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Effect of cross-flow velocity, oil concentration and salinity on the critical flux of an oil-in-water emulsion in microfiltration

Jia Wei Chew[1], **Henry J Tanudjaja**[1], **Anthony G Fane**[1] and **Volodymyr V Tarabara**[2]
[1]Nanyang Technological University, Singapore
[2]Michigan State University, USA

Microfiltration is an attractive means for treating oily wastewater, especially when the sizes of the oil droplets are micrometer-sized since the conventional techniques become deficient. A systematic study on the critical flux of oil-in-water emulsion, which behaves differently from other colloidal foulants concerning deformation, coalescence and splitting, has not been carried out to date. This was the goal of the current study, which employed the Direct Observation Through the Membrane (DOTM) technique to characterize the critical flux of oil-in-water emulsions of various concentrations, and at various cross-flow velocities (CFV) and salt concentrations. Five observations can be highlighted here. Firstly, the oil droplets with a mean droplet diameter of approximately five μm exhibited critical fluxes equal to or greater than latex particles of 10 μm. This is likely due to the twin effects of membrane oleophobicity promoting back-transport of the oil foulants from the membrane and the presence of a droplet size distribution with larger drops that can enhance the shear-induced diffusion of the average drops. Secondly, the critical flux values did not agree with the model that is valid for the size range the mean droplet diameter falls in, but instead agreed with the model adapted for smaller particulate foulants. Thirdly, the increase in the critical flux with CFV was more significant for the lower oil concentration. Fourthly, a striping phenomenon was observed at higher oil concentrations and lower CFV values. Striping was not observed for latex particles.

JChew@ntu.edu.sg