Fast and efficient mesoporous adsorbents for the separation of toxic compounds from aqueous media

Mansoor Anbia*, Nourali Mohammadi, Kaveh Mohammadi

Research Laboratory of Nanoporous Materials, Faculty of Chemistry, Iran University of Science and Technology, Farjam Street, Narmak, Tehran 16846, Iran

1. Introduction

Water pollution by toxic metallic, organic and metal–organic compounds is an important economic and environmental issue in numerous parts of the world [1]. Among heavy metals, chromium is a common contaminant in surface water and groundwater resulting from numerous industrial activities such as the preservation of wood, textile dyeing, leather tanning, electroplating and metal finishing [2,3]. Both of the common Cr(VI) anions, chromate (CrO_4^{2-}) and dichromate (Cr_2O_7^{2-}), have been reported as toxic species [4,5]. Therefore, the maximum contamination level (MCL) for total chromium in drinking water and inland surface waters, in the U.S.A. is stipulated by the Environmental Protection Agency (EPA) to be 0.05 and 0.1 mg/L, respectively [6].

Various technologies are employed for removing chromium ions from industrial wastewaters including reduction followed by chemical precipitation [7], activated carbon adsorption [8], electrochemical precipitation [9], ion exchange [10], solvent extraction [11], reverse osmosis [12], etc. Among these techniques, adsorption is the most promising technique to remove chromium species from aqueous solutions [13–29].

Furfural is an organic compound that is stable in the room temperature and decomposes to CO and CO_2 at high temperature. Its solubility in water is 83 g/L. Furfural accidental ingestion can cause death and its absorption from skin will damage human beings neurotic system and longs [30]. This compound is a frequent solvent for extractive refining of lubricating oils, as it is very effective in removing compounds containing oxygen or sulfur. Furfural is also a feedstock for producing furfuryl alcohol, which is used for making resins and tetrahydrofuran, an excellent solvent. This volatile organic compound is one of the major components of concern present in wastewater of petrochemical industry and petroleum refineries [31]. Separation of furfural is an important field of study for the sake of industrial safety and environmental protection. The common methods for organic compounds removal from aqueous solutions include biologic removal, chemical composition, liquid–liquid extraction, hydrolysis, osmotic methods and adsorption. A variety of different solvents has been tested for the extraction of furfural from aqueous solutions [32]. Also, extraction pervaporation with polymeric membrane is used for the separation of aqueous furfural solution [33]. However, there is no information in the literature on the separation of furfural from aqueous solution by adsorbents.

Phthalocyanines are the second most important class of colorant, and copper phthalocyanine is the single largest-volume colorant sold in the world [34]. Copper(II) phthalocyanine and its derivative copper(II) phthalocyanine-3,4,4′,4″-tetrasulfonic acid tetradsodium salt are used widely in different industries such as enamels, plastics, printing inks, linoleum and rubber goods [35]. Phthalocyanines have also found extensive use in many of the...