

Investigation of Kinetics and Thermodynamic of Methylene Blue Adsorption Onto Pyrolysed Lignite Sample at Different Conditions

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The presence of methylene blue (MB), an organic dye, in discharged water is hazardous for human beings and limits light diffusion and consequently the photosynthesis processes are reduced. Various techniques have been employed for the removal of dyes from wastewaters. Due to low biodegradability of dyes, a conventional biological treatment process is not very effective. Dye laden wastewaters are usually treated by physical or chemical processes. Among these processes, adsorption has been found to be superior to other techniques for wastewater treatment in terms of initial cost, simplicity of design, ease of operation, and insensitivity to toxic substances[1-4].

In this study, adsorption kinetics and thermodynamics of a cationic dye, methylene blue, onto pyrolysed lignite sample from aqueous solution with respect to the initial dye concentration, contact time, temperature, pH, mixing rate and sorbent dosage were investigated. In order to understand the adsorption mechanism in detail, zeta potentials and the conductivities of clay suspensions at various pHs (1–11) were measured. It was found that the amount adsorbed of methylene blue increases with increasing temperature and initial dye concentration. There are no clear variation in the adsorbed amounts of methylene blue in the pH range 2–10. Addition of the neutral electrolyte, NaCl, and polyvalent cations, such as Al³⁺ and Ca²⁺, were changed the adsorption efficiency and effectiveness of dye molecules due to decreased electrical repulsion between free MB⁺ ions and similarly charged adsorbed ions. The adsorption kinetics of methylene blue has been studied in terms of pseudo-first-order, pseudo-second-order sorption and intraparticle diffusion processes thus comparing chemical sorption and diffusion sorption processes. It was found that the pseudo-second-order mechanism is predominant. Thermodynamic parameters suggest that the adsorption process is spontaneous and endothermic in nature.

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