Performance of a Submerged Adsorption Column Compared with Conventional Fixed-Bed Adsorption

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ABSTRACT

Submerged adsorption (SA) process has been explored in this context for the first time as a dynamic and effective approach, comparable to the conventional fixed-bed adsorption. Various design parameters like breakthrough time (t_b), adsorption capacity (q_{eq}), and effective bed height (H_B) of the adsorption columns were determined for different flow patterns, e.g. up-flow and down-flow. A fixed bed of jackfruit (*Artocarpus heterophylus*) leaf powder, already proved by our group as an efficient, cost-effective adsorbent for the removal of methylene blue from water in continuous mode using fixed-bed column, was selected for this study. The design basis of the adsorption columns were regarded as different bed depths (H_T = 5–10 cm), flow rates (Q = 20–60 mL/min), and initial dye concentrations (C_0 = 300–500 mg/L), for the experiment. With decreasing flow rates as well as increasing bed height and initial dye concentration for any flow arrangement, adsorption capacity of the column increased as the breakthrough time and usable bed height increased. Moreover, adsorption columns with up-flow showed better performance than down-flow pattern may be due to increasing q_{eq} and H_B up to 40 and 20%, respectively. Comparing design parameters of SA column to conventional FBA found that q_{eq} increased up to 22% as well as H_B and t_b increased corresponding to 9–14% and 20–86%, respectively. The experimental data were fitted with Thomas model and correlated with theoretical breakthrough curves, which pointed out the evidence of the effective design approach.

KEYWORDS: Submerged adsorption module, Methylene blue, Low-cost adsorbent, Breakthrough analysis, Adsorption column design, Thomas model

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