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Short Communication

Study of performances, stability and microbial characterization of a Sequencing Batch Biofilter Granular Reactor working at low recirculation flow

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HIGHLIGHTS

- ▶ Stable granulation was achieved despite low organic load and shear stress.
- ▶ Methane production in an aerated granular reactor was obtained.
- ▶ Low sludge production was obtained.
- ▶ Optimization of wastewater recirculation flow can reduce process energy demand.
- ▶ Presence of filamentous bacteria didn't affect reactor depuration performances.

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ABSTRACT

The Sequencing Batch Biofilter Granular Reactor (SBBGR) is a promising wastewater treatment technology characterized by high biomass concentration in the system, good depuration performance and low sludge production. Its main drawback is the high energy consumption required for wastewater recirculation through the reactor bed to ensure both shear stress and oxygen supply. Therefore, the effect of low recirculation flow on the long-term (38 months) performance of a laboratory scale SBBGR was studied. Both the microbial components of the granules, and their main metabolic activities were evaluated (heterotrophic oxidation, nitrification, denitrification, fermentation, sulphate reduction and methanogenesis). The results indicate that despite reduced recirculation, the SBBGR system maintained many of its advantageous characteristics.

1. Introduction

Sequencing Batch Biofilter Granular Reactors (SBBGR) constitute a recent technology, still applied at laboratory and pilot scale. These systems have shown high performances treating both municipal and industrial wastewater, also containing toxic compounds (Di Iaconi et al., 2008, 2011). They display an ability to remove nitrogen, organic carbon (up to 3.5 kgCOD m_{bed}^{-3} d^{-1}, Di Iaconi et al., 2008) and recalcitrant compounds in most cases, coupled with low suspended solid levels in the final effluent and low sludge production (about 0.1 kgTSS $kgCOD_{removed}^{-1}$, De Sanctis et al., 2010). Moreover, packed configuration allows a sludge concentration as high as 30–40 gTSS L_{bed}^{-1} (Di Iaconi et al., 2008, 2011; De Sanctis et al., 2010). Compared with traditional plants, these SBBGR features greatly reduce both plant investment costs (smaller areas required) and operating costs for sludge treatment and disposal.

However, an SBBGR plant requires the presence of a relevant recirculation flow of wastewater through the bed (up-flow velocity about 3 m h^{-1}) which represent about 50–60% of the process energy demand (Di Iaconi et al., 2011). This recirculation flow is essential for the distribution of wastewater and oxygen through the bed, and the generation of the shear forces necessary for granule formation and maintenance. In fact, a high shear stress value in the reactor seems to be an essential condition for granule generation in both the current aerobic granulation technologies

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