Evaluating the efficiency of different microfiltration and ultrafiltration membranes used as pretreatment for Red Sea water reverse osmosis desalination

S.K. Al-Mashharawi, N. Ghaffour*, M. Al-Ghamdi, G.L. Amy

Water Desalination and Reuse Center, King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia

Tel. +966 28082180; email: noreddine.ghaffour@kaust.edu.sa

Received 16 March 2012; Accepted 29 May 2012

ABSTRACT

Conventional processes are widely used as pretreatment for reverse osmosis (RO) desalination technology since its development. However, these processes require a large footprint and have some limitation issues such as difficulty to maintain a consistent silt density index, coagulation control at low total suspended solids, and management of higher waste sludge. Recently, there has been a rapid growth in the use of low-pressure membranes as pretreatment for RO systems replacing the conventional processes. However, despite the numerous advantages of using this integrated membrane system mainly providing good and stable water quality to RO membranes, many issues have to be addressed. The primary limitation is membrane fouling which reduces the permeate flux; therefore, higher pumping intensity is required to maintain a consistent volume of product. This paper aims to optimize the permeation flux and cleaning frequency by providing high permeate quality. Different low-pressure polyethersulfone membranes with different pore sizes ranging from 0.1 μm to 50 kDa were tested. Eight different filtration configurations have been applied including the variation of coagulant doses aiming to control membrane fouling. Results showed that all the configurations with/without coagulation, provided permeate with excellent water quality which improves the stability of RO performance. However, more stable fluxes with less-energy consumption were achieved by using the 0.1 μm and 100 kDa membranes with 1 mg/L FeCl₃ coagulation. The use of UF membranes, having tight pores, without coagulation also proved to be an excellent option for Red Sea water RO pretreatment.

Keywords: Membrane pretreatment; Microfiltration (MF); Ultrafiltration (UF); Red Sea water reverse osmosis (SWRO); SDI; Membrane cleaning

*Corresponding author.

Presented at the International Conference on Desalination for the Environment, Clean Water and Energy, European Desalination Society, 23–26 April 2012, Barcelona, Spain