Removal of anionic dye from aqueous solution by magnesium silicate gel

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ABSTRACT

Mesoporous magnesium silicate gel was successfully synthesized and characterized by N$_2$ adsorption/desorption technique and FT-IR. The adsorption experiments of anionic dye (weak acid red 2R) onto prepared magnesium silicate gel were studied by varying mass of adsorbent, dye concentration, pH, temperature, and contact time. The results showed magnesium silicate gel had high surface area, 277.37 m$^2$g$^{-1}$. The adsorption capacity increases with increasing initial dye concentration, adsorption temperature, and contact time. The experimental data were applied to three adsorption kinetic models and the results indicated that the adsorption behavior was described very well by the second-order kinetics model with the high correlation coefficients ($R^2 > 0.99$). Intra-particle diffusion was performed in three different stages. The activated energy obtained was 127.6 kJ mol$^{-1}$ and the enthalpy, entropy, and standard free energy were calculated and given that $\Delta H^o$ was 80.1 kJ mol$^{-1}$, $\Delta S^o$ was 300.1 J mol$^{-1}$, and $\Delta G^o$ were negative values at the different temperatures. The adsorption process is rapid and physisorption in nature. Therefore, magnesium silicate gel would be used in the industrial wastewater treatment as a potential adsorbent.

Keywords: Magnesium silicate gel; Mesoporous adsorbent; Adsorption; Anionic dye; Kinetics study

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