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Short Communication

# An integrated approach for Cr(VI)-detoxification with polyaniline/cellulose fiber composite prepared using hydrogen peroxide as oxidant

Xiangyao Liu, Xueren Qian *, Jing Shen, Wanpeng Zhou, Xianhui An

*Key Laboratory of Bio-based Material Science and Technology of Ministry of Education, Northeast Forestry University, Harbin 150040, China*

## HIGHLIGHTS

- An integrated concept for detoxification of Cr(VI)-contaminated water was proposed.
- Polyaniline/cellulose fiber composite was used for water treatment.
- Hydrogen peroxide was used as oxidant to prepare the composite.
- The process conditions for preparation of the engineered fiber were optimized.
- The effectiveness of the process concept was demonstrated.

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## ABSTRACT

In this short communication, the demonstration of a new integrated process concept involving the use of a bio-based material for detoxification of Cr(VI)-contaminated water is presented. Specifically, the bio-based material is a polyaniline/cellulose fiber composite prepared by in situ polymerization of aniline in the presence of cellulose fibers, using the industrially favorable hydrogen peroxide (instead of costly oxidants such as ammonium persulfate) as the oxidant. Ferric chloride was used to catalyze the polymerization reaction. The process conditions for the preparation of the composite were preliminarily coptimized, and the proposed concept was demonstrated. Under the conditions studied, the use of the composite was quite effective in the detoxification of the model solution. The proposed concept may serve as an alternative approach for water treatment using renewable materials.



## 1. Introduction

The detoxification of water contaminated by the highly toxic Cr(VI) is highly needed to address the environmental concerns. In this regard, numerous methods/processes have been practiced or demonstrated. These mainly include adsorption, membrane filtration, ion exchange, and electrochemical treatment (Owlad et al., 2009).

One noteworthy fact is that the use of bio-based materials such as activated carbon (Li et al., 2012), modified corn stalk (Chen et al., 2012), and *Chlorella minutissima* (Singh et al., 2012), is an environmentally attractive approach for Cr(VI) detoxification, fitting well into the globally well-known strategy of sustainable development based on the use of renewable materials for various applications (Cha et al., 2012; Sannigrahi et al., 2010; Shen et al., 2011). In particular, the use of abundantly available cellulosic substrates can be rather promising in terms of Cr(VI) detoxification (Hubbe et al., 2011).

Due to the interesting fact that polyaniline (a conducting polymer) can be used to chemically convert the highly toxic Cr(VI) to much less toxic Cr(III) (Olad and Nabavi, 2007; Ruotolo and Gubulin, 2005), it is worth expecting that the use of polyaniline/cellulose fiber composite or other conductive composites for water treatment (Huang et al., 2005,2006; Li et al., 2010; Qian et al., 2010) may serve as an integrated approach for Cr(VI) detoxification, i.e., conversion of Cr(VI) to Cr(III) followed by Cr(III) adsorption onto the cellulosic substrate. These conductive composites can be prepared via the so-called in situ polymerization process, i.e., aniline or other monomers is polymerized in the presence of cellulose fibers, forming polymer-coated fibers (Huang et al., 2005,2006; Li et al., 2010; Qian et al., 2010).

In this study, a new integrated concept of using polyaniline/cellulose fiber composite for detoxification of Cr(VI)-contaminated

* Corresponding author. Tel./fax: +86 451 82192081.
*E-mail address:* qianxueren@yahoo.com.cn (X. Qian).

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