Research Article

Effect of Carboxylic Functional Group Functionalized on Carbon Nanotubes Surface on the Removal of Lead from Water

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Received 22 June 2010; Revised 15 December 2010; Accepted 22 December 2010

Academic Editor: Ian Butler

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The adsorption mechanism of the removal of lead from water by using carboxylic functional group (COOH) functionalized on the surface of carbon nanotubes was investigated. Four independent variables including pH, CNTs dosage, contact time, and agitation speed were carried out to determine the influence of these parameters on the adsorption capacity of the lead from water. The morphology of the synthesized multiwall carbon nanotubes (MWCNTs) was characterized by using field emission scanning electron microscopy (FESEM) and transmission electron microscopy (TEM) in order to measure the diameter and the length of the CNTs. The diameters of the carbon nanotubes were varied from 20 to 40 nm with average diameter at 24 nm and 10 micrometer in length. Results of the study showed that 100% of lead was removed by using COOH-MCNTs at pH 7, 150 rpm, and 2 hours. These high removal efficiencies were likely attributed to the strong affinity of lead to the physical and chemical properties of the CNTs. The adsorption isotherms plots were well fitted with experimental data.

1. Introduction

The pollution of water resources due to the disposal of heavy metals has been causing worldwide concern. The main sources of these metals are mining, metallurgical, chemical manufacturing, tannery, battery manufacturing industries, fossil fuel, the modern chemical industry based largely on catalysts, many of which are metals or metal compounds, production of plastics, such as polyvinyl chloride, involving the use of metal compounds, particularly as heat stabilizers, and so forth. The effects of heavy metals such as copper, lead, zinc, mercury, chromium, and cadmium on human health have been investigated extensively. Lead is ubiquitous in the environment and is hazardous at high levels. Long-term drinking water containing high level of lead will cause nervous system damage, renal kidney disease, mental retardation, cancer, and anaemia [1]. Lead is non-biodegradable and, therefore, must be removed from water [2]. Many methods have been developed and used to remove metal ions from wastewater such as granulated activated Carbon [3, 4], fly ash [5], peat [6], recycled alum sludge [7], peanut hulls [8], resins [9], kaolinite [10], manganese oxides [11], zeolite [12], and biomaterials [13, 14]. However, the removal efficiencies of metal ions of these adsorbents were low. Therefore, researchers carried out to evaluate new promising adsorbents [15]. Carbon nanotubes (CNTs), a member in carbon family, have novel properties that make them potentially useful in many applications in nanotechnology, electronics, optics, water treatment, and other fields of materials science. Since their discovery in 1991 [16], carbon nanotubes (CNTs) have attracted considerable researchers’ interest due to their exceptional mechanical