INFLUENCE OF CROSSLINKING AND PROCESS PARAMETERS ON THE SEPARATION PERFORMANCE OF POLY(DIMETHYLSILOXANE) NANOFILTRATION MEMBRANES

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ABSTRACT

The separation of organic solutes in organic solvents was assessed using dense poly(dimethylsiloxane) (PDMS) membranes with different degrees of crosslinking and varying thickness of the dense PDMS layer. The predominant rejection mechanism for low-polarity organic solutes is shown to occur via size exclusion, with the rejection also being dependent on the degree of membrane crosslinking, the swelling propensity of the membrane/feed stream and the transmembrane pressure. It is postulated that the size-exclusion mechanism arises as a consequence of the relatively large degree of swelling of the PDMS material (up to 300%), which induces appreciable regions between the polymer chains for solvent and solute transport to take place.

The degree of swelling governs the relative size of the transport regions within the membrane and hence the overall solvent flux and solute rejection characteristics. It is shown that solvent-solute coupling plays a major role in solute transport, with the convective element of solute flow increasing as the degree of swelling increases and solute size decreases. Despite the existence of a size-exclusion mechanism it is difficult to rule out the solution-diffusion model as an interpretation of the data, however it is also demonstrated that models based on pore-flow can adequately define the experimental data. The similarities between the two approaches are discussed, and potential evidence of a transition between solution-diffusion and pore flow is introduced.

KEYWORDS

PDMS; Nanofiltration; Organic solvents; Organic solutes; Solution-diffusion; Pore-flow.

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