ISSN NO: 2770-0003
Date of Publication: 26-09-2022

Method For Obtaining N-Permutite

F. I. Erkabaev, Sh.I.Berdiev, D.A.Muxammadieva
(Institute of General and Inorganic Chemistry, Academy of Sciences of the Republic of Uzbekistan)
(E-mail: erkabaevf@rambler.ru)

Abstract. In production, various sorbents are used to soften industrial waters, including sodium permutite, which removes calcium and magnesium ions from industrial waters, replacing them in an equivalent amount with sodium ions. At the same time, the water softens, but its mineralization remains, only cations are replaced. Permutite-softened waters are used in steam boilers, if in this case hydrogen permutite is used, the salinity decreases and the operation of steam boilers, especially high-pressure steam boilers, sharply improves, and their efficiency also increases markedly.

The purpose of this study is to obtain hydrogen permutite and study its sorption properties.

It has been established that hydrogen permutite can be obtained from aluminum trichloride and sodium silicate in an aqueous medium, while the accuracy of the component ratio plays an important role for the formation of hydrogen permutite.

Keywords: Permutite, aluminum trichloride, sodium silicate, sorption capacity, ion exchange.

Introduction. The use of activated carbon and zeolites as adsorbents in the softening and treatment of wastewater is effective, but their use in this industry is limited, since due to the complexity of the regeneration process, their cost increases. In this regard, the search and the possibility of using effective natural materials for wastewater treatment are considered relevant.

In the authors' research [1-4], sorbents derived from peat and wood chips are proposed for oil refining and softening of process water, purification of galvanic wastewater, while the cellulose in the composition of sawdust is inthe formofthe element, and are used to restore and isolate some heavy metal ions. Natural minerals like bentonite (montmorillonite), kaolinite, biotite, vermiculite, glauconite are considered effective and promising in the softening of industrial wastewater and the treatment of heavy metals [5-9]. This is due to the fact that natural minerals are inexpensive and in the deposits are available in sufficient quantities, the operational properties of which are quite high.

The adsorption properties of natural minerals are explained by their chemical, mineralogical composition, as well as the structure of crystals and the dispersion of their particles [10]. The main components in them are SiO_2 (30-70%), Al_2O_3 (10-40%) and H_20 (5-10%), the specific surface of which is up to 500 m^2 / g.

Of the sorbents of mineral and synthetic origin, natural and synthetic zeolites have found the greatest application in water treatment.

Zeolites belong to the group of scaffold aluminosilicates, the crystal lattice of which is formed by tetrahedrons $[SiO_4]^{4-}$ and $[AlO_4]^{5-}$ [11]. The presence of cavities and channels in the microstructure of zeolites, as well as a sufficiently large freedom of movement of cations and water molecules determine their unique properties: the combination of both adsorption properties and ion exchange properties. Zeolites are easy exchange cations (Ca^{2+}, Na +, K +, Mg^{2+}, etc.) in their composition for pollutant cations in solution, as well as zeolites are capable of selective absorption.

The paper [12] studies the sorption properties of zeolite in relation to such wastewater pollutants as petroleum products, phosphates, heavy metal ions: Fe^{2+}, Cu^{2+}, Zn^{2+}, Al^3+, Mn^2+, Cr^2+, Cd^2+ and Pb^2+. After treatment with zeolites of wastewater, the content of petroleum products is reduced by 74.2%; phosphates by 86.1%; Fe^2+ and Cu^2+ by 55%; Zn^2+ by 80%; Al^3+ by 50%; Mn^2+ by 57.1%; Cr^2+ by 60%; Cd^2+ by 50%; Pb^2+ by 75%.

According to the results of studies conducted in [13, 14], it was found that samples of zeolite-containing rocks of the clinoptilolite type have a significant sorption capacity for heavy metal ions. It was revealed that at the initial concentration of ion ^{226}Ra 30 Bq / l, the efficiency of purification with clinoptilolite is 96%. In

ISSN NO: 2770-0003
Date of Publication: 26-09-2022

addition, it has been shown that using clinoptilolite in Na It is possible not only to perform additional purification of water on zinc and aluminum, but also to reduce the content of the ammonium ion, the color and smell of water.

To increase the sorption properties, zeolites are subjected to chemical modification [15]. In the work [16], at the post-treatment stage, the process of adsorption of protein compounds from wastewater of food production using modified zeolites was investigated. The initial zeolites were modified with a 3% solution of chitosan and ferroferricyanide complexes. The degree of post-treatment of wastewater on protein on modified zeolites is 68-75%, while on unmodified ones samples it is <60%.

Disadvantages when using zeolites are restrictions in the size of the windows and cavities of zeolites, so only relatively small ions are capable of exchange on zeolites. Often there is an incomplete exchange, which is associated with the presence in zeolites of centers available for some and inaccessible to others. The degree of exchange is largely dependent on temperature, which prevents the use of zeolites in water treatment. In addition, the batches of extracted zeolites differ significantly in the sieve effect, differ in ion exchange capacity and in selectivity series, which complicates the creation and operation of ion exchange filters based on them [17].

Such disadvantages are devoid of synthetic zeolites, which have better properties in comparison with natural ones, but their use in water treatment is limited by a fairly high cost.

Despite the effectiveness of zeolites as sorption materials, their use increases the cost of the water purification process due to their high cost, selective efficiency, and the complexity of the regeneration process. Therefore, the problem of finding and studying the possibility of using cheap and effective natural materials for water treatment is relevant.

As mentioned above, the main problems in the treatment of wastewater contaminated with various organic and inorganic substances are expensive and mainly imported from abroad various sorbents, sorbents-ionites, which are used in various industries. Taking into account the above, we have conducted scientific research on the production of aluminosilicate adsorbents - permutite, in particular N-permutite.

In industrial enterprises, various mineral and synthetic adsorbents are used to soften technical waters, including sodium permutite, which removes calcium and magnesium ions from technical waters, replacing them in equivalent quantities with sodium ions. At the same time, water softens, but its mineralization remains, only calcium and magnesium cations are replaced with sodium cations. Water softened with permuthite is used in steam boilers, if in this case hydrogen permutite is used, the salt content decreases and the operation of steam boilers, especially high-pressure steam boilers, is markedly improved, and their efficiency increases.

The purpose of this study is to obtain hydrogen permutite and study its properties for softening process waters.

It is known that hydrogen permute can be obtained from aluminum trichloride and sodium silicate in an aqueous medium, while the accuracy of the ratio of components plays a large role in the formation of hydrogen permutite.

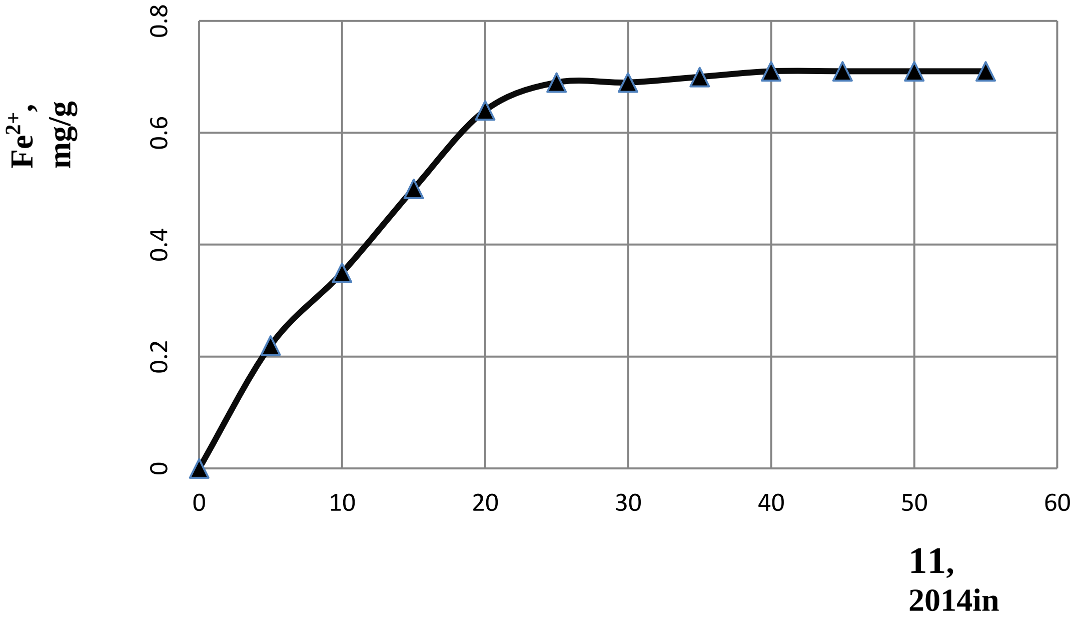
For the synthesis of hydrogen permutite, aluminum trichloride was used, for this purpose 23.5 grams of $NaSiO_3 \cdot 9H_2O$ were dissolved in distilled water, a volume of 2 liters and 3.4 grams of $AlCl_3$ in distilled water, a volume of 1 liter and stirred for 10 minutes at room temperature. The chemistry of the reaction of this process can be described in the form of the following equation:

$$2AlCl_3 + 3\ Na_2Sio_3 \cdot 9H_2O + H_2O = H_2to_2Si_2or_8 \cdot\ n\ H_2O\downarrow + 6NaCl + SiO_2$$

After that, the resulting product, i.e. hydrogen permutite precipitates, NaCl and SiO_2 remains in solution. The product was filtered, washed, dried at a temperature of $110^{0\circ}$ C to a constant weight and the product yield was determined. In our case, the dried product amounted to 14.3 grams, the yield of which was 53%. According to this technology, a sample of hydrogen permutite in the amount of 1.1 kg was obtained. The resulting product was subjected to granulation, for this purpose 8% enriched bentonite of the Navbahor field was added as a plasticizer. Water was added to the finished mixture in the optimal amount for granulation, determined in advance and which was 21%, and granulated in a laboratory granulator FSH-004, with a screw hole diameter of 1.0 mm. Finished granules were dried at a temperature of 175^{0} C with periodic stirring. The dried granules were sifted through sieves, the fractions of 1-3 mm were sorted to study the sorption properties.

 ISSN NO: 2770-0003
Date of Publication: 26-09-2022

The resulting product was placed in a sorption column, a model solution containing Fe^{2+} ions in an amount of 22 mg / l was prepared and the sorption properties of the resulting hydrogen permutite were investigated.



Rice. Kinetics of adsorption of Fe^{2+} ions on model solutions concentration of iron ions 10 mg/l

As you can see, from Fig. Fe^{2+} ions are actively absorbed in the first 20 minutes, then the sorbent is saturated and up to 50 minutes the process is relatively slow. According to preliminary data, the sorption capacity of the resulting sorbent for Fe^{2+} ions was 0.65 mg / g.

The data obtained made it possible to determine the optimal ratios of components for the production of hydrogen perutite, the resulting product was isolated from the aqueous medium, selecting a plasticizer and the optimal amount of water obtained granules of a certain fraction. The resulting granules were dried, placed in a sorption column and tested for sorption properties, the results of which showed that the resulting product is a good adsorbent, when softening and purifying waters, they do not pollute the aqueous medium, reducing its mineralization. The resulting product can be used to soften water in the manufacture of electrolytes of various compositions to be successfully used in the purification of water of high-pressure steam boilers, while effective softening and reduction of the overall mineralization of water has a positive effect on increasing the efficiency of steam plants.

Bibliography:

1. Avt.sv. No 882951, MKI SSSR S02F1/70. A method of wastewater treatment from chromium compounds. V.S. Galakhov, E.P. Aghasyan, V.A. Komarov, V.A. Ushkov and B.B. Blinov.
2. Shemyakin E. V., Fridman A. Ya., Polyakov I. Yu. et al. Neutralization of chrome-containing wastewater. Water supply and sanitation equipment, 1. l. 1995. № 10. 4-7 s.
3. Temporary recommendations for electrochemical treatment of industrial wastewater from hexavalent chromium using steel electrodes. - M: Khimiya, 1977. - 35 p.
4. Gurkov A. I., Mongait I. L., Rozel I. D. Methods of cleaning.
5. industrial wastewater.: Handbook.- M.: Stroyizdat, 1977.-
6. 204 pages.
7. Yakovlev S. V., Krasnoborodko I. G., Rogov V. M. Tekhnologiya elektrohimicheskoi vochinosheniya. Leningrad: Stroyizdat, Leningrad branch. -1987.- p. 145.
8. Khadzhibaev D.A., Mukhammadieva D.A., Erkabaev F.I. Wastewater treatment from heavy metals by electrochemical method // Journal "Chemical Industry", Sank-Petersburg. 2020, Vol.97., No. 2 P.77-81.

ISSN NO: 2770-0003
Date of Publication: 26-09-2022

9. D.A.Khadjibaev, F.I.Erkabaev. Selection of mineral raw material fields for glauconite sorption materials // Международный научно-технический журнал «Химическая технология. Контроль и управление», 2021, № 2 (98), С.11-18.
10. Erkabaev F.I., Khadzhibaev D.A., Mukhammadieva D.A. Preparation of pigment on the basis of precipitates of electrochemical purification of chromate-containing effluents. Sank-Perterburg. International Journal "Chemical Industry". 2021. Vol.98. No.1. pp.39-43.
11. Studies of the process of restoration of hexavalent chromium ions / F.I. Erkabaev, S. Ishankhodjaev, B. Khasanov, S.S. Ishankhodjaev. ToshKTI Fan Haftaligi. – Tashkent, April 3-5, 2001 – 87 p.
12. Vasil'eva V. N., Vasil'ev V. P. Komplektobranie chroma (III) s polyatomic alcoholami // Khimiya i khimicheskaya tekhnologiya. - 1970. - № 13. p. 21.
13. Volodchenko L.V. Mechanism of formation of aluminum hydroxide in the treatment of water with an activated solution of coagulant.- Communal services of cities: scientific and technical collection No. 45.-K.: Technics, 2004.-P. 107-110.
14. Chachina, S. B. Evaluation of the efficiency of purification of oil-contaminated waters using coke and zeolite / S. B. Chachina, O. O. Ovsyannikova // Omsk scientific bulletin. - 2012. - No 114. - P. 207-211.
15. Vatin, N. I. Application of zeolites of the clinoptilolite type for cleaning natural waters / N. I. Vatin, V. N. Chechevichkin // Inzhenerno-stroitelnyi zhurnal. - 2013. - No 2. - P. 81-88.
16. Nazarenko, O. B. Application of Badinsky zeolite for the removal of phosphates from sewage / O. B. Nazarenko, R. F. Zarubina // Izvestiya Tomsk Polytechnic University. - 2013. - v. 322. No 3. - P. 11-14.
17. Razmahnin, K. K. Modification of the properties of zeolites for the purpose of expanding the areas of their application / K. K. Razmakhnin, A. N. Khatkova // Gornyi inform
18. Zhamskaya, N. N. Study of the possibility of application
19. modified sorbents for wastewater treatment from protein substances / N. N. Zhamskaya, S. A. Mashkova, L. S. Byankina, N. P. Shapkin // Scientific works of the Far Eastern State Technical Fisheries University. - 2008. - № 20. - S. 37-40.
20. Belikov, S. E. Vodopodgotovka: Handbook / Ed. by S.E. Belikov; M.: Aqua-Term, 2007. - 240 p.