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REMOVAL OF CRYSTAL VIOLET DYE FROM WASTEWATER USING SLUDGE FROM TREATMENT PLANT: EQUILIBRIUM AND KINETICS STUDIES

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Abstract

The application of modified sludge waste and it's use as efficient and low-cost adsorbents lead to help diminish waste and thus reduce environmental problems. In this study the adsorption capacity of sludge was improved by activating it at 200°C for 60 minutes and used for the removal of crystal violet (CV) dye from wastewater. The sludge was characterized by XRF, FTIR, SEM and XRD. Experiments were conducted to optimize several parameters such as contact time, pH, adsorbent dosage and initial dye concentration. Batch tests demonstrated that CV adsorption was substantially pH dependent and the optimum pH value for dye adsorption was determined as 5.0. The maximum removal of CV was obtained at pH 5.0 as 96% for adsorbent dose of 0.30 g/20 mL and 10 mg/L initial dye concentration at 30^0C. Langmuir, Freundlich, Temkin and Dubinin-radushkevich isotherm models were used to correlate adsorption data. The Freundlich isotherm model best fitted the data which showed the multilayer adsorption of CV dye on adsorbent. Sum of error squares (SSE) function was applied to evaluate the sorption data.Thermodynamic studies showed that the adsorption of CV on activated sludge was an endothermic process. Negative values of ΔG^o (between -2.0379 KJ/mol to -1.4190 KJ/mol) revealed that the adsorption process was spontaneous in all the tested temperatures. Kinetic studies of CV dye were well described by pseudo-second order model. A mass transfer study of CV dye was performed and the value of the mass transfer coefficient was found to be 1.26×10^{-08} cm/s at 30°C. Results showed that activated CETP sludge can be effectively used as low-cost adsorbent for the removal of cationic dyes from wastewater.

Key words: adsorption, crystal violet dye, kinetic, sludge

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