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Cationic Surfactant-Modified Banan Stem For Adsorption Of Reactive Dye: Column Study

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Structured Abstract

Background: Reactive Orange 16, an anionic sulfonated reactive azo dye has demonstrated that the dye was difficult to remove from the wastewater. Agricultural waste was tested for its ability to adsorb Reactive Orange 16 dye from wastewater. In this study, a surfactant modified banana stem with Cetyltrimethylammoiumbromide (CTAB) was utilized as adsorbent to remove Reactive Orange 16. The banana stem is a herbaceous and non-woody portion of the banana tree that resembles a trunk whereas it has a soft inner core and tightly wrapped leaf sheaths. Moreover, banana stem fibers, also known as musa fibers, are a biodegradable substance made by converting dried stems into short, fiber-like strands.

Methods: The physiochemical properties of the raw banana stem, NaOH treated banana stem surfactant modified banana stem was characterized by Scanning Electron Microscopy (SEM), Fourier-Transform Infrared (FT-IR) and pHpzc. Furthermore, the performance of a fixed-bed column with surfactant modified banana stem as adsorbent media was evaluated using different flow rate (1, 3 and 5 ml/min), bed heights (1, 2 and 4 cm) and initial Reactive Orange 16 concentrations (50, 100 and 150 mg/L) to determine the breakthrough curve. The overall experimental data were fitted into Yoon-Nelson model. Moreover, overall low desorption efficiency %DE, was studied with various pH value (3, 5, 7, 9, 11).

Results: The surface of surfactant modified banana stem (SMBS) is seen to be rougher than that of raw banana stem (RBS) from SEM observation. Besides, form FTIR peak reading shown that the CTAB surfactant has been successfully impregnated into the banana stem. The breakthrough and exhaustion times were 100 minutes and 273.5 minutes, respectively. Meanwhile, the breakthrough time increased as the bed height increased, and breakthrough time decreased as the flow rate and initial concentration increased. The overall experimental data were best fitted with Yoon-Nelson model of R^2 to be greater than 0.9 with highest value of 0.98. A low %DE was obtained from the study, indicating the surfactant modified banana stem can be used for several times.

Conclusion: In conclusion, this study will explain better regarding the surfactant modified banana stem as an effective and low-cost biomass adsorbent for Reactive Orange 16 removal.

Keywords: Reactive Orange 16, Banana stem, cationic surfactant, physicochemical characterization, column study, and desorption efficiency.

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