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Impact of decreasing COD/N ratio on nitrogen removal and fouling in a membrane bioreactor for urban wastewater treatment

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ABSTRACT

This research focused on the identification of the minimum COD/N ratio needed for the complete two-step denitrification process. Thus, to quantify the role of low COD/N ratios on nitrification and denitrification rates and on biological suspension filterability, experiments were carried out on a laboratory-scale membrane bioreactor (MBR) with a nitrogen loading rate of 0.16 kg N m^{-3} d^{-1}. The investigation was comprised of two COD/N ratios, 3.5 and 5, and two sludge retention times (SRTs), 40 and 60 d. The best nitrogen removal performances were obtained when working with a COD/N ratio of 5 and a SRT of 60 d; nitrification and denitrification were achieved with total nitrogen removal reaching 82%. Experimental results appeared in good agreement with activated sludge model no. 1 (ASM1) predictions. Nevertheless, the minimum COD/N according to ASM1 was found close to 6.3, underlining that the hydrolysis phenomenon was underestimated when working at high sludge retention. The MBR performances confirm that operation at low organic loading rates is a promising strategy for decreasing energy requirements, without hampering water quality (nitrogen removal). More specifically, it allowed a significant reduction of oxygen requirements for carbon biodegradation and lower suspended solids in the bioreactor even at high SRT, allowing easier control of membrane fouling.

Keywords: Membrane bioreactor; COD/N ratio; Biodegradation; Fouling; Nitrogen removal

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