

Title

Nitrogen removal in MBBRs: The effect of low temperatures

Abstract

Nitrogen removal from wastewater in regions with low temperatures and long snow-melting periods represents a challenge for the performance of biological treatment processes and information on the efficiency of nitrification and denitrification processes under these conditions is lacking. This study evaluated the implementation of the MBBR treatment process in a pilot plant for wastewater treatment at Fillan WWTP in Sundsvall, Sweden, between January and May 2023. Each line had 6 different reactors, referred to as zones, including nitrification and denitrification (pre- and post-). They were used to evaluate the nitrogen removal efficiency during continuous plant operation.

Furthermore, batch activity tests were performed to follow up the biomass activities depending on temperature changes, and laboratory scale activity tests were used to analyze the influence of DO on the denitrification process. From the results, it was concluded that high nitrogen removal efficiencies can be achieved at low temperatures. Nevertheless, the denitrification process was highly affected during the snowmelt period, especially in April, when the nitrogen removal efficiency dropped below 50% in both lines. From the batch activity tests, the Arrhenius temperature dependence coefficient was calculated for the denitrification and nitrification processes. Although θ values were close to the values reported in the literature, no clear difference was observed between them. From the laboratory-scale activity test, the negative effect of high DO concentrations was evidenced not only in the denitrification process but also in $\text{NO}_2\text{-N}$ production, which is also related to the excess available carbon source.

Keywords: *wastewater, low temperature, nitrogen removal, MBBR*