PHYSICOCHEMICAL PROPERTIES OF IONITE EXTRACTION FROM NATURAL POLYMER VERMICULITE.

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ANNOTATSIYA.

In the article, the reduction of the concentration of oils in the polluted waters of factories and car washes by sorption on the basis of vermiculite, which is considered a natural polymer, and polyacrylonitrile (PAN) composition is studied. The expansion of the natural polymer Vermiculite mineral under the influence of temperature was investigated. Using vermiculite, based on its combined composition with PAN, experimental work was carried out to determine the properties of anion exchange in water, in addition, the ability of spongy vermiculite to absorb and absorb ligroin and motor oils in water was studied, and practical tests were also carried out.

Key words: porous vermiculite, anion exchanger, polyacrylonitrile, ionites, adsorbent, composite, sorption, oil.

INTRODUCTION:

It is known that for thousands of years, our ancestors regarded water as sacred and considered the saying that if you pollute it you will go blind as a law, they revered water, used it wisely, and freely used the water in the ditch as drinking water. Later, as a result of the development of industry and agriculture, the waters became unusable as a result of the use of various chemical agents. As a result, state control of water and water use has become not only necessary, but also necessary. This means that it is necessary to pay special attention to the identification of the sources of drinking water pollution, the development of effective methods of their neutralization, and it is one of the urgent problems of today [4].

As a result of water scarcity, which is becoming a global problem, effective use of available water resources is becoming a need of the hour. To solve this problem, scientists from all over the world are conducting scientific research. There are many methods of wastewater treatment, and the most effective, technologically and economically convenient method is water treatment with the participation of sorbents. Nowadays, many ion-exchange sorbents are obtained and used for water purification. At the same time, the demand for sorbents used in wastewater treatment increases with the increase in the size of the industry. Taking this into account, obtaining anion exchange composite materials based on vermiculite and PAN is economically effective and is considered one of the urgent issues [2].

Vermiculite is a natural mineral that can be used in many fields, it is used as an insulator, additives in concrete and plaster, fertilizer carrier and adsorbent. In addition, clay minerals have been studied as adsorbent materials for the removal of heavy metals from industrial and municipal wastewater. In Italy, the possibility of using vermiculite to treat metal-contaminated soil collected from a contaminated site by leaching extracts has been investigated. Natural sorbents based on vermiculite have been reused several times for effective extraction of metals [3].

Also, as a result of introducing polyacrylonitrile (PAN) into the vermiculite matrix through a solution of dimethylformamide (DMF), a resin with sorption properties was obtained. The surface morphology of the obtained sorbent was studied by IR spectroscopy (infrared spectroscopy) and scanning electron microscopy (SEM). The sorption of metals to this vermiculite-polyacryl based resin has been determined [4].

The water sorption properties of a new selective water sorbent were studied as a result of adding calcium chloride as a hygroscopic salt to the expanded vermiculite matrix. As a result of the study of isobars, isostrata and isotherms of sorption of water at different temperatures (30-150 ° C) at different partial pressures, the heat of isosteric sorption for water absorption and 76.3 kJ / mol for solid hydrates is 39.1-46.6 kJ / It was determined that it depends on the change in mol [5].

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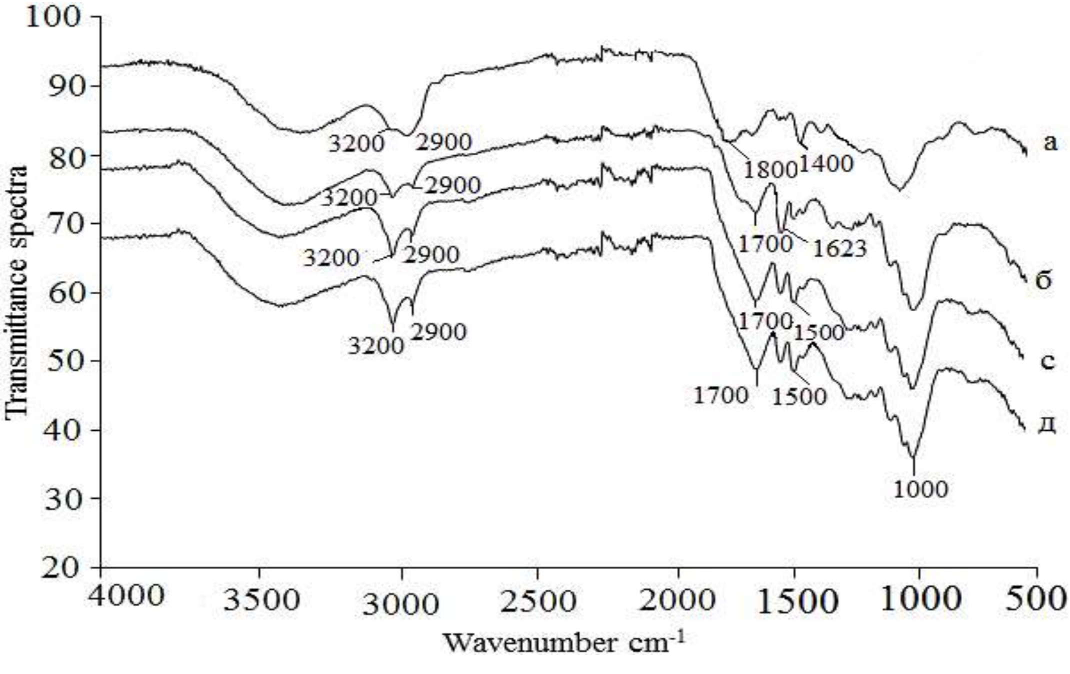


Figure 1. IR spectra of (a) cellulose, (b) sodium cellulose (calcified cellulose and (d) sulfocation

In the IR-spectrum of glucose -OH at a wavelength of 3100 cm-1 and
the absorption region indicating the valence vibrations of the group was observed, also the vibrations of –SN2 groups are formed at 2900 cm-1, and -ON, -SH- groups in the region of 1423-1321 cm-1, and –S- of ether bonds in the range of 1000-1150 cm-1 O-S- valence oscillations are observed.

The sample with Na metal attached to cellulose (Fig. 1(b)) shows additional absorption bands at 1623 cm-1, which are absorption bands typical for Na metal.[1]

Highly hydrophobic and oleophilic sorbents are used in oil and water separation. Studies have been conducted to evaluate the sorption capabilities of expanded and hydrophobized vermiculite. Carnauba (cerifera) wax is added to vermiculite to make it hydrophobic. Kinetic studies on the adsorption of oil and fats in water using expanded vermiculite and hydrophobized vermiculite were conducted. Expanded vermiculite was found to sorb synthetic mineral oil (SMO), vegetable oil, and Cutwell oil at 2.53g/g, 2.56g/g, and 2.62g/g, respectively. These studies have shown that vermiculite can be used as a sorbent for oil removal and that hydrophobized vermiculite is a better adsorbent for oil floating in water [6].

Summary:

As can be seen from the information given above, it is possible to obtain materials with different sorption properties using vermiculite-based materials. In this work, the properties of the expanded vermiculite+PAN composite for the treatment of waste water containing oils were studied.

Substances used in sorption methods include the use of sorbents with a high surface area, the ability to bind molecules (liquid or gaseous aggregates) and various ions on their surface, high porosity, and mechanical strength. Sorbents are commonly used to immobilize and remove pollutants from the environment. In many cases, it makes it possible to recycle them or re-separate the adsorbed substance from them.[8]

Materials and methods

The porous form of Tebinbulok vermiculite, polyacrylonitrile (K.T), HCl 0.1 N standard fixanal (K.T), waste motor oil, diesel oil were used as reagents to obtain a composite based on vermiculite+PAN and to study its properties.

An IRTracer-100 spectrometer filled with a single NPVO compound with a diamond/ZnSe MIRacle 10 prism was used to study the composition of the vermiculite-based composite. The scanning field of the IR spectrum was studied in the range of 4000-400 cm-1, designed for the analysis of solid, liquid, gel-like and difficult-to-process substances.

Natijalar va ularning tahlili

The composition of Tebinbulok vermiculite, which was used to obtain expanded vermiculite+PAN composite, and the results obtained based on chemical and radiographic analyzes are presented in Table 1 below [7].

Table 1.

Chemical composition of Tebinbulok vermiculite

Oxider	Oxide mass content %											
	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MgO	MnO	CaO	Na_2O	K_2O	P_2O_5	SO_3	H_2O
Mass share, %	34,83	0,09	13,52	8,96	16,71	0,06	8,43	2,52	0,6	0,02	0,01	14,25

Tebinbulok vermiculite is a natural mineral with a transverse layer, the color is from dark gray to silver, and after being porous, it turns yellow or brown. Vermuklite itself is an anion exchange material, and its composition with polyacrylonitrile (PAN) increases this property. In order to expand vermiculite, the muffle was heated to 1000 0C in an oven, and the effect of temperature on mass change and volume expansion was studied.

A B

Figure 2. Vermiculite rock based on local raw materials

A) vermiculite concentrate; B) porous vermiculite.

When the heated vermiculite is heated to 800-1000 0C, its volume increases up to 6 times, and its mass decreases due to the evaporation of the hydrated water in it. The graph below shows the change in the volume of vermiculite under the influence of temperature

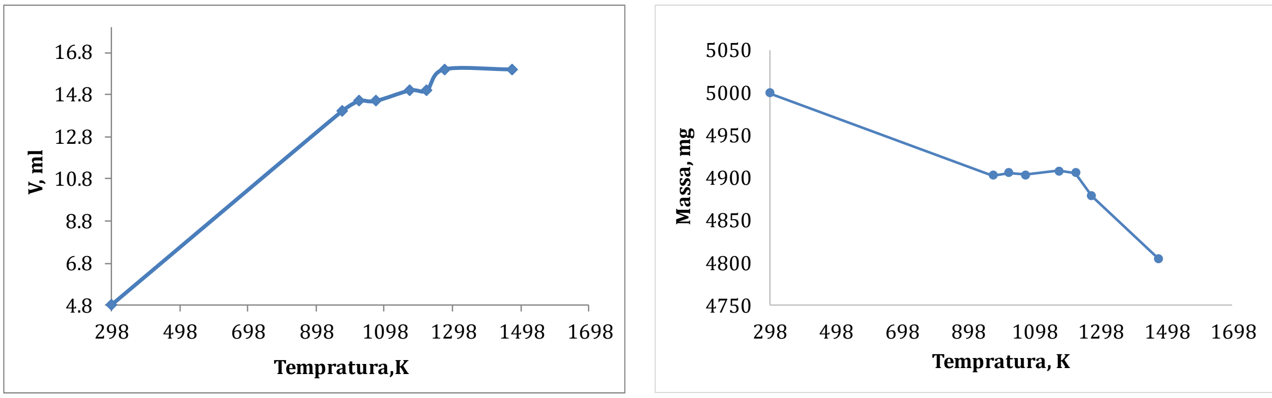
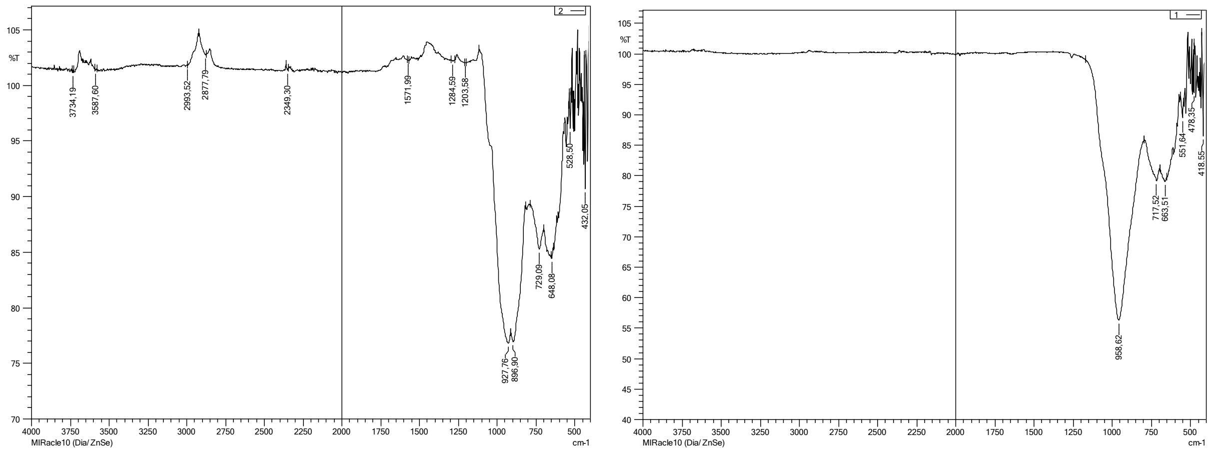


Figure 3. Tebinbulok vermiculite volume and mass changes depend on temperature

From Figure 3 above, we can see that the increase in temperature increases the volume of vermiculite, which means that it has changed to a porous structure. The sorption capacity of vermiculite with a porous structure increases accordingly, because it becomes easier for the adsorbate to reach the inner surface of the sorbent. Also, as a result of the improvement of PAN introduction into the expanded vermiculite, the anion absorbing properties and olihophilic properties of the obtained composite can be increased. In the given figure 3, the mass decrease is sharp with the temperature increase up to 973 K, and up to 1273 K, the mass change was less observed, the mass decrease occurred as a result of evaporation of water vapor and metal oxides.

In order to reveal the nature of the interaction of vermiculite mineral with modifiers, IR spectra of some samples of practical interest were obtained. For this purpose, IR spectra of Tebinbulok vermiculite and vermiculite samples expanded by heating are shown in Fig. 2



A B

Figure 4. IR spectra of loose vermiculite (A) and expanded vermiculite (B).

In Figure 4 above, IR absorption spectra were recorded in the spectrophotometer in the range of 400-4000 cm-1. It is known that the IR spectra of all natural vermiculite samples are similar, but differ in the intensity of the corresponding absorption bands 445-450, 640-670, 1000. The absorption range of 3420-3525, 3734 cm-1 and 459 cm-1 in the IR spectra of Tebinbulok vermiculite indicates the characteristic vibrations of the Si-O-Mg2+ bond. This is characteristic of trioctahedral structures. Absorption areas between 643 cm-1 and 998 cm-1 are vibrations characteristic of the Si-O bond. The absorption bands up to 1571 cm-1 belong to the deformation vibrations of adsorbed water molecules, and the absorption range up to 3459 cm-1 is due to the valence vibrations of its hydroxyl groups

In Fig. 4(B) IR spectrum of extended vermiculite, we can see differences from original vermiculite, in particular, absorption peaks after 1645,43 and 3500 area belonging to OH groups have disappeared. At 958.6 Si-O, 663.10 Me-O-Si (Fe, Al, Mg), 418.44 Si- corresponding absorption fields were found. This is the result of the release of water vapor and other hydroxyl groups as a result of heating.

In order to obtain anionite using the pore structure of expanded vermiculite, the conditions of obtaining anionite were studied by introducing PAN. For this, experiments were conducted in the ratio of reagents PAN and vermiculite 1:1, 1:2, 2:1. Vermiculite was heated in an open container in a muffle furnace at a temperature of 700-12000C and for a period of 2-6 hours. The value of the static exchange capacity (SAS) of the obtained vermiculite reached the highest value when we heated it at 850 0C for 3.5 hours. The SAS value of the obtained vermiculite/PAN composite was determined to be 1.5 mg·eq/g. The sorption properties of the obtained composite were studied. For this purpose, a porous vermiculite/PAN composite was studied for oil-contaminated water treatment. Because a large amount of water is polluted with waste oils in many industrial enterprises, household waste and car washes. Adsorption of two types of motor oil (motor oil, diesel fuel) on the vermiculite/PAN composite was studied. In this case, 0.5 g of dry adsorbent was placed in 300 ml conical flasks and 100 ml of distilled water was poured over it. Motor oil (0.8725g/ml) and kerosene oil (0.85g/ml) were measured in 5ml glasses and mixed in a saline mixer until sorption equilibrium (3 hours). After sorption, the solution was cooled, and the amount of absorbed oil was determined by filtering the precipitate of oil sorbed sorbents. For this purpose, the dried mass of the oil sorbed sorbent was measured on an analytical balance. It was heated in a drying oven at 300-

3200 C until the mass did not change, that is, until the oil came out. The amount of oil absorbed into the sorbent was determined using the following formula:

$$q_e = \frac{m_0 - m_e}{m_e}$$

Here: qe is the amount of sorption in g/g, m0 is the mass of the absorbed oil, me is the mass of the sorbent after heating. The dependence of oil absorption on vermiculite-based sorbent on oil concentration was studied. The graph below shows the dependence of the sorption equilibrium with the increase in the amount of oil in mixtures containing motor oil and diesel oil.

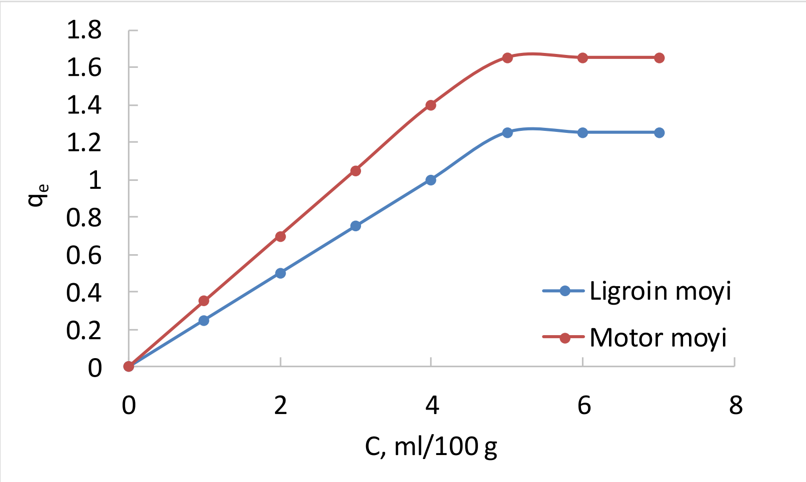


Figure 5. Dependence of sorption of motor oil and diesel oil on vermiculite-based sorbent on oil concentration.

In Figure 5, we can see that the sorption of kerosene and motor oil on expanded vermiculite increased with increasing oil concentration. Porosity and oleophilic properties of expanded sorbent based on vermiculite were found to adsorb diesel and motor oils up to 1.25 g/g and 1.65 g/g, respectively. It was found that the local vermiculite-based sorbent has a high sorption property in oil cleaning. It was found that the expanded adsorbent based on vermiculite can be reused several times in the treatment of oil-contaminated water. It is recommended to use expanded vermiculite mineral based on local raw materials to treat waste water of industrial enterprises, especially car washes.

References:

1. Nargiza, E., & Ulugbek, M. (2022). PHYSICO CHEMICAL PROPERTIES OF SULFOCATIONITE BASED ON WALNUT SKIN NUMA. Universum: химия и биология, (7-3 (97)), 23-26.
2. Тураева, Х. Т. (2022). ПРОВЕДЕНИЕ ЗАДАНИЯ РЕАКЦИИ ПОЛИКОНДЕНСАЦИИ КЛАСТЕРНЫМ МЕТОДОМ. Universum: психология и образование, (7 (97)), 4-8.3. Аширов А. Ионообменная очистка сточных вод, растворов и газов. М.: Химия, 1983.
4. Курбанов, Х. Г., Ахмедова, Н. Н., Сагдиев, Н. Ж., Турсунмуратов, О. Х., & Бекчанов, Д. Ж. (2020). МОДИФИКАЦИЯ ГИАЛУРОНОВОЙ КИСЛОТЫ. Universum: химия и биология, (10-1 (76)), 32-36.
5. O. Abollino, A. Giacomino, M. Malandrino, E. Mentasti. The Efficiency of Vermiculite as Natural Sorbent for Heavy Metals. Application to a Contaminated Soil. Water, Air, and Soil Pollution. vol 181, 149–160 p (2007).

4. З.М. Рохимбоева, Б.Г. Махкамов, Д.А. Гафурова. Сорбция ионов тяжелых металлов из водных растворов с использованием функционализированного полиакрилонитрила вермикулита. Universum: химия и биология.1-1 (79 ст.) 2021.
5. ESHCHANOV R., SHIRINOVA D. KIMYO DARSLARIDA MINERAL O'G'ITLAR MAVZUSINI O'QITISHDA BARQAROR TARAQQIYOT TA'LIMI TUSHUNCHALARINI RIVOJLANTIRISH //EDAGOGIK AHORAT. – С. 244.
6. Shirinova, D. O. Q., & Eshchanov, R. A. (2021). OSMOS VA TESKARI OSMOS HODISALARINI MAKTABDA O 'QITISHDA KLASTER METODI. Academic research in educational sciences, 2(12), 986-991.
7.I.N. Khaidarov, R.I. Ismailov, "Research of features and compositions of vermiculite for use as suspension fire retardant for textile materials" Technical science and innovation: Vol. 2020: Iss. 2, Article 9. (2020) https://uzjournals.edu.uz/btstu/vol2020/iss2/9
8. Juraev, M., Khushvaktov, S., Botirov, S., Bekchanov, D., & Mukhamediev, M. (2020). Kinetics of Sorption of Ca (II) And Mg (II) Ions from Solutions To a New Sulphocathionite. International Journal of Advanced Science and Technology, 29(7), 3395-3401.