Sorption of copper and lead by citric acid modified wood

ABSTRACT

The sorption characteristics of citric acid modified wood to remove copper and lead ions from aqueous solution under batch conditions have been investigated. Sorption was pH dependent with increasing uptake at higher pH values. The kinetics of sorption for both ions was rapid with 90% sorption taking place within the first 60 min regardless of its initial concentration. Sorption can be explained by a second-order kinetics model from which the rate constant, the equilibrium sorption capacity and the initial rate were calculated. From these parameters, the predictive models for Cu and Pb sorbed (qt) in time t and at an initial concentration (Co) are given by qt = Cot[0.31 Co-2.29 + (0.04C o + 5.19)t] and qt = Cot/[0.06C o-6.59 + (0.01 Co + 4.48)t] for Cu and Pb, respectively. Using these models the predicted and experimental uptakes of Cu and Pb were compared and discussed. Maximum sorption capacities of modified wood under present experimental conditions were 23.70 and 82.64 mg/g for Cu and Pb, respectively. However, for untreated wood the corresponding values were 2.56 and 7.71 mg/g indicating a tenfold increase in sorption upon citric acid modification. Ethylene diamine tetraacetic acid and nitrilotriacetic acid complexed with both ions render sorption less favorably. However, salicylic acid had little influence. In a binary system, Pb ions were more favorably sorbed than Cu ions which could be due to the larger ionic radius of the former ions.

Keyword: Copper; Ions; Mathematical models; Organic acids; pH effects; Sorption; Initial concentration; Initial rate; Second-order kinetics; Wood modification; Wood