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Removal of radiocobalt from aqueous solution by oxidized MWCNT

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摘要

Abstract
The study was undertaken to evaluate the feasibility of oxidized multiwalled carbon nanotube (oxidized MWCNT) for the removal of radiocobalt (^{60}Co) from aqueous solutions. The oxygen functional groups of oxidized MWCNT were characterized by FT-IR and XPS. Batch experiments were performed to study the sorption of cobalt as a function of contact time, solid contents, pH, ionic strength, foreign ions, and temperature. Two kinetic models viz. pseudo-first-order and pseudo-second-order were used to determine kinetic sorption parameters, and the kinetic sorption could be described more favorably by the pseudo-second-order model. The thermodynamic parameters ($\Delta G°$, $\Delta S°$, $\Delta H°$) calculated from the temperature-dependent sorption isotherms indicated that the sorption of Co(II) on oxidized MWCNT was an endothermic and spontaneous processes. The results suggest that oxidized MWCNT can be used efficiently in the treatment of industrial effluents containing radioactive and heavy metal ions.

Keywords

Removal, Co(II), Oxidized MWCNT, Sorption

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Removal of radiocobalt from aqueous solution by oxidized MWCNT

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Keywords Removal · Co(II) · Oxidized MWCNT · Sorption

Introduction

The disposal of radioactive waste from nuclear reactions is of great concern throughout the world [1–5]. It is necessary to decrease the concentration of radioactive nuclides before they are discharged to the environment. The radionuclide ^{60}Co(II) is one of the most serious radionuclides affecting the environment due to its non-degradable and accumulation through food chain. ^{60}Co and ^{58}Co are present in liquid wastes released from pressurized water nuclear power reactors. [6]. The permissible limits of cobalt in the irrigation water and livestock wastewater are 0.05 and 1.0 mg/L, respectively [7]. Excess intake of Co results in toxic, carcinogenic, and mutagenic effects [8]. Therefore, it is necessary to eliminate Co(II) concentration in contaminated groundwater to the permissible limits for the sake of public health, ecosystem stability and environmental safety. The sorption of Co(II) on different oxides and minerals has been studied extensively [9–16], and the results indicated that the sorption of Co(II) was strongly dependent on pH values. The sorption of Co(II) was mainly dominated by ion exchange or outer-sphere surface complexation at low pH, and by inner-sphere surface complexation at high pH values.

Sorption process is considered one of the best techniques due to low cost, simple operation, moderate and low concentrations. Many different sorbents [17–30] such as alumina, sepiolite, zeolite, rectorite, attapulgite, activated carbon, kaolinite, regosols, goethite, chitosan, hematite, and bentonite have been investigated. Carbon nanotubes (CNT) [31] have been studied extensively to remove radionuclides and organic pollutants [32–39] due to their large specific surface area, light mass density and easily to be modified to increase their adsorption capacity [40–43], especially by surface functional group modification to increase the sorption selectivity and ability [44–47]. However, the application of multiwalled carbon nanotube (MWCNT) in the removal of radiocobalt from large volume of aqueous solutions is still scarce.

In this work, we investigated cobalt removal from aqueous solutions by the oxidized MWCNT. The aims of

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