ARTICLE IN PRESS

Saudi Journal of Biological Sciences (2016) **xxx**, xxx–xxx

King Saud University
Saudi Journal of Biological Sciences
www.ksu.edu.sa
www.sciencedirect.com

ORIGINAL ARTICLE

Adsorption characteristics of sulfur solution by acticarbon against drinking-water toxicosis

Shengbo Ge [a], **Zhenling Liu** [b], **Yuzo Furuta** [c], **Wanxi Peng** [a,c,*]

[a] *School of Materials Science and Engineering, Central South University of Forestry and Technology, Changsha 410004, China*
[b] *School of Management, Henan University of Technology, Zhengzhou, Henan 450001, China*
[c] *Laboratory of Biomaterials Science, Kyoto Prefectural University, Kyoto, Japan*

Received 28 June 2016; revised 1 September 2016; accepted 2 September 2016

KEYWORDS

Acticarbon;
Drinking-water toxicosis;
$Fe_2(SO_4)_3$;
$Na_2S_2O_8$;
Na_2SO_3

Abstract Sulfur and ammonia nitrogen are rich nutrient pollutants, after entering water can cause algal blooms, cause eutrophication of water body, the spread of them will not only pollute the environment, destroy the ecological balance, but also harm human health through food chain channels, especially drinking-water toxicosis. Acticarbon can adsorb harmful substances, it was beneficial for people's health. In order to figure out the optimal adsorption condition and the intrinsic change of acticarbon, five chemicals were adsorbed by acticarbon and analyzed by FT-IR. The optimal adsorption condition of $Fe_2(SO_4)_3$, Na_2SO_4, $Na_2S_2O_8$, S and Na_2SO_3 was 9 g/1000 g at 80 min, 21 g/1000 g at 20 min, 15g/1000 g at 20 min, 21 g/1000 g at 60 min and 21 g/1000 g at 100 min, respectively. FT-IR spectra showed that acticarbon had eight characteristic peaks, such as S-S stretch, H_2O stretch, $O-H$ stretch, $-C-H$ stretch, $C=O$ or $C=C$ stretch, CH_2 bend, $C-H$ were at 3850 cm^{-1}, 3740 cm^{-1}, 3435 cm^{-1}, 2925 cm^{-1}, 1630 cm^{-1}, 1390 cm^{-1}, 1115 cm^{-1}, 600 cm^{-1}, respectively. For FT-IR spectra of $Fe_2(SO_4)_3$, the peaks at 3850 cm^{-1}, 3740 cm^{-1}, 2925 cm^{-1} achieved the maximum with 9 g/1000 g at 20 min. For Na_2SO_4, the peaks at 2925 cm^{-1}, 1630 cm^{-1}, 1390 cm^{-1}, 1115 cm^{-1}, 600 cm^{-1} achieved the maximum with 21 g/1000 g at 120 min. For ones of $Na_2S_2O_8$, the peaks at 3850 cm^{-1}, 3740 cm^{-1}, 1390 cm^{-1}, 1115 cm^{-1}, 600 cm^{-1}, achieved the maximum with 2 g/1000 g at 80 min. For ones of S, the peaks at 3850 cm^{-1}, 3740 cm^{-1}, 2925 cm^{-1} achieved the maximum with 19 g/1000 g at 100 min, the peaks at 1390 cm^{-1}, 1115 cm^{-1}, 600 cm^{-1} achieved the maximum with 19 g/1000 g at 20 min. For FT-IR spectra of Na_2SO_3, the peaks at 1630 cm^{-1}, 1390 cm^{-1}, 1115 cm^{-1}, 600 cm^{-1} achieved the maximum with 2 g/1000 g at 100 min. It provided that acticarbon could adsorb and desulphurize from sulfur solution against drinking-water toxicosis.

---

[*] Corresponding author at: School of Materials Science and Engineering, Central South University of Forestry and Technology, Changsha 410004, China.
E-mail address: pengwanxi@163.com (W. Peng).

Peer review under responsibility of King Saud University.

Production and hosting by Elsevier

http://dx.doi.org/10.1016/j.sjbs.2016.09.010
1319-562X

1. Introduction

Sulfur and ammonia nitrogen mainly come from chemical fertilizers, processed meat, leather and other industry emissions of industrial waste water, and city life sewage and farmland irrigation and drainage (He et al., 2008; Mao et al., 2000; Chai et al., 2010). Sulfur and ammonia nitrogen are rich nutrient pollutants, after entering water can cause algal blooms, cause eutrophication of water body, the spread of them will not only pollute the environment, destroy the ecological balance, but also harm human health through food chain channels, such as drinking-water toxicosis. Ecological effects of acid precipitation can be determined from the timing of changes in lake chemistry or acid-sensitive micro fossils and metallic pollutants in sediments. This is thought to be a result of a few factors: increased construction of large power plants and smelters with tall smokestacks coupled with a decrease in use of coal for home heating, converting the local air pollution problem into along-range, transboundary one; emissions of NO_x and other pollutants that aid in the oxidation of sulfur and nitrogen oxide have increased; and it took years for lakes, streams and their catchments to lose their buffering capabilities, so that lower pH levels were not recognized until sometime after the precipitation became acidic. Anthropogenic emissions are comparable to natural emissions on the global level, but regionally over 90% of sulfur deposited from the atmosphere is anthropogenic (Schindler, 1988).

Acticarbon can use almost any type of carbon materials, such as wood (Wang et al., 2009a), sawdust (Zhang et al., 2010), coal (Ahmadpour and Do, 1996), shells (Chandra et al., 2009), the stone of the fruit (Jumasiah et al., 2005), bagasse, oil waste, waste plastics (Zhou et al., 2007), paper and leather scrap (Yuan et al., 2004), waste tires and urban waste (Wang, 2004). Acticarbon with highly developed porous structure and huge specific surface area (Ding et al., 2002), good chemical stability and thermal stability, high mechanical strength and surface contains a variety of oxygen containing functional groups (Yu et al., 2005 and Pu and Jiang, 2005). What's more, acticarbon, which contained potassium, calcium and other minerals, could have adsorption and filtration of extractives, oil, other matters (Peng et al., 2013a,b,c, 2014a, 2012, 2011; Xiao et al., 2013; Wang et al., 2013; Peng and Le, 2012; Liu et al., 2008; Zhang et al., 2008; Qi et al., 2012). The fabric inhibited bacterial metabolism causing fewer allergic skin reactions than other fibers sterilized with antimicrobial agents. Because the trait was due to the highly porous structure of the bamboo fabric, it could absorb sulfur-based compounds, nitrogen-based compounds and so on (Milena et al., 2003; Ikuo et al., 2001; Masakazu et al., 2003; Kei et al., 1994; Wang et al., 2006; Xue et al., 2014; Cui et al., 2014). In order to figure out the optimal adsorption condition and the intrinsic change of the acticarbon, five chemicals were adsorbed by acticarbon and were analyzed by FT-IR.

2. Materials and methods

2.1. Materials

Acticarbon, $Fe_2(SO_4)_3$, Na_2SO_4, $Na_2S_2O_8$, S, and Na_2SO_3 were purchased from the market.

2.2. Methods

The $Fe_2(SO_4)_3$ powder was weighed in quantities of 5 g, 9 g, and 21 g . These powder and 4 g over dry acticarbon were put into beaker which equipped with 1000 ml water, respectively.It was stirred in a beaker for 20 min, 80 min and 120 min. The Na_2SO_4 powder was weighed in quantities of 11 g, 19 g, and 21 g. These powder and 4 g over dry acticarbon were put into beaker which equipped with 1000 ml water, respectively. It was stirred in a beaker for 20 min, 60 min and 120 min, respectively. The $Na_2S_2O_8$ powder was weighed

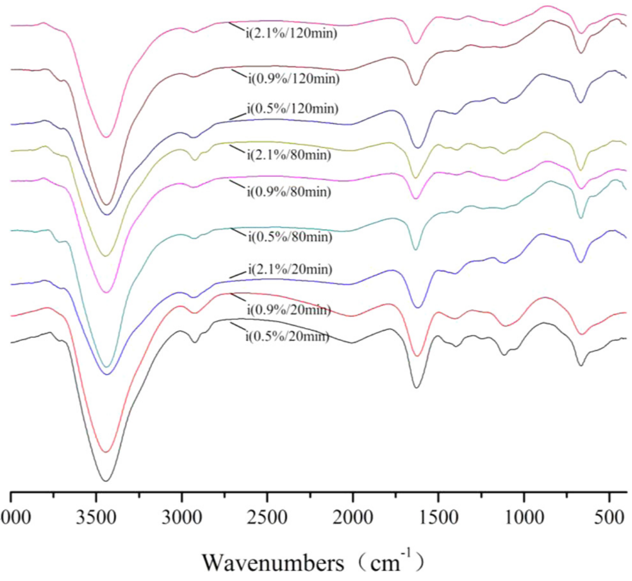

Figure 1 FT-IR spectra of acticarbon during adsorption of $Fe_2(SO_4)_3$ solution.

Table 1 Adsorption results.

SC (%)	$Fe_2(SO_4)_3$			SC (%)	Na_2SO_4			SC (%)	$Na_2S_2O_8$			SC (%)	S			SC (%)	Na_2SO_3		
	Stir time (min)				Stir time (min)				Stir time (min)				Stir time (min)				Stir time (min)		
	20	80	120		20	60	120		20	80	100		20	60	100		20	40	100
0.5	3.76	2.49	1	1.1	1.25	0.75	2.51	0.2	0.5	1.79	1.03	0.2	7.75	4.52	4.73	0.2	0	2.74	1.75
0.9	1.75	23.7	0.5	1.9	3.52	1.99	2.26	1.1	8.25	3.23	2.23	1.9	37.3	58.6	11.5	1.1	2.74	2.74	2.26
2.1	17.5	18.5	2.75	2.1	8.21	1.75	2.99	1.5	20.1	12.7	2.19	2.1	37.7	80.3	32.8	2.1	1.25	2.26	4.26

Note: SC – Concentration of sulfur solution.

Please cite this article in press as: Ge, S. et al., Adsorption characteristics of sulfur solution by acticarbon against drinking-water toxicosis. Saudi Journal of Biological Sciences (2016), http://dx.doi.org/10.1016/j.sjbs.2016.09.010