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The behaviors and characteristics of a mesoporous activated carbon prepared from *Tamarix hispida* for Zn(II) adsorption from wastewater

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ABSTRACT

In this study, for the first time the potential use of activated carbon provided from *Tamarix hispida* (ACTH) to remove Zn(II) from wastewater was investigated by considering parameter optimization, reusability, equilibrium, kinetic, and thermodynamic aspects. The ACTH was mesoporous adsorbent with a specific surface area of 1006 m^2/g. The main parameters in the adsorption process including pH, contact time and Zn(II) concentration, adsorbent dose, mixing rate, and temperature were considered. Over 95% of 70 mg/L Zn(II) was adsorbed using 10 g/L ACTH at the solution pH of 6. The Zn(II) adsorption onto ACTH increased from 93.2% to 98.33% by increasing the solution temperature from 10 to 50 °C. The ACTH was more efficient than the standard activated carbon. The results showed that the equilibrium adsorption of Zn(II) onto ACTH were well described by the Langmuir model. According to this model, the maximum adsorption capacity was found to be 246.4 mg/g. The nonlinear kinetic data were best fitted to the pseudo-second order model. The ACTH had acceptable performance after 4 times recycling. The suitability of ACTH in the treatment at field conditions was investigated with an industrial wastewater samples collected from a local plating wastewater. Based on the study's results, the ACTH was shown to be an affordable and a promising option for adsorbing zinc ions from wastewaters.

1. Introduction

Zinc is acts as an essential element for growth and metabolism of living organisms. The World Health Organization (WHO) recommends the maximum acceptable concentration of zinc in drinking water as 5 mg/L [1]. Zinc is found in high concentrations in various sources including metal smelters, effluents from plastics, paper industries, microelectronics, mining operations, pesticides, and usage of fertilizers [2]. Beyond the permissible limit, it is generally toxic and hazardous [3]. Zinc occurs in the list of primary pollutant elements suggested by the U.S. Environmental Protection Agency (EPA), since it has caused serious poisoning events. Too much intake of zinc can lead to desiccating muscles, imbalance of electrolytes, vertigo and disharmony, stomach ache, and coughing [1]. Therefore, it is necessary to remove zinc from effluents before discharging to the environment.

Various technologies have been examined for eliminating zinc from wastewaters including chemical precipitation, electrochemical treatment, ion exchange, membrane separation, and adsorption [2]. Adsorption process onto the activated carbon is a superior technique as this process is efficient, easy- design and operate, and unaffected by toxicity as well as being inexpensive [4,5]. Activated carbon has been studied as an efficient adsorbent for removal of heavy metal ions from streams for several decades. But the high production and regeneration costs of the activated carbon have inspired the researchers especially in developing countries to investigate for suitable low-cost adsorbents [6]. To solve this challenge, considerable attention has been given to prepare activated carbons derived from readily available and low or no cost materials. For this purpose, in the literature a variety of agriculture wastes and woods of self grown trees as alternative base materials were assessed for producing activated carbon. Several studies have been made significant contributions in this area, utilizing a number of materials including van apple pulp [5], *Bambusa vulgaris striata* [7], *Quercus rotundifolia* L. [8], bagasse [9], olive pulp [10], Ceiba pentandra hulls [11]. Therefore, the

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