Cultivation of aerobic granules through synthetic petroleum wastewater treatment in a cyclic aerobic granular reactor

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ABSTRACT

The aim of this study was to investigate the new structure of SBR (placement of baffles in different way) and its ability to treat petroleum wastewater, compared to a conventional system, as well as investigate the effects of pollutant concentration on the granules’ performance at ambient temperature (24 ± 1ºC). Two SBR were tested. R₁ had baffles including three risers and three down-comers, and R₂ had one riser and one down-comer. After an adaptation period of about 59 d, granules with a mean diameter of 6 mm and 5 mm, medium density of 1.0132 and 0.87720 gr/ml, and settling velocity of 2.51 and 2.13 cm/s were observed in R₁ and R₂, respectively. Step-wise increasing the OLR in R₁ and R₂ affected size, density, settling velocity, and the granules’ stability, by increasing them and gradually decreasing the COD removal efficiency. Maximum COD removal in R₁ and R₂ was achieved in OLR equal to 0.9 kg/m³d (95.4%–91.4%), and minimum COD removal was achieved in OLR equal to 2.4 kg/m³d (85.5–71.1%). Corresponding amounts for maximum removal of total petroleum hydrocarbon (TPH) were 94.2% and 90.8% (TPH in equal to 104.2 mg/l) and minimum amounts (TPH in equal to 157.9 mg/L) were equal to 82.1% and 70.4%, respectively. Appropriate placement of baffles in R₁ caused faster formation of granules, improved their physical properties and increased removal efficiency compared to R₂. By increasing in OLR and consequently, increasing in granule size and according to cell death, an anaerobic core generated in the center of the granules. Instability of anaerobic core as well as reduction of the granules’ ability to tolerate oil and toxic pollutants, gradually decreased removal efficiency, integrity coefficient and increased SVI.

Keywords: COD; Aerobic granules; Organic loading; petroleum wastewater; Sequencing batch reactor (SBR)