

Batch isotherm and thermodynamic studies of pineapple (*Ananas comosus*) plant stem as agricultural biosorbent for the removal of Basic Blue 3 and Congo Red dyes

ABSTRACT

There are considerable amount of dyes to be discharged in the effluent from dyeing and finishing processes in the textile industry. The discharged dyes are known to be toxic, carcinogenic and mutagenic toward the aquatic system. A low concentration of dyes in the effluent can affect the aesthetic and transparency of water stream. Remaining dyes in the effluent necessitated colour removal along with the stringent restrictions and regulations established. Agricultural waste generally is preferred due to its cost-effective and good performance in adsorption. Pineapple plant stem (PPS) is one of the agricultural residues after shoots transplantation. Utilisation of PPS in dyes removal not only can remediate textile wastewater but also reduce the agricultural waste management problem in Malaysia. In the present study, the performance of pineapple plant stem for cationic (Basic Blue 3, BB3) and anionic (Congo Red, CR) dyes removal has been evaluated in a batch process. The isotherm equilibrium studies indicated that BB3 could be well described by Freundlich model ($R^2 = 0.999$) while high correlation values of CR obtained from Langmuir ($R^2 = 0.999$) and Temkin ($R^2 = 0.997$) models. The maximum sorption capacities for BB3 and CR were found to be 59.52 and 11.92 mg g⁻¹, respectively under a favourable sorption process. The dependency of BB3 and CR adsorption on temperature was validated by van α Hoff equation. The effect of temperature on the BB3 and CR removal by PPS was ascertained by studying the temperature-dependence dyes distribution between bulk solution and adsorbent, and the interaction between dyes and adsorbent. Removal of BB3 and CR by PPS was found to be exothermic. The result suggests that PPS has higher affinity on cationic than anionic dye.

Keyword: Pineapple plant stem; Adsorption; Basic Blue 3; Congo Red