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An Eco-Friendly Ultrasound-Assisted Synthesis of a New Poly(thiourea-amide) and Its Application in the Removal of Ni(II) Ions from an Aqueous Solution

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Abstract—An ultrasound-assisted synthesis of a new polymer, poly[N^1-({4-[3-(4-aminophenoxy)phenoxy]phenyl}-carbamothioyl)-N^3-thioformylisophthalamide] by a polycondensation reaction of isophthaloyl diisothiocyanate and 4,4′-(1,3-phenylenedioxy)dianiline was reported. Different techniques were utilized to prove the chemical structure of the synthesized polymer, including FTIR, ^{1}H NMR, TGA, Brunauer–Emmett–Teller (BET), and field emission scanning electron microscopy (FESEM). The capability of the synthesized polymer to adsorb Ni(II) ions from an aqueous solution was analytically evaluated. The change of several parameters including contact time, Ni(II) ions concentration, pH, and temperature on the adsorption process onto the target polymer was extensively investigated. The results indicated that the optimal adsorption pH was about 7 with the removal efficiency of 78.379% and the adsorbed amount of Ni(II) ions increased when the temperature was increased. The adsorption isotherms analysis revealed that the Langmuir model was the most relevant to describe the adsorption process compared with the Freundlich model. The study of adsorption kinetics showed that the adsorption model of Ni(II) ions onto the surface polymer being significantly correlated with pseudo-second-order model. Based on the thermodynamic studies, the calculated ΔG was negative, ΔH was endothermic, and ΔS was positive, verifying that the adsorption process is spontaneous.

Keywords: ultrasound irradiation, poly(thiourea-amide), adsorption process, Ni(II) ions

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