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RESEARCH OF N-PERMUTITE TECHNOLOGY USING LOCAL RAW MATERIALS

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Abstract. *Ion exchangers, ion exchangers, ion-exchange sorbents are polymeric or inorganic substances containing ionogenic and (or) complex groups capable of exchanging ions when exposed to electrolyte solutions. In the work, the sorption properties of permutite with respect to waste water such as petroleum products, phosphates, and heavy metal ions were studied: Fe^{2+}, Cu^{2+}, Zn^{2+}, $Al^{3}+$, $Mn^{2}+$, $Cr^{2}+$, $Cd^{2}+$ and $Pb^{2}+$. The obtained product can be used for water softening in the production of electrolytes of different composition, it can be successfully used in water purification of high-pressure steam boilers, at the same time, effective softening of water and a decrease in general mineralization have a positive effect on increasing the efficiency of steam devices. According to the conducted experiments, it was found that samples of rocks containing permutite of the clinoptilolite type have significant sorption capacity for heavy metal ions. The efficiency of cleaning with clinoptilolite at the initial concentration of ^{226}Ra30 Bk/l ion was found to be 96%. Therefore, it is important to find ways to solve the problem of finding and studying the possibility of using cheap and effective natural materials for water purification.*

Keywords*: permutite, zeolite, aluminum trichloride, sodium silicate, ion exchange, pH indicator.*

Introduction. Ionites, ion exchangers, ion exchange sorbents are polymer or inorganic substances containing ionogenic and (or) complex groups that can exchange ions when exposed to electrolyte solutions. Most ionites are practically insoluble solids in amorphous or crystalline form. According to their chemical nature, they are divided into organic, inorganic, mineral-organic, natural and artificial ionites according to their origin [1]. Examples of organic ionites are ion exchange resins, chemically activated coal, peat, cellulose, inorganic ionites are aluminosilicates (zeolites, permutites) and hydroxides, phosphates, cyanides of polyvalent metals. Ionites can absorb positive or negative ions (cations or anions) from the solution of electrolytes (salts, acids and alkalis) and replace them with equivalent amounts of other ions of the same charge. High silica zeolites in the oil refining industry

Fig.1. Kaoline

It is widely used to improve the quality of motor fuels, to obtain motor fuels that meet Euro-4 and 5 standards, to soften drinking water, as a catalyst in organic synthesis, as a sorbent in the drying and purification of petroleum gases and natural gas.

In our republic is rich in kaolin and bentonite as shown in Figure 1. High-silica zeolites and sorbents are obtained from these natural sources and show high efficiency in cleaning polluted water and atmospheric air. It is possible to create high-silica zeolite from local raw kaolin. Today, laboratory tests were conducted to obtain high-silicon zeolites from kaolin in Nurabad district of Samarkand region and bentonite in Navbahor district of Navoi region [3]. Economic efficiency: allows localization of imported catalysts, acquisition of new substances and optimization of technological processes.

Water softened with permutite is used in steam boilers, if hydrogen is used in this case, the amount of permutite salt is reduced and the work of steam boilers, especially high pressure steam boilers, is significantly improved and their efficiency increases.

The purpose of research. Obtaining hydrogen permutite and developing analogues of its properties for softening technological waters.

Research materials and methodology.

Permutites belong to the group of framework aluminosilicates, whose crystal lattice is formed by tetrahedra $[SiO_4]^{4-}$ and $[AlO_4]^{5-}$. The presence of cavities and channels in the microstructure of permutites, as well as the freedom of movement of cations and water molecules determine their unique properties: a combination of adsorption properties and ion exchange. Permutites are capable of selectively adsorbing cations (Ca^{2+}, Na+, K+, Mg^{2+}, etc.) to pollutant cations in the solution, as well as permutites.

In the work, the sorption properties of permutite with respect to waste water such as petroleum products, phosphates, and heavy metal ions were studied: Fe^{2+}, Cu^{2+}, Zn^{2+}, Al^{3}+, Mn^{2}+, Cr^{2}+, Cd^{2}+ va Pb^{2}+. After wastewater treatment with permutites, the amount of oil products decreases by 74.2%; phosphates by 86.1%;

Fe^{2}+ and Cu^{2}+ 55% by;

Zn^{2}+ 80% to; Al^{3}+ 50% by;

Mn^{2}+ 57,1% by; Cr^{2}+ 60% by;

CD^{2}+ t 50%; Pb^{2}+ 75% by.

As mentioned above, the main problems of wastewater treatment contaminated with various organic and inorganic substances are expensive and mostly imported various sorbents, sorbents-ionites, which are used in various fields [6]. Taking into account the above, we conducted scientific research on obtaining aluminosilicate adsorbents - permutite, especially n-permutite.

Various mineral and synthetic adsorbents, including sodium permutite, are used to soften technical water in industrial enterprises, which remove calcium and magnesium ions from technical water and replace them with sodium ions in equal amounts [7]. In this case, the water is softened, but its mineralization remains, only calcium and magnesium cations are replaced by sodium cations.

The obtained data made it possible to determine the optimal ratio of components for obtaining hydrogen peroxide, as a result, the resulting product was separated from the water environment by selecting a plasticizer, and the granules of a certain fraction received the optimal amount of water. The resulting granules are dried, placed in a sorption column and tested for sorption properties, as a result, the resulting product has shown to be a good adsorbent, it does not pollute the water environment and reduces its mineralization during water softening and purification. The obtained product can be used for water softening in the production of electrolytes of different composition, it can be successfully used in water purification of high-pressure steam

boilers, at the same time, effective softening of water and a decrease in general mineralization have a positive effect on increasing the efficiency of steam devices.

The chemical formula of N-permutite is $Na_{58}Al_{58}Si_{134}O_{125}\cdot 240H_2O$, which is also called zeolite or ceolite in some literature.

Permutite is found in natural and synthetic form. It was designed for regeneration of technical water through permutite-based adsorbents synthesized during our research. Permutit is effective in softening and purifying waters. The structural view of permutite bonds is presented in Fig. 2.

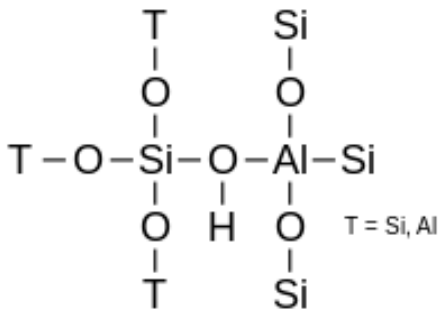


Fig.2. Structural view of permutite chemical composition bonds.

Usually, sodium permutite is widely used in industrial technical and technological water softening, during the process calcium and magnesium ions in the water are exchanged for sodium ions contained in permutite in an equivalent amount. If N-permutite is used, calcium and magnesium ions are replaced by equivalent amounts of hydrogen ions[10]. When N-permutite is used for the cleaning process, the level of mineralization of water decreases, and this is clearly noticeable in the operating processes of heating boilers, which increases its efficiency. To get Na-permutite containing aluminum: we dissolved 24g of Na_2SiO_3 in 1l of water and dissolved 4g of $AlCl_3$ in 1l of water and added them to each other without heating and mixing. The precipitated Na-permutite ($Na2SiO_3$) was filtered off (18 g, 72% yield) and treated with calcium bicarbonate to convert Na-permutite to N-permutite, where the Na^+ ions in the permutite structure are Ca^{2+} ions are replaced [11,12]. Then, if the saturated permutite is treated with a 5% hydrochloric acid solution, 86-90% of Ca^{2+} ions are exchanged for hydrogen ions and N-permutite is formed. The physico-chemical properties of the synthesized N-permutite were studied and presented in Table 1.

Table 1

Mineral sorbents processed in different ways adsorption kinetics analysis

Sorbent	Absorbable ion	Amount of absorption, mg/g	External mass exchange coefficient, min-1	Adsorption equilibrium time, min
N-permutit	Fe2+	120	0,051	13
	Ni2+	111	0,049	15
	Cu2+	103	0,031	22
	Zn2+	123	0,036	19
	Cr6+	129	0,049	12
	Cr3+	117	0,39	17

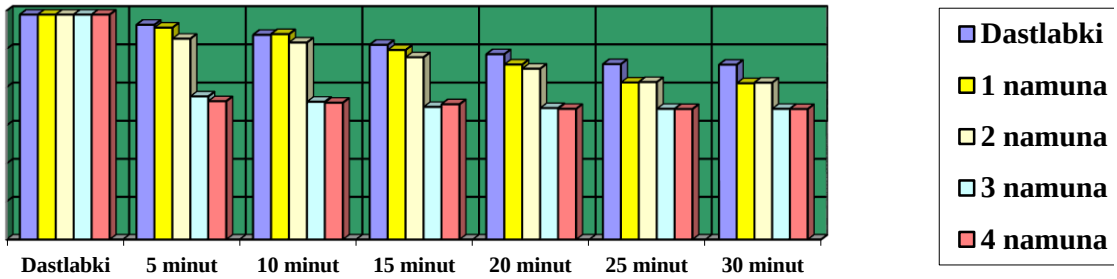
Activated bentonite, modified glauconite, Na-permutites can be used to soften industrial technical and technological waters, but in these cases, adsorbents soften water, and the general level of mineralization almost does not change due to ion exchange[13]. Such waters can be easily used as technical water in various fields of production to save drinking water, but their use is

limited in boiler rooms, especially in boiler rooms operating at high pressure, due to their high mineralization.

The use of N-permutite in boiler rooms is very effective, and such adsorbents not only soften circulating water, but also significantly reduce the level of mineralization.

It is known that the treatment of heavy metals, especially chromate ions, in industrial wastewater is a very complicated process[14]. Currently, such wastewater and waste solutions are processed using imported iron (II) sulfate, and the de-particled waste is dewatered and transported to landfills in the form of sludge, compensation payments are made depending on the amount of waste disposed. If the amount of chromate ions is low, that is, the concentration in the wastewater is below 1 g/l, such wastewater can easily be treated up to permissible standards by electrochemical or other combined methods.

We used N-permutite, obtained in laboratory conditions, for technical waters, which were found to contain Fe^{2+}, Ni^{2+}, Cu^{2+}, Zn^{2+}, Cr^{6+}, Cr^{3+} ions. In order to reduce these indicators and water hardness, we used N-permutite to purify boiler water. In our experience, we used H-permutite in different ways and with different additives. In a static state, water purification indicators in N-petmutite continued for 5-30 minutes. We put 250 ml of water taken from the heating boiler room into 5 pre-prepared flasks. The measured acidity level showed 11.8 Ph. We put 5 grams of 4 types of N-permutite prepared in advance into 4 flasks and determined the ***pH*** indicators over time. Indicators are shown in diagram 1.



1 – diagram. pH indicators of H-permutite in different samples.

Our conducted experiments show that in our 3,4- samples with a high Na (sodium) content in N-permutite, the pH indicators are much lower than others and the absorption process took place quickly.

Research results. According to the conducted experiments, it was found that samples of rocks containing permutite of the clinoptilolite type have significant sorption capacity for heavy metal ions. The efficiency of cleaning with clinoptilolite at the initial concentration of ^{226}Ra30 Bk/l ion was found to be 96%. In addition, it has been shown that using Na-form clinoptilolite, it is possible not only to purify water through zinc and aluminum, but also to reduce the content of ammonium ions, chromium and water odor [15].

Permutites undergo chemical modification to increase their sorption properties. In the work, the process of adsorption of protein compounds from food industry wastewater was studied when using modified permutites at the processing stage. The initial permutites were modified with a 3% solution of chitosan and ferroferricyanide complexes. In modified permutites, the level of protein purification of wastewater is 68-75%, and in unmodified samples it is <60%. The use of permutites as softeners and adsorbents for wastewater treatment is effective, but their use in this

field is limited, because of the complexity of the regeneration process, their cost increases. In this regard, it is considered relevant to search for and use effective natural materials for wastewater treatment.

The adsorption properties of natural minerals are explained by their chemical and mineralogical composition, as well as the structure of crystals and distribution of particles. Their main components are SiO_2 (30-70%), Al_2O_3 (10-40 %) and H_20 (5-10%) their specific surface is up to 500 m2/g.

Of the sorbents of mineral and synthetic origin, natural and synthetic permutites are most often used in water purification.

Discussion.

The disadvantages of using permutites are limitations in the size of active surfaces and cavities of permutites, so only relatively small ions are able to exchange in permutites. Incomplete exchange is often observed, which is due to the presence of centers in permutites that are available for some and not available for other ions. The level of metabolism depends mainly on temperature, which prevents the use of permutites in water purification. In addition, batches of mined permutites differ significantly in terms of sieving effect, ion exchange ability and selectivity, which makes it difficult to create and use ion exchange filters based on them.

Summary.

Synthetic permutites, which are better than natural ones, do not have such disadvantages, but their use in water purification is limited by a much higher price.

Despite the effectiveness of zeolites as sorption materials, their use makes the water treatment process more expensive due to the high cost, selective efficiency and complexity of the regeneration process. Therefore, it is important to find ways to solve the problem of finding and studying the possibility of using cheap and effective natural materials for water purification.

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