Chemical Cleaning of Micro-Filtration Members Used for Pretreatment of Oil Contaminated Seawater

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Abstract

Oil removal from contaminated seawater is one of the major challenges facing the reverse osmosis (RO) desalination industry, particularly in oil producing regions such as the Arabian Gulf. In order to prevent fouling of RO membranes, oil must be removed from the feed water using a pretreatment step such as micro-filtration (MF) membranes. However, the MF membranes will then need to be cleaned periodically or they will also stop functioning. The aim of this study was to develop a suitable procedure for cleaning MF membranes that have been employed for removal of oil from contaminated seawater. Specifically, the influences on permeate flux of different types of cleaning agents (i.e., acidic and alkaline) for the MF membranes were investigated. The results showed that after cleaning with an acidic cleaning agent, the permeate water flux significantly increased, initially. However, the flux decreased continuously with time. On the other hand, the permeate water flux after membrane cleaning with alkaline agent increased but not as much as with the acidic cleaning agent. However, there was no significant decrease in flux with respect to time. The experiments showed that the best membrane performance after the chemical cleaning was obtained when both chemical agents were used sequentially in the cleaning process. The permeate flux and operating cycle time recovery after chemical cleaning using both agents sequentially were 94.4% and 96%, respectively. In addition, the effects of reducing the soaking time during chemical cleaning were assessed. The results showed that a short soaking time (8-10 hours) may be used in the case of small capacity MF membrane plants of one tray, and a longer soaking time (30 hours or more) may be used for large capacity MF membrane plants of more than one tray of membranes.

The Scanning Electron Microscopy (SEM) membrane surface analysis showed that in case of the alkaline cleaning agent, most of the pores remained covered with a foulant layer, resulting in low flux recovery. On the other hand, the SEM results of the acid cleaned membranes showed more complete removal of the foulant layer from the pores resulting in better flux recovery. The SEM surface analysis of membranes cleaned with the combined acid/base cleaning agents showed the best results by giving a membrane surface similar to the original one.