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THE ADSORPTIVE BEHAVIOUR OF HEAVY METALS ON MAGNETIC NANO-SORBENTS

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Currently, water is one of the most vital human resources and is of the economic, social, political and environmental importance throughout the world. With the rapid development of the economy and industry, large amounts of wastewater containing different kinds of heavy metal ions and organic pollutants are generated. Unlike organic contaminants, heavy metals are not biodegradable and tend to accumulate in living organisms and many heavy metal ions are known to be toxic or carcinogenic. Nano-composites possessing magnetic properties can be used for the efficient removal of various toxic elements from contaminated solutions. Magnetic nano-materials, apart from having the high surface area to volume ratio, possess so many unique properties which make the remediation process economical, efficient and environmentally friendly. In this work we synthesized magnetic nano-sorbents (magnetite (M), magnetic graphene oxide (MGO), magnetic Prussian blue (MPB), magnetic Prussian blue with graphene oxide (MPBGO)) and applied them to the Cu(II), Co(II), Ni(II) and Pb(II) removal.

The batch technique was used to study the adsorption (concentration, pH dependences, dosage, reuse and etc.) of Cu(II), Co(II), Ni(II) and Pb(II) and three sets were conducted for each experiment. The kinetics of the adsorption process were investigated to determine the effect of the initial concentration of metal ions on the Q_e (Equilibrium concentration) with respect to time and the time required to achieve the equilibrium adsorption. Two kinetic models, the pseudo-first-order and the pseudo-second-order, were used to analyze the rate of sorption. To analyze the rate controlling steps such as mass transport and chemical reaction processes, the intraparticle diffusion model (IDM) was applied to kinetics results.

Sorption dependences on the metal ion initial concentrations showed that, the maximum sorption capacities were characteristic for M, MGO, MPB and MPBGO in experiments with Ni (II) (150.86 mg/g), Co (II) – (145.9 mg/g), Pb (II) - (778.9 mg/g) and Cu (II) - (138.5 mg/g). Magnetic nano-sorbents are characterized by fast kinetics –the equilibrium is reached in 60 minutes. Results with M and MGO indicated that one step occurred in the sorption process (ion-exchange reactions on the surface). MPB and MPBGO showed multiple characterizations, indicating that two steps occurred in the sorption process.

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