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## SORPTION PROPERTIES OF SORBENTS THAT PURIFY SUNFLOWER OIL

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### Abstract

Today, the variety of materials with sorption properties is expanding. Similarly, activation methods are also becoming more diverse. Among materials with sorption properties, clay minerals are some of the most effective, inexpensive, and environmentally safe options. It is important to note that obtaining sorbents with selective and desorption properties is one of the most pressing issues of our time. Research on obtaining sorbents for the purification of sunflower oil has been limited. However, at the same time, the consumption of sunflower oil is increasing, and along with it, various diseases are emerging. This article presents experiments on the production and application of selective sorbents. A comparative analysis of the resulting sorbents is also provided.

**Keywords:** *Bentonite clay, sorption capacity, activation, aromatic fiber, silicon, activated carbon, filtration*

### The urgency of the issue

Sunflower oil is widely used in industrial and food applications, but significant contamination occurs during its production and processing. These contaminants can cause environmental damage, making it necessary to develop effective purification methods. Bentonite clays, along with their activation techniques, are of high importance in this purification process. This article examines the role of bentonite clays in refining sunflower oil, their activation methods, and their overall effectiveness. The objective is to analyze the use of bentonite as a sorbent and evaluate its efficiency in the refining process.

Currently, numerous scientific studies are being conducted to improve the use

of bentonite as a sorbent. The majority of these are aimed at refining the methods for its physical and chemical activation. In this article, we will review the latest scientific works and innovations.

Sunflower oil is a material widely used in industrial and food applications due to its properties. It is rich in fatty acids and lipids, and also contains high levels of polyphenols. However, sunflower oil can oxidize quickly and lose its quality during long-term storage. These processes lead to the formation of impurities, which must be effectively removed. Bentonite clays, with their high sorption capacity and chemical neutrality, play a crucial role in this process.

The contamination of sunflower oil harms the environment. Polluted oils contaminate water resources and negatively affect terrestrial flora and fauna. Sorbent materials used in the purification process, particularly bentonite, help to reduce this contamination.

Bentonite is a natural clay mineral primarily composed of montmorillonite, illite, kaolinite, and other minerals. It is highly hygroscopic and exhibits excellent surfactant and sorption properties. The sorption characteristics of bentonite are attributed to the voids and chemical groups present in its porous surface structure.

### Experimental section

The effectiveness of bentonite clays is increased through chemical activation methods. The activation methods are as follows:

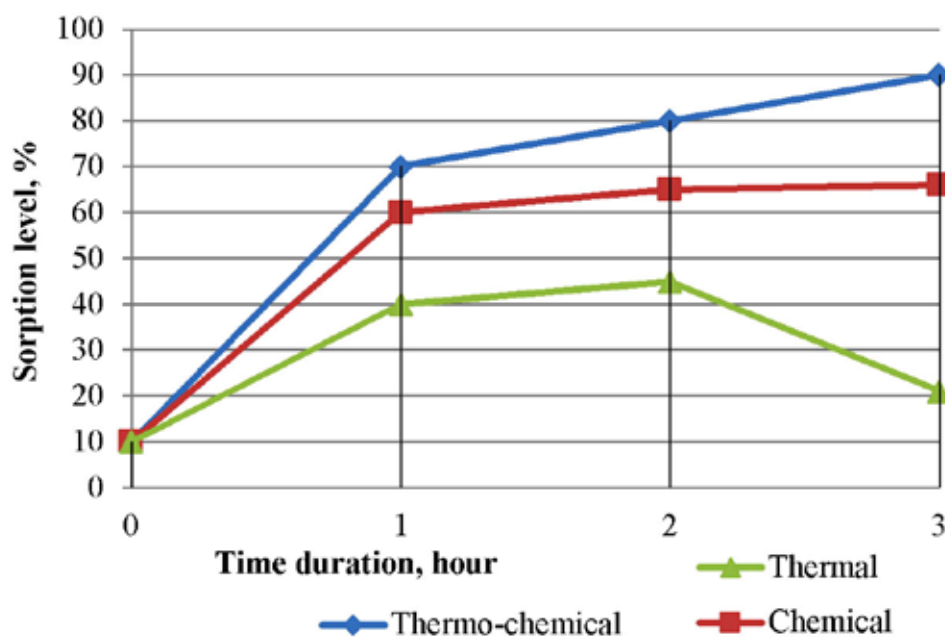
**Thermo-chemical activation:** Acids (sulfuric acid, nitric acid, hydrochloric acid, phosphoric acids) or bases (hydroxides of alkali and alkaline earth metals) are added to the bentonite and heated in the range of 200–250 °C. This activates its surface and increases its sorption capacity.

**Chemical Activation:** Acids or bases are added to bentonite, which activates its surface and increases its sorption capacity.

**Thermal Activation:** Bentonite is heated to a high temperature (400–600 °C), modifying its structure and enhancing its absorption capacity.

The effect of activation methods on the oil purification efficiency of bentonite clays is shown in the diagram in Figure 1.

**Figure 1.** The effect of activation methods on the sorption properties of bentonite



Bentonite, through its activation methods, works effectively in the purification of sunflower oils. It possesses the ability to absorb substances that are harmful to living organisms, contaminate the oil, and reduce its shelf life, which ensures the output of a purified oil.

Bentonite clays are used to refine sunflower oil. This process concludes with the removal of excess substances after the sorbent material is used, followed by the reprocessing of the refined oil. The sorption properties of bentonite make it a highly effective material.

Bentonite clays are inexpensive, natural, and environmentally safe. They possess a high absorption capacity and are effective in purifying many chemical compounds. However, bentonite is difficult to process, and sometimes additional external factors or activating agents are required for chemical activation. Furthermore, some types of bentonite have poor water solubility, which reduces processing efficiency.

**Table showing the effectiveness of bentonite clays and other sorbent materials in refining sunflower oil.**

**Table 1.**

Type of sorbent	Cleaning efficiency (%)	Ecological security	Price range
Bentonite	90%	High	Middle
Activated carbon	85%	Middle	High
Silicon	75%	High	Middle
Aromatic fibers	80%	Low	Low

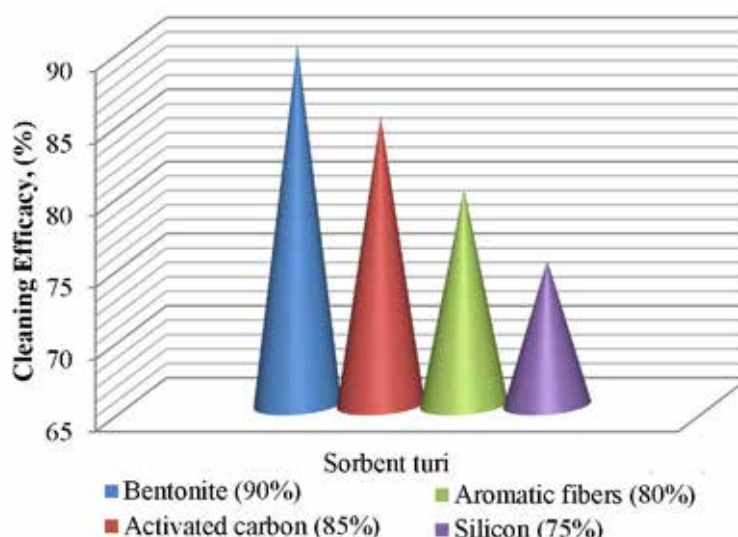
The data in Table 1 indicates that bentonite effectively purifies oil, is an environmentally friendly material that does not harm the environment, and is moderately priced compared to other sorbents.

Several companies worldwide have developed technologies for refining sunflower oil using bentonite clays. For instance, BASF

successfully utilizes bentonite clays for the purification of oily liquids.

When selecting bentonite, its adsorption capacity, mechanical strength, chemical stability, and environmental safety are important. Furthermore, the solubility of bentonite in liquid, as well as its potential for recycling, are also taken into account during the selection process.

**Figure 2.** Stages of the sunflower oil refining process



A diagram illustrating the sunflower oil purification process and the role of sorbents at each stage.

1. Oil Collection → 2. Impurity Identification → 3. Sorbent Application → 4. Filtration → 5. Purified Oil

1. Oil Collection: Sunflower oil is collected.
2. Impurity Identification: Impurities (chemical or mechanical) in the oil are identified.
3. Sorbent Application: Bentonite or another sorbent is added.
4. Filtration: Impurities are absorbed by the sorbent.
5. Purified Oil: The oil, now free of impurities, is separated.

Bentonite materials are considered affordable and effective. Their cost is directly related to their absorption properties. The processing and activation of bentonite should also be economically viable. The reusability of bentonite is an important aspect. Specifically, after the oil is purified, the desorption properties of the sorbent are utilized. The purified oils can be reprocessed and used as new products. The reprocessing of bentonite ensures its environmental safety. As a result, this facilitates the development of waste-free technologies and prevents the release of environmental pollutants.

Bentonite clays are significant from an environmental safety perspective, as they are natural and biodegradable.

Bentonite clays are considered environmentally friendly materials, and their negative impact on the environment is minimal. They decompose naturally and do not release harmful substances into the environment.

The effectiveness of bentonite clays can be enhanced through the use of nanotechnologies, biosorbents, and other advanced materials. These materials possess high sorption capacities, which further improve

the purification process. It is possible to develop new approaches for bentonite activation methods, for instance, by utilizing nanotechnologies. This increases the efficiency of bentonite and expands its range of applications.

Bentonite clays are an effective and ecologically safe material for refining sunflower oil, and their activation methods contribute to improving the technological process. In the future, it is anticipated that bentonite clays will be further developed with the aid of new materials and technologies.

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