Study of Adsorption Isotherms for Methyl Red Removal using Activated Carbon Derived from *Ormosia amazonica* Seeds

B.A.A. Izzadheen, P.K.G.T. Shashinkamali, S.M.W.T.P.K. Ariyaratne and R. Shanthini

Department of Chemical and Process Engineering, Faculty of Engineering, University of Peradeniya

As an inexpensive alternative to charcoal-based activated carbon (CAC) in pollution control applications, several carbon-based materials have been studied. In this study, we researched the adsorption capacity of activated carbon derived from *Ormosia amazonica* (OA) seeds in the removal of an organic dye, methyl red (MR). OA seeds are found in the dry zone of Sri Lanka, almost free of cost.

OA seeds-based activated carbon (OASAC) was prepared in the laboratory using chemical methods. Batch equilibrium adsorption experiments were carried out using 0.7 g OASAC thoroughly mixed with 50 ml of synthetic MR solutions of initial MR concentrations varying in the range of 25 to 200 mg/L at pH 4.0. The adsorption equilibrium isotherm best fitting the equilibrium experimental data was chosen from among the most commonly used isotherms, namely, the Langmuir, Freundlich and the Tempkin isotherms. Another set of similar experiments were carried out with commercially available CAC. The results obtained with OASAC and CAC were compared in order to assess their relative adsorption capacities.

Batch equilibrium studies carried out with one sample showed that 100 min were adequate for equilibrium to be reached. A set of seven equilibrium liquid-phase and solid-phase concentrations were used to determine the isotherm parameters. Estimated correlation coefficients, given by adjusted R^2, provided evidence for the adsorption of MR onto OASAC/ CAC being best explained by the Langmuir isotherm,

$$q_e = \frac{Q_{max} K_L C_e}{1 + K_L C_e}$$

where q_e (in mg/g) and C_e (in mg/L) are the equilibrium concentrations of MR in solid-phase and liquid-phase, respectively. The Langmuir adsorption capacity reflecting the maximum capacity of a monolayer adsorption, given by Q_{max}, was estimated as 5.425 mg/g for OASAC and 5.667 mg/g for CAC. The Langmuir adsorption coefficient, given by K_L, was estimated as 0.142 L/mg for OASAC and 0.180 L/mg for CAC.

The similarities found among the parameters reported above as well as in the estimated parameters of the reasonably fitting Freundlich and the Tempkin isotherms in this study, therefore, bear strong evidence for the adsorption performance of OASAC being comparable with that of CAC when it comes to MR removal. Therefore, we recommend the use of OASAC as a low-cost alternative to the relatively expensive CAC for the removal of dyes or colour from industrial effluents.