Removal of Cu(II) Metal Ions from Aqueous Solution by Amine Functionalized Magnetic Nanoparticles

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Abstract. The adsorption behavior of Cu(II) metal cations was investigated on the amine functionalized magnetic nanoparticles (MNPs). TheMNPs were synthesized by thesolvothermal method and functionalized with (3-Aminopropyl)triethoxysilane (APTES). MNPs were characterized by X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM) and vibrating sample magnetometer (VSM). The MNPs have pure magnetite phase with particle size around 10-12 nm. MNPs exhibits superparamagnetic behavior with asaturation magnetization of 68 emu/g. The maximum 38 % removal efficiency was obtained for Cu(II) metal ions from the aqueous solution.

INTRODUCTION

Heavy metal pollution in wastewater due to rapid industrialization has become a serious problem for theenvironment and all forms of life. The toxic heavy metals are released to the environment from various industries such as metal plating, tanneries, chloralkali, mining operations, radiator manufacturing, smelting, alloy industries and storage batteries industries.[1] Heavy metals like Cd, Pb, Cu, and Zn, are the majordeadly pollutants which are found to be in surface and ground water. Between these heavy metals, copper is detected in the most of the waste water resourcesdue to release from many other copper electroplating and textile industries.[2]Copper is one of the essential nutrient required for the human body, but the excess consumption of copper by the human body causes serious diseases such as liver and kidney damage, stomach and intestinal irritation and anemia.[3]So, the removal of copper and many other heavy metals from wastewater resources becoming afocused area for the researchers.

In last few decades, many strategies have been developed to remove Cu metal ions such as chemical precipitation, liquid–liquid extraction, biosorption, ion exchange, electrodialysisand so on.[4]Currently,adsorption method has become the most prominent method for the removalof various heavy metal ions from wastewater as they provide high removal efficiency and economic feasibility.[5]However rapid separation of adsorbents from large volumes of thesolution is difficult. This problem can be overcome by magnetic adsorbents as they can be separated easily from solution by an external magnetic field. Magnetic nanoparticles (MNPs) exhibiting superparamagnetism offers good colloidal stability and easy separation from solution and hence would remove heavy metal ions effectively. Up to now, several MNPs, including Fe_2O_3 and Fe_3O_4MNPs functionalized with some compounds, such as chitosan, gum Arabic, polyvinyl acetate–iminodiaceticacid and amino-functionalized polyacrylic acid (PAA) have been explored for the removal of copper ions.[4] Among them, APTES-functionalized MNPs can be used for removing avariety of metal ions due to free amino groups. Therefore, APTES modified MNPs as an adsorbent is

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