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Functionalized magnetite / silica nanocomposite for oily wastewater treatment

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Abstract. A new magnetite-silica core/shell nanocomposite ($Fe_3O4@nSiO_2@mSiO_2$) was synthesized and functionalized with trimethylchlorosilane (TMCS). The prepared nanocomposite was used for the removal of diesel oil from aqueous media. The characterization of magnetite-silica nanocomposite was studied by X-ray diffraction (XRD), Fourier transform infrared (FTIR), transmission electron microscopy (TEM), surface area measurement, and vibrating sample magnetization (VSM). Results have shown that the desired structure was obtained and surface modification was successfully carried out. FTIR analysis has confirmed the presence of TMCS on the surface of magnetite silica nanocomposites. The low- angle XRD pattern of nanocomposites indicated the mesoscopic structure of silica shell. Furthermore, TEM results have shown the core/shell structure with porous silica shell. Adsorption kinetic studies indicated that the nanocomposite was able to remove 80% of the oil contaminant during 2 h and fit well with the pseudo-second order model. Equilibrium studies at room temperature showed that the experimental data fitted well with Freundlich isotherm. The magnetic property of nanocomposite facilitated the separation of solid phase from aqueous solution.

Keywords: magnetite silica nanocomposite; core-shell; oily pollutant; adsorption; functionalized surface

1. Introduction

Over recent years most waters have become increasingly polluted by oil. A large amount of oil spills into the aquatic ecosystem can cause serious environmental problems, including clogging of sewage treatment plants, adversely affecting the aquatic biota, and increasing biochemical oxygen demand due to large amount of bacteria necessary to decompose the oil (Wang *et al*. 2010a). The most frequent oils that are found in oily wastewater include lubricants, cutting oil, vegetable oil, light and heavy hydrocarbons. Major industrial sources of oily wastewater are petroleum refining and petrochemical plants, steel manufacturing and metal working, vehicle repair (Wang *et al*. 2012), and food processing.

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