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Enhanced arsenic removal by using iron modified rice straw biochar

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ABSTRACT

The potential of Fe modified biochar (BC) as an alternative, inexpensive adsorbent for removing As(V) from aqueous solution was investigated. BC was synthesized from the slow pyrolysis of rice straw and then modified with $FeCl_3$. FTIR, SEM-EDX analyses demonstrated that Fe had loaded successfully on the surface of biochar. In comparison to the raw biochar, the Fe modified BC not only had stronger magnetic property but also showed much greater ability to remove As(V) from aqueous solution. The Fe modified BC showed a maximum adsorption with an initial solution pH of 5.0. The adsorption data were better fitted with the Langmuir isotherm and pseudo-second kinetic model. The maximum adsorption capacity (qmax) by the modified BC, based on the Langmuir isotherm, was 28.49 mg g^{-1}. This Fe modified BC can be an effective, inexpensive, and environmentally sustainable adsorbent to replace typical granular activated carbons (AC) commonly utilized in the treatment of arsenic-contaminated wastewater.

Introduction

Arsenic is the 12th most abundant element in the biosphere and 20th most abundant element in the earth's crust. Arsenic occupies around 0.00005% of the total entire earth's surface [1]. Arsenic occurs in most natural waters in the inorganic form of As (III) and As (V). These two ions are either naturally occurring or byproducts of industrial waste. The predominant species for As in groundwater are H_3AsO_3 for As (III) and $H_2AsO_4^-$ and $HAsO_4^{2-}$ forAs (V). Chronic exposure inorganic arsenic may lead to cancer or non-cancer health effects [2]. Arsenic has been classified as a Class A carcinogen by the USEPA. Ingestion of arsenic, even at low concentration (less than 50 ppb), has been resulted to health complications, including cancer of the lung kidney, skin, etc., as well as other skin diseases or the neurological and cardiovascular systems [3].

Several technologies are effective for removal of lowering total arsenic in aqueous solutions such as coagulation/precipitation, ion exchange, reverse osmosis and adsorption processes. Adsorption has been considered the most common and effective technology for removing contaminated from ground