Reuse of petrochemical condensate: pilot MABR for the treatment of a real waste stream

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Treating petrochemical waste streams can be tricky, the organics load and toxicity can often impact traditional biological treatment. Here, membrane aerated biofilm reactors (MABR) were evaluated for the treatment of a waste stream containing organic acids, phenol, BTEX and other organics. A pilot scale set-up with two reactors in series was operated for over a year to assess removal efficiency, final water quality, and suitability and robustness of the MABR technology compared to conventional activated sludge treatment.

Materials and methods

Two identical MABRs, supplied by OxyMem DuPont (Athlon, Ireland), in series treated a heavily polluted petrochemical condensate.

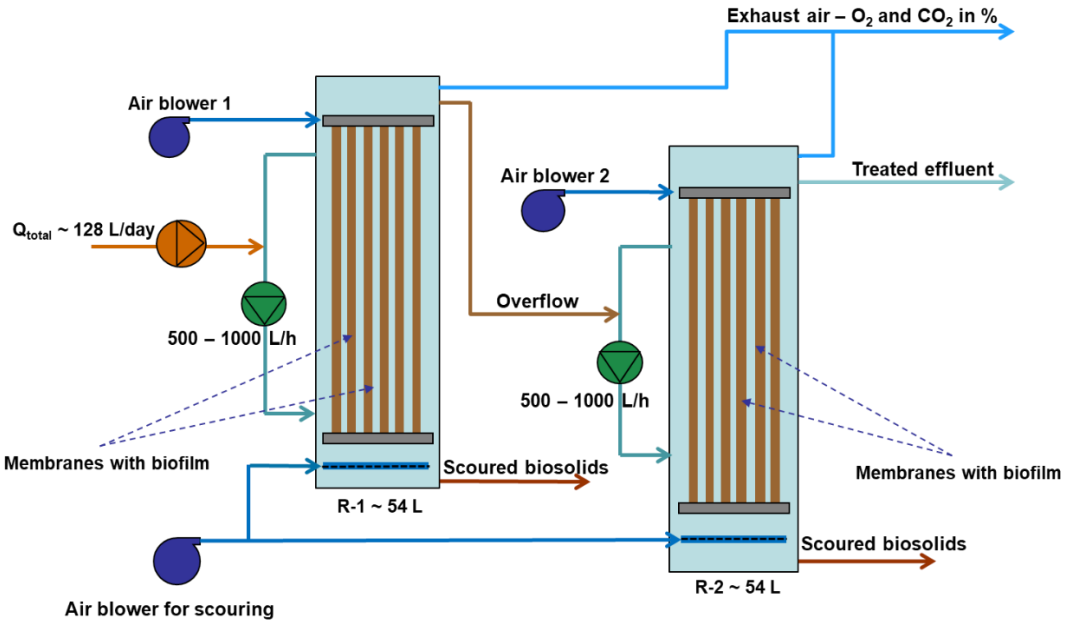

Figure 1. Schematic representation of the pilot scale MABR system in series. Own figure.

In short, the reactors were inoculated using on site WWTP sludge, biofilm thickness was controlled through regular scouring, macro and micronutrients were dosed, and an HRT of 10 h/reactor was initially maintained. The concentration of phenol, acetate, propionate, formate, total organic carbon, ammonia,

and phosphate was monitored as well as dissolved oxygen, conductivity, and pH. Based on these measurements, removal efficiencies and oxygen transfer rates were determined.

Results and conclusions

At stable operations, the pilot in series achieved a total removal efficiency of 85% TOC, 95% BOD_5, >98% organic acids, 98% phenol, and 90% ammonia. The formed biofilm was able to remove C and N and both nitrification and denitrification were observed without traces of intermediate byproducts (NO_2^- and NO_3^-). Although removal efficiencies were comparable to that of a traditional activated sludge system, the aeration efficiency of the MABR is higher because of the more effective and flexible aeration.

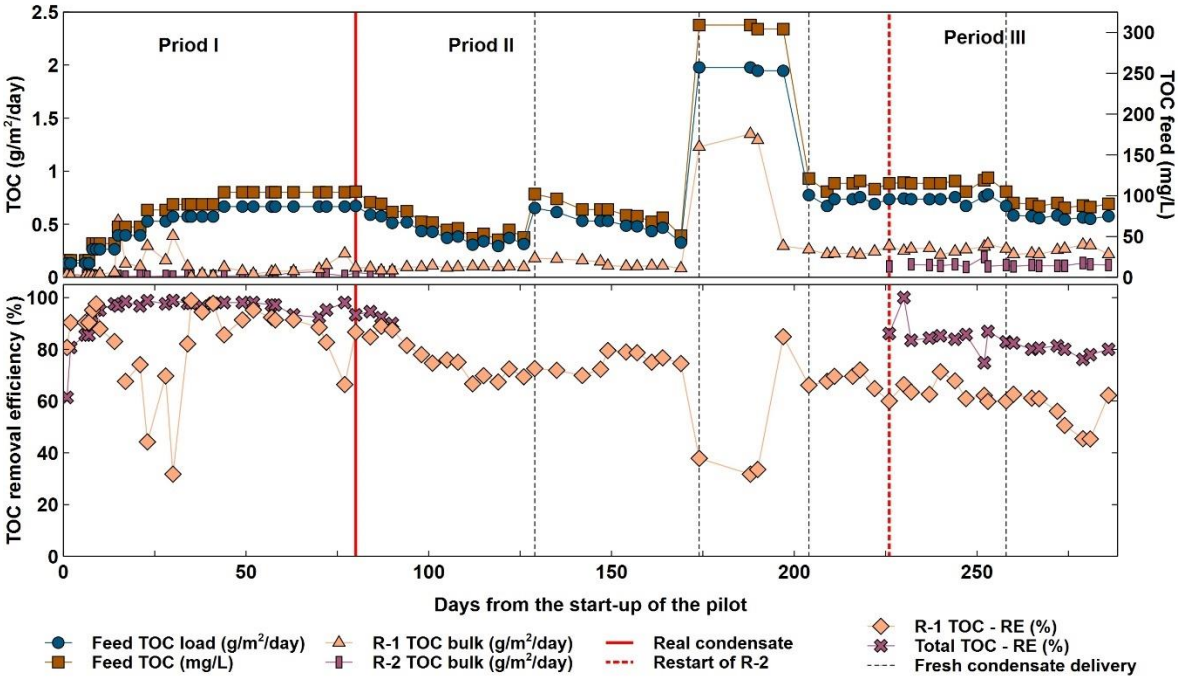

Figure 2. Total organic carbon (TOC) load and removal efficiency (RE) in the first (R-1) and second (R-2) reactor

The system was able to handle shock loads and feed fluctuations in TOC, ammonia, and organic acids. This is attributed to the rich microbial community and abundance in the MABR biofilm and indicated the value of the system for treatment of complex industrial streams. Although polishing of the effluent is required to reuse the effluent as high-quality water, this study clearly demonstrates the applicability and advantages of the MABR system.