Bioresource Technology 117 (2012) 33–39

Contents lists available at SciVerse ScienceDirect

Bioresource Technology

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

Performance and microbial community analysis of a novel bio-cord carrier during treatment of a polluted river

Xingcheng Yuan, Xin Qian *, Ruibin Zhang, Rui Ye, Wei Hu

State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment, Nanjing University, Nanjing 210046, PR China

HIGHLIGHTS

- ▶ We report a novel bio-cord carrier for treatment of polluted rivers.
- ▶ The bio-cord exhibits good filtration and pollutant removal performance.
- ▶ The bio-cord fibers provide suitable conditions for microorganism growth.
- ▶ 16S rDNA libraries of bacteria in the bio-cord are created.
- ▶ Aerobic/anoxic/anaerobic zones are formed based on the microbial distribution.

ARTICLE INFO

Article history:
Received 10 February 2012
Received in revised form 13 April 2012
Accepted 19 April 2012
Available online 26 April 2012

Keywords:
Bio-cord
Polluted river
Microbial community
16S rDNA library

ABSTRACT

The performance and microbial community structure of a novel bio-cord carrier during treatment of a polluted river at the laboratory scale was investigated. The bio-cord exhibited good filtration performance, with 87.2% SS removal and an 84.9% reduction in turbidity in 120 min, as well as 19.4–34.4%, 55.2–74.0%, 46.2–55.9% and 13.1–18.5% reductions in the COD, NH_3–N, TN and TP, respectively, under three different hydraulic retention times. The bio-cord fibers also provided suitable conditions and support media for microbial growth. Additionally, 114 cloned 16S rDNA sequences were composed of Proteobacteria (57.9%), Bacteroidetes (17.5%) and other phyla (24.6%). There were great differences in bacterial quantity and composition between the surface and inside of the bio-cord. Furthermore, nitrifying and denitrifying bacteria were detected, suggesting that simultaneous nitrification and denitrification processes were occurring. Overall, the results of this study demonstrated that the carrier could attach microorganisms for polluted river treatment.

1. Introduction

Domestic, industrial and agricultural effluents have long been discharged into rivers with no or poor treatment, particularly in developing countries, which has led to serious river pollution in many areas (Mulliss et al., 1996; Ongley et al., 2010). For example, the water quality in 40.1% of the important river sections in China have been reported to be below the level IV standard in 2010, with organics and ammonia nitrogen as the main pollutants (Chinese SEPA, 2011). Many small rivers in China have also been polluted more seriously, with water bodies blackening and developing foul odors, as well as undergoing oxygen depletion and general aquatic ecosystem deterioration (Huang et al., 2011). Most of these rivers are also the influents of lakes or larger rivers; therefore, they play key roles in transferring pollutants to these larger systems (Xie et al., 2007). Accordingly, it is important to take appropriate measures to reduce the pollution load so that the water quality in downstream lakes and rivers improves.

Early treatment measures simply depended on the self-purifying mechanisms of natural water bodies to degrade, disperse and redistribute low concentrations of wastewater (Dong et al., 2010). However, the concentration and volume of wastewater now discharged into many of these systems are too great to be treated by natural ecosystems alone. Thus, other technologies for polluted river remediation must be considered to enhance the river self-purification capability and improve water quality. These technologies include dredging, artificial aeration, sedimentation and filtration, contact oxidation, and enhanced microbial purification (Hofman et al., 1998; Sun et al., 2009; Wu et al., 2009; Yu et al., 2009). Among these methods, contact oxidation technology has received a great deal of attention in recent years, owing to its cost-effectiveness, low energy consumption and easy management; accordingly, it is commonly employed to treat polluted river water using the river channel as the reactor (Park et al., 2004; Takada et al., 1994). In this process, artificial carriers are

* Corresponding author. Address: 163 Xianlin Avenue, Nanjing 210046, PR China. Tel./fax: +86 25 89680527.
E-mail address: xqian@nju.edu.cn (X. Qian).

0960-8524/$ - see front matter
http://dx.doi.org/10.1016/j.biortech.2012.04.058