Adsorption and desorption of phenol onto barley husk-activated carbon in an airlift reactor

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ABSTRACT

Batch studies of phenol adsorption onto barley husk-activated carbon (BHAC) were performed at different BHAC doses, solution pH, temperatures, stirring speeds, BHAC particle sizes and initial phenol concentrations. The maximum phenol adsorption capacity onto BHAC was 98.83 mg g$^{-1}$ at 25°C and pH 7, similar to commercial activated carbon. The external mass transfer was minimised at stirring speeds greater than 400 min$^{-1}$, and the adsorption kinetics were affected by both the initial phenol concentration and the temperature. Ethanol/water solutions at 10% V/V were the most effective regenerating agent, with a desorption capacity of 47.79 mg g$^{-1}$, after five adsorption–desorption cycles. The breakthrough data for phenol adsorption using an airlift reactor were obtained at different air flow rates, initial phenol concentrations, BHAC doses and influent flow rates. Experimental data confirmed that the time to achieve the breakthrough point increases when the air flow rate or the BHAC dosage increases, as a result of more turbulent flow or greater available surface area, respectively. Additionally, the breakthrough point decreases when the initial phenol concentration or inlet flow rate increases, due to the rapid exhaustion of adsorption sites. These promising results demonstrate the feasibility of adsorption in continuous operation in an airlift reactor.

Keywords: Airlift reactor; Breakthrough curves; Desorption; Intraparticle diffusion; Modelling