

Investigation of the Use of Surface-Modified Waste Orange Pulp for the Adsorption of Remazol Black B

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Abstract : The adsorption of Remazol Black B (RBB), an anionic dye, onto dried orange pulp (DOP) adsorbent prepared by only drying and by treating with cetyltrimethylammonium bromide (CTAB), a cationic surfactant, surface-modified orange pulp (SMOP) was studied in a stirred batch experiments system at 25°C. The adsorption of RBB on each adsorbent as a function of surfactant dosage, initial pH of the solution and initial dye concentration was investigated. The optimum amount of CTAB was found to be 25g/l. For RBB adsorption studies, while working pH value for the DOP adsorbent system was determined as 2.0, it was observed that this value shifted to 8.0 when the 25 g/l CTAB treated-orange pulp (SMOP) adsorbent was used. It was obtained that the adsorption rate and capacity increased to a certain value, and the adsorption efficiency decreased with increasing initial RBB concentration for both DOP and SMOP adsorbents at pH 2.0 and pH 8.0. While the highest adsorption capacity for DOP was determined as 62.4 mg/g at pH 2.0, and as 325.0 mg/g for SMOP at pH 8.0. As a result, it can be said that permanent cationic coating of the adsorbent surface by CTAB surfactant shifted the working pH from 2.0 to 8.0 and it increased the dye adsorption rate and capacity of orange pulp much more significantly at pH 8.0. The equilibrium RBB adsorption data on each adsorbent were best described by the Langmuir isotherm model. The adsorption kinetics of RBB on each adsorbent followed a pseudo-second-order model. Moreover, the intraparticle diffusion model was used to describe the kinetic data. It was found that diffusion is not the only rate controlling step. The adsorbent was characterized by the Brunauer-Emmett-Teller (BET) analysis, Fourier-transform-infrared (FTIR) spectroscopy, and scanning-electron-microscopy (SEM). The mechanism for the adsorption of RBB on the SMOP may include hydrophobic interaction, van der Waals interaction, stacking and electrostatic interaction.

Keywords : adsorption, Cetyltrimethylammonium Bromide (CTAB), orange pulp, Remazol Black B (RBB), surface modification

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