Chemical Engineering Journal 220 (2013) 67–71

Contents lists available at SciVerse ScienceDirect

Chemical Engineering Journal

journal homepage: www.elsevier.com/locate/cej

Characterization of Se(IV) removal from aqueous solution by *Aspergillus* sp. J2

Zhijian Li [a,*], Haifeng Li [b], Xiaolu Yang [a], Huang Zhang [a], Changhong Liu [a], Binhui Cao [c]

[a] College of Food Science and Technology, Henan University of Technology, Zhengzhou 450052, China
[b] College of Bioengineering, Henan University of Technology, Zhengzhou 450001, China
[c] COFCO Food Sales and Distribution Co., Ltd., Beijing 100020, China

HIGHLIGHTS

- *Aspergillus* sp. J2 is used as an adsorbent for the biosorption of Se(IV).
- SO_4^{2-} had significant effect on the biosorption of Se(IV).
- Removal of Se(IV) by *Aspergillus* sp. J2 was pH independent in the initial pH range 4.0–10.7.
- FTIR analysis suggested the role of sulfur compound in the Se(IV) biosorption process.

ARTICLE INFO

Article history:
Received 11 September 2012
Received in revised form 26 November 2012
Accepted 28 November 2012
Available online 23 January 2013

Keywords:
Aspergillus sp. J2
Biosorption
Selenium

ABSTRACT

Experiments were conducted to study the removal of Se(IV) from aqueous solution using *Aspergillus* sp. J2. Batch Se(IV) removal experiments including biosorption kinetics, isotherms, effects of pH and competitive ions were investigated. Removal of Se(IV) was pH independent in the initial pH range from 4.0 to 10.7. The kinetics of Se(IV) sorption were better fit to both pseudo-second order and the pseudo-first order kinetic model. The Langmuir isotherm model gave a better fit to the experimental data than the Freundlich model. The presence of 0.2 mM competing anions, such as Cl^-, NO^{3-}, HCO_3^- and HPO_4^{2-}, except SO_4^{2-}, had no significant effect on the removal of Se(IV). The biosorption capacity increased from 4.14 to 5.67 mg/g as temperature increased from 18 to 38 °C, which indicated the endothermic nature of the Se(IV) removal by *Aspergillus* sp. J2. FTIR analysis indicated that the sulfur compound was involved in Se(IV) biosorption.

1. Introduction

Selenium (Se) has been recognized to be an essential micronutrient for humans and animals at low concentration, but at elevated concentration little above those required for health it can also be considered as a harmful element due to its potential toxicity. The range between essentiality and toxicity is narrow [1]. Inorganic selenate (SeO_4^{2-}), selenite (SeO_3^{2-}), insoluble elemental selenium, and selenide including methylated forms (Se[-II]) are four species of selenium. In aqueous systems, selenium exists predominantly as SeO_3^{2-} and SeO_4^{2-} referred to Se(IV) and Se(VI). Both Se oxyanions are known to bioaccumulate in organisms and can lead to serious health effects. Se(IV) is more toxic than Se(VI) as selenite is taken-up faster and in greater amounts than selenate [1]. To minimize the health impact of selenium, World Health Organization (WHO) has recommended a maximum selenium concentration in drinking water of 10 μg/L [2].

In order to combat the problem of selenium contamination, various technologies for selenium removal from water sources have been proposed and adopted, such as: coagulation, ion exchange, adsorption and reverse osmosis. Adsorption process is regarded as one of the most promising techniques for selenium removal from water. Although in the last years, considerable work has been reported on the preparation of metal oxide adsorbents and biomass such as green algae, modified rice husk and peanut shell for selenium removal [3–7], the literature is quite scarce in dealing with identifying highly efficient microorganisms for selenium removal. The acknowledged potential of using microorganisms in the treatment of heavy metal-contaminated aqueous solutions is well known [8,9]. Therefore, biosorption of selenium using microorganism may also emerge as an option for selenium removal. In addition, the effects of competitive anions such as Cl^-, NO^{3-}, SO_4^{2-}, HCO_3^- and HPO_4^{2-} on selenium removal also have not been thoroughly investigated.

* Corresponding author. Tel./fax: +86 0371 67758022.
E-mail address: zjli@haut.edu.cn (Z. Li).

1385-8947/$ - see front matter
http://dx.doi.org/10.1016/j.cej.2012.11.136