Biosorption of methylene blue by natural and chemical modified wheat straw in fixed-bed column

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ABSTRACT

Adsorption of methylene blue (MB) from aqueous solution was studied by natural wheat straw (NWS) and modified wheat straw (MWS) with citric acid in fixed-bed column. The experiments were conducted to investigate the effects of the bed depth, the flow rate, and the influent concentration of MB. The column data were fitted by the Thomas model and Yan model using nonlinear regressive analysis, while bed depth/service time analysis (BDST) model was applied at different bed depths. The Yan and BDST were found suitable for describing the adsorption process. The exhausted adsorbent was regenerated using hydrogen chloride solution and the adsorbent was reused. The results showed that the adsorption capacity of MWS was higher than NWS and both NWS and MWS can be reused.

Keywords: Wheat straw; Modified wheat straw; Methylene blue; Column adsorption; Model

1. Introduction

Dyes are discharged from various industries, such as textile, paper, cosmetics, plastics, food, and so on. The presence of dyes in wastewater is greatly visible and undesirable even at very low concentrations. Color retards light penetration, impedes photosynthetic activity, and inhibits the development of biota. Currently, considerable attention has been given to the methods for eliminating dyes from wastewater because of their toxic nature and refractory biodegradation. The conventional wastewater treatment methods, such as chemical precipitation, solvent extraction, reverse osmosis, electrolysis, and ion exchange, are not very effective owing to the low biodegradability of dyes, high energy requirement and operational cost, and incomplete removal [1]. Adsorption technique has a wide variety of applications and has been demonstrated to be a valid and promising process for the treatment of these dye-bearing wastewaters because of its easy operation, insensitivity to toxic or harmful substances, ability to treat concentrated solution of pollutant, and the possibility of reusing the exhausted adsorbent through regeneration [2]. In recent years, the most widely used adsorbent, activated carbon, has good capacity for the removal of dyes. However, the critical challenges of the sorption method are the high price of the adsorbent and difficult regeneration, which increases the cost of wastewater treatment [3–5]. Therefore, attempts have already been made to change this dilemma. For instance, it is preferable to use low-cost materials; agricultural by-products, such as fallen leaves [6], rice husk [7,8], wheat husk [9,10], peanut...