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REMOVAL OF ACID BLACK DYE BY PUMICE STONE AS A LOW COST ADSORBENT: KINETIC, THERMODYNAMIC AND EQUILIBRIUM STUDIES

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Abstract

The removal of Acid Black 1 dye was investigated by acid treated pumice stone as a low cost adsorbent, since acidic modifications were expected to improve the sorption capacity. The main components of the considered adsorbent were SiO_2 and Al_2O_3 and acid treated pumice shows irregular structure. The effect of various parameters such as the initial dye concentration, the contact time, the temperature and the pH were studied. An increase of the contact time, the initial dye concentration or an acidification of the medium had a positive impact of dye removal. Among the tested isotherms, linear regression analysis showed that the removal of Acid Black 1 dye follows a Temkin model (r^2>0.93). The value of the separation factor (R_L) was 0.17, showing a favorable adsorption. Despite a low specific area (54m^2/g), pumice stone displayed a high sorption capacity (72.46 mg/g), which should be related to its high porosity (85 %). The fitting of experimental time-course data showed that kinetics followed a pseudo-second order model (r^2>0.99). Mass transfer coefficient was determined at various initial dye concentrations and showed external mass transfer cofficient values in the range of 10^{-3}-10^{-4} (cm/s), namely in agreement with the values reported in the available literature. Thermodynamic study demonstrated an exothermic adsorption, which however was not spontaneous. pH and heating methods were tested for dye desorption and confirmed the relevance of pumice stone for dye removal, since the heating method led to 83 % pumice regeneration.

Key words: adsorption, azo dye, batch study, equilibrium, pumice

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