Removal of copper and cobalt from aqueous solutions using natural clinoptilolite

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Abstract

Southern African clinoptilolite capability as an ion-exchanger with respect to Cu^{2+} and Co^{2+} was investigated in order to consider its possible application at removing metals from aqueous solutions. The column method was used in the cation-exchange processes with synthetic solution concentrations of 0.07 M (3.86 g/ℓ), 0.33 M (19.31 g/ℓ) and 0.66 M (38.63 g/ℓ) of Cu^{2+} solution and 0.07 M (3.34 g/ℓ), 0.33 M (16.69 g/ℓ) and 0.66 M (33.37 g/ℓ) of Co^{2+} solution. Synthetic non-mixed sulphate solutions of copper and cobalt recorded maximum cation uptakes of 79% and 63% with 0.02 M HCl-activated clinoptilolite respectively. From the Cu/Co mixed solutions, both cobalt and copper recorded a 79% uptake with 0.02 M HCl-activation. The 0.04 M HCl activation gave percentage removals of 79% and 77% for Co^{2+} and Cu^{2+} respectively. In the ion-exchange evaluation part of the study, it was found that in every concentration range, the adsorption mass ratio of clinoptilolite to metal concentration conformed to both Langmuir and Freundlich adsorption isotherms. However, the non-mixed aqueous solutions of Cu^{2+} and Co^{2+} fitted mainly the Langmuir equation. It was found that the adsorption process depends on the hydrated radius of the cation being exchanged, the concentration of the acid that activates the clinoptilolite and the concentration of the targeted cation in solution.

Keywords: clinoptilolite, cation exchange, copper, cobalt; wastewater