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Effective Removal of Metal Ions from Aqueous Solution by Mesoporous MnO_2 and TiO_2 Monoliths: Kinetic and Equilibrium Modelling

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Abstract: In the present study, ordered hierarchically porous silica (by sol-gel method) and metal-oxide monoliths (through nanocasting method) were synthesized. Porous silica and metal oxide monoliths (MnO_2 and TiO_2) exhibited excellent adsorption for heavy metal ions such as Pb(II) & Cd(II). The morphological and structural study of the synthesized silica and metal oxide monoliths were done by FESEM and XRD analysis. The adsorption studies were conducted in different batches. The maximum adsorption of Pb(II) on SiO_2, MnO_2 and TiO_2 varied from 91-125, 166-200 and 769-857 mg/g respectively depending upon the choice of PEG, which is used as a structure directing/controlling agent. Similarly the maximum adsorption of Cd(II) on SiO_2, MnO_2 and TiO_2 varied from 90-100, 100-125 and 667-770 mg/g respectively. The effects of contact time (0-80 min), temperature (at 303, 313 and 323 K) and pH (3-10) on the Pb(II) & Cd(II) removal were also explored.

Keywords: Nanocasting; Mesoporous; Monoliths; Metal-oxide; Metal-ions adsorption; Wastewater treatment.

1. Introduction

Removal of heavy metals from wastewater is very important to reduce the environmental toxicant load. Heavy metals are non-biodegradable and cause serious consequences when present in aquatic and soil ecological system. The pollutant in water hinders aquatic life [1] and