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Microfiltration of stable oil-in-water emulsions using kaolin based ceramic membrane and evaluation of fouling mechanism

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ABSTRACT

This work addresses experimental and modeling studies on the treatment of oily wastewater emulsions using prepared lowcost ceramic membrane. Flat circular disk type membranes (52.5 mm diameter and 4.5 mm thickness) were used for microfiltration (MF) tests possessed a hydraulic pore diameter of 0.77 μm and total porosity of 42%. Synthetic oil-in-water emulsions constituting 50–150 mg/l oil concentrations were subjected to MF in batch mode of operation with varying transmembrane pressure differentials (ΔP) ranging from 41.37 to 206.8 kPa. Typical permeate flux of 15.05×10^{-6} m^3/m^2 s and a rejection effi ciency of 98.51% was observed for 150 mg/l feed oil concentration at ΔP of 206.8 kPa. Different pore blocking models such as complete pore blocking, standard pore blocking, intermediate pore blocking and cake filtration were used to gain insights into the nature of membrane fouling during permeation. The observed flux decline data trends infer that the decrease in permeate flux is due to intermediate pore blocking for the initial 1–10 min and later by cake filtration. Linear extrapolation of the data trends reveals that for feed oil concentrations above 250 mg/l, only cake filtration would be the flux decline mechanism. Finally, phenomenological models were proposed to illustrate the dependency of total hydraulic resistance of membrane on ΔP, initial oil concentration (c) and time (t).

Keywords: Microfiltration; Ceramic membrane; Oil-in-water; Flux decline; Cake filtration

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