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THE INFLUENCE OF THE SUSPENSION SOLUTION (PULP) ENVIRONMENT ON THE SORBENT'S SORBENT SORBENCE

Sultonov Shavkat Abdullayevich [1], ***Narkulov Dilshod Axmatovich*** [1]

[1] Navoiy State Universitet

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Abstract

Today, one of the most effective methods of modifying clay powders is the effect of thermochemical processes. The main purpose of the article is to increase the sorption properties of specific sorbents for cleaning vegetable oils.

When processed by the thermochemical method, two-sided (temperature and acid) clays can be artificially modified. As a result, it was found that the size of the sorbent volume increased. The increase in the depth of the pores along with the surface area of the sorbent was analyzed and studied using the adsorption-isothermal analysis method. The most effective method for obtaining sorbents was determined using the thermochemical process. In addition, the sorption properties differ depending on the type of clay powder. It was found that the pH of the clay powders during the washing process is important for achieving a standard pH environment.

Keywords: *Palygorskite clay powder, porosity, sulfuric acid, grinding, bleaching, activation*

The urgency of the issue

Today, there are more than 100 types of clays that exhibit sorption properties in the world. Sorbents obtained by thermally activating the sorption properties of clay powders are used only for the purification of vegetable oils and drinking water, especially when small molecules are mixed with the product to be purified. There are also more than 10 types of clays for purifying cottonseed oil, and their activation processes have also been found to differ from each other. Depending on the method of processing clay powders and the type of clay powder, there are variations in the methods of carrying out activation processes, which differ from each other. According to the Lewis and Brønsted-Lowry theories, metals in sorbents play an auxiliary role in the sorption of organic substances that exhibit the properties of pollutants in dusty products.

The thermal method of processing clay powders produces pores of various sizes due to the reduction in the percentage of alkali and some alkaline earth metals. Therefore, depending on the quantitative ratio of elements with high metallicity in such clay powders, it is possible to increase the sorption properties. It was found that thermal activation leads to relatively similar results with chemical activation. A comparative analysis of the activation processes can be observed in Figure 1 below.

Figure 1. *Changes in sorption properties through chemical and temperature effects during the activation process*

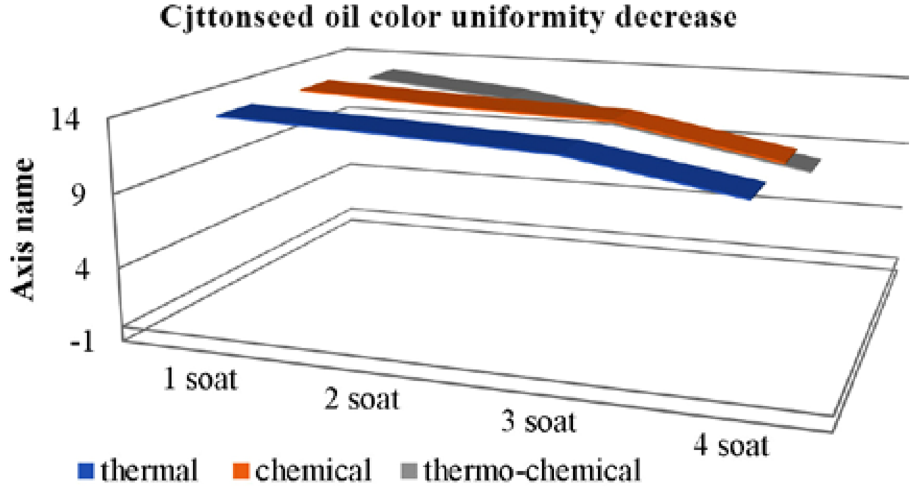
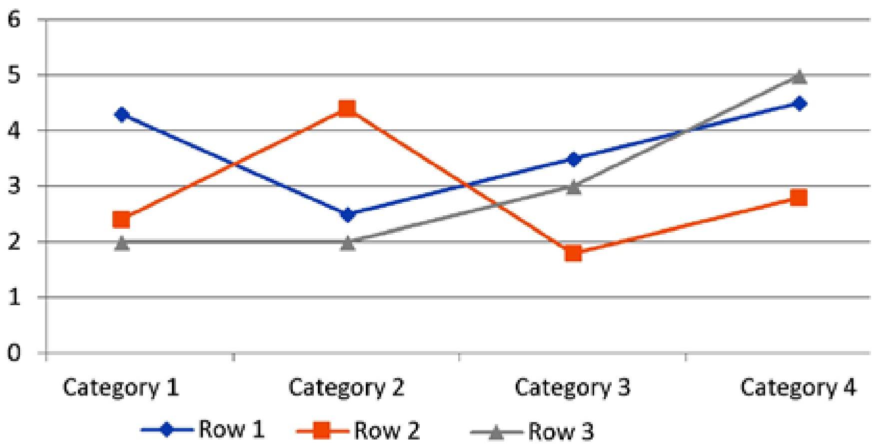


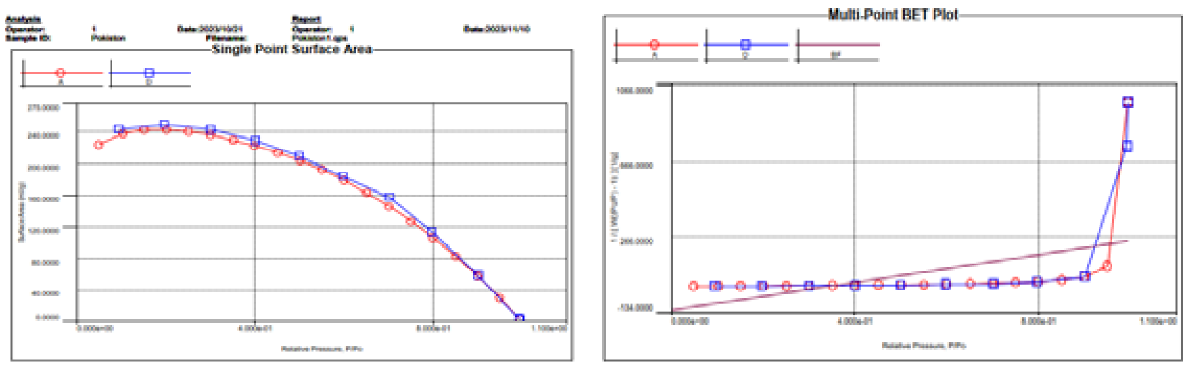
Figure 2. *As can be seen in the figure, thermochemical reactions achieve highly efficient results*



One of the effective methods for increasing the sorption properties of clay powders is thermochemical. When activated by this method, reactions occur as a result of two external influences (both temperature and acid). As a result, it was found that the sorption surface area increased. The results of adsorption-isothermal analysis show that the diameter and depth of the pores of the sorbent, along with the surface area, also increased, as can be seen in Figure 1 (a and b).

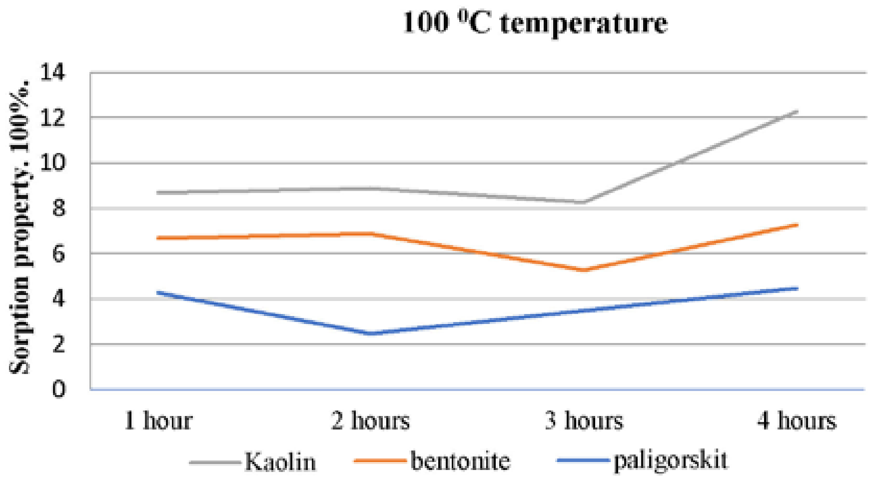
Figure 3.

a) b)



In the example of the most effective method of obtaining sorbents, the result of thermochemical processes was determined as the most optimal. In addition, the sorption properties of clay powders also differ depending on the type of clay powder. For example, in the process of activating palygorskite clay powders, the concentration of the acid solution and the acidic environment of the sorbent differ from those of kaolin and bentonite powders, as can be seen in Figure 2 below.

Figure 2. *Effect of activation time on clay powder types*



The figures and data presented in Figure 2 show that the concentration of the acid solution is lower when activating palygorskite clay powder and the sorption properties are higher.

A suspension solution (pulp) environment is also determined during the washing process at the final stages of obtaining sorbents. During the research, it was found that white or yellow palygorskite or clays that react violently with an acid solution have a sharp decrease in pH values during washing processes. The hardness of these clays, in particular, the difficulty of grinding, is explained by the strength of these inter-element interactions or bonds. The ability to react violently indicates that the clay consists of elements that exhibit strong metallic properties. In addition, from the results of the experiments, it can be concluded that if their electronegativity differs sharply from each other, the grinding properties of clays decrease.

If the pulp activated at high temperatures (from 100 °C to 300 °C) is dried until the pH value is equal to 3 during washing, the resulting sorbent is again observed to approach 5. This sharp decrease in the pH value is explained by the fact that the activation process also occurs during the drying process. It was also found that when activated twice without boiling (when the amount of water is small), but only as a result of drying, the pH value changes to 0.2.

Clay powders, which require a large amount of water during the reprocessing process, on the contrary, when dried in an acidic environment, the pH value increases to 1.5. It was observed that when activating such clays, if the quantitative ratio of acid is used less, the phenomenon of suffocation occurs. To determine the sorption properties of the resulting sorbent, a test was conducted by cleaning cottonseed oil. During the cleaning process, it was found that the sorbent darkened. This darkening is accompanied by sorption and partial saturation, as can be seen in Table 1 below.

From Table 1, it can be concluded that the higher the water content during activation, the greater the reduction in the occurrence of clogging. The optimal water content is 4 times higher than that of clay. At the same time, even if the water content is low, the optimal acid content is 1 time lower.

In both of the above activation methods, drying in an air dryer is required. It was found that the sorption properties of bentonite clays decreased sharply when dried by boiling in a reactor. In Figure 2 below, it can be seen that the pH of palygorskite clays decreased to the maximum as a result of drying.

Table 1. *Effect of different clay: water ratios on sorption properties during activation. At 150 0C, clay: acid ratio 1:0.5*

T/r	lay: water ratios	Volume of the sorbent relative to the sorbent	Sorption property	lay: water ratios	Volume of the sorbent relative to the sorbent	Sorption property
1	1:3	1.4	40	1:1	2	48
2	1:4	1.1	48	1:1.5	1.8	48
3	1:5	0.9	34	1:1.3	2	47
4	1:6	0.7	30	1:1.2	2.3	40

If the pH value is determined during the first washing (for the first time) and after filtering and drying, there is a sharp difference. It was found that the activation process does not change the pH value significantly when the drying process is carried out 2 or 3 times in a row. It was observed that the pH value decreases sharply when clay powders that require a lot of water during the activation process are dried. If the acid concentration is reduced in such clay powders, the activated powder exhibits a fouling property, and the fouling phenomenon is also observed in the purification of oils, and the filtration process is also sharply reduced or stopped. If the acidic environment is even higher, it turns the oil red. In the drying process without boiling, if all stages are carried out in air dryers, the sorption property is high. The effect of acid concentration and suspension solution medium on the sorption properties of clay powders is presented in Table 2 below.

Changes in sorption properties of different clays under the influence of temperature, acid concentration, and solution medium

Table 2.

T/r	Activated clays	Temperature (at °C)	Acid concentration	Suspended solution pH indicator	Sorption property (in %)
1	Palygorskite	200	10	2.5	80
				3.5	82
			20	2.5	90
				3.5	92
		300	10	2.5	86
				3.5	88
			20	2.5	96
				3.5	94
2	Bentonite	200	10	2.5	50
				3.5	76
			20	2.5	80
				3.5	78
		300	10	2.5	80
				3.5	80
			20	2.5	86
				3.5	84

T/r	Activated clays	Temperature (at °C)	Acid concentration	Suspended solution pH indicator	Sorption property (in %)
3	Kaolin	200	10	2.5	60
				3.5	62
			20	2.5	78
				3.5	82
4		300	10	2.5	82
				3.5	80
			20	2.5	86
				3.5	90

When sorbents are used for food purification and other purposes, it is necessary to compare their compliance with standard requirements and conduct various important analyzes. Even after activation, it is advisable for the researcher to check the effects of sorbents on the environment, the human body, the possibility of repeated use and in which other areas the used sorbent can be used, in particular, other properties. Analysis and comparison indicators, that is, combining theoretical, practical, laboratory work experiences, are written as experimental results.

To find out what the initial pH of the sorbent obtained by processing natural clay powder is, add 1 g of sorbent to 15 ml of water and mix for 1–2 minutes. If it is not mixed, an error is made in determining the acidity of the medium. It is also advisable to mix slowly during the determination. The active metals in the clay powder react and come out in the form of soluble salts. The metals are replaced by hydrogen cations, and since these cations are somewhat difficult to determine, they must be mixed. According to the Lewis theory, the hydrogen cation exhibits an electrophilic nature that accepts electrons from other metals in the clay. As the clay powder settles to the bottom of the solution, the acidity decreases in the upper part of the solution, which interferes with the analysis of the sorbent. The pH should be between 3.8–5, taking into account the areas of application of sorbents and the type of clays to be activated.

The density of sorbents also varies. After activation of clay powders, their density decreases. If the density of the processed sorbent is reduced by two or more compared to the initial clay powder, the expected result is achieved.

When using sorbents, it is also necessary to pay attention to the composition of the product. The properties of the product being cleaned are determined by the presence of similar properties in the sorbent, since these properties are explained by the ability of the sorbent to react.

References:

Sultonov Sh. A., Kholov Kh. Influence of acid environment changes on sorption properties during clay powder processing \\ Austrian Journal of Technical and Natural Sciences — № 7–8. 2023. July, — August. — P. 14–17.

Xolov X. M., Sobirov B. B., Sultonov Sh. A. Solid State Technology — Volume: 63. — Issue: 6. Publication Year: 2020. Archives Available @ www.solidstatetechnology.us 13910. Exploitational Effects on Physical and Chemical Processing and Cleaning of Motor Oils Used in Cars.

Sultonov Sh., Xolov X., Sayimova D. Influence of acid concentration and activation method on paligor-skitniadsorption properties Republican scientific-practical conference with the

participation of interna-tional scientists on "Actual problems of chemical-technological sciences". March, 10–11, 2021.
Sultonov Sh. A., Sayimova D. K., Kholov Kh. M. Physico-chemical analysis of clay powder with sorption characteristics \\ Austrian Journal of Technical and Natural Sciences – № 7–8. 2023. July – August. – P. 17–21.

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Contact: sshav85@bk.ru