Bioresource Technology 126 (2012) 56–63

Contents lists available at SciVerse ScienceDirect

Bioresource Technology

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

Influence of the presence of three typical surfactants on the adsorption of nickel (II) to aerobic activated sludge

Dongfang Liu, Yun Tao, Kexun Li *, Jie Yu

[a] The College of Environmental Science and Engineering, Nankai University, Tianjin 300071, PR China
[b] MOE Key Laboratory of Pollution Processes and Environmental Criteria, Nankai University, Tianjin 300071, PR China

HIGHLIGHTS

- ▶ Surfactants were first set as operational parameters during nickel(II) adsorption.
- ▶ Influence on nickel(II) adsorption strongly depended on surfactant's type.
- ▶ C_{14}BDMA and nickel(II) almost competed to same functional groups on biomass.
- ▶ Surfactants impelled nickel(II) adsorption from chemisorption to physisorption.

ARTICLE INFO

Article history:
Received 9 May 2012
Received in revised form 5 September 2012
Accepted 9 September 2012
Available online 19 September 2012

Keywords:
Influence
Surfactants
Aerobic activated sludge
Nickel(II) removal
Adsorption

ABSTRACT

The effects of different surfactants (SDBS, C_{14}BDMA, Tween20) on the sorption of nickel(II) onto aerobic activated sludge were studied. Results showed that the influence of surfactants on the adsorption of nickel(II) strongly depended on the type of the surfactants. The presence of SDBS enhanced nickel(II) sorption, in contrast, the presence of C_{14}BDMA and Tween20 both caused a nickel(II) sorption reduction, but Tween20 had a slighter effect. With the presence of individual surfactant, the sorption kinetics and isotherms were good agreement with pseudo-second-order kinetic model and Langmuir isotherm, respectively. The surfactant impelled the nickel(II) adsorption process onto aerobic activated sludge to transform from chemisorption to physisorption, and the existence of SDBS in solution even changed the exothermic nature. From FT-IR measurements and zeta potential measurements, there was competitive relationship between C_{14}BDMA and nickel(II) at the adsorption onto sludge.

1. Introduction

Heavy metals are persistent environmental contaminants since they cannot be degraded or destroyed, and heavy metal pollution represents an important problem due to its toxic effect and accumulation throughout the food chain leading to serious ecological and health problems even at very low concentration (Xu et al., 2006). Nickel(II) is one common heavy metal. It is essential nutrients needed by the body in trace amounts and takes part in synthesis of vitamin B12, however, an increase in the intake of Ni(II) and its compounds can lead to birth defects, embolism, chronic bronchitis (Han et al., 2009), So the tolerance limit of nickel in drinking water is 0.01 mg L^{-1}, and for industrial wastewater it is 2.0 mg L^{-1} (Panneerselvam et al., 2011). Nickel(II) is used in a large number of industries, such as electroplating, batteries manufacturing, mine, metal finishing and forging and so on (Futalan et al., 2011). Wastewater with Ni^{2+} was discharged into sewage system, and the concentration in effluent was extensively concerned. It was reported that during wastewater biological treatment nickel(II) was concentrated in sludge (Williams et al., 1998).

In recent years, the removal of nickel(II) from wastewater was well documented by using adsorption techniques with different low-cost materials, such as activated sludge (Hawari and Mulligan, 2006) , chitosan (Futalan et al., 2011), tea waste (Panneerselvam et al., 2011), brown algae (Montazer-Rahmati et al., 2011), carbohydrate biopolymer (Vinod et al., 2010), barley straw (Chmielewski et al., 1997), meranti sawdust (Rafatullah et al., 2009), coir pith (Ewecharoen et al., 2008), etc. The activated sludge, being the most commonly used biological wastewater treatment method in WWTP, has been proved to be one efficient adsorbent to remove and accumulate heavy metals in wastewater (Al-Qodah, 2006). In most of these studies, the effects of operational parameters like pH, temperature, and initial nickel(II) concentration on the metal removal capacity of various forms of activated sludge were investigated, but little attention seems to be given to the study of influence of organic matter on the adsorption process of nickel(II) in

* Corresponding author at: Environmental Engineering Program, College of Environmental Science and Engineering, Nankai University, 94 Weijin Road, Tianjin 300071, PR China. Tel./fax: +86 22 23495200.

E-mail address: Likx@nankai.edu.cn (K. Li).

0960-8524/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.biortech.2012.09.025