INVESTIGATION OF ENRICHMENT OF DAMO MICROORGANISMS AND THE EFFECT OF NANOPARTICLES ON THEIR ACTIVITY

Anaerobic biotechnology has been a widely-used wastewater treatment process. However, the loss of dissolved methane via supernatant and lack of nitrogen removal are two big challenges which must be overcame. In these systems, around 30% of produced methane is lost as dissolved gas in the treated effluent. This is both energy loss from the system and a critical greenhouse gas (GHG) emission, the latter being a significant problem in terms of global warming because methane has 25 global warming potential (GWP). It is expected that methane emissions from wastewater treatment plants, which is 7% of the total global methane emissions in 2010, will increase to 19% by 2030.

Denitrifying anaerobic methane oxidation (DAMO) is a novel, recently discovered bioprocess which uses methane as electron donor, and nitrate or nitrite as electron acceptor. It can overcome both challenges in a complementary way. Methane is oxidized to supply electrons for denitrification; thus, DAMO process can be alternative treatment strategy for nitrogenous compounds-contaminated wastewaters with low carbon content such as landfill leachate and anaerobic digester supernatant. There are two responsible mechanisms for DAMO process which are carried out by DAMO bacteria (*Candidatus* Methylomirabilis oxyfera) and DAMO archaea (*Candidatus* Methanoperedens nitroreducens). DAMO process has also challenges like slow growth and substrate utilization kinetics. Thus, the topic of shortening the enrichment period or increasing the DAMO activity is extensively studied; however, most of the points on DAMO are still unclear. Research studies reveal the nanoparticles as a promotion mechanism for growth of microorganisms. Nanoparticles (NPs) have gained importance with development of nanotechnology due to their specific properties such as superparamagnetic behaviour, a high surface area-to-volume ratio, thus they can have impact on activity of microorganisms. Indeed, iron-containing NPs were reported to stimulate a slowly-growing bacteria, namely anaerobic ammonium oxidation (Anammox) bacteria.

In this study, it is aimed to investigate the enrichment of DAMO microorganisms in sequencing batch reactors (SBRs) with different nitrogen source combinations. One SBR fed with only nitrate was operated to improve mainly DAMO-archaea, which is expected to further support the DAMO-bacteria due to nitrite produced by the former. It is also aimed in this study to investigate the effect of NPs on DAMO activity; thus batch studies will be performed with iron-NPs and DAMO cultures. A second SBR, containing already enriched DAMO-Anammox cultures will be also further exposed to iron-NPs to research its potential effect on DAMO-Anammox co-culture and their synergetic relationship. Within this scope, DAMO bacteria and DAMO archaea activities will be also examined. This presentation will cover the operational results of two DAMO SBRs and further plans on NPs applications.

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