Effect of Medium Composition and System Operation on Membrane-Attached Biofilm Morphology Alteration and System Performance in Membrane Bioreactor

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ABSTRACT

The formation and accumulation of membrane-attached biofilm (MAB) in membrane processes can prove to be detrimental to process performance due to mass transfer limitation. This effect demands countermeasures to minimize its accumulation. In this research, the influence of medium composition and system operation on morphology alteration of MAB and consequently their influence on mass transfer rate and overall system performance was investigated in a lab - scale extractive membrane bioreactor used for the extraction and degradation of phenol. The factors investigated included dilution rate, ammonium concentration, iron concentration and phenol feed concentration. The continuous feed of the growth medium and the change in dilution rate produced thinner but stronger and more controllable biofilm than that observed in a semi-batch experiment. Washout of the suspended cells was achieved by increasing the dilution rate to a value of 0.03 h^1 and from this moment on, visible cell growth occurred only within the biofilm. Complete absence of iron from the growth medium affected biofilm morphology whereas a decrease in ammonium concentration did not. However, in both cases phenol degradation efficiency was not affected. A feed concentration of 5 g/l resulted in large - scale detachment of biofilm but detached cells were well adapted to high phenol concentration environment and kept their ability to degrade transferred phenol. It is, therefore, concluded that this system is very robust to alteration in the nutrient feed and that once the biofilm is formed, alteration in its morphology and thickness did not have a significant effect on the system performance.

Key words: Membrane-attached biofilm, Membrane bioreactor