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Simultaneous nitritation and denitritation of domestic wastewater without addition of external carbon sources at limited aeration and normal temperatures

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ABSTRACT

Nitrogen removal via nitrite and simultaneous nitrification-denitrification (SND) are two processes for nitrogen removal from wastewater. The combination of these two processes, i.e., simultaneous nitritation-denitritation or SND via nitrite, is highly beneficial for the domestic wastewater treatment in terms of lower carbon requirements, reduced oxygen demand and less biomass production. A lab-scale sequencing batch reactor (SBR) treating domestic wastewater with low C/N ratios was operated to investigate simultaneous nitritation-denitritation without addition of external carbon sources under limiting aeration and normal temperatures (19+1°C). The results showed that at a longer sludge retention time (SRT) of 50-66 d and an average dissolved oxygen (DO) concentration of 0.65 mg/L, nitritation was successfully achieved with nitrite accumulation rate over 95%. Fluorescence in-situ hybridization (FISH) analysis proved that ammonia oxidizing bacteria (AOB) became dominant nitrifying bacteria. Furthermore, denitritation occurred during the above aerobic period. The average total nitrogen (TN) removal through simultaneous nitritation-denitritation was maintained at 52% with a maximum of 63.1%. Low DO concentration under limited aeration is the key factor to achieve simultaneous nitritationdenitritation. Under long-term operation with low DO concentrations, the altering of nitrifying communities, establishment of anoxic micro-environment for denitrifiers growth and the characteristics of COD and NH⁺₄-N biodegradation promoted the occurrence of simultaneous nitritation-denitritation.

Keywords: Simultaneous nitritation and denitritation; Domestic wastewater; Limited aeration; Low DO concentration; Normal temperature

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