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Utilizing treatment train concepts to remove PFAS compounds from wastewater from sludge treatment reed beds

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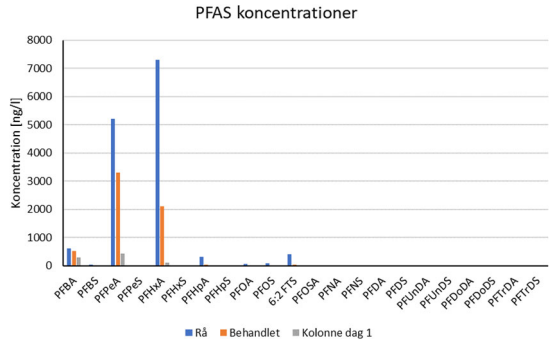
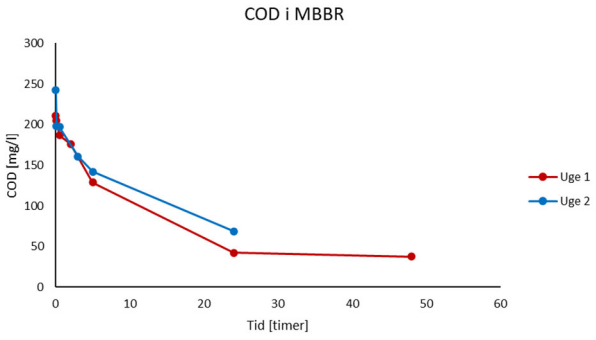
Introduction: In recent years PFAS have had large media coverage and a lot of remediation efforts have been put on removing PFAS from soils and water. PFAS compounds have been used extensively since the 1950's in firefighting foam, shoes, clothing, cosmetics, food wrapping etc., and many have become prohibited in a wide range of products, with more laws and regulations against their use planned to take effect in the coming years. However, wastewater treatment plants (WWTP) that receive water from industry, landfills, incineration plants etc. still measure high concentrations of PFAS. A wastewater treatment plant in Esbjerg, Denmark experiences this problem from their Sludge Treatment Reed Beds (STRB) where PFAS has been concentrated to very high levels. In this project several experiments were conducted to remove the majority of the PFAS leached from the STRB, before the reject water was led to the WWTP.

Methods and data: Polluted water from STRBs were led into a 1000 m3 water tank where 100 ml/m3 PAX, 100 ml/m3 fluorfloc and polymer were added to flocculate and coagulate any suspended particles and PFAS detected in the reject water. Afterwards the water was decanted and led into another 1000 m3 tank. The pre-treated water was then pumped through a 200 ml resin column with a flow of 1,5 l/h. Samples were taken of raw water, the pre-treated water and water after the resin column. Water after the resin column was sampled once every weekday for 21 days. Samples were sent to DTU and Eurofins for analysis of 22 PFAS.
A moving bed biofilm reactor (MBBR) was constructed to determine if biological treatment of the reject water would remove COD and thereby prolong the lifetime of the resin column. The microbes in the MBBR were subjected to pre-treated water at a 50% dilution. The water had a hydraulic retention time of 1 week.

Results: Pretreatments of the raw water with PAX, fluorfloc and polymer reduced the PFAS concentrations with a >50% reduction in all 22 PFAS. COD measurements revealed breakthrough of COD already on day 1 of resin filter operation, which suggests that breakthrough of some PFAS can be anticipated. This was also confirmed by PFAS analysis which revealed that the resin could remove 96% PFHxA and 87% of PFPeA, but only removed 44% of PFBA. Some long chain PFAS also broke through the resin column. COD measurements from the MBBR revealed that the microbes could reduce COD by 70-80% after 24 hours and 82% after 48 hours.

Discussion and take-home message: Results showed that the concentration of PFAS could be reduced by treatment with PAX, fluorfloc and polymer and could be further reduced via a resin filter. However, breakthrough on day 1 of PFAS/COD suggests that the COD in the pretreated water was too high. MBBR results revealed that a biological treatment step after pretreatment with PAX, fluorfloc and polymer and before the resin filter, could potentially prolong the lifetime of the resin filter. This will be tested in future pilotscale experiments conducted in December 2023. Results obtained closer to the conference will also be included in the presentation.





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