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From Pollutant to Solution of Wastewater Pollution: Synthesis of Activated Carbon from Textile Sludge for Dyes Adsorption

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Abstract

Adsorption is an important process in wastewater treatment, and conversion of waste materials to adsorbent offers a solution to high material cost related to the use of commercial activated carbon. This study investigated the adsorption behaviour of Reactive Black 5 (RB5) and Methylene Blue (MB) onto activated carbon produced from textile sludge (TSAC). The activated carbon was synthesized through chemical activation of precursor followed with carbonization at 650 ºC under nitrogen flow. Effects of time (0-200 min), pH (2-10), temperature (25-60 °C), initial dye concentration (0-200 $mg \cdot L^{-1}$), and adsorbent dosage (0.01-0.15 g) on dyes removal efficiency were investigated. Preliminary screening revealed that TSAC synthesized via H_2SO_4 activation showed higher adsorption behaviour than TSAC activated by KCl and $ZnCl_2$. The adsorption capacity of TSAC was found to be 11.98 $mg \cdot g^{-1}$ (RB5) and 13.27 $mg \cdot g^{-1}$ (MB), and is dependent on adsorption time and initial dye concentration. The adsorption data for both dyes were well fitted to Freundlich isotherm model which explains the heterogeneous nature of TSAC surface. The dyes adsorption obeyed pseudo-second order kinetic model, thus chemisorption was the controlling step. This study reveals potential of textile sludge in removal of dyes from aqueous solution, and further studies are required to establish the applicability of the synthesized adsorbent for the treatment of waste water containing toxic dyes from textile industry.

Keywords: Activated carbon; textile sludge; Reactive black 5; Methylene blue; adsorption

1. Introduction

Remediation of industrial wastewater has become an important issue in scholar research, as the pollutant contained in the wastewater, when flow into river bodies, creates negative impacts on the ecosystem and human health, which are irreversible in some cases. The current strategy applied