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Abstract

Advanced Adsorbent Materials for the Remediation of Contaminated Waters with Heavy Metals via Enhanced Adsorption Mechanisms †

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Abstract: The study depicts the synthesis and potential application of composite materials based on natural polymers (such as chitosan, alginate) with incorporated inorganic substance in their matrix (zeolites, TiO_2, CNT) to adsorb heavy metals ions from contaminated aqueous sources.

Keywords: heavy metal; adsorption; biopolymers

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Introduction: Heavy metals in water can lead to significant environmental and human health problems. These kinds of toxic substances, such as lead, copper, nickel, mercury, cadmium, and arsenic, can infiltrate inside water bodies through industrial discharge, agricultural, and some natural geological processes. Drinking and bathing water sources can become contaminated and can affect the aquatic ecosystem when the quantity of heavy metals is excessive. Additionally, heavy metal pollution of water sources can harm aquatic life. Therefore, it is crucial to control and remove heavy metals from water sources in order to safeguard the ecosystem and the health of the general public [1].

The need to discover new, economically viable techniques (in terms of low cost, simplicity, and fast appliance) and materials that can be used to successfully remove heavy metals from water has become a new trend in research [2].

In this manner, adsorption of heavy metal ions using adsorbent materials can be efficiently used over other typical removal methods (such as reverse osmosis, ion exchange, electrochemical treatments, and chemical precipitation).

Composite materials based on natural polymers (such as chitosan, alginate) with inorganic substances incorporated in their matrix (zeolites, TiO_2, CNT) have attracted attention due to the combination of the properties of two different classes of compounds in a single material. The adsorption process generally depends on several factors, such as pH, temperature, and the nature of the adsorbent material [3].

Materials and methods: Adsorbent materials were synthesized from natural polymers as an organic matrix, and a zeolite-based composite was used as a filler. In this study, the method of obtaining adsorbent materials based on natural polymers and an inorganic matrix did not require a long time or resource-intensive processes. To determine the adsorption capacity of heavy metals in simulated laboratory waters, a kinetic study was carried out.

Results: The adsorption capacity of the composite material was analyzed using atomic absorption spectroscopy (AAS). In addition, Fourier-transform infrared spectroscopy (FTIR) and thermal gravimetric analysis (TGA) were used to evaluate the chemical composition and thermal properties of the adsorbents.

Conclusions: In summary, adsorbent materials based on natural polymers and inorganic fillers offer a viable solution for the removal of heavy metals from water.

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