Removal of Anionic Dye from Textile Effluents by using Kaolinite as Adsorbent

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Abstract

The removal of anionic dye from textile effluents by using clay samples as adsorbents were carried out using Tunisian raw clay (Tabarka) composed of kaolinite and illite and standard clay (KGa-2). Various parameters were investigated such as the contact time adsorbent-adsorbate, the initial dye concentration, the ionic strength, the pH of the aqueous phase, and the temperature. The kinetic studies of the dye adsorption from water onto clay substrate were done and the data were compared to Langmuir, Freundlich, Dubinin-Radushkevich, Harkins–Jura, and Halsey adsorption isotherms models. The electrophoretic mobilities of Tabarka and KGa-2 clay aqueous dispersions in the absence and the presence of the anionic dye were determined by using microelectrophoresis method. The chemical structures of the Reactive Red 120 anionic dye, as determined by ion-trap mass spectrometry method, before and after its adsorption on the clay particles, were found to be the same. The adsorption isotherms showed that the standard clay KGa-2 has higher adsorption capacity for the RR 120 dye as compared to the raw clay (Tabarka). Further, the bare KGa-2 clay has an Isoelectrical point (IEP) about 4.2 which increases to 8.9 after adsorption of the RR 120 dye. However, no Isoelectrical point was observed for the Tabarka clay either in the absence or in the presence of the anionic RR 120 dye. Increasing the ionic strength and/or lowering the pH of the aqueous phase was found to enhance the adsorbed amount of the anionic dye on the clay sample. The adsorption kinetics followed the pseudo-second-order model and leveled out after 60 min of the contact time. At the equilibrium, the adsorption isotherms were well described by the Langmuir model. Finally, adsorption process of the dye onto the clay sample was feasible and spontaneous at ambient temperature, but the temperature increase greatly decreases the adsorption capacity.

Key words: anionic dye; adsorption; Kaolinite clay; kinetic, Surface properties