Extruded and overlapped geometries of feed spacers for solution mixing in electrochemical reactors and electrodialysis-related processes

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ABSTRACT

Permeate spacers, which act as static mixers, are sandwiched at regular intervals between each pair of membranes. Spacers keep membranes separated, reinforce membranes against feed pressure, and increase turbulence. However, inefficient geometry of spacers may reduce cell active area and increase boundary layer effects near the membranes. The purpose of the present research is to discuss the designs of extruded and overlapped channel spacers. The current study is significant because it reveals the fundamental mechanisms that have a considerable impact on spacer-filled channel flow hydrodynamics. Extruded and overlapped spacers are usually composed of conventional polymeric material. The flow behavior in extruded and overlapped spacer-filled channel passages differs dramatically according to the geometry of the spacers. Spacer geometry determines flow dynamics, and mass transfer to energy loss rates. The addition of more transverse spacer strands in respect to the dominant flow direction enhances solution flow disturbance and lowers concentration polarization. Transverse filaments dominate all flow features, but longitudinals induce no impact. However, extruded and overlapped spacers reduce polarization while raising wakes and pressure drop. Spacers provide more boundary disturbance when oriented at a 45° spacer-bulk attack angle. An attack angle less than 45° results in a reduced pressure drop associated with a slight rate of wakes and flow disturbance because when filaments become nearly longitudinal to the flow direction, the poorer their influence. New spacer designs must demonstrate a favorable flow pattern of velocity vectors and maximized mass transfer rates, which could aid in improving membrane performance and cross-flow power consumption.

KEYWORDS

Extruded spacers; Flow attack angle; Membrane spacer geometry; Overlapped spacers; Pressure drops; Spacer filament/strand

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