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Adsorptive removal of tartrazine and methylene blue from wastewater using melamine-formaldehyde-tartaric acid resin (and a discussion about pseudo second order model)

Ahmad Baraka

Egyptian Armed Forces, Cairo, Egypt
Tel. +202 29283998; email: brkamtc@yahoo.com

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ABSTRACT

In this study, a new resin Melamine-Formaldehyde-Tartaric acid (MF-T) was synthesized to investigate the removal of tartrazine (TZ) and methylene blue (MB) dyes. The resin was chemically, physically and morphologically characterized using IR, BET, SEM, TGA, and water content analyses. Kinetics and isotherms of TZ and MB adsorption by MF-T were studied applying batch method. Adsorption-rate data was modeled by pseudo first order (PFO) and pseudo second order (PSO) kinetic models. It was concluded that the rate of adsorption follows PSO model for both dyes. Isotherm study suggests Freundlich and Langmuir models to represent adsorption of TZ and MB respectively at equilibrium. Thermodynamic study revealed that adsorption of TZ and MB onto MF-T is spontaneous. Adsorption is exothermic for TZ in the range 15–30°C and endothermic in the range 30–45°C while it is exothermic for MB over the whole temperature studied range; 15–45°C. The regeneration experiment of MF-T by a physical treatment indicated the ease of desorbing MB from MF-T surface compared to TZ. From kinetic, isotherm, thermodynamic and regeneration studies, it is revealed that physical adsorption is the predominant removal mechanism for TZ at low temperature range and a chemical/physical adsorption process is postulated at higher temperature range. For MB, it is proposed that physical adsorption is the sole removal mechanism over all studied temperature range. It is concluded that MF-T is suitable to remove MB. The present work gives evidence that PSO model can fit both physical and chemical adsorption processes.

Keywords: Polymeric resin; Chemical; Physical; Adsorption; Pseudo-second order model; Dyes