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CHITOSAN-BASED COPOLYMER — AN ECO-CONSCIOUS APPROACH TO REMOVE HARMFUL HEAVY METALS FROM MINING WASTEWATERS

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Introduction

Human exposure to toxic levels of heavy metals can result in both acute and chronic effects, such as "itai-itai" disease, renal tubular dysfunction, encephalopathy, hypertensive disorders, cancer, coma, and death. Heavy metal contamination has been a serious environmental problem in Romania as well, mostly because of the absence of control and depollution measures during and after the extraction of ores. These facts attracted increasing interest among researchers in the field of wastewater decontamination.

Materials and methods

The structure and morphology of the copolymer were analysed using various techniques, including solid-state nuclear magnetic resonance (NMR), scanning electron microscopy (SEM), X-ray photon electron spectroscopy (XPS), and Fourier transform infrared spectroscopy (FTIR). Flame atomic absorption spectrometry (FAAS) was used to measure heavy metal concentrations. Equilibrium isotherms, kinetic models, and artificial neural networks (ANN) were applied on experimental data to describe the adsorption process. Additional adsorption tests were conducted using water samples from two Romanian mining regions, namely Roşia Montană and Novăț-Borșa. The samples were collected during both the summer and winter seasons to ensure a comprehensive analysis of the adsorption levels. The study aimed to provide a detailed understanding of the water quality in these regions, which were formerly known for their mining activities. The results of the study would be crucial in developing strategies to improve water quality in these areas.

Results and conclusions

The findings showed high adsorption efficiency (50–100%) for Pb and Cd after performing tests on stock solutions. Maximum adsorption was reached fast, after 45-60 minutes of contact time. The models used suggest that the sorption capacity of the material is directly dependent on the contact time and initial metal concentrations. The regeneration study of the copolymer showed that the adsorption efficiency decreased to 10-20% after 7 adsorption-desorption cycles.

On the other hand, the tests on mining wastewater samples indicated excellent removal efficiencies (100%) for Ni, Pb, Cd, and Cu on all investigated samples (Figure 1). Nevertheless, high adsorption efficiencies (85-95%) were found for Fe and Zn in water samples from Rosia Montana and Novat-Borsa, respectively.

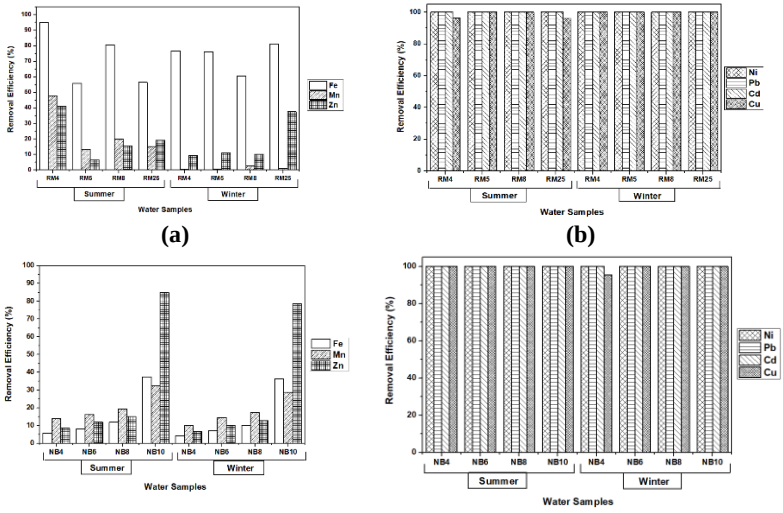

Fig. 1. Heavy metals removal efficiencies in water samples from Rosia Montana **(a ,b)** and Novat-Borsa **(c, d)** Mining Areas, Romania.

To summarize, chitosan was modified using eco-friendly methods to synthesize a new hybrid material. The results of the current investigation suggest that the "green" copolymer is cost-effective, eco-friendly and has excellent performances in removing metal ions, recommending it for applications in the field of water and wastewater treatment technologies.

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