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Rapid Start-Up and Efficient Long-Term Nitritation of Low Strength Ammonium Wastewater with a Sequencing Batch Reactor Containing Immobilized Cells

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Abstract : Major concerns regarding nitritation of low-strength ammonium wastewaters include low ammonium loading rates (usually below 0.2 kg/m3-d) and uncertainty about long-term stability of the process. The purpose of this study was to test a sequencing batch reactor (SBR) filled with cell-immobilized polyethylene glycol (PEG) pellets to see if it could achieve efficient and stable nitritation under various environmental conditions. SBR was fed with synthetic ammonium wastewater of 30±2 mg-N/L and pH: 8±0.05, maintaining the dissolved oxygen concentration of 1.7±0.2 mg/L and the temperature at 30±1oC. The reaction was easily converted to partial nitrification mode within a month by feeding relatively high ammonium substrate (~100 mg-N/L) in the beginning. We observed stable nitritation over 300 days with high ammonium loading rates (as high as ~1.1 kg-N/m3-d), nitrite accumulation rates (mostly over 97%) and ammonium removal rate (mostly over 95%). DO was a major limiting substrate when the DO concentration was below ~4 mg/L and the NH4+-N concentration was above 5 mg/L, giving almost linear increase in the ammonium oxidation rate with the bulk DO increase. Low temperatures mainly affected the reaction rate, which could be compensated for by increasing the pellet volume (i.e. biomass). Our results demonstrated that an SBR filled with small cell-immobilized PEG pellets could achieve very efficient and stable nitritation of a low-strength ammonium wastewater.

Keywords : ammonium loading rate (ALR), cell-immobilization, long-term nitritation, sequencing batch reactor (SBR), sewage treatment

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