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REMOVAL OF MULTILAN RED AND MULTI-ACTIVE BLUE DYES FROM AQUEOUS SOLUTION BY ADSORPTION AND OXIDATION TECHNIQUES: EQUILIBRIUM, KINETICS AND THERMODYNAMIC STUDIES

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Abstract

This study evaluated the performances of adsorption and Fenton oxidation for the removal of multilan red (MLR) and multi-active blue (MActB) dyes from aqueous solution. Zeolite, the adsorbent used in the study was modified using two surfactants: hexadecyltrimethylammonium bromide (HDTMA-Br) and cetyltrimethylammonium bromide (CTAB). The modified zeolite characterized using FTIR, SEM and XRD analysis. The modification studies revealed that HDTMA-modified zeolite exhibited better performance than CTAB-modified zeolite for both dyes. Acidic pH (pH 2) was found favourable for the removal of both dyes from aqueous solution. The equilibrium data was well described by Freundlich and Langmuir isotherm models in that order. The maximum adsorption capacity of HDTMA-modified zeolite was found to be 476.19 mg g^{-1} for MActB and 1000 mg g^{-1} for MLR dye. The sorption kinetics followed pseudo second order and Elovich mechanisms. The thermodynamic studies showed that the adsorption of MActB dye onto HDTMA-modified zeolite is endothermic in nature whereas the adsorption of MLR is temperature-independent. The ΔH^o, ΔS^o and ΔG^o in the sorption of MActB dye was 27.1 kJ mol^{-1}, 52.54 J mol^{-1} K^{-1} and 42.8 kJ mol^{-1}, respectively. The low value of ΔH^o (< 40 kJ mol^{-1}) suggests that the MActB dye sorption occurred through a physical means. Further, the Fenton's oxidation was able to achieve dye removal efficiency of 25-45 %. The combination of adsorption and Fenton oxidation significantly enhanced the dye removal efficiency to a maximum of 95 %, demonstrating its potential application in the treatment of textile dye effluents.

Key words: adsorption, dye, modeling, oxidation, wastewater, zeolite

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