Biofilm Thickness Influences Biodiversity in Nitrifying MBBRs-Implications on Micropollutant Removal - DTU Orbit (16/02/2019)

Biofilm Thickness Influences Biodiversity in Nitrifying MBBRs-Implications on Micropollutant Removal
In biofilm systems for wastewater treatment (e.g., moving bed biofilms reactors-MBBRs) biofilm thickness is typically not under direct control. Nevertheless, biofilm thickness is likely to have a profound effect on the microbial diversity and activity, as a result of diffusion limitation and thus substrate penetration in the biofilm. In this study, we investigated the impact of biofilm thickness on nitrification and on the removal of more than 20 organic micropollutants in laboratory-scale nitrifying MBBRs. We used novel carriers (Z-carriers, AnoxKaldnes) that allowed controlling biofilm thickness at 50, 200, 300, 400, and 500 μm. The impact of biofilm thickness on microbial community was assessed via 16S rRNA gene amplicon sequencing and ammonia monooxygenase (amoA) abundance quantification through quantitative PCR (qPCR).

Results from batch experiments and microbial analysis showed that (i) the thickest biofilm (500 μm) presented the highest specific biotransformation rate constants (kbio, L g(-1) d(-1)) for 14 out of 22 micropollutants; (ii) biofilm thickness positively associated with biodiversity, which was suggested as the main factor for the observed enhancement of kbio; (iii) the thinnest biofilm (50 μm) exhibited the highest nitrification rate (gN d(-1) g(-1)), amoA gene abundance and kbio values for some of the most recalcitrant micropollutants (i.e., diclofenac and targeted sulfonamides). Although thin biofilms favored nitrification activity and the removal of some micropollutants, treatment systems based on thicker biofilms should be considered to enhance the elimination of a broad spectrum of micropollutants.

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