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Studies of Heavy Metal Ions Removal Efficiency in the Presence of Anionic Surfactant Using Ion Exchangers

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Abstract : Nowadays heavy metal ions as well as surfactants are widely used throughout the world due to their useful properties. The consequence of such widespread use is their significant production. On the other hand, the increasing demand for surfactants and heavy metal ions results in production of large amounts of wastewaters which are discharged to the environment from mining, metal plating, pharmaceutical, cosmetic, fertilizer, paper, pesticide and electronic industries, pigments producing, petroleum refining and from autocatalyst, fibers, food, polymer industries etc. Heavy metal ions are non-biodegradable in the environment, cable of accumulation in living organisms and organs, toxic and carcinogenic. On the other hand, not only heavy metal ions but also surfactants affect the purity of water and soils. Some of surfactants are also toxic, harmful and dangerous because they are able to penetrate into surface waters causing foaming, blocked diffusion of oxygen from the atmosphere and act as emulsifiers of hydrophobic substances and increase solubility of many the dangerous pollutants. Among surfactants the anionic ones dominate and their share in the global production of surfactants is around 50 ÷ 60%. Due to the negative impact of heavy metals and surfactants on aquatic ecosystems and living organisms, removal and monitoring of their concentration in the environment is extremely important. Surfactants and heavy metal ions removal can be achieved by different biological and physicochemical methods. The adsorption as well as the ion-exchange methods play here a significant role. The aim of this study was heavy metal ions removal from aqueous solutions using different types of ion exchangers in the presence of anionic surfactants. Preliminary studies of copper(II), nickel(II), zinc(II) and cobalt(II) removal from acidic solutions using ion exchangers (Lewatit MonoPlus TP 220, Lewatit MonoPlus SR 7, Purolite A 400 TL, Purolite A 830, Purolite S 984, Dowex PSR 2, Dowex PSR3, Lewatit AF-5) allowed to select the most effective ones for the above mentioned sorbates and then to checking their removal efficiency in the presence of anionic surfactants. As it was found out Lewatit MonoPlus TP 220 of the chelating type, show the highest sorption capacities for copper(II) ions in comparison with the other ion exchangers under discussion, e.g. 9.98 mg/g (0.1 M HCl); 9.12 mg/g (6 M HCl). Moreover, cobalt(II) removal efficiency was the highest in 0.1 M HCl using also Lewatit MonoPlus TP 220 (6.9 mg/g) similar to zinc(II) (9.1 mg/g) and nickiel(II) (6.2 mg/g). As the anionic surfactant sodium dodecyl sulphate (SDS) was used and surfactant parameters such as viscosity (η), density (ρ) and critical micelle concentration (CMC) were obtained: $\eta = 1.13 \pm 0{,}01$ mPa·s; $\rho = 999.76$ mg/cm3; CMC = 2.26 g/cm3. The studies of copper(II) removal from acidic solutions in the presence of SDS of different concentration show negligible effects on copper(II) removal efficiency. The sorption capacity of Cu(II) from 0.1 M acidic solution of 500 mg/L initial concentration was equal to 46.8 mg/g whereas in the presence of SDS 45.3 mg/g (0.1 mg SDS/L), 47.1 mg/g (0.5 mg SDS/L), 46.6 mg/g (1 mg SDS/L).

Keywords : anionic surfactant, heavy metal ions, ion exchanger, removal
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