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ИССЛЕДОВАНИЕ ФАКТОРОВ, ВЛИЯЮЩИХ НА ОСНОВНОЙ ПРОЦЕСС ОЧИСТКИ СТОЧНЫХ ВОД АДСОРБЦИОННЫМ МЕТОДОМ

STUDY OF THE FACTORS INFLUENCING THE MAIN PROCESS OF WASTEWATER TREATMENT BY ADSORPTION METHOD

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Аннотация. Исследования посвящены очистке воды, загрязненной нефтью и нефтепродуктами, методом адсорбции. В качестве адсорбента использовали сорбент из скорлупы фундука. В зависимости от времени сорбции приведена способность адсорбента поглощать нефть и бензин в зависимости от времени. Зависимость сорбционной емкости адсорбента от времени, степени очистки сточных вод и скорости адсорбции приведены графически.

Ключевые слова: сорбент, адсорбция, вода, масло, бензин, график, активность.

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Annotation. The research is devoted to the treatment of water contaminated with oil and oil products by adsorption. A sorbent made from hazelnut shell was used as an adsorbent. Depending on the sorption time, the adsorbent's ability to absorb oil and gasoline depending on the time is given. The dependence of the sorption capacity of the adsorbent on the time, the degree of puri-fication of wastewater and the adsorption rate are given graphically.

Keywords: sorbent, adsorption, water, oil, gasoline, graph, activity.

In order to effectively purify wastewater from oil or oil products using adsorbents, it is expedient to study their sorption properties under dynamic conditions. For this purpose, the filtration method is used by passing the mixture to be cleaned through the absorbent layer. When studying the sorption properties under dynamic conditions, the rate of water supply and the concentration of oil in the treated water should be taken into consideration. The effectiveness of adsorbents is determined by the degree of purification of oil-contaminated water (1). Depending on the rate of passage through the stationary adsorbent layer, a number of experiments are carried out in advance to determine the degree of purification of wastewater from oil or oil products. The volume velocity of water passing through the adsorbent layer should be taken 6, 15 and 32 ml/min. The tank, 45 cm high and 3,5 cm in diameter, is filled with adsorbent at a level of 20 cm and then raw material is given from the top of the tank. The purified water passing through the sorbent layer under hydrostatic pressure is distributed in 250 ml containers. The purified water is odorless, transparent and complies with GOST 3551-46. The allowable concentration of oil in household water is 0,05 mg/l (2).

As it is known, the study of sorbent absorption capacity is of special importance in the process of adsorption purification (3). The ability of an adsorbent treated at 300 ° C to sorb oil or oil products at different time intervals is given in Table 1. Figure 1 shows a time dependence of the sorption capacity of the adsorbent.

As can be seen from the table, the sorption capacity of sorbents during long-term processing is low, which prevents them from being used to collect spilled oil or petroleum products.

Table 1 – Sorption capacity of used sorbents

Adsorbent prosecced at a temperature of 300 °C	Sorption time, hours	Sorption capacity, gr/gr	
		Oil	Gasoline
	1	0,38	0,21
	2	0,56	0,17
	24	0,82	0,22

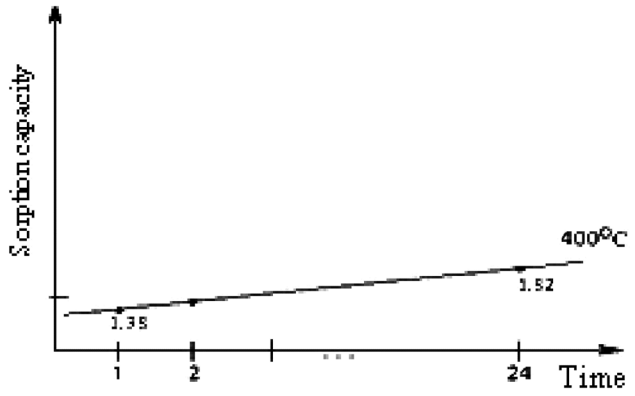

Figure 1 – Time dependence of adsorbent sorption capacity

The conduct research within 1 hour to determine the oil content of the sorbent. It turns out that 1 g of sorbent has the ability to absorb 0,38 g of oil or oil products. The longer the sorption time, the greater the sorption capacity of the adsorbents. The kinetic dependences of the sorption capacity of the synthesized sorbent used were also investigated.

The literature shows that it is more convenient to use carbon adsorbents in the treatment of water contaminated with oil or oil products (4).

Therefore, in our research we used coal processed at a temperature of 300 °C.

Adsorption rate is one of the main parameters in the process of purification of wastewater from oil or oil products, because the contact time of the adsorbent with water is very short (5). During this time, it is very important to have enough time to completely clean the water from oil or oil products. After the adsorption process are selected the most effective and inexpensive methods for cleaning coal. Regeneration of the sorbent used in the purification process is carried out by mixing it with gasoline, the purified sorbent is processed at a temperature of 300 °C to completely remove oil products. Therefore, it was found that the high mechanical strength of the sorbent allows it to be regenerated many times. During the process, the sorption properties of the adsorbent obtained from the hazelnut shell were taken into consideration. As mentioned, this sorbent is obtained by compressing the product of hazelnut shell combustion in airless conditions under pressure. The dependence of the degree of purification of water containing 23,5 mg/l of contaminant on the adsorption rate is shown in Figure 2.

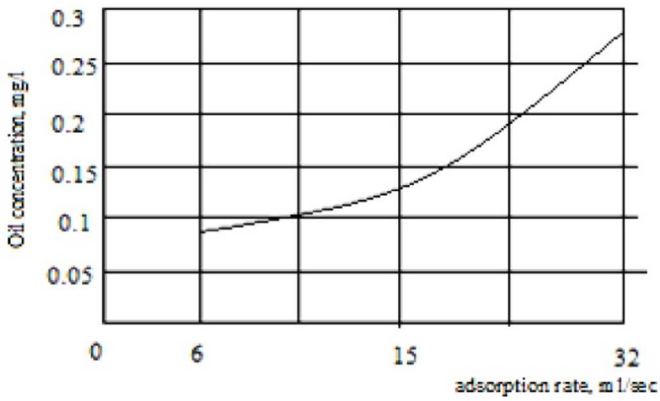

Figure 2 – The dependence of the degree of purification of water containing 23,5 mg/l of contaminant on the adsorption rate

An important indicator of the adsorbent used compared to other sorbents is the aeration of the water on it. This is due to the presence of air bubbles in the pores on its surface.

The high amount of dissolved air creates microbubbles in the crystal lattice of carbon, which leads to the destruction of the active centers. Therefore, one of the main stages in the process of sorption by coal is the elimination of the aeration process. The high specific gravity of the adsorbent, as well as the presence of carbon, gives it mechanical and thermal strength, which allows you to use the adsorbent from the hazelnut shell in the first stage of cleaning (6). The results of research in the process of physical adsorption treatment of oil and oil products from wastewater allow to study the requirements for the porous structure of the adsorbent. These requirements include the size of micropores and intermediate pores r > 0,6–0,7 nm and r = 2 ÷ 2,5 nm. Today, it is impossible to achieve the development of the production of carbon-containing sorbents with the selection of raw materials and technological regimes. Currently, the problem of activating adsorbents is directly related to changes in their surface properties.

The study of the sorption properties of pollutants on the surface of the adsorbent allows the process of their separation from the water, which ultimately ends with the purification of water. Thus, adsorbents that meet the requirements of physical and chemical properties are widely used in the treatment of water contaminated with oil and oil products (7). Synthesized coals, the pore structure of which corresponds to the size of the molecules of the adsorbed substances, are involved in the process of deep purification of water.

As mentioned, the sorbent made from hazelnut shell meets the above criteria, so it is widely used in the treatment of water contaminated with oil and oil products. The graph below shows the time dependence of the absorption capacity of a sorbent made from hazelnut shell.

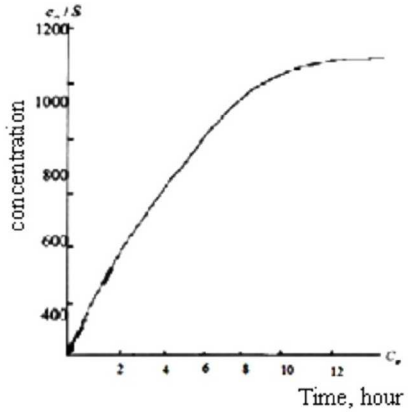

Figure 3 – Time dependence of sorbent activity

The result

The following results were obtained in the research:

– The process of adsorption treatment of water contaminated with oil and oil products is selected and justified.

– Charcoal made of hazelnut shell, processed at a temperature of 300 °C and economically and emologically advantageous, was selected as an adsorbent for the process.

– Absorption capacity of the adsorbent for oil and gasoline depends on time.

– The change in the activity of the sorbent over time is shown in the graph.

Литература:

1. El-Naas M., Alhaija M., Sulaiman A.Z. Evaluation of an activated carbon packed bed for the adsorption of phenols from petroleum refinery wastewater // Environ. Sci. Pollut. Res. – 2017. – 24 p.

2. Зубарева Г.И., Копытова Е.В., Гуринович А.В. Глубокая очистка сточных вод нефтехимического производства // Экология и промышленность. – 2007. – 15 с.

3. Petroleum hydrocarbons adsorption from aqueous solution by raw sugarcane bagasse / R. Behnood [et al.] // Int. J. Emerg. Sci. Eng. – 2013. – № 1. – P. 96–99.

4. Ксеник Т.В., Юдаков А.А., Перфильев А.В. Новый сорбент для очистки сточных вод от органических загрязнителей // Экология и промышленность. – 2009. – С. 19-21.

5. Adsorption-oriented processes us-ing conventional and non-conventional adsorbents for wastewater treatment. Green Adsorbents for Pollutant Removal / G. Crini [et al.] // Environmental Chemistry for a Sustainable World 18. Springer Nature, 2018. – P. 23–71.

6. Corwin C.J. Adsorption and desorption of trace organic contaminants from granular actiated carbon adsorbers after intermittent loading and thoughout backwash cycles // Water research. – 2018. – № 2. – P. 417–426.

7. Valdivieso A., Song S. Temperature effect on the zeta potential and fluoride adsorption at the α-Al_2O_3 // Journal of Colloid and Interface Science. – 2006. – Vol. 298. – № 1. – P. 10–15.

References:

1. El-Naas M., Alhaija M., Sulaiman A.Z. Evaluation of an activated carbon packed bed for the adsorption of phenols from petroleum refinery wastewater // Environ. Sci. Pollut. Res. – 2017. – 24 p.

2. Zubareva G.I., Kopytova E.V., Gurinovich A.V. Deep treatment of petrochemical wastewater // Ecology and industry. – 2007. – 15 p.

3. Petroleum hydrocarbons adsorption from aqueous solution by raw sugarcane bagasse / R. Behnood [et al.] // Int. J. Emerg. Sci. Eng. – 2013. – № 1. – P. 96–99.

4. Ksenik T.V., Yudakov A.A., Perfiliev A.V. New sorbent for wastewater treatment from organic pollutants // Ecology and industry. – 2009. – P. 19–21.

5. Adsorption-oriented processes us-ing conventional and non-conventional adsorbents for wastewater treatment. Green Adsorbents for Pollutant Removal / G. Crini [et al.] // Environmental Chemistry for a Sustainable World 18. Springer Nature, 2018. – P. 23–71.

6. Corwin C.J. Adsorption and desorption of trace organic contaminants from granular actiated carbon adsorbers after intermittent loading and thoughout backwash cycles // Water research. – 2018. – № 2. – P. 417–426.

7. Valdivieso A., Song S. Temperature effect on the zeta potential and fluoride adsorption at the α-Al2O3 // Journal of Colloid and Interface Science. – 2006. – Vol. 298. – № 1. – P. 10–15.