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7.Title:

A mixed charged polyelectrolyte complex nanofiltration membrane: mitigating scaling in effluents desalination

Authors & affiliations:

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Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

Preparation of Your Abstract

1. The title should be as brief as possible but long enough to indicate clearly the nature of the study. Capitalise the first letter of the first word ONLY (place names excluded). No full stop at the end.
2. Abstracts should state briefly and clearly the purpose, methods, results and conclusions of the work.
Introduction: Clearly state the purpose of the abstract
Methods: Describe your selection of observations or experimental subjects clearly
Results: Present your results in a logical sequence in text, tables and illustrations
Discussion: Emphasize new and important aspects of the study and conclusions that are drawn from them

Introduction: Effluent desalination using nanofiltration (NF) membranes is an attractive approach to producing high-quality effluent. However, the high calcium phosphate scaling of polyamide NF membranes due to high scalnt ions rejection restricts the recovery ratio of effluent desalination, which is extremely important for inland desalination, and produces permeate with high sodium adsorption ratio. Fabricating NF membranes with lower selectivity towards the scaling-forming ions but similar salts selectivity is a promising direction for overcoming these challenges. This research presents mixed-charged polyelectrolyte complex NF (PECNF) membranes with moderate selectivity toward scalant forming ions to achieve a high recovery effluent desalination and produce effluent suitable for sustainable irrigation.

Methods: The PECNF membranes were fabricated by coating an ultrafiltration membrane with a homogeneous layer of polysodium 4-styrene sulfonate (PSS) and polyethyleneimine (PEI), followed by chemical and physical cross-linking using glutaraldehyde and thermal treatment (Figure 1). The membranes were characterized, and their performance and antiscaling properties were studied using synthetic and real effluent.

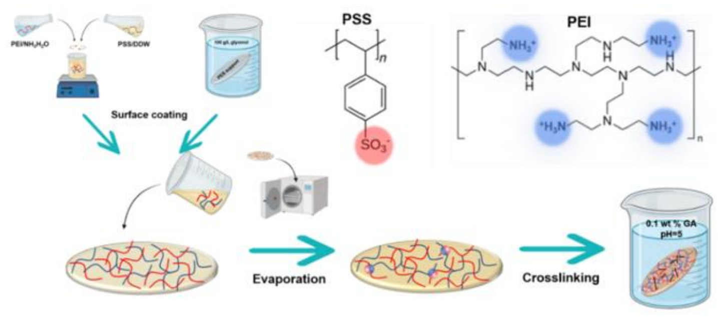

Figure 1. A schematic diagram for the preparation of PECNF membranes.

Results: A thin-film PEC membrane (~25 nm measured by HR-SEM) with optimal permeance and salt selectivity was obtained by changing the PE ratio and polymer concentration. This PECNF has similar selectivity of multivalent ions with opposite charges and ~60% phosphate ions selectivity (Figure 2a) and 7.2 LMH/bar water permeance. Consequently, the scaling and permeate flux reduction (27%) was much lower than that of commercial NF membrane (~70% reduction) after 50 hours of filtration (Figure 2b) using real effluent mimicking 80% recovery.

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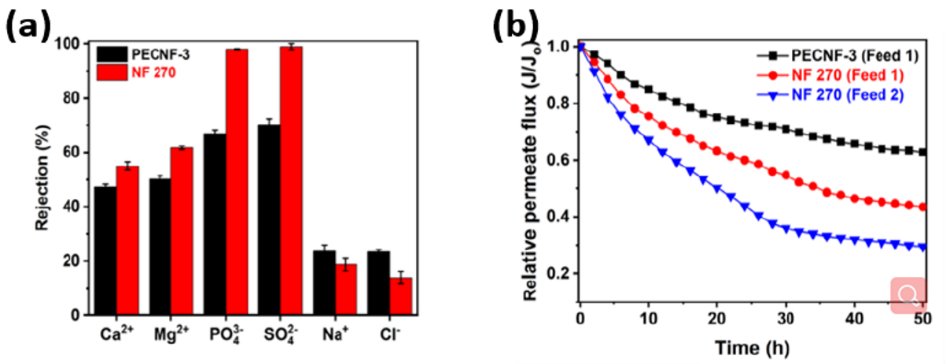

Figure 2. (a) Ion selectivity of PECNF-3 and NF 270 membranes for real wastewater effluent; (b) Relative permeate flux versus time for the NF 270 and PECNF-3 membranes using the real wastewater effluent supplemented with ions to mimic 80% water recovery for the PECNF-3 (Feed 1) and 80% water recovery for NF270 (Feed 2);

Discussion: The study demonstrates a mixed-charged PECNF membrane with near symmetric ions selectivity, allowing effluent desalination at a much higher recovery ratio than the typical polyamide NF membranes while producing permeate with lower SAR values. Overall, the stability, permeate quality, and anti-scaling properties of the PECNF membranes make them a promising alternative for polyamide membranes for high recovery effluent desalination.