Available online at www.sciencedirect.com
ScienceDirect
Desalination 238 (2009) 333–346
DESALINATION
www.elsevier.com/locate/desal

Scale formation in reverse osmosis desalination: model development

Hyun-Je Oh[a], Youn-Kyoo Choung[a], Sangho Lee[b*], June-Seok Choi[b], Tae-Mun Hwang[b], Joon Ha Kim[c]

[a]*School of Civil and Environmental Engineering, Yonsei University, Seoul 120-749, Korea*
[b]*Environmental Research Division, Korea Institute of Construction Technology, Gyeonggi-Do 411-712, Korea*
Tel. +82 (31) 910-0320; Fax: +82 (31) 910-0291; email: s-lee@kict.re.kr
[c]*Department of Environmental Science and Engineering, Gwangju Institute of Science and Technology (GIST), Gwangju 500-712, Korea*

Received 20 May 2008; Accepted 16 October 2008

Abstract

Scale formation of soluble salts is one of the major factors limiting the performance of reverse osmosis (RO) membranes for desalination. In this study, a dynamic model based on the crystallization theory was developed to analyze the effect of $CaSO_4$ scale formation on RO desalination process. Taking into consideration two mechanisms in scale formation including surface and bulk crystallization, the performance of RO filtration was predicted as a function of crossflow velocity, transmembrane pressure, permeate recovery, and operation mode. The model results indicated that RO fouling due to surface crystallization is important in batch filtration whereas both surface and bulk crystallization is important in crossflow filtration. This is because concentration polarization is directly related to surface crystallization. RO fouling due to bulk crystallization appeared to increase with increasing crossflow velocity and permeate recovery. The effects of background organic matters and antiscalant on scale formation were quantified using the model. The effect of operating parameters on RO fouling and concentration polarization was explored based on the model analysis.

Keywords: Eesalination; Reverse osmosis; Scale formation; Fouling; Model; Crystallization mechanisms

1. Introduction

As water resources become more limited, desalination of seawater and brackish water is becoming important [1–3]. Recently, reverse osmosis (RO) membrane processing has been considered a promising technology for desalination. RO membrane processing removes ions and organic chemicals, and its treatment effi-

*Corresponding author.

Presented at the IWA Efficient 2007, May 20–23, 2007, Jeju, Korea.

0011-9164/09/$– See front matter
doi:10.1016/j.desal.2008.10.005