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Regenerable hydrogels based on poly(acrylic acid-sodium acrylate-acrylamide) modified by sodium humate for high removal of Pb^{2+} and Fe^{2+} ions: metal adsorption kinetics and thermodynamic studies

Tripti Singh, Reena Singhal*

Department of Plastic Technology, Harcourt Butler Technological Institute, Kanpur, UP 208002, India
Email: reena_singhal123@rediffmail.com

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ABSTRACT

A novel superabsorbent hydrogel based on poly(acrylic acid-sodium acrylate-acrylamide)/sodium humate poly(AAc-SA-AM)/SH was applied as adsorbent to adsorb metal ions (Pb^{2+}, Fe^{2+}) from the aqueous solutions. The factors affecting adsorption capacity of the poly(AAc-SA-AM)/SH hydrogel such as contact time, pH, temperature, SH content (wt.%), initial concentration of the metal ion, and ionic strength were systematically investigated. Results from the experimental data revealed that an appropriate addition of SH (2.44 wt.%) not only increases the metal ion adsorption of poly(AAc-SA-AM) hydrogel but also improves its regeneration ability. The results showed that the adsorption equilibrium data fitted the Langmuir isotherm better than the Freundlich isotherm. The maximum binding capacity for Pb^{2+} ion was 198 and 164 mg/g/l for Fe^{2+} ion for per g of poly(AAc-SA-AM)/SH (SH_4) hydrogel (high as compared to many other adsorbents). The changes in thermodynamic parameters were also calculated, and the negative ΔG° and ΔH° confirmed that the adsorption process was spontaneous and exothermic. The kinetic studies revealed that the adsorption process can be well described by the pseudo-second-order kinetic model.

Keywords: Hydrogels; Metal ion adsorption; Adsorption kinetics; Thermodynamic parameter

*Corresponding author.