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PII: S0376-7388(16)32182-2
DOI: <http://dx.doi.org/10.1016/j.memsci.2016.12.059>
Reference: MEMSCI14984

To appear in: *Journal of Membrane Science*

Received date: 6 November 2016
Revised date: 27 December 2016
Accepted date: 28 December 2016

Cite this article as: Hai-Zhen Zhang, Zhen-Liang Xu, Yong-Jian Tang and Hao Ding, Highly chlorine-tolerant performance of three-channel capillary nanofiltration membrane with inner skin layer, *Journal of Membrane Science* <http://dx.doi.org/10.1016/j.memsci.2016.12.059>

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Highly chlorine-tolerant performance of three-channel capillary nanofiltration membrane with inner skin layer

Hai-Zhen Zhang, Zhen-Liang Xu^{*}, Yong-Jian Tang, Hao Ding

State Key Laboratory of Chemical Engineering, Membrane Science and Engineering R&D Lab, Chemical Engineering Research Center, East China University of Science and Technology, 130 Meilong Road, Shanghai 200237, China

^{*}Corresponding author. Fax: +86 21 64252989. chemxuzl@ecust.edu.cn

Abstract

Good mechanical strength, high water flux and salt rejection, and highly chlorine-tolerant property are essential for nanofiltration (NF) membrane. To achieve these properties, polyethersulfone (PES) NF thin-film composite (TFC) membrane was prepared via interfacial polymerization using piperazine (PIP) and 2,2'-bis(1-hydroxyl-1-trifluoromethyl-2,2,2-trifluoroethyl)-4,4'-methylenedianiline (BHMTM) as aqueous monomers, trimesoyl chloride (TMC) as organic monomers, and PES three-channel capillary ultrafiltration (UF) membrane as substrate. The prepared NF membrane displays pure water flux of $36.1 \text{ L}\cdot\text{m}^{-2}\cdot\text{h}^{-1}$ and Na_2SO_4 rejection of 96.8% at 4 bar. NaClO solution was used to treat NF membranes for the evaluation of NF membrane chlorine-tolerant property. The effects of NaClO concentration, contact time and operating pressure on the chlorine-tolerant property of NF membrane have been thoroughly investigated. Particularly, the durability of NF membrane versus Cl was tested through long-term test. The pure water flux and Na_2SO_4 rejection of NF membrane after 5000 ppm-h NaClO immersion was $43.4 \text{ L}\cdot\text{m}^{-2}\cdot\text{h}^{-1}$ and 99.8% at 4 bar, respectively. The fabricated NF membrane could tolerate 13000 ppm-h Cl under 4 bar, and the water flux and Na_2SO_4 rejection are maintained at $51.6 \text{ L}\cdot\text{m}^{-2}\cdot\text{h}^{-1}$ and 99.6% during NF running process, respectively. Moreover, NF membrane exhibits 3.84×10^5 ppm-h chlorine-tolerant at 0 bar. These results indicated that the fabricated PES three-channel capillary NF membrane could be applied to practical process of desalination or water softening.

Keywords: Three-channel capillary NF membrane, inner skin layer, preparation, chlorine-tolerant property, long-term stability

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