Investigating AOB and NOB kinetic parameters for oxygen under moderate climate wastewater conditions

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To date, almost all reported kinetic parameters of ammonia and nitrite oxidizing bacteria (AOB and NOB) for oxygen are measured at temperatures higher than 20°C. The oxygen competition between these two groups of organisms at lower temperatures is however of great interest for the realization of a nitrite shunt in municipal wastewater treatment. This study investigated the temperature dependency of AOB and NOB oxygen Monod kinetics, i.e. R_max and K_{O_2}. Nitrifying sludge originating from a sewage treatment plant (Breda, NL) was sampled over the temperature range of 10.5-17.2°C. The sludge contained AOB *Nitrosomonas* as detected by Illumina*, and* NOB genera *Nitrospira* and *Nitrobacter*, as revealed by qPCR. The Arrhenius temperature relationship, with $R\_max_T = R\_max_{Tref^*}$ θ^(T-Tref), was fitted to the Rmax data (Tref=13.9°C). The results yielded θ values that were in line with literature values: θ=1.11 (R^2=0.81), for AOB and θ=1.06 (R^2=0.53) for NOB. Surprisingly, AOB R_max rates were higher than NOB R_max rates over the whole temperature interval, which is in contrast to typical activated sludge. For K_{O_2} values, no good temperature relationships were found. In contrast to textbook knowledge, the results showed a higher K_{O_2} for AOB (0.55-2.43 mg O_2/L) compared to NOB (0.12-0.84 mg O_2/L). Overall, the obtained biokinetic parameters provide further insight for a better process modeling and control towards achieving energy-neutral wastewater treatment.