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Treatment of artificial soybean wastewater anaerobic effluent in a continuous aerobic–anaerobic coupled (CAAC) process with excess sludge reduction

Jun Wang[a,1], Xiaoxia Li[a,1], Weichao Fu[b], Shihan Wu[a], Chun Li[a,b,*]

[a] Department of Biological Engineering, School of Life Science and Technology, Beijing Institute of Technology, Beijing 100081, PR China
[b] School of Chemistry and Chemical Engineering, Shihezi University, Shihezi 832003, PR China

HIGHLIGHTS

- ▶ A CAAC process was designed for COD and nitrogen removal.
- ▶ In situ sludge reduction was achievable in this CAAC process.
- ▶ The mechanism of sludge reduction was discussed in this research.

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ABSTRACT

In this study, treatment of artificial soybean wastewater anaerobic effluent was studied in a continuous aerobic–anaerobic coupled (CAAC) process. The focus was on COD and nitrogen removal as well as excess sludge reduction. During the continuous operation without reflux, the COD removal efficiency was 96.5% at the optimal hydraulic retention time (HRT) 1.3 days. When HRT was shortened to 1.0 day, reflux from anaerobic zone to moving bed biofilm reactor (MBBR) was introduced. The removal efficiencies of COD and TN were 94.4% and 76.0% at the optimal reflux ratio 30%, respectively. The sludge yield coefficient of CAAC was 0.1738, the simultaneous removal of COD and nitrogen with in situ sludge reduction could be achieved in this CAAC process. The sludge reduction mechanism was discussed by soluble components variation along the water flow.

1. Introduction

In China, the wastewater from a soybean processing plant has a high chemical oxygen demand (COD) concentration of about 10,000–20,000 mg/L (Zhu et al., 2008). Anaerobic processes such as up-flow anaerobic sludge bed (UASB) and anaerobic baffled reactor (ABR) are appropriate methods for treatment and energy recovery from high-strength wastewater, such as soybean processing wastewater (Dong et al., 2010; Zhu et al., 2008). But after anaerobic treatment, the effluent COD concentration often remains up to 1000–1500 mg/L (Luostarinen et al., 2006). Furthermore, anaerobic treatment has limited capacity to remove nitrogen. When discharged to the environment, the insufficiently treated anaerobic wastewater commonly causes several problems, such as eutrophication, oxygen consumption and toxicity. So, adequate post-treatment processes to directly aim at anaerobic effluent are needed to achieve complete COD and nitrogen removal.

The conventional activated sludge (CAS) process is most widely used for biological wastewater treatment in both domestic and industrial plants all over the world. It is also used as a post-treatment process for anaerobic effluent. Generally, this typical type of biological wastewater treatment process involves the transformation of dissolved and suspended organic contaminants to biomass and evolved gases (CO_2, CH_4, N_2 and SO_2) (Low and Chase, 1999). However, the production of excess sludge has been one of the apparent drawbacks of CAS process and sludge yield coefficient is typically about 0.5 (Gray, 1989). Currently, excess sludge disposal is raising challenge for wastewater treatment plants due to economic and environmental aspects, which has become a serious issue for water pollution protection. The excess sludge disposal cost often accounts about half, even up to 60% of the total cost of wastewater treatment from wastewater treatment

* Corresponding author at: School of Life Science and Technology, Beijing Institute of Technology, 5 ZhongGuanCun South Street, Beijing 100081, PR China. Tel./fax: +86 10 68913171.
E-mail address: lichun@bit.edu.cn (C. Li).
[1] These authors contributed equally to this work.

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