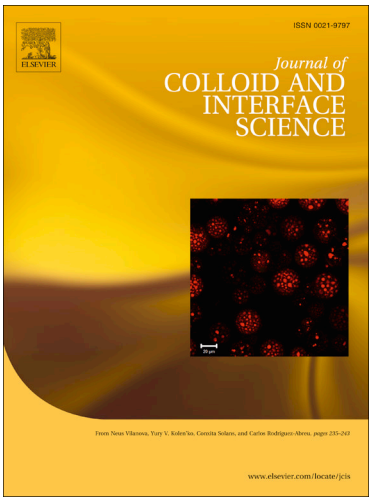

Removal of mercury ions from aqueous solution by thiourea-functionalized Magnetic Biosorbent: Preparation and mechanism study

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Removal of mercury ions from aqueous solution by thiourea-functionalized Magnetic Biosorbent: Preparation and mechanism study

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Abstract: A novel magnetic bio-material (MCIT) was synthesized via coupling reaction and functional modification after load of Fe_3O_4 nano-particle on the puckered surface of cyclosorus interruptus (CI). The synthesized material was characterized by fourier transform infrared (FTIR), field emission scanning electron microscope (FE-SEM), X-ray photoelectron spectroscopy (XPS) and X-ray powder diffractometer (XRD). The influence factors like pH, temperatures, contact time, initial concentration and cycle times on the adsorption of Hg (II) in aqueous solution were studied. Adsorption isotherm, kinetics, selectivity and mechanism were investigated. The results indicated that the isotherm model well agreed with monolayer adsorption model. The adsorption process could be divided into three steps, which included a fast step controlled by chemical adsorption, a slow step limited by intraparticle diffusion and an equilibrium stage. The maximum adsorption capacity of Hg (II) was 385.3mg/g at 318K. MCIT possessed high reusability (retained 93% after five successive cycles) and sharply magnetic nature (9.5emu/g), which endowed it easy and efficient separation from aqueous solution.

Keywords: Bio-based adsorbent; Magnetic adsorption; Separation; mercury ions.

1. Introduction

The presence of contaminants like heavy metals and organic compounds in effluents has become a worldwide problem due to their terrible impacts on human health and environment [1-2]. Hg (II) discharged from industrial-related sources is one of the most hazardous contaminants, which acquires high toxicity even at low concentrations [3]. In order to curb the impacts of heavy metals, wastewater needs to be treated before being discharged to the environment. These traditional treatments like reduction, extraction, precipitation and membrane separation are utilized to remove the mercury compounds [4-5]. However, these treatments expose many problems including high operation cost and low efficiency.

Adsorption is one of the most effective and low-cost treatments for removing pollutants from aqueous solution [6]. Adsorption process could achieve via an adsorbent combining pollutants with physical and chemical attractive forces [7]. With increasing emphasis on low-cost and sustainable chemistry, the development of green adsorbents has become a new research trend direction in the past few decades [8]. The bio-based adsorbent is a promising candidate for the removal of pollutant from wastewater, because it exhibits excellent adsorption property and derives from renewable resources [9-10]. In our previous study, a novel bio-based material – cyclosorus interruptus (CI) with large lignin, cellulose and hemicellulose, a fern plant growing in