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Abstract

Synthesis and Evaluation of Novel Chitosan-Based Materials for Efficient Removal of Heavy Metal Ions from Wastewaters †

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1. Introduction

Heavy metals are considered toxic pollutants as they are not biodegradable and tend to accumulate in living organisms, causing various adverse effects such as cancer, neurological disorders, and damage to the kidneys, liver, and other organs. Additionally, heavy metals can also alter the physical and chemical properties of water, making it unsuitable for consumption or agricultural use. The negative impact of heavy metals on water has led to the development of various technologies for their removal and remediation from contaminated water sources [1,2]. Chitin, a naturally occurring polymer found in the shells of crustaceans like shrimp and crabs, is the source of the biopolymer chitosan. Due to its ability to adsorb heavy metals, dyes, and organic molecules from contaminated water, it has generated interest for wastewater treatment. Various wastewater treatment processes, including coagulation–flocculation, membrane filtration, and adsorption, can use chitosan-based materials as adsorbents, flocculants, and membranes. Chitosan is an promising material for efficient and long-lasting wastewater treatment because of its characteristics, including its high cationic charge density and biodegradability [3,4]. The main objective of the present research is to develop novel polymeric materials utilizing chitosan as a base for the purpose of adsorbing heavy metals from wastewaters.

2. Materials and Method

Chitosan was synthesized through the chemical deacetylation of chitin, which is a cost-effective process that does not involve the extensive use of reagents.

3. Results

Novel chitosan-based adsorbents were obtained, and innovative methods were used to evaluate the adsorption capacities of the materials. Using X-ray diffraction (XRD), Brunauer–Emmett–Teller (BET) analysis, and Scanning Electron Microscopy (SEM), the physical, morphological, and textural characteristics were determined. Adsorption capacity over time was observed using Atomic Absorption Spectroscopy (AAS). For insight into how synthesis parameters affected the final material properties, Thermal Gravimetric Analysis (TGA) and Fourier Transform Infrared Spectroscopy (FTIR) were used.

4. Conclusions

The results demonstrate that the obtained innovative materials possess an exceptional adsorption performance.

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