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Efficient removal of neutral red dye using microporous materials: synthesis, isotherms, and kinetics studies

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ABSTRACT

The objective of this study was to determine the power of four microporous materials synthesized not incorporated (S-1, ZSM-5) and incorporated into metals (VS-1, CuZSM-5) in the degradation of a cationic dye (Neutral Red). These materials were synthesized in a fluorinated medium under well-defined temperature and crystallization time conditions. They were characterized by different techniques, X-ray diffraction (XRD), infrared spectroscopy (IR), and ultraviolet-visible spectroscopy (UV-Vis). The degradation of the neutral red (NR) dye on the four adsorbents was analyzed using two kinetic models to study the adsorption process: pseudo-first-order and pseudo-second-order. Parameters affecting the dye adsorption, such as pH and contact time also were studied. The adsorption kinetics were better described by the pseudo-first-order model. Isothermal models were also applied in this study, Langmuir, Freundlich, and Temkin. The adsorption of NR dye on Cu/ZSM-5 seemed to conform to the Langmuir model with a high correlation coefficient R^2 value of 0.999 and the highest adsorption capacity of 16.129 mg/g was achieved at a pH level of 5.19 and a removal rate of 98.75% could be achieved within 50 min.

Keywords: Zeolites; Silicalite-1; Cu/ZSM-5; VS-1; Degradation; Neutral red

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