi bilan ajralib turadi. CQDs asosida yaratilgan luminescent bo‘yoqlarni olishda ularni polimer matritsalar (masalan, PVA, PMMA, epoksi smolalar) bilan birlashtirish keng qo‘llaniladi. Bunday kompozit tizimlar CQDs ni tashqi muhit ta’siridan himoya qiladi, ularning agregatsiyasini kamaytiradi hamda yorug‘lik emissiya barqarorligini oshiradi. Natijada hosil bo‘lgan bo‘yoqlar yuqori intensivlikdagi yorug‘lik chiqarish qobiliyatiga ega bo‘lib, optik qurilmalar va funksional qoplamalar uchun mos keladi. Optik xossalarni baholashda bir nechta asosiy parametrlar qo‘llaniladi. Emissiya spektri CQDs ning rang diapazonini va maksimal to‘lqin uzunligini aniqlaydi. Kvant chiqish samaradorligi esa yutilgan energiyaga nisbatan chiqarilgan fotonlar ulushini ifodalaydi va materialning yorug‘lik berish samaradorligini ko‘rsatadi. Fotostabillik esa CQDs ning uzoq muddatli nurlanish ta’sirida degradatsiyaga uchramaslik qobiliyatini belgilaydi. Tadqiqotlar shuni ko‘rsatadiki, to‘g‘ri sintez va sirt modifikatsiyasi orqali ushbu parametrlarni sezilarli darajada yaxshilash mumkin. Shuningdek, CQDs asosidagi bo‘yoqlarning amaliy qo‘llanilish sohalari kengayib bormoqda. Ular xavfsizlik belgilari, optik kodlash tizimlari, lyuminescent indikatorlar, bioimaging va sensor qurilmalarda samarali ishlatilishi mumkin. Ularning ekologik xavfsizligi va past toksikligi esa tibbiyot va biologiya sohalarida qo‘llanilish imkoniyatlarini yanada kengaytiradi. Umuman olganda, CQDs asosidagi innovatsion bo‘yoqlar yuqori optik samaradorlik, barqarorlik va ekologik tozalik kabi afzalliklari bilan ajralib turadi hamda zamonaviy materialshunoslikning istiqbolli yo‘nalishlaridan biri hisoblanadi.

Muammo va uning tahlili: So‘nggi yillarda uglerod nano nuqtachalari (CQDs) asosida yaratilayotgan luminescent materiallar va innovatsion bo‘yoqlar

keng ilmiy qiziqish uygʻotayotgan boʻlsa-da, ushbu yoʻnalishda bir qator dolzarb muammolar mavjud. Mazkur muammolar CQDs ning optik samaradorligi, sintez jarayonlarini boshqarish, hamda amaliy qoʻllanilishdagi barqarorlik bilan bevosita bogʻliqdir. Birinchi asosiy muammo CQDs ning fotolyuminesans xossalarini toʻliq va bir xil darajada boshqarishning murakkabligidir. Turli sintez usullari natijasida olingan CQDs zarrachalari oʻlchami, sirt funksional guruhlar va tuzilishi jihatidan sezilarli farq qiladi. Bu esa emissiya spektrining beqarorligiga, yaʼni bir xil sharoitda turli rang va intensivlikda yorugʻlik berilishiga olib keladi. Natijada ularni sanoat miqyosida standartlashtirish qiyinlashadi. Ikkinchi muammo kvant chiqish samaradorligining (quantum yield) yetarlicha yuqori va barqaror emasligidir. Ayrim CQDs namunalari yuqori PL intensivlikka ega boʻlsa-da, koʻplab hollarda bu koʻrsatkich past yoki tashqi omillar (harorat, pH, oksidlanish darajasi) taʼsirida tez oʻzgaradi. Bu esa ularning amaliy optik qurilmalarda uzoq muddat ishlatilishini cheklaydi. Uchinchi muhim masala CQDs ning agregatsiyalanish (yigʻilib qolish) tendensiyasidir. Nanomateriallar oʻzaro Van-der-Vaals kuchlari taʼsirida birikib, yirik agregatlar hosil qilishi mumkin. Bu holat ularning faol sirt maydonini kamaytiradi va fotolyuminesans samaradorligini pasaytiradi. Shu sababli ularni polimer matritsalar bilan bir xil darajada barqaror dispersiya qilish dolzarb muammo hisoblanadi. Toʻrtinchi muammo — uzoq muddatli fotostabillikning yetarli darajada taʼminlanmaganligidir. Kuchli yorugʻlik yoki ultrabinafsha nurlanish taʼsirida CQDs yuzasidagi funksional guruhlar degradatsiyaga uchrashi mumkin, bu esa emissiya intensivligining pasayishiga olib keladi. Ayniqsa, tashqi muhitda qoʻllaniladigan boʻyoqlar uchun bu juda muhim cheklov hisoblanadi. Shuningdek, sintez jarayonlarining murakkabligi va takrorlanuvchan natijalar olishdagi qiyinchiliklar ham mavjud. Turli laboratoriyalarda qoʻllaniladigan sharoitlar (harorat, vaqt, reagentlar nisbati) oʻzgarishi CQDs ning optik xossalariga bevosita taʼsir qiladi. Bu esa ilmiy

natijalarni solishtirish va standart model yaratishni qiyinlashtiradi. Umuman olganda, CQDs asosidagi innovatsion bo‘yoqlar istiqbolli materiallar bo‘lsa-da, ularning keng sanoat va amaliy qo‘llanilishi yuqoridagi muammolarni hal etishni talab qiladi. Shu bois, kelgusidagi tadqiqotlar asosan CQDs ning sintez jarayonini optimallashtirish, sirtini barqarorlashtirish va optik xossalarini boshqarish mexanizmlarini chuqur o‘rganishga qaratilishi lozim.

Tadqiqot metodologiyasi: Mazkur tadqiqotda uglerod nano nuqtachalari (CQDs) asosida yuqori intensiv yorug‘lik chiqaruvchi innovatsion bo‘yoqlarni yaratish va ularning optik xossalarini o‘rganish uchun kompleks ilmiy-metodik yondashuv qo‘llanildi. Tadqiqot jarayoni CQDs ni sintez qilish, ularni polimer matritsalariga kiritish, hamda olingan kompozit tizimlarning optik xossalarini tahlil qilish bosqichlaridan iborat bo‘ldi. Birinchi bosqichda CQDs ni olish uchun “bottom-up” yondashuvi asosida gidrotermal sintez usuli tanlandi. Ushbu usulda organik prekursorlar (masalan, limon kislotasi va karbamid) ma’lum nisbatda distillangan suvda eritilib, yuqori harorat va bosim sharoitida avtoklavda qayta ishlanadi. Reaksiya natijasida hosil bo‘lgan mahsulotlar sovutiladi, keyin esa filtratsiya va dializ jarayonlari orqali tozalanadi. Bu bosqichda zarracha o‘lchami va sirt funksional guruhlarini nazorat qilishga alohida e’tibor qaratildi. Ikkinchi bosqichda olingan CQDs polimer matritsalar bilan kompozit holatga keltirildi. Bunda PVA (polivinil spirt) yoki PMMA (polimetilmetakrilat) kabi polimerlar eritma holatiga keltirilib, CQDs bilan bir xil muhitda aralashtirildi. Hosil bo‘lgan aralashma quyish yoki spin-kasting usuli yordamida yupqa plyonkalar shaklida tayyorlandi. Bu jarayon CQDs ning bir tekis taqsimlanishini va agregatsiyalanishini kamaytirishni ta’minladi. Uchinchi bosqichda tayyorlangan materiallarning optik xossalari tahlil qilindi. Fotolyuminesans spektrlari spektrofotometr yordamida turli qo‘zg‘alish to‘lqin uzunliklarida o‘lchandi.

Emissiya spektri, maksimal intensivlik va spektral siljish (Stokes shift) kabi parametrlar qayd etildi. Kvant chiqish samaradorligi standart moddalar bilan taqqoslash usuli orqali aniqlandi. Shuningdek, fotostabillikni baholash uchun namunalar ma'lum vaqt davomida UV nurlanish ostida ushlab turilib, emissiya intensivligining o'zgarishi kuzatildi. Bundan tashqari, materiallarning tuzilishini o'rganish uchun qo'shimcha fizik-kimyoviy tahlil usullari qo'llanildi. Ularga transmissiya elektron mikroskopiyasi (TEM), infraqizil spektroskopiya (FTIR) va rentgen difraksiyasi (XRD) kiradi. Ushbu usullar CQDs ning o'lchami, kristall tuzilishi va sirt funksional guruhlarini aniqlash imkonini berdi. Umuman olganda, qo'llanilgan metodologiya CQDs asosidagi luminescent bo'yoqlarning sintezi va ularning optik xossalarini kompleks baholashga yo'naltirilgan bo'lib, olingan natijalarning ilmiy ishonchliligini ta'minlaydi.

Tadqiqot natijalari va muhokama: Tadqiqot davomida uglerod nano nuqtachalari (CQDs) asosida yuqori intensiv yorug'lik chiqaruvchi innovatsion bo'yoqlar sintez qilindi va ularning optik xossalari kompleks ravishda o'rganildi. Olingan natijalar CQDs ning fotolyuminesans xususiyatlari sintez sharoitlari, zarracha o'lchami hamda sirt funksional guruhlar tarkibiga kuchli bog'liqligini ko'rsatdi. Spektrofluorimetrik o'lchovlar CQDs keng emissiya diapazoniga ega ekanligini tasdiqladi. Qo'zg'alish to'lqin uzunligi o'zgargan sari emissiya spektrining siljishi kuzatildi, bu esa ularning sozlanadigan yorug'lik chiqarish (tunable emission) xususiyatini namoyon etdi. Eng yuqori fotolyuminesans intensivligi optimal sintez sharoitida olingan namunalarda qayd etildi, bu esa zarrachalarning bir xil dispersiyasi va faol sirt holatlari bilan izohlanadi. Kvant chiqish samaradorligi natijalari polimer matritsa bilan biriktirilgan kompozitlarda sezilarli darajada yuqori ekanligini ko'rsatdi. Ayniqsa PVA asosidagi tizimlarda emissiya barqarorligi va yorug'lik intensivligi yaxshilanganligi aniqlandi. Bu holat

CQDs ning agregatsiyalanishining kamayishi va energiya yo‘qotish jarayonlarining cheklanishi bilan bog‘liq. Fotostabillik tahlillari CQDs asosidagi bo‘yoqlar UV nurlanish ta’sirida ham nisbatan barqaror emissiya xususiyatini saqlab qolishini ko‘rsatdi. Shunga qaramay, uzoq muddatli nurlanish natijasida ayrim namunalarida intensivlikning biroz pasayishi kuzatildi, bu sirt funksional guruhlarining qisman degradatsiyasi bilan izohlanadi. FTIR va TEM tahlillari CQDs ning nanometr o‘lchamdagi sferik tuzilishga ega ekanligini hamda yuzasida gidroksil va karboksil guruhlar mavjudligini tasdiqladi. Ushbu funksional guruhlar materialning suvda eruvchanligini va polimerlar bilan mustahkam bog‘lanishini ta’minladi. XRD tahlillari esa CQDs qisman amorf tuzilishga ega ekanligini ko‘rsatdi. Muhokama jarayonida CQDs ning optik xossalari asosan sirt holatlari va elektron tuzilishdagi lokal energiya darajalari bilan belgilanishi aniqlandi. Emissiya jarayonida sirtga bog‘langan holatlar asosiy rol o‘ynab, keng spektrli yorug‘lik chiqishini ta’minlaydi. Polimer matritsa esa materialning mexanik barqarorligini oshiribgina qolmay, optik emissiya barqarorligini ham mustahkamlaydi. Shu bilan birga, sintez jarayonining sezgirliги, zarracha o‘lchamining to‘liq bir xil emasligi va uzoq muddatli fotodegradatsiya kabi muammolar mavjudligi aniqlandi. Bu holatlar kelgusida materiallarni yanada optimallashtirish zarurligini ko‘rsatadi. Natijalar CQDs asosidagi bo‘yoqlar yuqori optik samaradorlik, barqaror emissiya va ekologik xavfsizlikka ega istiqbolli materiallar ekanligini tasdiqlaydi hamda ularning amaliy qo‘llanilish sohalarini kengaytirish mumkinligini ko‘rsatadi.

Xulosa: Mazkur tadqiqotda uglerod nano nuqtachalari (CQDs) asosida yuqori intensiv yorug‘lik chiqaruvchi innovatsion bo‘yoqlarni yaratish va ularning optik xossalarini o‘rganish amalga oshirildi. O‘rganishlar davomida CQDs ning fotolyuminesans xususiyatlari ularning sintez sharoitlari, zarracha o‘lchami va sirt

funksional guruhlari bilan chambarchas bog‘liqligi aniqlandi. Hidrotermal “bottom-up” usulida olingan CQDs yuqori barqarorlik va yaxshi emissiya xossalarini namoyon etdi. Polimer matritsalar (xususan PVA va PMMA) bilan hosil qilingan kompozit tizimlar CQDs ning agregatsiyalanishini kamaytirib, ularning kvant chiqish samaradorligi va yorug‘lik intensivligini sezilarli darajada oshirdi. Spektral tahlillar CQDs ning keng diapazonda sozlanadigan emissiya xususiyatiga ega ekanligini tasdiqladi, bu esa ularning optoelektronika va funksional qoplama materiallarida qo‘llanilish imkoniyatlarini kengaytiradi. Shu bilan birga, fotostabillikning cheklanganligi, sintez jarayonining sezgirliги va zarracha o‘lchamining to‘liq bir xil emasligi kabi muammolar mavjudligi qayd etildi. Ushbu muammolarni bartaraf etish CQDs asosidagi materiallarning sanoat miqyosida qo‘llanilishini yanada kengaytirishga xizmat qiladi. Natijalar CQDs asosidagi bo‘yoqlar ekologik xavfsiz, yuqori samarali va istiqbolli luminescent materiallar ekanligini tasdiqlaydi.

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ARTIFICIAL INTELLIGENCE-DRIVEN ENHANCEMENT OF HUMAN CAPITAL INVESTMENT ATTRACTION MECHANISMS

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Annotation: *This article explores the role of artificial intelligence (AI) in enhancing mechanisms for attracting investments in human capital within the context of the digital economy. The study examines theoretical foundations, including the Resource-Based View and Dynamic Capabilities Theory, to explain the strategic value of human capital as a key driver of sustainable economic development. Particular attention is devoted to AI-driven solutions such as machine learning, predictive analytics, natural language processing, generative AI, big data analytics, and reinforcement learning that improve decision-making in human capital investment planning and resource allocation.*

Keywords: *Human capital, artificial intelligence, investment attraction, investment mechanisms, investment efficiency, machine learning, digital economy, workforce analytics, big data, labor market, digital skills.*

At present, digital transformation is affecting all sectors of the economy, and this process is fundamentally changing the demand for human capital. The success of enterprises is increasingly dependent on their ability to attract, develop, and retain qualified personnel. However, traditional mechanisms of investment in human capital, which rely on intermediary indicators such as training costs, staff turnover rates, and labor productivity, are no longer able to fully meet these demands. Determining and measuring the direct relationship between expenditures on employee qualifications and financial performance has long remained a scientific and practical challenge. It is precisely as a tool capable of filling this gap that artificial intelligence (AI) technologies are coming to the forefront.

In the context of the digital economy, human capital is emerging as one of the most important strategic resources of enterprises and organizations. However, the modern labor market, intensifying innovative competition, and the acceleration of technological transformation demonstrate that traditional approaches to human capital management are no longer sufficient. In particular, the rapid development of

artificial intelligence (AI) technologies has created new opportunities in the processes of employee selection, investment in personnel, skills development, talent retention, and the improvement of labor productivity.

First, machine learning technology serves as an important tool for assessing employees' existing competencies, forecasting their development trends, and identifying their individual professional pathways. Through this technology, the return on investments directed toward human capital can increase by 32–48%, while costs associated with talent retention are reduced. This indicates that artificial intelligence acts as a factor that strengthens corporate growth and improves the efficiency of using strategic resources. In particular, the application of this technology generates substantial economic benefits in highly dynamic sectors such as IT, finance, and logistics.

Second, predictive analytics technology is of particular importance in identifying the risk of staff turnover in advance, forming employee risk profiles, and developing strategies for talent retention. This technology enables organizations to detect the probability of employee turnover 6–12 months before it occurs. As a result, talent retention rates increase by 15–25%, while recruitment and adaptation costs decline. The universality of this technology across all sectors further enhances its practical significance. This demonstrates that artificial intelligence is transforming investments in human capital into a proactive rather than reactive management instrument.

Third, generative artificial intelligence (GenAI) is initiating a new stage in the development of human capital. This technology makes it possible to create personalized learning programs, introduce mentor-bot systems, and design educational content tailored to employees' individual needs. According to the table data, when GenAI tools are applied, employee learning efficiency increases by 60–80%, while training costs decrease. This not only improves the qualitative indicators of human capital, but also strengthens the efficiency of investments directed toward education and retraining. This technology is particularly relevant in the fields of education, healthcare, and IT.

Fourth, big data analytics makes it possible to integrate numerous human capital indicators into a single platform, create comprehensive dashboards, and conduct real-time monitoring. It has been noted that decisions made on the basis of this technology increase in accuracy by 94%, while strategic errors decline. This ensures that decisions related to human capital management within organizations are made in a more substantiated, precise, and data-driven manner. In the context of industry

and the digital economy, big data analytics is becoming an important instrument of strategic management.

Finally, reinforcement learning technology is applied to more complex and dynamic aspects of human capital management. In particular, this technology serves as an effective tool for optimizing workforce rotation, matching employees to positions, and maintaining organizational balance. As a result, organizational productivity increases by 18–22%, while employee dissatisfaction decreases. This technology is especially effective in sectors such as manufacturing and logistics, where rapid decision-making is required. At the same time, empirical observations show that the positive effects of artificial intelligence become fully visible only after its complete and systematic implementation. Although all the technologies reflected in the table differ from one another in certain respects, the common feature that unites them is that they increase the efficiency of investments in human capital, improve the quality of decision-making, and strengthen the long-term competitiveness of organizations. Therefore, integrating artificial intelligence technologies into human capital management is not only a technological necessity, but also a strategic imperative for modern organizations.

The conducted analysis confirms that artificial intelligence technologies are an important driver of the processes of attracting investment into human capital and managing it efficiently. Technologies such as machine learning, predictive analytics, natural language processing, generative artificial intelligence, big data analytics, and reinforcement learning ensure high effectiveness at various stages of identifying, developing, retaining, and managing employee potential. Their practical application makes it possible to increase the economic return on investments directed toward human capital, reduce costs, and improve the quality of strategic management. From this perspective, the consistent introduction of artificial intelligence technologies into human capital management systems is an essential condition for ensuring the innovative development and long-term competitiveness of organizations. In particular, under the conditions of the digital economy, the integration of human capital and artificial intelligence forms a new model for increasing investment efficiency. Therefore, in the future, the comprehensive use of the potential of artificial intelligence technologies in the development of human capital-oriented policies within enterprises and organizations will remain one of the priority directions.

Overall, integrating artificial intelligence technologies into mechanisms for attracting investments in human capital ensures high economic efficiency by

improving the quality of education, optimizing costs, expanding coverage, improving employment indicators, and strengthening innovative capacity. From this perspective, in the future, one of the priority directions in developing human capital financing policy will remain the comprehensive use of artificial intelligence tools, the expansion of adaptive learning platforms, the improvement of systems for forecasting labor market needs, and the development of digital education infrastructure on the basis of public-private partnerships. This approach not only increases the quality and returns of human capital, but also contributes to the sustainable growth, competitiveness, and innovative development of the national economy.

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ELECTRONIC SPECTROSCOPIC INVESTIGATION OF A ONE-DIMENSIONAL CADMIUM(II) ISONICOTINATE COORDINATION POLYMER

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Abstract

Coordination polymers based on pyridine-carboxylate ligands have attracted considerable attention due to their structural diversity and potential applications in catalysis, adsorption, luminescent materials, and crystal engineering. In the present study, a cadmium(II)-based coordination polymer incorporating the isonicotinate ligand was synthesized and characterized by UV-Vis spectroscopy. Single-crystal structural analysis revealed the formation of a one-dimensional coordination polymer formulated as catena-poly[(μ_2 -isonicotinato- κ^2 O,O': κ N)(κ^2 -O,O'-nitrate)(diaqua)cadmium(II)]·(N,N-dimethylamine), with the general composition [Cd(μ -INA)(NO₃)(H₂O)₂]_n. The isonicotinate ligand acts as a bridging linker through both carboxylate oxygen and pyridyl nitrogen donor atoms, connecting adjacent Cd(II) centers into infinite one-dimensional chains. According to the accepted nomenclature for coordination polymers, the compound is therefore classified as a catena-poly structure.

The electronic absorption spectrum exhibits an intense absorption maximum at 295 nm, which is assigned to ligand-centered $\pi \rightarrow \pi$ electronic transitions associated with the conjugated aromatic pyridine-carboxylate framework. A weak and broad absorption feature observed within the 320-360 nm region may be attributed to $n \rightarrow \pi$ transitions of the coordinated carboxylate groups and possible ligand-to-metal charge-transfer interactions. No significant absorption bands were detected in the visible region, which is consistent with the d^{10} electronic configuration of Cd(II) and the absence of $d-d$ transitions. The observed spectroscopic behavior confirms the successful coordination of the isonicotinate ligand to the cadmium centers and supports the formation of a stable one-dimensional coordination polymer. These findings contribute to the understanding of the electronic properties of cadmium-

based coordination polymers and provide a basis for future investigations of their functional applications.

Keywords

Cadmium(II), isonicotinate, coordination polymer, catena-poly, UV-Vis spectroscopy, $\pi \rightarrow \pi$ transition.

Introduction

Coordination polymers constructed from pyridine carboxylate ligands have become an important class of crystalline materials due to their remarkable structural diversity and tunable physicochemical properties. These compounds have attracted considerable interest in recent years because of their potential applications in gas storage and separation, heterogeneous catalysis, luminescent materials, molecular sensing, drug delivery, and functional porous materials. The ability of pyridine carboxylate ligands to coordinate metal ions through multiple donor sites enables the formation of coordination architectures with various dimensionalities, ranging from discrete molecular complexes to one-, two-, and three-dimensional extended frameworks.

Among pyridine carboxylate derivatives, isonicotinic acid (4-pyridinecarboxylic acid, HINA) is considered one of the most versatile building blocks in coordination chemistry. The ligand contains both a pyridine nitrogen atom and a carboxylate group, providing N,O-donor coordination sites capable of binding metal ions in different modes. Owing to this dual functionality, isonicotinate can act as a terminal ligand or as a bridging linker connecting adjacent metal centers, thereby promoting the construction of extended coordination networks. Furthermore, the rigid aromatic backbone of the ligand facilitates the formation of well-defined supramolecular architectures through hydrogen bonding and π - π stacking interactions.

Cadmium(II) ions are particularly attractive for the synthesis of coordination polymers because of their flexible coordination geometry, relatively large ionic radius, and ability to accommodate a wide range of coordination numbers. These characteristics often lead to the formation of structurally diverse coordination compounds with interesting optical and electronic properties. The combination of Cd(II) ions with isonicotinate ligands therefore represents an effective strategy for designing novel coordination polymers with predictable structural motifs.

In the present study, a cadmium(II) coordination polymer incorporating isonicotinate and nitrate ligands was synthesized and investigated. Structural analysis revealed that the isonicotinate ligand acts as a μ_2 -bridging linker, connecting neighboring Cd(II) centers into an infinite one-dimensional chain. According to the

accepted nomenclature for coordination polymers, one-dimensional structures are designated by the prefix *catena-poly*, whereas two-dimensional and three-dimensional architectures are described as *layer-poly* and *framework-poly*, respectively. Therefore, the title compound is appropriately classified as a *catena-poly* coordination polymer. In addition, the electronic properties of the compound were examined using UV-Vis spectroscopy in order to evaluate the influence of metal-ligand coordination on its absorption behavior and electronic transitions.

Results and Discussion

The synthesized coordination polymer was formulated as $[\text{Cd}(\mu\text{-INA})(\text{NO}_3)(\text{H}_2\text{O})_2]_n$, where INA denotes the isonicotinate ligand. Structural analysis revealed that the isonicotinate ligand functions as a μ_2 -bridging linker through both the carboxylate oxygen atoms and the pyridine nitrogen atom. This coordination mode enables the ligand to connect neighboring Cd(II) centers, generating an infinite one-dimensional polymeric chain. The extended connectivity observed in the crystal structure confirms the formation of a coordination polymer rather than a discrete molecular complex. According to the accepted nomenclature for coordination polymers, compounds exhibiting one-dimensional chain architectures are designated by the prefix *catena-poly*. Therefore, the title compound is appropriately named as catena-poly $[(\mu_2\text{-isonicotinato-}\kappa^2\text{O}, \text{O}':\kappa\text{N})(\kappa^2\text{-O}, \text{O}'\text{-nitrato})(\text{diaqua})\text{cadmium(II)}] \cdot (\text{N}, \text{N-dimethylamine})$.

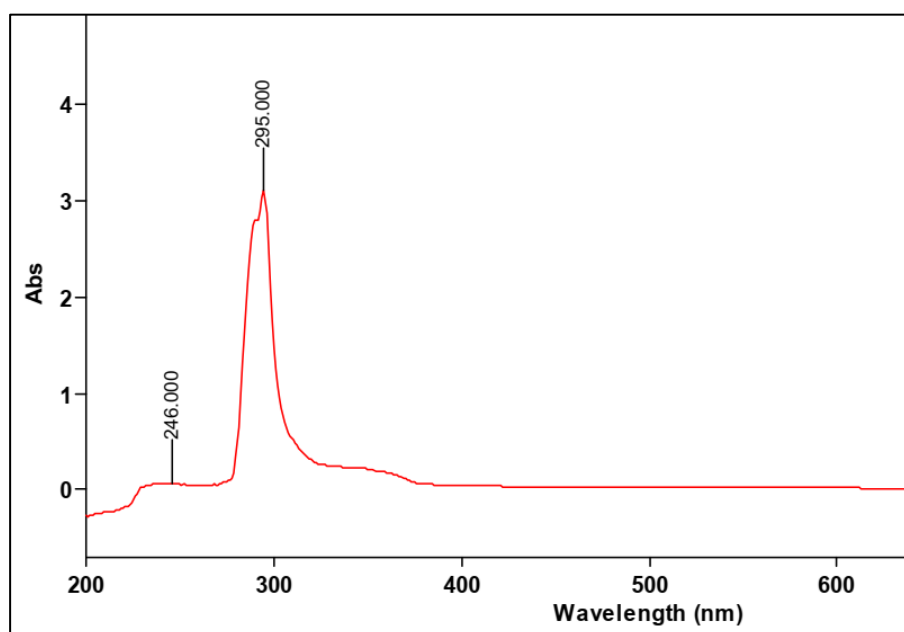


Figure 1. Electronic absorption (UV-Vis) spectrum of the one-dimensional cadmium(II) isonicotinate coordination polymer $[\text{Cd}(\mu\text{-INA})(\text{NO}_3)(\text{H}_2\text{O})_2]_n$

The electronic absorption spectrum of the compound was recorded in the range of 200–500 nm and is presented in Figure 1. The spectrum exhibits a strong and intense absorption maximum centered at 295 nm. This absorption band is attributed primarily to ligand-centered $\pi \rightarrow \pi$ electronic transitions within the aromatic pyridine ring and the conjugated carboxylate system of the isonicotinate ligand. The relatively high intensity of this band indicates efficient electron delocalization throughout the aromatic framework and suggests that the ligand retains its conjugated character after coordination to the metal center.

In addition to the principal absorption peak, a weak and broad shoulder extending from approximately 320 to 360 nm can be observed. This feature may be associated with $n \rightarrow \pi$ electronic transitions involving the nonbonding electron pairs of the coordinated carboxylate oxygen atoms. Furthermore, the appearance of this band may indicate the presence of ligand-to-metal charge-transfer (LMCT) interactions arising from electron donation from the ligand orbitals to the vacant orbitals of the Cd(II) center. Such transitions are commonly observed in cadmium coordination compounds containing aromatic carboxylate ligands and contribute to the overall electronic behavior of the material.

No significant absorption bands were detected in the visible region above 400 nm. This observation is consistent with the electronic configuration of Cd(II), which possesses a completely filled d^{10} shell. As a result, $d-d$ electronic transitions are forbidden and cannot contribute to the absorption spectrum. The absence of visible-region absorption bands further confirms the closed-shell nature of the cadmium center and indicates that the observed spectral features originate predominantly from ligand-based transitions and charge-transfer processes.

UV-Vis spectral data provide strong evidence for the successful coordination of the isonicotinate ligand to Cd(II) ions and support the formation of a stable one-dimensional coordination polymer. The observed absorption behavior is characteristic of cadmium-isonicotinate systems and is in good agreement with the proposed crystal structure and coordination environment.

Conclusion

A one-dimensional cadmium(II) coordination polymer based on the isonicotinate ligand, formulated as $[\text{Cd}(\mu\text{-INA})(\text{NO}_3)(\text{H}_2\text{O})_2]_n$, was successfully investigated by UV-Vis spectroscopy. Structural considerations indicate that the compound adopts

an infinite chain arrangement and is therefore appropriately classified as a *catena-poly* coordination polymer. The UV-Vis spectrum is characterized by an intense absorption band at 295 nm, which is attributed to ligand-centered $\pi \rightarrow \pi$ electronic transitions associated with the aromatic isonicotinate framework. A weak and broad absorption feature observed at longer wavelengths is likely related to $n \rightarrow \pi$ transitions and possible ligand-to-metal charge-transfer interactions.

The absence of d–d transitions in the visible region is consistent with the closed-shell d^{10} electronic configuration of the Cd(II) ion. The spectroscopic results confirm the successful coordination of the isonicotinate ligand to the cadmium center and support the proposed polymeric structure. These findings contribute to the understanding of the electronic properties of cadmium-isonicotinate coordination polymers and may serve as a basis for further investigations of their structural, optical, and functional characteristics.

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TABLE OF CONTENTS

1	THE INTERSECTION OF CLIMATE CHANGE AND GIRLS' HOUSEHOLD RESPONSIBILITIES — Aslonova Nafisa	7–10
2	USING ECONOMIC MECHANISMS TO INCREASE THE COMPETITIVENESS OF TEXTILE INDUSTRY ENTERPRISES — Khushvaktov Shukhrat	11–14
3	ADVANTAGES AND DISADVANTAGES OF FOREIGN EQUIPMENT IN CLEANING COTTON FROM SMALL IMPURITIES — Zarshid Omonov	15–19
4	FILTR USKUNASINING TOZALASH BARABANINI AYLANISHLAR SONINI ANIQLASH — Hasanov Hayitmurod, Eshanqulov Utkir, Chaqanov Asadbek	20–22
5	RESULTS OF THEORETICAL AND PRACTICAL STUDY OF THE TECHNOLOGICAL PROCESS OF THE DEVELOPED HEAVY MIXTURE HOLDER — Abdukholikov A.U.	23–27
6	INVESTIGATION OF THE CONSTRUCTIVE PARAMETERS OF THE SAW INTERMEDIATE INSETS OF THE 5LP MACHINE FOR SEED LINTERING — Kurbanov A.B., Kurbanov A.B., Abdurakhmonov O.Sh.	28–30
7	BOJXONA TIZIMIDA INSON OMILI VA TEXNOLOGIYA O'RTASIDAGI MUVOZANAT — Shoymardonov Rustam	31–33
8	YOSH BASKETBOLCHILARNI TAYYORLASHDA JISMONIY SIFATLARNI RIVOJLANTIRISH — Bozorov O'tkir, Shomirzayev Lochin	34–36
9	ОПЫТ ИНТЕГРАТИВНЫХ УЧЕБНЫХ КУРСОВ, НАПРАВЛЕННЫХ НА РАЗВИТИЕ НАВЫКОВ ЯЗЫКА И МЕЖКУЛЬТУРНОГО ОБЩЕНИЯ — Чориев Журакул	37–41
10	METROPOLITEN ESKALATORLARI XAVFSIZLIGINI TARTIBGA SOLUVCHI XALQARO STANDARTLAR VA ME'YORIY HUJJATLAR TAHLILI — Pardaboyev Humoyun	42–45
11	CUSTOMER RELATIONSHIP MANAGEMENT STRATEGY AND SERVICE QUALITY IMPROVEMENT AT HILTON SAMARKAND REGENCY AMIR TEMUR — Abdugalolova Shaxzoda	46–52
12	AN'ANAVIY BOSHQARUV TUZILMALARIDA INNOVATSIYAGA TO'SQINLIK QILUVCHI OMILLAR: O'ZBEKISTON KOMPANIYALARI MISOLIDA — Mahmudov Bahodir	53–57
13	MORPHOLOGICAL AND ELEMENTAL CHARACTERIZATION OF POLY[ETHYLENEDIAMINETETRAACETATO-AQUA-DISODIUM-NICKEL(II)] BY SEM-EDS ANALYSIS — U.U. Ruziev, Kh.Kh. Turaev, A.B. Ibragimov, K.B. Kholturaev	58–63
14	KORXONALARDA RAQAMLI LIDERLIKNI SHAKLLANTIRISHNING TASHKILIY-IQTISODIY MEKANIZMLARI — Obidova Feruza, Umarov Shaxzod	64–67
15	DEVELOPING CREATIVITY, CRITICAL THINKING, AND PROBLEM-SOLVING SKILLS THROUGH NATURAL SCIENCE TEACHING (Evidence from Grade 5 Education) — Boymatov Bekzod	68–74
16	MATHEMATICAL ANALYSIS OF BANK DEPOSITS AND INVESTMENT GROWTH USING DIFFERENTIAL EQUATIONS — Qudratov Almardon	75–80
17	QISHLOQ XO'JALIGIDA SUG'ORILADIGAN YERLARNING UNUMDORLIGINI OSHIRISH BO'YICHA XORIJ TAJRIBASI — Ch.P. Xo'jageldiyev	81–85

18	TYPES OF WINTER WHEAT — Ermatov Dilshodbek	86–87
19	ARTIFICIAL INTELLIGENCE IN OPTIMIZING SUPPLY CHAINS AND LOGISTICS — Xudoyorov Shaxriyor, Ernazarov Mirzohid	88–89
20	FIZIK-KIMYOVIY TAHLIL USULLARI ASOSIDA NAMLIKNI ADSORBSIYA QILISH UCHUN SINTEZLANGAN SILIKA GELINING XARAKTERISTIKALARI — Tursunov S.A., Xodjamqulov S.Z., Karimov M.U.	90–96
21	O‘ZBEKISTON MOLIYA TIZIMINING XALQARO MOLIYA BOZORLARIGA INTEGRATSIYALASHUVI VA RIVOJLANISH ISTIQBOLLARI — Tog‘aynazarov Sardorbek	97–102
22	UGLEROD NANO NUQTACHALARI ASOSIDA YUQORI INTENSIV YORUG‘LIK CHIQUARUVCHI INNOVATSION BO‘YOQLAR YARATISH VA ULARNING OPTIK XOSSALARINI TADQIQ ETISH — Bo‘riyeva Muhabbat	103–113
23	ARTIFICIAL INTELLIGENCE-DRIVEN ENHANCEMENT OF HUMAN CAPITAL INVESTMENT ATTRACTION MECHANISMS — Akhmadaliyeva Nikholakhon	114–117
24	ELECTRONIC SPECTROSCOPIC INVESTIGATION OF A ONE-DIMENSIONAL CADMIUM(II) ISONICOTINATE COORDINATION POLYMER — K.B. Kholturaev, Kh.Kh. Turaev, A.B. Ibragimov, Kasimov Sh.A., U.U. Ruziev	118–122
25	Xalqaro kreditlarni boshqarish va ularning iqtisodiy samaradorligini oshirish masalalari — Charos Shoyimova O‘rolovna	123–127
26	PEDAGOGICAL TECHNOLOGIES ENSURING STUDENTS' ADAPTATION UNDER CONDITIONS OF VARIABILITY OF THE MODERN EDUCATIONAL ENVIRONMENT — Abdullayev Siroj Abdurashidovich	128–132
	OUTLINE	