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A Multi-Templated Fe-Ni-Cu Ion Imprinted Polymer for the Selective and Simultaneous Removal of Toxic Metallic Ions from Wastewater

Authors : Morlu Stevens, Bareki Batlokwa

Abstract : The use of treated wastewater is widely employed to compensate for the scarcity of safe and uncontaminated freshwater. However, the existence of toxic heavy metal ions in the wastewater pose a health hazard to animals and the environment, hence, the importance for an effective technique to tackle the challenge. A multi-templated ion imprinted sorbent (Fe,Ni,Cu-IIP) for the simultaneous removal of heavy metal ions from waste water was synthesised employing molecular imprinting technology (MIT) via thermal free radical bulk polymerization technique. Methacrylic acid (MAA) was employed as the functional monomer, and ethylene glycol dimethylacrylate (EGDMA) as cross-linking agent, azobisisobutyronitrile (AIBN) as the initiator, Fe, Ni, Cu ions as template ions, and 1,10-phenanthroline as the complexing agent. The template ions were exhaustively washed off the synthesized polymer by solvent extraction in several washing steps, while periodically increasing solvent (HCl) concentration from 1.0 M to 10.0 M. The physical and chemical properties of the sorbents were investigated using Fourier Transform Infrared Spectroscopy (FT-IR), X-ray Diffraction (XRD) and Atomic Force Microscopy (AFM) were employed. Optimization of operational parameters such as time, pH and sorbent dosage to evaluate the effectiveness of sorbents were investigated and found to be 15 min, 7.5 and 666.7 mg/L respectively. Selectivity of ion-imprinted polymers and competitive sorption studies between the template and similar ions were carried out and showed good selectivity towards the targeted metal ion by removing 90% - 98% of the templated ions as compared to 58% - 62% of similar ions. The sorbents were further applied for the selective removal of Fe, Ni and Cu from real wastewater samples and recoveries of 92.14 ± 0.16% - 106.09 ± 0.17% and linearities of R2 = 0.9993 - R2 = 0.9997 were achieved.

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