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Removal of Rhodamine B from Aqueous Solution on to Modified Jack Wood Sawdust: A Comparative Study

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Abstract

Among many environmental pollutants, dyes releasing from industries play a major role in contaminating the aquatic environment. Most of the dyes are non biodegradable, stable and carcinogenic due to their synthetic nature and aromatic structure. Therefore it is necessary to reduce the pollution load including decolourization of industrial effluents before disposal. Though the adsorption on to commercial activated carbon is a promising method, it is expensive. The present study was carried out to investigate the possibility of using a low cost adsorbent for the removal of carcinogenic dye, Rhodamine B in a more effective manner.

Three different forms of sawdust, formaldehyde treated sawdust (SD), base treated sawdust (BTSD) and acid activated charred sawdust (AASD) were prepared and used for the removal of Rhodamine B from an aqueous solution. Batch experiments were carried out to investigate the potential efficiency of the three forms of sawdust to remove Rhodamine B from the aqueous solution as a function of the initial Rhodamine B concentration, Contact time and temperature. Equilibrium was found to be attained at about 30 min, 50 min and 60 min respectively for SD, BTSD and AASD. Based on Langmuir isotherms, the maximum adsorption capacity was found to be 319.5 mgg^{-1} at 60°C for AASD among three different forms of sawdust.

Various isotherms and kinetic models were fitted to describe the adsorption process and the activation parameters were evaluated in all three types of sawdust. Kinetic data of all three types of sawdust were well fitted for the second order rate model. Based on Langmuir, Freundlich and D-R isotherms, a better adsorption capacity was obtained for the AASD adsorbent compared to SD and BTSD. Thermodynamic parameters suggest that the adsorption of Rhodamine B onto all three type of adsorbent is spontaneous and the process is physisorption. SEM images revealed that AASD has more porous and irregularities in the surface which makes it a better adsorbent. IR spectral data reveal the disappearance of many functional groups in AASD adsorbent compared to SD and BTSD.

Keywords: Rhodamine B, Kinetics, Equilibrium, Isotherms, Modified jackwood sawdust