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ТҮЙІН

Бұл мақала мемлекетіміздің аумағы арқылы өтетін көлік дәліздерін дамытудың маңыздылығы мен стратегиялық маңыздылығын ескере отырып, Қазақстан Республикасының жол бойындағы сервис саласындағы өзекті мәселелерді зерттеуге арналған. Мақалада жол бойындағы сервистің толыққанды дамуына кедергі келтіретін негізгі проблемалар қарастырылады. Мұндай проблемалардың қатарына қазіргі заманауи объектілер мен жол бойындағы сервис инфрақұрылымының жетіспеушілігі, қолданыстағы объектілердің техникалық жарақтандырылуының жеткіліксіздігі, сондай-ақ әртүрлі мемлекеттік және жеке құрылымдар арасындағы іс-қимылдардың сәйкес келмеуі жатады. Бұдан басқа, көрсетілетін қызметтердің сапасы жағынан проблемалар атап өтіледі, бұлардың бәрі көлік желісінің жұмыс істеуінің жалпы тиімділігіне кері әсерін тигізеді.

Жол бойындағы сервис қызметтердің қауіпсіздігінің, жайлылығының және қолжетімділігінің қажетті деңгейін қамтамасыз ету заманауи технологияларды енгізуді және қызмет көрсету сапасын арттыруды талап етеді. Бұл мәселелерді талдау оларды тиімді шешу үшін кешенді және жүйелі тәсіл қажет екенін көрсетеді. Жеке инвестициялар да, мемлекеттің белсенді және мақсатты қатысуы да маңызды рөл атқарады.

Мақалада жол бойындағы сервис инфрақұрылымын жаңғырту және жақсарту жөніндегі бағдарламаларды әзірлеуге және іске асыруға мемлекеттің қатысу дәрежесін арттыру қажеттігіне ерекше назар аударылады. Осы секторға жеке инвестицияларды ынталандыратын және жоғары сапа стандарттарын қамтамасыз ететін тиімді нормативтік базаны құру мен енгізудің маңыздылығы талқыланады.

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MINERAL RAW MATERIALS AS SORBENTS IN GROUNDWATER PURIFICATION PROCESSES

ANNOTATION

Reducing the amount of fresh water necessitates the effective use of groundwater along with surface water. The use of mineral sorbents in the process of groundwater purification is environmentally and economically acceptable. For this reason, it is recommended to use mineral raw materials such as clays, activated carbon as a sorbent. Mineral sorbents are an effective means of removing various pollutants from water, including heavy metals, organic compounds and radioactive substances. This study examined the use of diatomite and montmorillonite as sorbents. They worked to improve the organoleptic characteristics of the groundwater of the Akkurai deposit, reducing the hardness and chloride content in the water. The physicochemical properties were determined using the methods of argentometry and iodometry. Comparative work was carried out with the results obtained by filtration on various sorbents. The results show that the thermomodified sorbent has a good adsorption capacity. These results show that mineral sorbents are an effective solution for groundwater purification and that the use of mineral sorbents in various compositions to increase the efficiency of groundwater purification in the future is one of the promising methods.

Key words: *groundwater, sorbent, diatomite, gaize, organoleptic parameters*

Introduction. With the continuous industrialization process, water pollution has become a major environmental issue around the world, causing severe environmental crises. This issue is challenging to solve, as water contamination not only harms the environment but also poses a significant threat to human health and ecosystems. The demand for fresh water continues to increase with the growing human population and rising living standards. Unfortunately, water contaminants are reducing the supply of freshwater from both surface and groundwater sources. Due to their limited availability, natural freshwater reserves are unable to meet the rising demand. The World Meteorological Organization has predicted that by 2050, over 5 billion people will lack access to adequate water [1-2].

Currently, Kazakhstan is grappling with a serious environmental challenge due to water pollution. This pollution is mainly caused by mineral resource extraction, transportation, industrial operations, and agricultural activities. While providing a sufficient water supply is technically feasible, it is essential that this water meets specific quality standards for drinking. Ensuring safe drinking water for the population is therefore a top priority. To tackle this issue effectively, a comprehensive strategy is needed that maximizes the use of groundwater resources, as surface waters alone cannot meet the freshwater demand. Groundwater is crucial in this context, and its use must be managed carefully.

Water purification can be accomplished through various methods, including mechanical, physicochemical, chemical, and biological processes. Physicochemical methods involve techniques such as extraction, ultrafiltration, coagulation, ion exchange, reverse osmosis, electrolysis, oxidation, and sorption [3-4].

The most effective method of water purification is the sorption purification method. This is due to the fact that water purification by sorption methods is a technologically advanced, high-performance, widely used and promising method for development. These methods make it possible to purify both industrial wastewater and natural water.

With the help of sorption, soluble organic compounds, cations and anions of inorganic compounds, as well as radioactive substances can be qualitatively extracted from water.

Modern highly active sorbents work effectively at any, even minimal, concentration of undesirable impurities, as a result of which no residual concentrate remains in the water [5].

The sorption method has a number of advantages, such as the possibility of cleaning water bodies to the required concentration of pollution (MPC) and desorption by reusing sorption material in industrial technologies [6].

The efficiency of purification by sorption methods can reach 80-90% and depends on the chemical nature of the sorbents, the size of the adsorption surface, its accessibility, as well as on the chemical structure of the adsorbate and the form of its presence in solution. There are many types of sorbents, which are divided into four groups: the first group – elements based on primary or processed organic products consisting of peat, moss, buckwheat and rice cleaning waste; the second group-sorbents based on polymeric materials-polypropylene, polyurethane, foam; the third group-mineral sorbents; The fourth group is nanosorbents based on graphite or other carbonaceous materials.

One of the important conditions for the use of sorbent in the process of water purification is its availability, low cost and the possibility of regeneration. These requirements are met by various natural minerals capable of adsorbing charged particles on their surface to varying degrees [7-8].

Diatomite is a sedimentary rock formed by silica fragments of the shells of microscopic diatoms – diatoms and radillaries. The main part of the siliceous carapace (skeleton) is amorphous silica hydrates of various degrees of water content – varieties of opal of the $mSiO_2 \cdot H_2O$n type, the crystal component is represented by quartz admixtures [9].

Diatomite-based sorbents are used as filter media in water treatment. The high dispersion and porosity of diatomite promote the adsorption of water pollutants on its surface. The main requirements for the methods of rock processing when obtainingsorbents are manufacturability, efficiency, and environmental friendliness. It is also necessary to take into account the characteristics of the raw materials. For example, the ability of diatomite to absorb water is 149.77±0.34 wt. %, and therefore it is impossible to grind it without first drying it [10].

Diatomite is a mineral of silicon dioxide consist-ing of fossilized skeleton remnants of microscopic single-celled aquatic plants (algae) called diatoms. Diatomite from Aktobe field of Kazakhstan can be used to remediate many environmental problems. It has a unique combination of physical and chemical properties (good absorption ability, chemical inertness and a large surface area) that makes it applicable as a sorbent for purification of water from heavy metals and ion exchange. Modern methods make it possible to purify water from heavy metals, in principle, to any depth, for example, using activated carbons. Nevertheless, the implementation of existing technological procedures is limited by the its high cost associated mainly with activation or combination with other active phases in the diatomite-based sorbent production, recovery of used sorbent, and regeneration. To overcome these drawbacks, it was planned to exploit ready-for-use sorbents (native solid sorbents) the performance of which could be further implemented after minimal activation treatments. Different natural solid sorbents modification protocols are conventionally used by researchers to enhance specific diatomite properties, such as high efficiency, considerable adsorption capacity operated selectivity. Among them are: thermal activation; mechanical activation; chemical activation [11].

Diatomites also purify water very well from heavy metals. Shen et al. [12] indicated that modified diatomite (using NaOH and MnCl2) was an effective cadmium wastewater adsorbent and suitable for recycling. Those results showed the removal rate of Cd(II) on modified diatomite was 98.69%, while unmodified diatomite was 58.30%. Memedi et al. [13] removed 100% of chromium ions from water using clay diatomite. Sharipova et al. [14] tried to remove triclosan from model solutions, and Hadri et al. [15] examined the adsorption of methylene blue on diatomaceous earth. Gokirmak Sogut and Caliskan [16] removed lead, copper, and cadmium ions from an aqueous solution using crude and thermally modified diatomite.

Inorganic adsorbents have an advantage over organic ion-exchange resins, for example, resistance to acids or ionizing radiation. Minerals with the structure of montmorillonite (MT) are widely used in various industries – as sorbents for water and gas purification, desiccants, as binders in cracking catalysts, and catalyst carriers, as well as medical sorbents. MT is a clay mineral from the smectite group of a subclass of layered silicates with variable chemical composition [17].

The use of natural clay minerals in sorption processes is promising and relevant due to their low cost and inexhaustible reserves. In this regard, the development of methods for the preparation of new effective sorbents based on natural montmorillonites is of great practical importance for the purification of wastewater and liquid waste from heavy metal ions and various toxic substances [18].

Montmorillonite is a mineral with a layered structure and an expanding structural cell. It is the most widely distributed amphoteric ion exchanger in nature. Its cation exchange ability is due to the permanent negative charge of the aluminosilicate layers caused by isomorphic substitutions in the oxygen grid of the mineral. Exchange interlayer cations, which help restore the electroneutrality of the structure, are weakly held by the surface and can be replaced by other cations. On the other hand, so-called "terminal" aluminol and silanol groups are located on the sides of the aluminosilicate layers and are capable of carrying both negative and positive charges, depending on the pH of the surrounding medium. Despite the fact that the surface area of these groups does not exceed 7-9% of the total particle surface, they can act as potential centers for anion adsorption [19].

Montmorillonite belongs to the class of layered aluminosilicates of the dioctahedral smectite group and is a 2:1 layer consisting of Si-O tetrahedral grids joined in the middle with an Al-OH octahedral grid. Due to the isomorphic substitutions of Al^{3+} to Mg^{2+} and Fe^{2+} in octahedral grids (mainly) and a small proportion of isomorphic substitutions of Si^{4+} to Al^{3+} in tetrahedral grids, the montmorillonite layer has a negative charge of the order of 0.3–0.6 f.u., which is neutralized by the exchange of interlayer hydrated cations Na^{+}, Ca^{2+}, Mg^{2+} and others . Such a structure leads to the lability of the montmorillonite structure, makes the external and internal surfaces in crystallites available for adsorption and provides high swelling and high sorption capacity with respect to heavy metals, radionuclides and other anthropogenic components dangerous to human health [20].

Materials and methods. Methods for determining stiffness

The determination of the total hardness of water is hampered by: copper, zinc, manganese and a high content of carbon dioxide and bicarbonate salts. The influence of interfering substances is eliminated during the analysis. The titration error of 100 cm^3 of the sample is 0.05 mol/m^3.

100 cm^3 of filtered test water or a smaller volume diluted to 100 cm^3 with distilled water is added to a conical flask. In this case, the total amount of the substance equivalent to calcium and magnesium ions in the volume taken should not exceed 0.5 mol. Then add 5 cm^3 of the buffer solution, 5-7 drops of the indicator or approximately 0.1 g of a dry mixture of the chromogen black indicator with dry sodium and immediately titrate with a strong stirring of 0.05 n. with a solution of trilon B until the color changes at an equivalent point (the color should be blue with a greenish tinge).

If more than 10 cm^3 0.05 n of trilon B solution was used for titration, then this indicates that in the measured volume of water the total amount of the substance equivalent to calcium and magnesium ions is more than 0.5 mol. In such cases, the definition should be repeated by taking a smaller volume of water and diluting it to 100 cm^3 with distilled water.

An indistinct color change at the equivalent point indicates the presence of copper and zinc. To eliminate the influence of interfering substances, 1-2 cm^3 of sodium sulfide solution is added to the water sample measured for titration, after which the test is carried out as indicated above.

If, after adding a buffer solution and an indicator to the measured volume of water, the titrated solution gradually discolors, acquiring a gray color, which indicates the presence of manganese, then in this case, five drops of 1% hydroxylamine hydrochloride solution should be added to the sample of water selected for titration before applying reagents and then determine the hardness as indicated above.

If titration becomes extremely protracted with unstable and indistinct coloration at an equivalent point, which is observed with high alkalinity of water, its effect is eliminated by adding to the sample of water selected for titration, before adding reagents of 0.1 n. hydrochloric acid solution in the amount necessary to neutralize the alkalinity of water, followed by boiling or blowing the solution with air for 5 min. After that, a buffer solution is added, an indicator and then the stiffness is determined, as indicated above.

Determination of chloride (Cl^-) content in drinking water (argentometry)

Argentometry is a volumetric analytical method based on the reactions of deposition of halogen ions by silver cations to form poorly soluble halides:

$$Cl^- + Ag^+ = AgCl\downarrow \quad (1)$$

The most common argentometric determination of chlorine is by the Mohr method. Its essence consists in direct titration of the liquid with a solution of silver nitrate with an indicator of potassium chromate before browning the precipitate.

The indicator of the Mohr method - K_2CrO_4 solution gives a red precipitate of silver chromate Ag_2CrO_4 with silver nitrate, but the solubility of the precipitate (6.2○10-3 mol/l) is much greater than the solubility of silver chloride (1.33○10-5 mol/l). Therefore, when titrated with a silver nitrate solution in the presence of potassium chromate, a red precipitate of silver chromate appears only after the addition of an excess of Ag^+ ions, when all chloride ions have already been precipitated. At the same time, a silver nitrate solution is always added to the analyzed liquid, and not vice versa.

Determination of adsorption activity by iodine.

Due to its simplicity and accuracy, the iodometry method is considered one of the best methods of quantitative analysis. This method is based on redox reactions of conversion of free iodide into iodide ions or vice versa.

$$I_2 + KI = K[I_3] \qquad (2)$$

The standard redox potential of the system is relatively low. Therefore, many iodometric reactions are reversible and do not proceed to completion. Only when specific conditions are met, they proceed almost to completion. Crystalline iodine is only slightly soluble in water, so a solution of iodine in potassium iodide is used as a reference solution. In this solution, a less stable, more soluble complex compound of iodine forms.

Both oxidants and reducing agents can be determined using iodometry.

The main working solutions used in iodometric titrations are: iodine solution for directly titrating strong reducing agents, and solutions of potassium iodide and sodium thiosulfate, which are used for determining oxidants through substitution titration, and reducing agents through reverse titration.

About 1 g of the sorbent is weighed (the weighing result is recorded to the fourth decimal place), placed in a conical flask with a capacity of 250 cm^3, 100 cm^3 of iodine solution in potassium iodide is added, closed with a stopper and manually shaken every minute for 30 minutes. Then the solution is allowed to settle and from the flask with a pipette, carefully so that coal particles do not get in, 10 cm^3 of the solution is taken, placed in a conical flask and titrated with 0.1 n sodium thiosulfate solution. At the end of titration, 3 ... 5 drops of starch solution are added and titrated until the blue color disappears. At the same time, the initial iodine content in the solution is determined, for this 10 cm^3 of iodine 5 solution in potassium iodide is placed in a conical flask and titrated with 0.1 n sodium thiosulfate solution, adding a starch solution at the end of titration.

The arithmetic mean of the results of two parallel definitions is taken as the result of the analysis, the absolute discrepancy between which does not exceed the permissible discrepancy of 3%.

Results and discussion. When analyzing the test water, the following indicators were determined in the test samples as the total hardness and quantitative chloride content of the water before and after purification with a natural mineral sorbent: diatomite, raw flask and thermally modified at 800°C.

To study water after purification with a mineral sorbent, 10 grams, 20 grams and 30 grams per 100 milliliters of water are taken in the following proportions, respectively.

All prototypes are well mixed and maintained for a day. The filtered water sample is further examined using the titrimetric analysis method.

Table 1 – Description of the properties and chemical elements of the investigated groundwater "Akkurai"

№	Physico-chemical properties of water	standard	result	description
1	2	3	4	5
1	Water temperature	7-11 °C.	11 °C	corresponds
2	Color of water	it should not be higher than 20 degrees. (in special cases, no higher than 35 degrees.)	30 degrees. The water has a greenish tint	corresponds
3	Turbidity	Not higher than 1.5 mg/l.	1,5 mg/l.	corresponds

1	2	3	4	5
4	Taste	It can be salty, bitter, sweet and sour. Natural waters, as a rule, have only a salty and bitter aftertaste.	Salty taste	The salty taste is caused by the sodium chloride content
5	Smells	According to the norms of Sanitary rules and regulations 2.1.4.559-96, the smell of water should be no more than 2 points	3 points - noticeable smell or taste, easily detectable	Increased by 1 unit
6	Active water reaction	According to the norms of Sanitary rules and regulations 2.1.4.559-96, the pH of drinking water should be within 6.0.9.0	pH = 6,8	the reaction of the water is neutral, it corresponds.
7	Water hardness	According to the norms of Sanitary rules and regulations2.1.4.1074-01, the hardness of drinking water should be no higher than 7 (10) mg-eq/l, (or no more than 350 mg/l).	5.5 mg-eq/l	corresponds, medium hardness water (from 4 to 8 mg-eq/l)
8	Chlorides	The maximum permissible concentration of chlorides in drinking water is 300...350 mg/l	443 mg/l	Increased by 100 units

As described in Table 1, the water was tested for some organoleptic and physicochemical properties before water purification. From the indicators it became known that the water complies with many standards, but there is also an excess above the norm in such parameters as the content of dissolved chloride ions in the water and the overall hardness is average. In view of this, while continuing the work, special emphasis was placed on reducing these numerical values in water.

Table 2 – Water purification using raw gaize

№	Physico-chemical properties of water	Standard	Result				Description
			before water purification	After water purification			
				10:100	20:100	30:100	
1	2	3	4	5	6	7	8
1	Water temperature	7-11 °C.	11 °C	15 °C	15 °C	15 °C	It was purified in the laboratory at room temperature
2	Color of water	it should not be higher than 20 degrees.	30 degrees. The water has a greenish tint	30 degrees	25 degrees	20 degrees	It's fine
3	Turbidity	Not higher than 1.5 mg/l.	1,5 mg/l.	1,5 mg/l.	1,5 mg/l.	1,5 mg/l.	It's fine
4	Taste	It can be salty, bitter, sweet and sour.	salty taste	-	-	-	The salty taste did not settle

1	2	3	4	5	6	7	8
6	Active water reaction	According to the norms, the pH of drinking water should be within 6.0...9.0	pH = 6,8	7	7	7	It's fine
7	Water hardness	the hardness of drinking water should be no higher than 7 (10) mg-eq/l	5,5 mg-eq/l	5,5	4,5 mg-eq/l	4,5 mg-eq/l	It's fine
8	Chlorides	The maximum permissible concentration of chlorides is 300...350 mg/l	443 mg/l	296 mg/l	301 mg/l	337 mg/l	It's fine

Water purification using raw gaize (Table.2) showed results in samples of 20 grams of sorbent per 100 ml of test water, where there is a slight decrease in both water hardness from 5.5 mg-eq/l to 4.5 mg-eq/l, and chlorides in the sample from 443 mg/l to 301 mg/l, which corresponds to the norms in the Sanitary rules and regulations.

Table 3 – Results of the analysis of the physico-chemical characteristics of the tested water sample using a therrmally modified gaize at 800°C

№	Physico-chemical properties of water	Standard	Result				Description
			before water purification	After water purification			
				10:100	20:100	30:100	
1	2	3	4	5	6	7	8
1	Water temperature	7-11 °C.	11 °C	15 °C	15 °C	15 °C	It was purified in the laboratory at room temperature
2	Color of water	it should not be higher than 20 degrees.	30 degrees. The water has a greenish tint	20 degrees	15 degrees	10 degrees	It's fine
3	Turbidity	Not higher than 1.5 mg/l.	1,5 mg/l.	1,5 mg/l.	1,5 mg/l.	1,5 mg/l.	It's fine
4	Taste	It can be salty, bitter, sweet and sour.	Salty taste	-	-	-	The salty taste did not settle

1	2	3	4	5	6	7	8
5	Smells	According to the norms, no more than 2 points	3 points - noticeable smell or taste, easily detectable	2 points	2 points	2 points	It's fine
6	Active water reaction	According to the norms, the pH of drinking water should be within 6.0...9.0	pH = 6,8	7	7	7	It's fine
7	Water hardness	the hardness of drinking water should be no higher than 7 (10) mg-eq/l	5,5 mg-eq/l	4.25	4,0 mg-eq/l	3,5 mg-eq/l	It's fine
8	Chlorides	The maximum permissible concentration of chlorides is 300...350 mg/l	443 mg/l	355 mg/l	319 mg/l	301 mg/l	It's fine

The obtained results of the analysis of the physico-chemical characteristics of the tested water sample (Table.3) using thermally modified gaize at 800 ° C, it gives good results both in reducing water hardness and in reducing chlorides in water in ratios of 30 : 100 g/ml of gaize to water, compared with raw gaize.

Table 4 – Examination of the test sample of water purified with diatomite (groundwater "Akkurai")

№	Physico-chemical properties of water	Standard	Result				Description
			before water purification	After water purification			
				10:100	20:100	30:100	
1	2	3	4	5	6	7	8
1	Water temperature	7-11 ºC.	11 ºC	15 ºC	15 ºC	15 ºC	It was purified in the laboratory at room temperature
2	Color of water	it should not be higher than 20 degrees.	30 degrees. The water has a greenish tint	20 degrees	15 degrees	10 degrees	It's fine
3	Turbidity	Not higher than 1.5 mg/l.	1,5 mg/l.	1,5 mg/l.	1,5 mg/l.	1,5 mg/l.	It's fine
4	Taste	It can be salty, bitter, sweet and sour.	salty taste	-	-	-	The salty taste did not settle
5	Smells	According to the norms, no more than 2 points	3 points - noticeable smell or taste, easily detectable	2 points	2 points	2 points	It's fine

1	2	3	4	5	6	7	8
6	Active water reaction	According to the norms, the pH of drinking water should be within 6.0...9.0	pH = 6,8	7	7	7	It's fine
7	Water hardness	the hardness of drinking water should be no higher than 7 (10) mg-eq/l	5,5 mg-eq/l	11	10	8	Increased by 3-6 units (water is hard)
8	Chlorides	The maximum permissible concentration of chlorides is 300...350 mg/l	443 mg/l	425 mg/l	419 mg/l	458 mg/l	Slight increase

Experimental data obtained by purifying water through diatomite in the ratios indicated in Table 5 showed that this mineral increases the hardness of water to 5-7 units of soft water, but does not affect chloride ions in water.

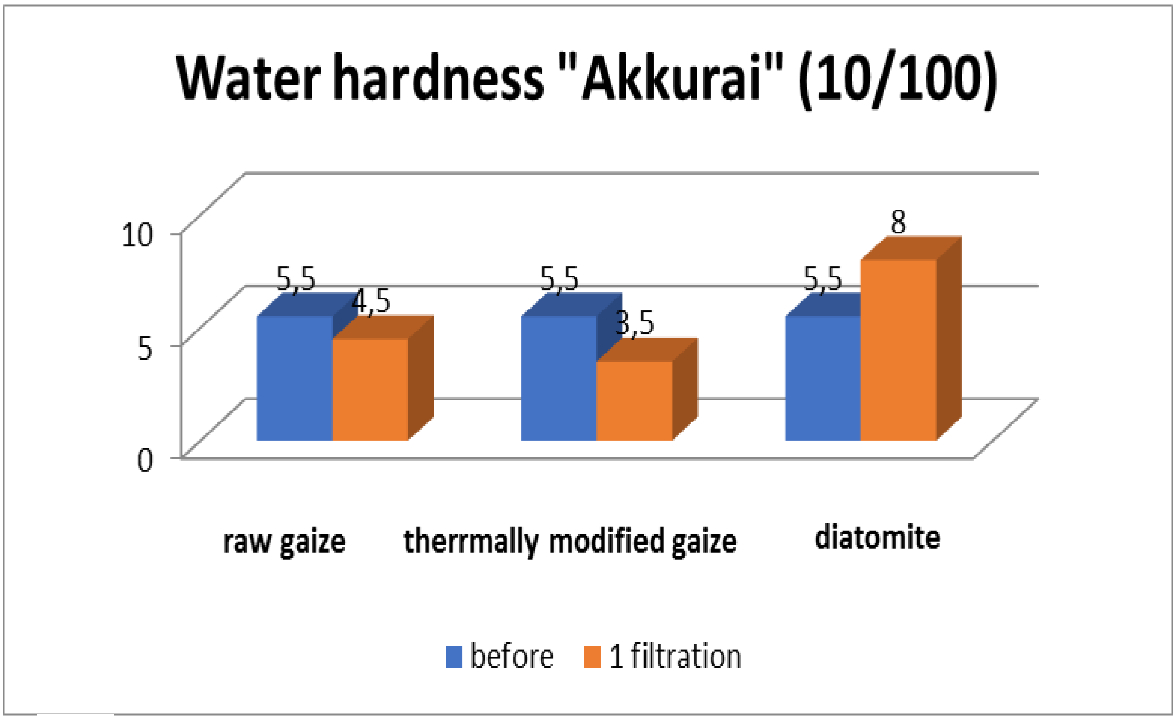

Figure 1 – Comparative diagram of mineral sorbents for water hardness in proportions 10/100

Figure 1 clearly shows that thermal gaize has a better effect on water hardness than other sorbents. Thermal gaize lowered the quality hardness index from 5.5 mg-eq/l to 4.25 mg-eq/l.

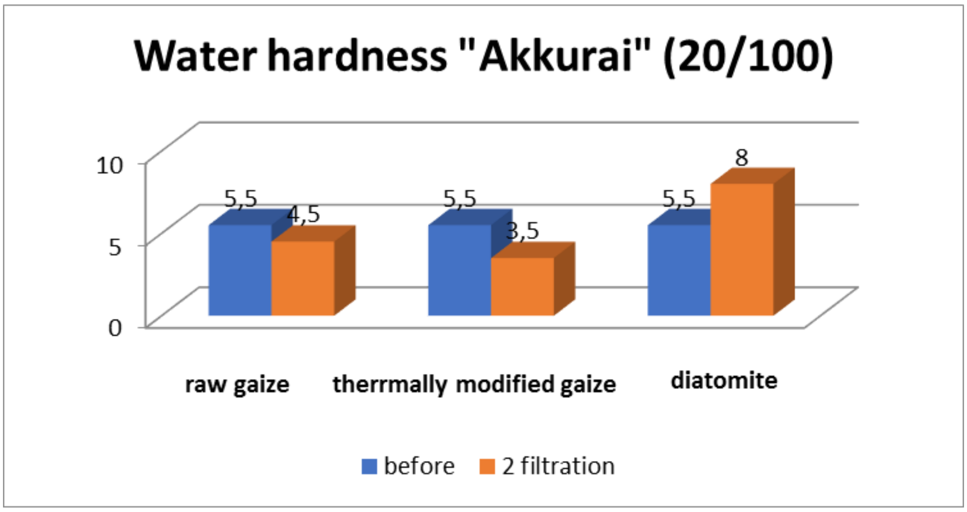

Figure 2 – Comparative diagram of mineral sorbents for water hardness in proportions 20/100

In a ratio of 20/100 samples, the water hardness was well reduced by thermal gaize (Figure 2). Reduced the quality hardness index from 5.5 mg-eq/l to 4.0 mg-eq/l.

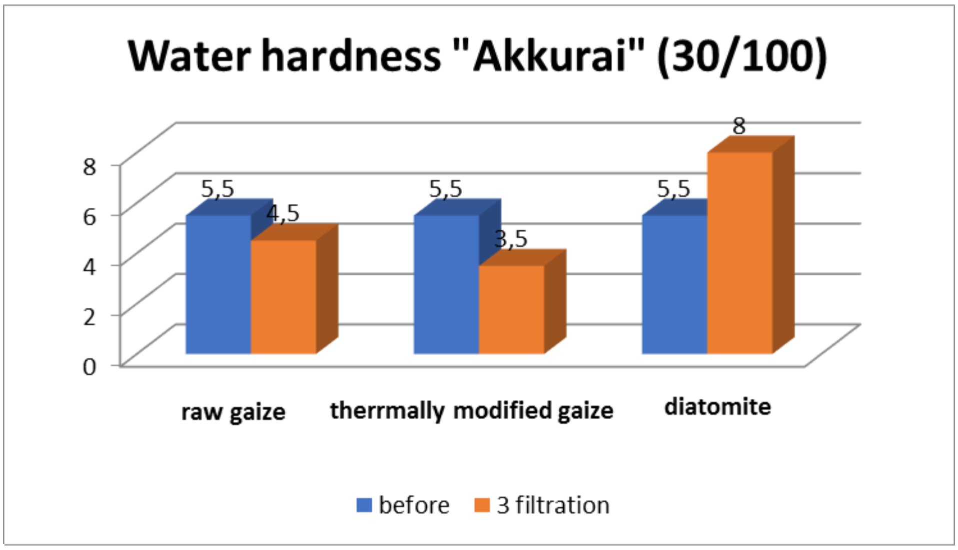

Figure 3 – Comparative diagram of mineral sorbents for water hardness in proportions 30/100

In Figure 3, in a ratio of 30/100 samples, thermal gaize well reduced water hardness compared to other sorbents. Reduced the quality indicator of hardness from 5.5 mg-eq/l to 3.5 mg-eq/l.

Table 5 – Results of determination of the adsorption activity of mineral sorbents by the iodometric titration method

№	Mineral sorbents	Indicators of consumed titrant, ml	A, %
3	Thermal gaize	10,2	0,07
6	Diatomite	9,3	0,18
8	Gaize	10	0,1

According to Table 6, the results of determining the adsorption activity of mineral sorbents by the iodometric titration method showed the following activity to reduce activity: diatomite > ordinary gaize > thermally modified gaize.

Conclusions. As described in Table 1, the water before water purification was examined for some organoleptic and physico-chemical properties, such as temperature, color, turbidity, taste, odor, pH of the medium, total hardness and chlorides. It became known from the indicators that the water meets many standards, but there is also an excess above the norm in such parameters as the content of dissolved chloride ions in water and the total hardness has an average value. In view of this, continuing the work, special emphasis was placed on lowering these numerical values in water:

Water purification using raw gaize (Table.2) showed results in samples of 20 grams of sorbent per 100 ml of test water, where there is a slight decrease in both water hardness from 5.5 mg-eq/l to 4.5 mg-eq/l, and chlorides in the sample from 443 mg/l to 301 mg/l, which corresponds to the norms in the Sanitary rules and regulations.

The obtained results of the analysis of the physico-chemical characteristics of the tested water sample (Table.3) using thermally modified gaize at 800 ° C, it gives good results both in reducing water hardness and in reducing chlorides in water in ratios of 30 : 100 g/ml of flask to water, compared with raw flask.

In view of this, it is necessary to consider different compositions of these natural mineral sorbents in the purification of various types of water to improve their physico-chemical, organoeptical and technological qualities.

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ТҮЙІН

Тұщы су мөлшерінің азаюы жер үсті суларымен қатар жер асты суарын тиімді пайдаланудың қажеттлігін тудырады. Жер асты суларын тазарту процесінде минералды сорбенттерді қолдану экологиялық және экономикалық жағынан қолайлы. Сол себепті сорбент ретінде саздар, белсендірілген көмірлер сияқты минералды шикізаттарды қолдану ұсынылады. Минералды сорбенттер судан әртүрлі ластаушы заттарды, соның ішінде ауыр металдарды, органикалық қосылыстарды және радиоактивті заттарды кетірудің тиімді құралы болып табылады. Бұл зерттеуде сорбенттер ретінде диатомит пен монтмориллониттің қолданылуы қарастырылды. Олар Аққурай кен орнындағы жер асты сувының органолептикалық көрсеткіштерін жақсартып, кермектілігін және судың құрамындағы хлоридтерді мөлшерін азайтуға жұмыс жасады. Аргентометрия және йодометрия әдістерін қолдана от ырып физика-химиялық қасиеттері анықталды. Әртүрлі сорбенттерде фильтрлеу арқылы алынған нәтижелерге салыстыру жұмыстары жүргізілді. Нәтижелер термиялық модифицирленген сорбенттің адсорбция қабілеті жақсы екенін көрсетеді. Бұл нәтижелер минералды сорбенттер жер асты суын тазартудың тиімді шешімі екенін және болашақта жер асты суларын тазарту тиімділігін арттыру үшін минералды сорбенттерді әртүрлі композицияларда қолдану перспективалы әдістердің бірі екенін көрсетеді.

РЕЗЮМЕ

Уменьшение количества пресной воды обусловливает необходимость эффективного использования грунтовых вод наряду с поверхностными. Использование минеральных сорбентов в процессе очистки грунтовых вод является экологически и экономически приемлемым. По этой причине в качестве сорбента рекомендуется использовать минеральное сырье, такое как глины, активированный уголь. Минеральные сорбенты являются эффективным средством удаления из воды различных загрязнителей, включая тяжелые металлы, органические соединения и радиоактивные вещества. В этом исследовании рассматривалось использование диатомита и монтмориллонита в качестве сорбентов. Они работали над улучшением органолептических показателей подземных вод Аккурайского месторождения, снижением жесткости и содержания хлоридов в воде. Определены физико-химические свойства с использованием методов аргентометрии и йодометрии. Были проведены сравнительные работы с результатами, полученными фильтрацией на различных сорбентах. Результаты показывают, что термомодифицированный сорбент обладает хорошей

адсорбционной способностью. Эти результаты показывают, что минеральные сорбенты являются эффективным решением для очистки грунтовых вод и что использование минеральных сорбентов в различных композициях для повышения эффективности очистки грунтовых вод в будущем является одним из перспективных методов.

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КОНДЕНСАЦИЯЛАНҒАН "SILICA FUME" МИКРОКРЕМНЕЗЕМІНІҢ АЛДЫН АЛА КЕРНЕЛГЕН ТЕМІРБЕТОН ҚАДАЛАРЫНЫҢ ҚАСИЕТТЕРІНЕ ӘСЕРІ
INFLUENCE OF CONDENSED MICROSILICA “SILICA FUME” ON THE PROPERTIES OF PRETRESSED CONCRETE PILES

Аннотация

Мақалада, «Silica fume» конденсацияланған микрокремнеземының, алдын-ала кернелген қадалы іргетастарды өңдеу технологиясындағы модификацияланған бетонның қасиеттеріне әсерін зерттеу барысында алынған эксперименттік деректер берілген. Құрамында кремний бар қорытпаларды өндіру кезінде технологиялық пештерді газбен тазарту процесінде алынған техногендік шыққан "Silica fume" микрокремнеземін қолдану алдын ала кернелген қадаларды өндіру кезінде бетонда өзінің тиімділігін және өңделмеген Тауритті белсенді емес минералды қоспа ретінде қолдану мүмкіндігін көрсетілді. Сонымен, Тауритті енгізу нәтижелері көрсеткендей, портландцемент шығыны 20% - ға азайған кезде және Тауритті 5, 8 және 10% мөлшерінде бетонның құрамына енгізілген кезде бетон сапасына әсер етеді, бұл ретте 5 және 8% шығынмен өсімі 2-3%-дан аспайды, ал 10% шығынмен өсім 7%-ға дейін жетеді. 5, 8 және 10% мөлшеріндегі "Silica fume" микрокремнеземінің нәтижелері қалыпты-ылғалды қатайтуы бетонының беріктігіне оң әсер етеді, өсім 5-тен 12% - ға дейін жетеді. Сонымен, бетонның