Modification of polyamide membranes by hydrophobic molecular plugs for improved boron rejection

Shiran Shultz, Maria Bass, Raphael Semiat, Viatcheslav Freger

www.elsevier.com/locate/memsci

PII: S0376-7388(16)32369-9
DOI: https://doi.org/10.1016/j.memsci.2017.10.003
Reference: MEMSCI15629

To appear in: *Journal of Membrane Science*

Received date: 26 November 2016
Revised date: 12 September 2017
Accepted date: 2 October 2017

Cite this article as: Shiran Shultz, Maria Bass, Raphael Semiat and Viatcheslav Freger, Modification of polyamide membranes by hydrophobic molecular plugs for improved boron rejection, *Journal of Membrane Science,* https://doi.org/10.1016/j.memsci.2017.10.003

Modification of polyamide membranes by hydrophobic molecular plugs for improved boron rejection

Shiran Shultz, Maria Bass, Raphael Semiat, Viatcheslav Freger*

Technion - Israel Institute of Technology, Wolfson Department of Chemical Engineering, Technion City, 32000 Haifa, Israel

*Corresponding author: e-mail: vfreger@technion.ac.il

Abstract

Commercial polyamide RO membranes, though effective in terms of flux and salt removal, have a few drawbacks, in particular, poor rejection of boron (B), thus they are often unable to remove B to the required level in a one-pass sea desalination process. This complicates the process and available solutions increase the cost of desalinated water significantly. Here we explore in-situ modification procedure that can significantly increase their boron rejection by incorporating in the suitable modifying molecules selective polyamide layer. We propose that aliphatic amines be used as such "plug" molecules that combine a bulky hydrophobic moiety with a reactive group that can chemically or physically bind to polyamide layer, tighten its structure and increase selectivity. Based on previous results, we hypothesize that hydrophobicity of the selective layer increased by the immobilized amine "plug", along with reduced pore size, may help disrupt water-boric acid association and decouple water and boron permeation. The results show that the proposed treatment with sufficiently long (up to 10-12 carbons) aliphatic amines may indeed reduce the boron passage by a factor of 2 to 4, without impairing the salt rejection of the membrane. The improved selectivity comes at the expense of some flux reduction, but the flux-selectivity tradeoff improves compared with commercial polyamide membranes.

Graphical abstract