

The influence of membrane formation on functional performance of organic solvent nanofiltration membranes

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1. Introduction

Organic solvent nanofiltration (OSN) has been used in recent years on many new applications [1]. Usually OSN membranes are made from polydimethylsiloxane (PDMS) and polyimides (PI). PIs have shown to have good chemical stability (low swelling in organic solvents). In particular, Lenzing P84 (P84) shows better chemical resistance than other PIs such as Matrimid and Sixef [2], making it a prime candidate for use in OSN. Commercial P84 membranes (Starmem™ [3]) have been produced but these membranes fall under a low MWCO range (<220 gmol⁻¹). Higher MWCO membranes could see further applications of OSN in the separation of high molecular weight compounds (e.g. homogeneous catalyst recovery [4]).

In this work, Lenzing P84 was used in the study of the various parameters of membrane formation by immersion precipitation with the aim of increasing the MWCO. These parameters include polymer concentration in the casting solution, type of non-solvent, additives, post casting modifications, etc. The func-

tional performance of the membranes produced will be characterised using the pure solvent flux and MWCO. Membrane physical parameters can be estimated by other physical characterisation techniques (e.g. SEM, FTIR-ATR) and be used in simplified mathematical transport models [5,6]. The transport models will also be used in the prediction and comparison of the observed data.

2. Results and discussion

Lenzing P84 was used as the base polymer for the formation of asymmetric flat sheet OSN membranes. The membranes were tested on a lab-scale cross-flow nanofiltration rig (Fig. 1) over extended periods to determine the flux of pure solvents and the steady state MWCO. The MWCOs were estimated using a feed mixture of different molecular weight *n*-alkanes at low concentrations (0.2 wt%). The compact nature of the set up allows for several membranes to be tested simultaneously under similar conditions.

Reproducible flux and MWCO results were only observed after a minimum of 24 h. Various factors (e.g. polymer concentration, evaporation

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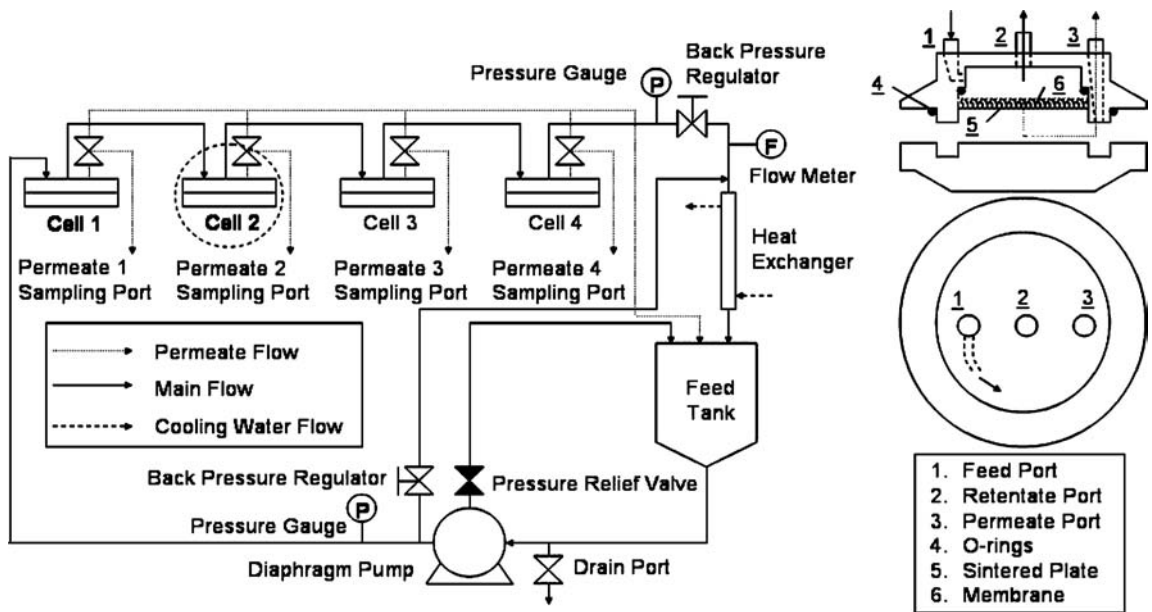


Fig. 1. Cross-flow nanofiltration cross flow rig.

time, additives etc.) during the fabrication of the membranes were varied to view the effects of these properties on the steady state flux and MWCO of the membranes. Fig. 2(a) shows that by increasing the polymer concentration, a lower MWCO was achieved. Fig. 2(b) shows that there was little variation in the MWCO

curves at different evaporation times. However a trend of decreasing flux was observed with increasing polymer concentration and evaporation times. The effect of varying pressure (10–30 bar) on the MWCO curves was also investigated (Fig. 2c).

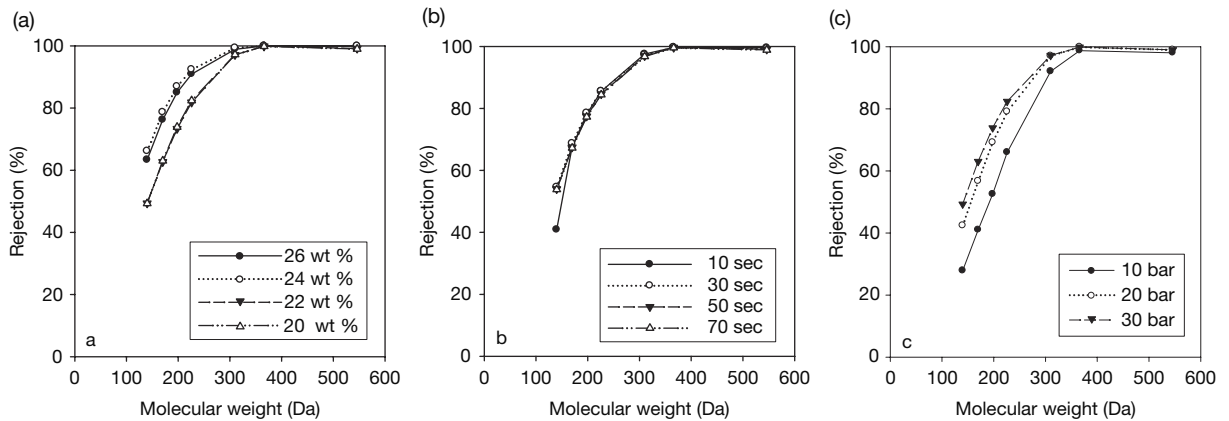


Fig. 2. Effects of (a) polymer concentration (b) evaporation time (c) pressure and on the MWCO of PI membranes. Experiments were conducted at 30 bar and 30°C for 48 h.

The experiments have been performed at a low *n*-alkane concentration in the feed solution allowing the inclusion of ideal solution behaviour such as negligible solute interactions and other bulk properties in mathematical modelling. Several membrane properties (e.g. active layer thickness, solute/solvent permeability) were also determined experimentally and employed as parameters in the proposed models to predict the fluxes and observed MWCO curves.

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