

Dynamic anaerobic membrane bioreactor (DAnMBR) with phase separation for food processing wastewater treatment at mesophilic temperature: Characterization of cake layer

ABSTRACT

The treatment of high-strength wastewater using an anaerobic digester coupled with a dynamic membrane has gained significant interest of late due to its small footprint and low cost of supporting material for the membrane. Dynamic membrane fundamentally performs similarly to the conventional membranes by the cake layer deposited onto the supporting material with eventual fouling stage. The filtration performance is proportionally related to the cake layer development. Thus, the objective of this study is to characterize the cake layer affecting the filtration performance. A two-phase anaerobic digester with submerged 20- μm woven filter cloth as the supporting membrane (DAnMBR) was used in this study to treat food-processing wastewater. The organic loading rate of 5.0 g COD/L.day was fed into the DAnMBR, and the cake layer samples were taken at 14 days intervals until fouling occurred. The performance of the wastewater treatment and characteristics of the cake layer and bulk sludge were analyzed. It took a total of 35 days for the dynamic membrane to foul with a final flux of 2.5 L/m²·h and transmembrane pressure of 0.7 bar. The protein ratio to polysaccharide (PN/PS) of the extracellular polymeric substances increased significantly compared to soluble microbial product PN/PS ratio; thus, it is the main contributor to the membrane fouling. The thickness of the cake layer increased slightly from day 14 to 28 but sharply at the fouled stage (day 35), agreeing with the treatment performance. The concentrations of COD, BOD₅, ammoniacal nitrogen, oil and grease, total suspended solids, and turbidity followed closely the inverse proportional trend of cake layer development. The size of the foulants that made up the cake layer resulted in micropore size dynamic membrane emanating the treatment performance of the DAnMBR is comparable to the conventional microfiltration AnMBR.

Keyword: Food processing wastewater; Dynamic membrane; Anaerobic membrane bioreactor; Fouling; Cake layer