PERFORMANCE OF THE CSTR-IN-SERIES EXTRACTIVE MEMBRANE BIOREACTOR IN INDUSTRIAL WASTEWATER TREATMENT

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The extractive membrane bioreactor (EMBR) is a treatment method which had demonstrated success in the removal of organic compounds such as phenol, nitrochlorobenzene, dichloroaniline from complex industrial wastewaters that are naturally hostile to bioprocessing (eg. extreme pH and salinity) (Livingston 1993, Brookes and A.G.Livingston 1994). As shown in
Figure, the targeted organics from the feed wastewater are extracted by the membrane into the bioreactor downstream of the membrane while salt and acid/alkaline are retained at the feed side, creating an environment conducive to the bioremoval of organics downstream of the membrane. The biofilm on the downstream side of the membrane surface removes and biodegrades the organics, creating the concentration gradient required to sustain the organic flux across the membrane. In this study, the EMBR is applied for the first time in the CSTR-in-series configuration using in-house hollow fiber membranes (Loh, Zhang et al. 2016) in submerged EMBR systems. Preliminary studies were conducted using a synthetic feed solution comprising of 860 ppm phenol and 5 g/L NaCl. The phenol that diffused across the membranes served as a carbon source for the biofilm downstream of the membrane while additional inorganic nutrients comprising of $MgSO_4.7H_2O$, $CaCl_2.2H_2O$, KH_2PO_4, K_2HPO_4, $FeCl_3$ and NH_4Cl were supplied to the bioreactor on a daily basis. At a feed flow rate of 0.86 L/day, the effluent treatment concentration can be as low as 84 ppm (just 10% of the influent). No phenol was detected on the bioreactor side throughout the operation, indicating all phenol was removed by the biofilms on the membrane surface. Our study demonstrates that the EMBR is a promising system that can treat difficult industrial wastewater at source and could potentially reduce costs associated with other treatment strategies (eg. maintenance of activated carbon cartridges). Biofilm characterization results and the performance of the CSTR-in-series EMBR in treatment of actual industrial wastewater will be shared.

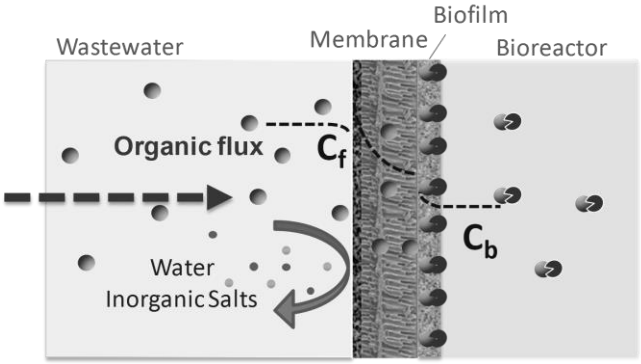

Figure 1. Schematic of mass transfer across the membrane and bioiflm in the EMBR system

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