Short-sludge age EBPR process – Microbial and biochemical process characterisation during reactor start-up and operation - DTU Orbit (14/10/2018)

The new paradigm for used water treatment suggests the use of short solid retention times (SRT) to minimize organic substrate mineralization and to maximize resource recovery. However, little is known about the microbes and the underlying biogeochemical mechanisms driving these short-SRT systems. In this paper, we report the start-up and operation of a short-SRT enhanced biological phosphorus removal (EBPR) system operated as a sequencing batch reactor (SBR) fed with preclarified municipal wastewater, which is supplemented with propionate. The microbial community was analysed via 16S rRNA amplicon sequencing. During start-up (SRT = 8 d), the EBPR was removing up to 99% of the influent phosphate and completely oxidized the incoming ammonia. Furthermore, the sludge showed excellent settling properties. However, once the SRT was shifted to 3.5 days nitrification was inhibited and bacteria of the Thiothrix taxon proliferated in the reactor, thereby leading to filamentous bulking (sludge volume index up to SVI = 1100 mL/g). Phosphorus removal deteriorated during this period, likely due to the out-competition of polyphosphate accumulating organisms (PAO) by sulphate reducing bacteria (SRB). Subsequently, SRB activity was suppressed by reducing the anaerobic SRT from 1.2 day to 0.68 day, with a consequent rapid SVI decrease to ~200 mL/g. The short-SRT EBPR effectively removed phosphate and nitrification was mitigated at SRT = 3 days and oxygen levels ranging from 2 to 3 mg/L.

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