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Short Communication

Cultivation of aerobic granular sludge for rubber wastewater treatment

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HIGHLIGHTS

- Aerobic granular sludge showed excellent settling ability and sludge volume index.
- A COD removal rate of 96.5% was observed at an OLR of 3.7 kg COD m^{-3} d^{-1}.
- Ammonia and total nitrogen removal efficiencies were 94.7% and 89.4%, respectively.

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ABSTRACT

Aerobic granular sludge (AGS) was successfully cultivated at 27 ± 1 °C and pH 7.0 ± 1 during the treatment of rubber wastewater using a sequential batch reactor system mode with complete cycle time of 3 h. Results showed aerobic granular sludge had an excellent settling ability and exhibited exceptional performance in the organics and nutrients removal from rubber wastewater. Regular, dense and fast settling granule (average diameter, 1.5 mm; settling velocity, 33 m h^{-1}; and sludge volume index, 22.3 mL g^{-1}) were developed in a single reactor. In addition, 96.5% COD removal efficiency was observed in the system at the end of the granulation period, while its ammonia and total nitrogen removal efficiencies were up to 94.7% and 89.4%, respectively. The study demonstrated the capabilities of AGS development in a single, high and slender column type-bioreactor for the treatment of rubber wastewater.

1. Introduction

Rubber is one of the main agro-based industrial sectors that play an important role in Malaysia's economy. Presently, Malaysia is the fourth largest rubber producer in the world after Thailand, Indonesia and India (Vijayaraghavan et al., 2008). There are two types of processes in raw natural rubber processing; the production of latex concentrate and the Standard Malaysian Rubber (SMR) (Sulaiman et al., 2010). SMR is the current bulk of Malaysian rubber which is produced in the form of technically specified crumb rubber. Large quantities of effluent were produced from the processing of raw natural rubber since it required huge amount of water for its operation. The effluent typically contains a small amount of uncoagulated latex, serum with substantial quantities of proteins, carbohydrates, sugars, lipids, carotenoids, as well as inorganic and organic salts and also includes washings water from the various processing stages (Mohammadi et al., 2010). Both biological and chemical methods are used to treat the rubber wastewater.

Research into aerobic granular sludge technology applications in the real-industrial wastewater has been initiated by previous researchers. The applicability of aerobic granulation in treating a wide variety of industrial wastewater under laboratory scale conditions like abattoir (Yilmaz et al., 2008), dairy (Wichern et al., 2008), livestock (Kishida et al., 2009), winery (López-Palau et al., 2009), chemical industrial wastewater (Liu et al., 2011), palm oil mill effluent (Abdullah et al., 2011), landfill leachate (Wei et al., 2012) as well as industrial effluents (Val del Río et al., 2012) were also been investigated. To date, there is no reported study on the use of aerobic granular sludge system for the treatment of wastewater from rubber industry.

Hence, aerobic granular sludge technology seems to be a reasonable option for studying rubber wastewater treatment. In this study, the process of aerobic granulation in a Standard Malaysian Rubber (SMR) wastewater treatment system were examined by focusing on the feasibility of aerobic granular sludge in treating

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