

Effect of extrusion rate on morphology of Kaolin / Poly Ether Sulfone (PESf) membrane precursor

Abstract

This study aims to investigate the influence of apparent viscosity induced by spinneret geometry and extrusion rate on morphology of Kaolin/PESf hollow fiber membranes. Different extrusion rates at two different rheology properties were introduced on a straight and conical spinneret resulting in various shear rates. The hollow fiber membrane precursors were spun using the wet spinning method to decouple the effect of shear and elongation stress due to gravity stretched drawing. The morphology of the spun hollow fiber was observed under Scanning Electron Microscope (SEM) and the overall porosity were measured using mercury intrusion porosimeter. Shear rate and apparent viscosity at the tip of the spinneret annulus were simulated using a computational fluid dynamics package; solidworks floworks. Simulation data shows that extrusion rate increment increases the shear rate at the spinneret wall which in turn reduce the apparent viscosity; consistent with a non Newtonian shear thinning fluid behavior. Thus, the outer finger-like region grows as the shear rate increases. Also, overall porosity of hollow fiber membrane decreases with extrusion rate increment which is caused by better molecular orientation; resulting in denser hollow fiber membrane. Thin outer finger-like region is achieved at low shear experience of 109.55 s^{-1} via a straight spinneret. Increasing the extrusion rate; thus shear rate will cause outer finger-like region growth which is not desirable in a separation process.