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Surface modification of pine cone powder and its application for removal of Cu(II) from wastewater

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ABSTRACT

Pine cone powder is an agricultural waste material from the wood industry. In this investigation, chemical modification of pine cone powder using NaOH solution of different concentrations (0.01, 0.05, 0.10, and 0.15 mol dm^{-3}) was carried out. The changes in surface properties produced by modification and the ability of the modified products to remove copper(II) from aqueous solution was examined. Chemical characterization of the adsorbent surface by FTIR and Bohem titration showed that an increase in NaOH concentration in the wash solution was found to reduce the amounts of carboxyl and phenolic groups and increase the iodine number. The pH_{PZC} of the raw pine cone powder reduced with NaOH concentration in the wash solution from 7.49 to 2.55. Optimum NaOH concetration for pine cone powder surface modification was 0.15 mol dm^{-3}, while the optimum solution pH, contact time and biosorbent dose for copper(II) removal were pH 5.0, 5 min and 4.0 g dm^{-3} for all samples. Copper(II) removal capacity was higher for samples washed with higher concentrations of NaOH solution (PCP 6.8 mg g^{-1}, PCP 0.1 13.01 mg g^{-1}, PCP 0.05 15.03 mg g^{-1}, PCP 0.10 16.38 mg g^{-1} and PCP 0.15 17.22 mg g^{-1}). The equilibrium solution pH at the end of the biosorption experiments were higher than the initial solution pH when modified samples were used for biosorption but lower than the initial pH when the raw pine cone powder was applied. This may suggest a different mechanism of copper(II) uptake by raw pine cone powder as compared with the modified samples. The paseudo-second order kinetics for copper(II) biosorption gave the best fit with the experimental data for both the raw and NaOH modified pine cone powder.

Keywords: Pine cone powder; NaOH modification; Equilibrium solution pH; Copper(II) capacity

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