

Sorptive removal of ciprofloxacin hydrochloride from simulated wastewater using sawdust: Kinetic study and effect of pH

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Abstract

The present work describes dynamic uptake of the antibiotic drug ciprofloxacin hydrochloride (CH), by using a cost-effective agricultural by-product – sawdust (SD). The sawdust was characterised by FTIR and SEM analysis. The sorbent particles were highly porous with average pore diameter of nearly 10 μm . The optimum pH and solid/liquid ratio for sorption of CH were found to be 5.8 and 2.0, respectively. The dynamic drug uptake data was applied to various kinetic models and their order of fitness was found to be pseudo second order > Elovich equation > power function model, as indicated by their regression values. The experimental equilibrium uptake values (q_e) were in close agreement with those evaluated from the pseudo second order equation for initial sorbate concentrations of 10 and 20 $\text{mg}\cdot\ell^{-1}$ at 33°C. The drug uptake mechanism was found to be attractive non-electrostatic interactions, involving H-bonding interactions between H atoms and other electronegative species such as F, O and N of the drug molecule. The mechanism is discussed on the basis of pH_{pzc} of sawdust and zwitterionic nature of drug CH. Mass transfer analysis was carried out using the drug uptake data obtained with sorbate concentrations of 10 and 20 $\text{mg}\cdot\ell^{-1}$. The used sorbent could be regenerated using 1.0 $\text{mol}\cdot\ell^{-1}$ HCl solution with a regeneration efficiency of nearly 85%.

Keywords: sawdust, antibiotic drug, pseudo second order, intra-particle diffusion, mass transfer analysis