WATER RESOURCES RESEARCH GRANT PROPOSAL

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Title: Preventing the Initiation of Biofouling of Membrane Bioreactors in Wastewater Treatment

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Abstract

The objective of this project is to prevent the initiation of biofouling of membrane bioreactors in wastewater treatment. To accomplish this objective we propose to examine the initiation of biofilm formation on membrane surfaces through a synergistic study of membrane properties, the chemical composition of representative wastewaters, and the ecology of the microbial populations. The application of membranes to separate suspended materials from waste streams is an evolving technology. Membrane bioreactors have many advantages as compared to conventional activated sludge wastewater treatment systems that rely upon clarifiers and quiescent settling to remove suspended materials. Membrane bioreactors:

a) eliminate the problems associated with bulking sludge in conventional activated sludge systems,

b) allow increased biomass concentrations in reactors permitting increased loading rates and promoting higher reaction rates,

c) increase the concentration of extracellular enzymes which improves the kinetics and extent of biodegradation reactions, and

d) permit excessively long sludge ages which promote higher endogenous decay rates, lower excess sludge production, and maintains sludge age sensitive populations including grazing protozoa and higher life forms as well as nitrifiers.

The primary disadvantages of membrane bioreactors include capital costs for the membranes and operating costs associated with routine membrane cleaning. Biofouling is a serious problem for the operation of membrane bioreactor systems because it results in decreased transmembrane fluxes. Biofouling involves the synergistic effects of biological, physical, and chemical clogging of membrane pores. Clogged pores result in: (a) reduced transmembrane fluxes, (b) a need for higher operating pressures, and (c) deterioration of the membrane. To eliminate the problems associated with biofouling, we propose to elucidate the mechanisms of biofilm formation on membrane surfaces. By understanding the mechanisms of biofilm formation, we hope to provide improvements in membrane bioreactor technology to eliminate the initiation of biofouling formation. If the initiation of biofouling is eliminated, the costs associated with cleaning the membranes should be dramatically reduced. Lower costs for membrane bioreactor technology should help in the widespread application of this technology for protecting the quality of the water environment in the state of Ohio and the protection of human health.