Effective Biological Nitrogen Removal Treatment Processes for Domestic Wastewaters with Low C/N Ratios: A Review - DTU Orbit (26/09/2019)

Discharge of nitrogenous components to water bodies can cause eutrophication, deterioration of water quality, toxicity to aquatic life, and pose a potential hazard to human and animal health. Biological nitrogen removal can remove nitrogenous components via conversion to harmless nitrogen gas with high efficiency and relative low costs. However, the removal of nitrogen from domestic wastewater with a low carbon/nitrogen (C/N) ratio can often be limited in municipal wastewater plants (WWTPs) because organic carbon is a limiting factor for denitrification. The present work reviews innovative bacterial nitrogen removal pathways such as shortcut nitrification/denitrification, simultaneous nitrification/denitrification, and the nitritation Anammox process, which can remove nitrogen with low or zero dosage of organic carbon sources. We conclude that advanced process control and some new biological treatment processes including the modified anaerobic/anoxic/oxic (A(2)/O) process, the step-feed multistage anaerobic/oxic (A/O) process, and new reactors like the membrane bioreactors (MBRs) and the membrane-aerated biofilm reactors (MABRs) can support the innovative biological nitrogen removal pathways. They can effectively be used for nitrogen removal from low C/N domestic wastewater without external carbon addition. In addition, conventional and alternative carbon sources for enhanced biological nitrogen removal were also reviewed. We conclude that alternative carbon sources such as wine distillery effluent, the leachate of food waste, digested piggery manure, hydrolyzed molasses, biologically hydrolyzed or mechanically disintegrated sludge offer the same or better performance for nitrogen removal at reduced costs. Finally, we suggest that (1) these new processes and technologies are implemented at large scale for nitrogen removal from low C/N domestic wastewater, (2) further method logic are explored to introduce the Anammox pathway into domestic wastewater treatment, and (3) alternative carbon sources are explored and optimized for supporting the denitrification. With these efforts, cost-effective nitrogen removal from low C/N ratio domestic wastewater can be obtained in the near future.

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