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Optimization of Color and Turbidity Removal from Batik Wastewater by Coagulation and Flocculation Using Poly-Aluminum Chloride (PAC) with Response Surface Methodology (RSM)

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Abstract

The batik industry is a part of the textile industry, which is one of the largest consumers of water and complex chemicals during various stages of processing. Batik industries generate wastewater containing heavy metals, dyes, and suspended solids, which contribute to environmental pollution. Physical-chemical methods are used for batik wastewater treatment; among these, coagulation-flocculation is one of the simplest and most common methods. Polymeric forms of metal coagulants are often used in batik wastewater treatment; however, the conditions are not well optimized. The effectiveness of polyaluminium chloride (PAC) as a coagulant for turbidity and color removal of batik wastewater was evaluated in this study. The two variables, coagulant dose and pH, were considered for the optimization of color and turbidity removal using PAC. The pH range of 2-12, and PAC dose of 0.5-1 g/L, were selected for the optimization study based on the preliminary experiments. The study ranges were chosen as coagulant dosage 0.5-1 g/L and pH 6-8. Central composite design (CCD) within the response surface methodology (RSM) was used to optimize two independent variables (coagulant dosage and pH), each evaluated at five levels. To obtain the optimum dosage and pH, two dependent variables (turbidity and color removal) were determined as responses. Quadratic models developed for the two responses showed that a coagulant dosage of 0.82 g/L and a pH of 6.3 are the optimum conditions, resulting in turbidity and color removal efficiencies of 88.3% and 84.8%, respectively. The experimental data and model predictions showed good agreement (turbidity, R^2=0.9639; color, R^2=0.9192). This study demonstrates that PAC effectively removes the colour and turbidity in batik wastewater under optimum conditions. Therefore, it can be concluded that optimizing the coagulation-flocculation process with PAC is an effective approach for treating batik wastewater.

Keywords: *Coagulation-flocculation, Batik wastewater, Polyaluminium chloride, Response surface methodology, Central composite design*