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Isotherm, kinetics, and thermodynamics modelling for the removal of chemical oxygen demand, colour, and NH_3–N from coffee processing wastewater by ion exchange resins

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ABSTRACT

Coffee processing wastewater (CPW) is a highly polluted industrial wastewater that can be detrimental to the environment when it is discharged into a watercourse without treatment. The present study looks at the performance of a strong acid cation exchange resin and a strong base anion exchange on the removal of chemical oxygen demand (COD), colour, and ammoniacal nitrogen (NH_3–N) from CPW using batch experiment. The experiments were carried out with varying pH, resin dosage (g), contact time (min), temperature (°C), and shaking speed (rpm). It was observed that over 70% reduction of NH_3–N was achieved under optimal conditions by cation exchange resin, while more than 70% COD, 60% colour removal was attained by anion exchange resin. Langmuir, Freundlich, and Brunauer–Emmett–Teller isotherm models were applied to determine the COD, colour and NH_3–N removal behaviour from CPW using cationic and anionic resins. The findings revealed that the Langmuir equation was the best-described isotherm model for removing COD, colour and NH_3–N from CPW using both cationic and anionic resins. The kinetic study showed that the removal of COD, colour, and NH_3–N was well-fitted with the pseudo-second-order kinetic model. Furthermore, it was observed that the diffusion was the rate-controlling process. The determination of the thermodynamic properties analyses showed that the COD, colour and NH_3–N removal from CPW using cationic and anionic resins was spontaneous and endothermic. The study suggests that both ion exchangers could reduce the concentration of pollutants in the coffee processing wastewater.

Keywords: Kinetics; Ion exchange resin; Chemical oxygen demand; Colour; NH_3–N

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