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Publication date

2025

Document Version

Final published version

Citation (APA)

Sutton, N. B., Feng, Z., Schmitt, H., & van Loosdrecht, M. C. M. (2025). *Sorption and Biodegradation of Organic Micropollutants in Aerobic Granular Sludge*. 865-865. Abstract from SETAC Europe 35th Annual Meeting, Vienna, Austria.

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4.07.P-Mo353 Sorption and Biodegradation of Organic Micropollutants in Aerobic Granular Sludge

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Aerobic Granular Sludge (AGS) is a relatively new approach to wastewater treatment. As opposed to activated sludge with mainly flocculant biomass of relatively even composition, the granules in AGS differ in size and composition. Biomass ranges from flocs similar to activated sludge to granules of >6 mm. Granules also have distinct biomass due to the stratification of redox conditions across the granules. Typically organic micropollutants (OMPs) are removed via sorption and biodegradation during wastewater treatment, however this has yet to be thoroughly investigated for AGS systems. We hypothesized that different sized granules have potentially different sorption behaviour due to the differences in extracellular polymeric substances (EPS) and have different biodegradation patterns due to the differences in biomass composition among size fractions. Therefore, we investigated the capacity of AGS to remove OMPs via sorption and biodegradation by performing controlled batch experiments in the lab. We separated the sludge into different sizes in order to understand the role of different sludge composition on OMP removal.

We observed notable sorption (>40% removal) for 10 of the 24 OMPs tested in our study (Figure 1). The 10 OMPs include 3 fluoroquinolones (norfloxacin, ofloxacin, and ciprofloxacin), 3 macrolides (clarithromycin, azithromycin, and erythromycin), 2 beta-blockers (propranolol and atenolol), tetracycline, and citalopram. We noted that all of these 10 compounds are ionizable, with 6 positively charged compounds and 4 zwitterionic compounds at pH 7. Considering that sludge biomass typically has a negative charge, this seems to indicate electrostatic interactions between the 10 OMPs and the sludge. Larger fractions contributed more to sorption than smaller granules and flocs, as expressed per unit of biomass. Specifically, the normalized K_d for large fractions was up to 100% larger than for small fractions, suggesting that larger fractions contribute more to sorption in real AGS systems than smaller fractions and flocs. However, sorption kinetics were most likely retarded by diffusion limitations in large granules. Biodegradation was observed for a number of compounds. Overall, this study elucidated the roles of sorption and biodegradation in the removal of OMPs in AGS WWTPs, showing that these processes are size fraction dependent.