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Column adsorption study for the removal of phenol from aqueous medium using agro-residue adsorbent

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ABSTRACT

In the wastewater treatment process, fixed-bed and packed bed studies on adsorption have become a popular technical application in industrial sector. In this work, the potential of activated carbon produced from black gram husk (BGH) for the removal of aqueous phenol in a fixed column was investigated. The study of breakthrough time and adsorption capacity augmented with an increase in bed height and minimized with an increase in rate of flow, initial concentration of phenol, and size of the particle. At best conditions of 10 cm height of bed, 100 mg/L as initial phenol concentration, 10 mL/min as flow rate and 300 μm is particle size and the breakthrough-curve of the lesser rate of flow (10 mL/min) increases sharply near the point of exhaustion, signifying that the zone of adsorption was squatter. The best rate of flow should not be greater than 10 mL/min. since the bed depth studied up to 14 cm, the minimum depth (D_{min}) was found to be 4 cm for a rate of flow of 10 mL/min. The time of breakthrough (T_b) vs bed depth [D] for bed depth service time plots were developed, and their comparisons of linear relationship were obtained with all correlation R^2 above 0.94. The capacity of adsorption (N_o) of BGH was considered to be 68.59 and 53.4 mg/cm^3 by using the rate of flow of 10 and 20 mL/min but N_o was sharply decreased to 30.57 mg/cm^3 with the rate of flow of 30 mL/min. The surface physical morphology of the adsorbents studied and the effect of adsorption, as explored by scanning electron microscopy micrographs showed increase in un-evenness of textures. In conclusion, our study has demonstrated that BGH can be utilized for successful removal of phenol from aqueous solutions. It was also shown that the modelling approach has a substantial impact on the outcome of dynamic adsorption system analysis.

Keywords: Phenol adsorption; Fixed-bed; Bed depth; Breakthrough time; Flow rate

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