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Simultaneous adsorption of atrazine and Cu (II) from wastewater by magnetic multi-walled carbon nanotube

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HIGHLIGHTS

- ▶ Magnetic carbon nanotubes were used to adsorb atrazine and Cu (II) simultaneously.
- ▶ The adsorbent exhibited good adsorption behavior for atrazine and Cu (II).
- ▶ Convenient magnetic separation and effective reuse.

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ABSTRACT

In this paper, a magnetic multi-walled carbon nanotube (MMWCNT) was developed and investigated to explore the possible application in the simultaneous removal of atrazine and Cu (II) from contaminated water. The Brunauer–Emmett–Teller (BET) specific surface area, magnetization measurement, scanning electron microscopy (SEM), Thermo-gravimetric Analysis (TGA) and X-ray photoelectron spectroscopy (XPS) analyses were used to characterize the adsorbent. Batch adsorption experiments were conducted to study the sorption performance of MMWCNT. The adsorption of atrazine and Cu (II) were both unfavorable under acidic conditions. The sorption kinetics data were well described by pseudo-second-order kinetic model. The sorption isotherms for atrazine and Cu (II) were better fitted by Freundlich model and Langmuir model, respectively. Cu (II) had a strong suppression effect on atrazine uptake in the simultaneous adsorption and atrazine preloading experiment. As for Cu (II) preloading, the impact of atrazine on Cu (II) desorption was almost negligible. The regeneration of MMWCNT for several cycles using acidic ethanol solution and practical application of MMWCNT were also investigated. Due to its high adsorption capacity, easy separation and effective reusability, MMWCNT showed great potential in wastewater treatment.

1. Introduction

According to the layers involved, carbon nanotubes (CNTs) mainly include single-walled (SWCNTs) and multi-walled (MWCNTs) carbon nanotubes [1]. CNTs as novel adsorbents have attracted increasing attention of numerous researchers because of their large specific surface areas and unique structures. Extensive investigations for removal of contaminants, such as PAHs [2], naphthalene [3], microcystins [4], natural organic matter [5], cadmium [6] and zinc [7], suggest that CNTs exhibit high sorption capacities for various toxic organic compounds and metallic ions. However, CNTs suffer from separation inconvenience. Combining the magnetic properties of iron oxide with adsorption properties of CNTs is of increasingly environmental concern as a rapid, effective and promising technology for removing hazardous pollutants in water [8,9] and has been proposed for widespread environmental applications in wastewater treatment and potentially in situ remediation [10–12].

To date, several studies have reported the cosorption of metallic cations and organic compounds by CNTs and revealed that metal ions may affect the environmental fate of toxic chemicals or vice versa [13–16]. Also, recently, many research have been focused on employing various modified CNTs to better remove pollutants from wastewater [17–20]. However, very few reports have been

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