

## Equilibrium modeling, kinetic and thermodynamic studies on the adsorption of basic dye by low-cost adsorbent

### ABSTRACT

In this study, the removal of methylene blue (MB) dye from aqueous solutions using low-cost material as adsorbent by a batch system was investigated. Experiments were carried out as a function of contact time, initial concentration (50-300 mg/L), pH (2-12) and temperature (303-323K). The equilibrium adsorption of MB dye on petai (*Parkia speciosa*) seed adsorbent was analyzed by Langmuir and Freundlich models. The results indicate that the Freundlich model provides the best correlation of the experimental data. The adsorption capacities of the petai seed adsorbent for removal of MB dye was determined with the Langmuir equation and found to be 91.74, 94.34 and 100.03 mg/g at 303, 313, and 323 K, respectively. The kinetic data was found to follow closely the pseudo-second-order model. Various thermodynamic parameters such as enthalpy ( $\Delta H^\circ$ ), entropy ( $\Delta S^\circ$ ) and free energy ( $\Delta G^\circ$ ) were evaluated. The positive value of the enthalpy change (17.89 kJ/mol) indicates that the adsorption is endothermic process. The results indicate that petai seed adsorbent is suitable as adsorbent material for adsorption of MB dye from aqueous solutions.

**Keyword:** Adsorption; Methylene blue; Petai (*Parkia speciosa*) seed; Isotherm; Kinetics; Thermodynamic