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Inorganic carbon to improve wastewater treatment

Wastewater Treatment Plant biological reactors where a complex population of microorganisms is grown degrading the organic matter of the wastewater. In this work, researchers have studied a possible way to eliminate, as well as organic matter, nitrogen and phosphorus, two elements that affect nutrients richness of ecosystems.

Activated sludge is the most widespread technology for urban wastewater treatment in conventional WWTP. In short, WWTP are aerated biological reactors where a complex population of microorganisms is grown degrading the organic matter of the wastewater. In the last decades, the upgrade of this process to remove nitrogen and phosphorous together with organic matter has gained a lot of attention. Nitrification, i.e. biological ammonia oxidation to nitrate, is the first step of biological nitrogen removal. These populations are autotrophic (i.e. their carbon source is inorganic) and, as such, a deficit of this substrate should result in a decrease of the process rate.

This work examines the total inorganic carbon (TIC) limitation on nitrification. This limitation has not received much attention in the past, since the levels of TIC in a conventional WWTP are very

high due to the aerobic CO2 production. However, recent technology advances such as the SHARON® or the ANAMOX processes have brought new scenarios in biological nitrogen removal with very low Carbon to Nitrogen ratio wastewaters where TIC limitations should be considered.

For this aim, on-line reliable measurements of nitrification rate and the TIC concentration in the system were required. On the one hand, nitrification rate was measured using respirometric techniques, i.e. measuring the biological oxygen consumption rate. On the other hand, TIC was indirectly measured with a novel application of titrimetric techniques based on measuring the biological proton generation rate.

This study demonstrates that the nitrification process underlies limitations at low inorganic carbon concentrations. It was experimentally observed that the limitation started at values lower than 3 mmol C·L-1. The values of the nitrification rate versus TIC concentration could not successfully be fitted to the classical Monod and Tessier kinetics. The best fit was obtained with the sigmoidal kinetics. This work will improve the current nitrification models by extending its application to high N-strength wastewater treatment systems where process failures due to TIC limitation will be predicted.

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References

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