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Site-specific raw seawater quality impact study on SWRO process for optimizing operation of the pressurized step

Seung Joon Kim[a], Young Geun Lee[a], Kyung Hwa Cho[a], Young Mi Kim[a], Seokho Choi[b], In S. Kim[a,d], Dae Ryook Yang[c], Joon Ha Kim[d,e]

[a]*Department of Environmental Science and Engineering, Gwangju Institute of Science and Technology (GIST), Gwangju, 500-712, Korea*
[b]*Desalination R&D Center, Doosan Heavy Industries and Construction, Sh. Zayed Road, Office 6-112, Bldg. No. 6, Gold and Diamond Park, PO Box 282350, Dubai, UAE*
[c]*Department of Chemical and Biological Engineering, Korea University, Seoul, 136-701, Korea*
[d]*Center for Seawater Desalination Plant, GIST, Gwangju, 500-712, Korea*
[e]*Sustainable Water Resource Technology Center, GIST, Gwangju, 500-712, Korea*
Tel. +82 (62) 970-3277; Fax +82 (62) 970-2434; email: joonkim@gist.ac.kr

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Abstract

As a means of optimizing desalination processes, site-specificity in the determination of seawater quality conditions is a crucial point for improving the overall energy efficiency of a seawater reverse osmosis (SWRO) process. To this end, field studies were carried out at 16 sampling sites along the shoreline in South Korea to investigate the site-specific features of seawater quality. Also, two mathematical models were developed for the simulation of SWRO processes dependent on seawater quality in macroscopic and microscopic contexts, respectively. As a result, the microscopic dynamic model revealed that concentration polarization in the vicinity of the membrane surface and permeate concentration are affected by the feed seawater concentration and pressure. Then, the application of Fujairah SWRO plant operation data to the macroscopic simulation of a non-isobaric SWRO process model resulted in significant energy savings in terms of operational pressure savings, reducing 0.3 bar from the annual average value in the first pass operational pressure. These findings suggest that a cost-effective SWRO operation can be feasible using non-isobaric pressure controls by considering site-specific feed seawater concentrations. Results of the study presented here can be applied to improving the energy efficiency in SWRO plants through the optimization of pressurized systems.

Keywords: Site-specificity; Desalination; Reverse osmosis membrane; Seawater; SWRO; Optimization; Model; Concentration polarization; Non-isobaric operation

*Corresponding author.

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