Title: Study on the thin film composite poly(piperazine-amide) nanofiltration membranes made of different polymeric substrates: effect of operating conditions

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Abstract: Three composite nanofiltration (NF) membranes made of different substrate materials—polysulfone (PSf), polyethersulfone (PES) and polyetherimide (PEI)—were successfully prepared by interfacial polymerization technique. Prior to filtration tests, the composite NF membranes were characterized using field emission scanning electron microscope (FESEM), atomic force microscope (AFM) and X-ray photoelectron spectroscope (XPS). It was observed that the surface properties of composite NF membranes were obviously altered with the use of different substrate materials. The separation performance of the prepared composite NF membranes was further evaluated by varying operating conditions, which included feed salt concentration and operating temperature. Experimental results showed that the water flux of all TFC membranes tended to decrease with increasing Na2SO4 concentration in feed solution, due to the increase in feed osmotic pressure. Of the three TFC membranes studied, PSf-based membrane demonstrated the highest salt rejection but lowest water flux owing to its highest degree of polyamide cross-linking as shown in XPS data. With respect to thermal stability, PEI-based TFC membrane outperformed the rest, overcoming the trade-off effect between permeability and rejection when the feed solution temperature was gradually increased from 30 °C to 80 °C. In addition, the relatively smoother surface of hydrophilic PEI-based membrane when compared with PSf-based membrane was found to be less susceptible to BSA foulants, leading to lower flux decline. This is because smoother surface of polyamide layer would have minimum “valley clogging,” which improves membrane anti-fouling resistance.