SORPTION OF PATENT BLUE V FROM AQUEOUS SOLUTIONS
ONTO ORGANOPHILIC BENTONITE

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ABSTRACT

The increasing use of organic compounds endangering the environment encourages search for more efficient adsorbents. Industrial effluents contains many complex refractory organics such as dyes and phenolic compounds etc. Dyes and pigments are predominant contaminants among wastewaters generated fro textile, food, plastic, paper, leather, printing and cosmetic industries. A majority of these dyes are immune to chemical oxidation and other treatment processes. Clays have been in use for the sorption of metals and organics, but have not been fully utilized. Bentonite is a naturally occurring clay that is hydrophilic and has a good cation exchanging ability. The raw form of the clay is a poor adsorbent of dyes due to its hydrophilic nature and net negative surface charge. The objective of the present work is to improve the adsorptive properties of the bentonite clay by exchanging the intralamellar cations of the clay with cetyltrimethyl ammonium ions, thereby rendering the clay organophilic. The organophilic bentonite was batch tested for the adsorption of the anionic dye patent blue v from aqueous solutions. The dependence of removal on various parameters such as contact time, initial concentration, sorbent dosage, initial pH and temperature of the adsorptive solution were investigated. The organophilic bentonite clay was characterized by FTIR analysis, XRD measurement for the confirmation of cetyltrimethyl ammonium cation loading, SEM analysis for surface morphology. The amount of dye adsorbed per gram of adsorbent was found to increase with increase in initial concentration, sorbent dosage and a decrease in the initial pH of the dye solution. The adsorption of the dye patent blue V on the raw bentonite was found to very negligible. The equilibrium amount of dye adsorbed per gram of organophilic bentonite was found to increase with increase with initial concentration. The equilibrium amount of dye uptake was increased from 40.61 mgg⁻¹ to
95.05 mgg⁻¹. The increase in dye uptake is attributed to increase in the mass driving force which enforces more ionic dye species to pass from the bulk solution to the clay surface at a given time. It was also established that an increase in equilibrium dye uptake was observed with increasing sorbent dose. The increase is attributed to the fact that the number of active sites increases enhancing dye uptake. However, with the increase in initial pH of the solution, the equilibrium dye uptake was found to decrease due to competent OH⁻ ions for the active sites in the clays. There was a noted increase in amount of dye uptake with decreasing initial pH of the dye solution. On varying the temperature of the dye solution, the equilibrium dye uptake was found to increase with increasing temperature, thereby indication the process to be endothermic. To further investigate the nature of adsorptive mechanisms, the simplified kinetics models such as the pseudo first order, and pseudo second order were tested with the pseudo second order fitting better with a correlation coefficient of 0.998. The experimental data was also fit with Langmuir and Freundlich isotherms, with the Langmuir isotherm fitting better (R² =0.999). The results indicate that bentonite clay exchanged with cetyltrimethyl ammonium ions can be used as potential adsorbent for Patent blue v from aqueous solutions.