Influence of microbial community composition on activated sludge floc properties

Hansen, Susan Hove; Nierychlo, Marta; Larsen, Poul; Jørgensen, Mads Koustrup; Albertsen, Mads; Christensen, Morten Lykkegaard; Nielsen, Per Halkjær

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Influence of microbial community composition on activated sludge floc properties

Susan H. Hansen, Marta Nierychlo, Poul Larsen, Mads K. Jørgensen, Mads Albertsen, Morten L. Christensen, Per H. Nielsen
Center for Microbial Communities, Department Of Chemistry And Bioscience, Aalborg University, Denmark

Background

The activated sludge process is key in modern wastewater treatment. The activated sludge ecosystem contains a core community of abundant organisms and it must be stable in order to maintain the desired nutrient removal. In addition, bacterial morphology, mode of growth and extracellular polymeric substances (EPS) composition determine floc size, shape and strength, which in turn influence sludge properties that are important for plant operation. A few organisms have been correlated with different sludge properties, however, the picture is far from complete.

Aim

• To investigate whether the microbial community composition differs between the flocs and the supernatant (bulk water) and whether certain bacterial species correlate to floc strength.

Methods

Sludge fractions

Activated sludge was collected from 23 wastewater treatment plants (WWTP) and physico-chemical sludge characteristics were determined. Each sludge sample was then split in three fractions.

16S amplicon sequencing

Community composition relates to different activated sludge fractions from 23 WWTPs

Comparison of relative abundance between the different activated sludge fractions

Spearman correlation of bacteria present in different sludge fractions with important sludge characteristics: Sludge Volume Index (SVI) and shear sensitivity. Bacteria that were strongly correlated (0.6>R>0.6) with the mentioned parameters are listed above. One abundant OTU, belonging to the class of Betaproteobacteria, seems to have a positive impact on SVI. High abundance of Sulfuritalea correlates with high shear sensitivity, whereas the presence of Tetrasphaera correlates to low shear sensitivity.

Correlation between sludge parameters and bacteria in the sludge fractions

Multivariate analysis visualized the relationship between all samples analyzed from 23 WWTPs. Samples grouping into individual sludge fractions (total sludge – bulk water – loosely bound fraction) can be clearly observed. WWTP city names are presented.

Conclusion

• Microbial community composition relates to different activated sludge fractions.
• Acrobacter and Sulfuritalea are enriched in the bulk water fraction and in the fraction loosely bound to the floc and could therefore be associated as poor floc formers.
• Dechloromonas and Tetrasphaera abundances decreased in supernatants and could therefore be associated with potential strong floc formers.
• Sulfuritalea and Tetrasphaera can be correlated to sludge characteristics that are important for the proper plant operation (SVI and shear sensitivity).