

Adsorption of Pb(II) in aqueous solutions by bamboo charcoal modified with KMnO_4 via microwave irradiation

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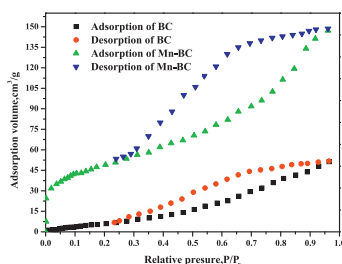
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HIGHLIGHTS

- ▶ A novel KMnO_4 modified bamboo charcoal (Mn-BC) is prepared with microwave irradiation.
- ▶ The binary oxidation process of KMnO_4 and HNO_3 can improve the porosity of bamboo charcoal.
- ▶ Mn-BC has a higher adsorption capacity for Pb(II) than that of BC.
- ▶ The spent Mn-BC can be readily regenerated for reuse by dilute H_2SO_4 solution.

GRAPHICAL ABSTRACT

The results suggested that KMnO_4 treatment could improve the porosity of bamboo charcoal based material under a short time microwave heating, as its oxidation process could enlarge the pores and consequently form mesopores.



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ABSTRACT

A novel KMnO_4 modified bamboo charcoal (Mn-BC) was prepared with microwave irradiation. The surface characteristics of the adsorbent were measured by means of N_2 adsorption, XRD, FTIR, SEM, EDS and pH_{ZPC} , respectively. The composite exhibited higher surface area of $172.3 \text{ m}^2/\text{g}$ for Mn-BC than that of unmodified bamboo charcoal (BC) ($15.5 \text{ m}^2/\text{g}$). The adsorption behavior of Pb(II) by Mn-BC was studied as a function of contact time, pH, ionic strength and temperature under ambient conditions. The results showed that the kinetic adsorption could be described by a pseudo-second order model very well. The Langmuir model fitted the adsorption isotherms of Pb(II) better than the Freundlich model and the maximum adsorption capacities at 298 K of Pb(II) were 25.03 and 55.56 mg/g for BC and Mn-BC, respectively. The thermodynamic parameters indicated that the adsorption was spontaneous and exothermic. The spent Mn-BC could be readily regenerated for reuse. The results show that Mn-BC is a promising material for the preconcentration and separation of heavy metals from large volumes of aqueous solutions.

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1. Introduction

Water pollution due to toxic heavy metals has been causing worldwide concern for the last few decades. Among the different heavy metals, lead is one of the common and toxic pollutants released into the natural waters from various industrial activities such as metal plating, oil refining, paint and pigment producing

and battery manufacturing [1]. Unlike most organic pollutants, Pb(II) are nonbiodegradable and tend to accumulate in living tissues, causing various diseases and disorders. The permissible limit of Pb(II) in drinking water is 0.05 mg/L according to the current Chinese Standards for Drinking Water Quality [2], but the actual concentration of lead in wastewater is as high as several hundred milligram per liter. Strict environmental protection legislation on the disposal of hazardous metal ions and increasing demands for water cleaning with fairly low level of hazardous metal ions make it greatly significant to exploit various effective techniques for hazardous metal ions removal.

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