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Study of performance of sequencing batch reactor during transition from oxic to anoxic conditions

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Abstract: *Sequencing batch reactors (SBRs) are usually preferred as small and decentralized wastewater treatment systems. Using a frequent enough switching between oxic and anoxic conditions, it is possible to bypass the second step of nitrification (i.e. conversion of nitrite to nitrate nitrogen) in SBR*

Sequencing batch reactors (SBRs) are usually preferred as small and decentralized wastewater treatment systems. Using a frequent enough switching between oxic and anoxic conditions, it is possible to bypass the second step of nitrification (i.e. conversion of nitrite to nitrate nitrogen) in SBR. Intermittently aerated reactors have been successfully used for nitrogen removal from wastewater by achieving partial nitrification denitrification (PND) technology for combined carbon and nitrogen removal.Intermittently aerated reactors can potentially be optimized if used to perform partial nitrification followed by denitrification via nitrite, resulting in reduced oxygen demand for ammonia removal and reduced organic substrate for denitrification. We hypothesized that aeration cycles with sufficiently short aerated periods or sufficiently long nonaerated periods can provide appropriate conditions for partial nitrification and denitrification via nitrite. This process is based on the facts that, since nitrite and nitrate are intermediary compounds in nitrification and denitrification, a partial nitrification to nitrite and denitrification from accumulated nitrite, instead from nitrate, would be feasible to remove high concentrations of nitrogen compounds in the wastewaters. In contrast to the traditional biological nitrogen removal (BNR) process, PND has the following advantages: Lower oxygen consumption by 25% in the aerobic phase implies 60% energy saving in the entire process, the requirement for electron donors is as much as 40% lower in the anoxic phase, NO2denitrification rate is 1.5 to 2 times higher than NO3denitrification rate and reduction of the generated sludge by up to 75%. The inhibition of nitrite-oxidizing bacteria (NOB) is critical for PND because NOB oxidizes NO_2^- to NO_3^- and converts partial nitrification to complete nitrification. Several parameters, including DO concentration, temperature, pH, SRT, substrate concentration, ratio of carbon to nitrogen (C/N), aeration pattern, and chemical inhibitor,...etc. have been found to selectively inhibit NOB. Intermittent aeration favors partial nitrification. a SBR system was operating with a “react” phase divided into three sets of consecutive aerobic and anoxic periods with a duration ratio of 1:3, the nitrogen removal was achieved via nitrite. This was attributed to the suppression of the nitrite-oxidizers activity due to the short aerobic phase duration. PND was successfully completed using the aeration control strategy, even though the temperature decreased from 32 °C to 21°C. References showed that the aeration per cycle, taking advantage of the lag-time of nitrite-oxidizers behind ammonia oxidizers was important parameters for effective PND in the proposed SBR. The removal efficiency of N and P was improved when anoxic reaction time as long as possible when allocating anoxic/aerobic reaction time within a cycle, and also the first and last reactions of cycle in SBR should be anoxic and aerobic, respectively. Each anoxic or aerobic time in a cycle should be over 30 minutes for high removal of nitrogen and phosphorus, but the repetition frequencies of alternate anoxic/aerobic state may be insignificant in removal efficiency. References studied the operation of SBR under three different variations of aerobic-anoxic sequence, viz. 4:4, 5:3 and 3:5 hours. It has been observed that 85 to 92% of soluble COD removal would be possible at the end of 8.0 hour of overall reaction period, irrespective of the length of the aerobic react period. In the case of 4:4 hour operating cycle, reasonable degree of nitrification (88-100%) and denitrification (73-75%), along with 91-94% of organic carbon removal have been achieved, which has been considered to be the optimum performance of the reactor. In this study, different lag phases were adopted to treat a real wastewater in order to reduce the final COD and nitrogen concentration. The ratio of aerobic/anoxic for each cycle was different.

The effect of oxic/anoxic ratio (R) on nutrient removal from municipal wastewater was examined in 5 m3 pilot-scale SBR operated at ambient temperature. During the react phase, the reactor was intermittently aerated specific aeration intervals. DO, pH and oxidation–reduction potential (ORP) in the reactors were real-time monitored. It was found that partial nitrification followed by denitrification successfully occurred in the intermittently aerated SBR system with R =3/6 (30 min oxic/60 min anoxic). Results showed aeration ratios, above R > (1/6), do not have a significant effect on COD and TSS removal efficiency.