COMPARISON OF REVERSE OSMOSIS AND NANOFILTRATION MEMBRANES IN WASTEWATER RECLAMATION FOR DIRECT POTABLE USE

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Introduction

Currently, water reuse and reclamation are considered as an essential technology available for alternative water resources with respect to non-potable as well as potable uses [1]. Therefore, lots of studies have been developing various technologies for water reuse, reclamation, and desalination to producing the more reliable and higher quality reclaimed/reused water. In addition, there are several practical plants to reuse the secondary effluent of wastewater around the world. Among them, membrane filtration process is recognized as one of effective technologies for wastewater reuse/reclamation due to its great performance, especially for inorganic/organic micropollutants and wastewater effluent organic matter (EfOM) removal [2]. Even though high quality water production of membrane technology, reused water from membrane filtration is still used in non-potable use such as agricultural, industrial and recreation water and in indirect potable use. Thus, reliability and safety of reclaimed/reused water should be guaranteed by establishing database of reused water quality and system optimization for a direct potable use. In this study, both RO and NF membranes were evaluated by pilot-scale system for wastewater reuse in direct potable use. The objectives of this study are 1) to evaluate the membrane performances including treated water quality and water production as well as membrane fouling, 2) to provide the database of reclaimed water quality for potable application, and 3) to optimize the membrane system in terms of membrane selection as well as system maintenance. Through this study, membrane filtration for wastewater reclamation can be evaluated as a novel process with respect to efficiency, safety, and economical aspect.

Methods

RO and NF membranes were monitored through the pilot-scale system with module of length and diameter of 1.016m (40inch) and 10.16cm (4inch), respectively, connected in parallel series. Both membranes are commercialized ones offered from Saehan Industries INC., Korea and their properties were listed in Table 1. Feed water of membrane pilot system was MBR treated water for sewage drained from restaurant and dormitory in Gwangju Institute of Science and Technology (GIST), Gwangju, Korea. The MBR systems had a membrane with pore size of 0.2μm, and MBR treated water was pretreated by 10μm MF filter prior to RO and NF membranes. Membrane performances were evaluated in terms of operating condition including water production rate, temperature, and transmembrane pressure and water qualities such as dissolved organic carbon (DOC), UV absorbance at 254nm, conductivity, ammonia, and nitrate. Membrane flux decline and fouling were also monitored and controlled by membrane cleaning with respect to organic fouling as well as biofouling. To optimize membrane system for potable water application, disinfection is considered with respect to microbial stability based on drinking water regulation in Korea as well as DBP formation potential. In addition, organic

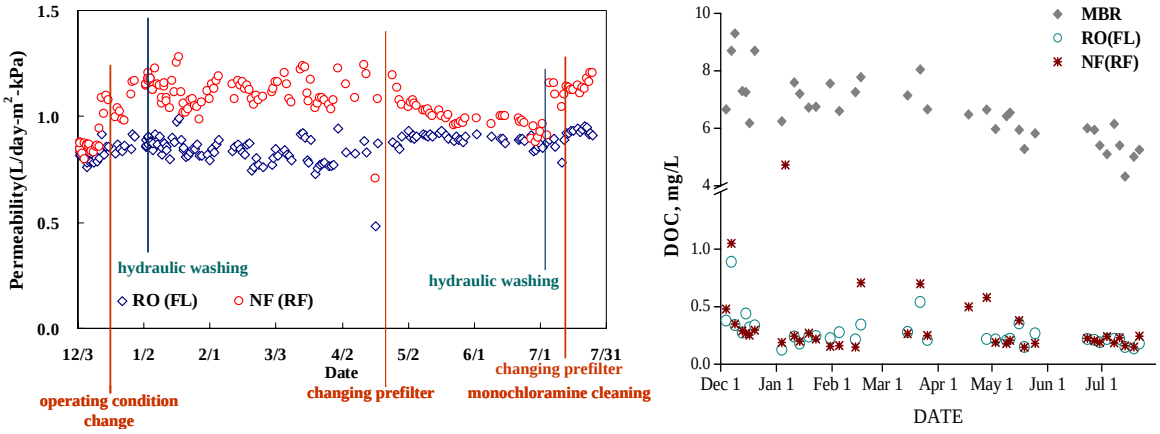
micropollutant removals were performed by NF and RO membranes in terms of endocrine disruptors (EDC) and pharmaceutical and personal care products (PPCP) in this presentation.

Table 1. Membrane properties tested in pilot system (manufactured by Saehan Industries INC., Korea)

code	material	PWP (L/day-m^2-Pa)	Contact Angle (°)	zeta potential @ pH 7 (mV)
RE4040-FL	polyamide TFC	1.5	38±5.3	-14.90
NE4040-90		1.6	43.3±2.8	-21.55

Results

The temperature-normalized permeability and DOC removal of RO and NF membranes were monitored as shown in Fig 1. During the operation, membrane cleaning was conducted by hydraulic washing and chemical cleaning. In Fig 1, water permeability of NF membrane was somewhat higher than that of RO membrane even though almost similar PWP values from membrane properties in Table 1. Moreover, flux of both RO and NF membranes were affected not by hydraulic washing but by changing prefilter and chemical cleaning. Removal of DOC and conductivity of both two membranes were very stable, and the NF membrane treated water exhibited almost similar DOC level to the RO treated water through more than 6 month operation. DOC concentrations of treated water showed around 0.2mg/L, which can be acceptable for potable water considering organic removal related to DBP formation. Other parameters were evaluated for potable water application based on drinking water regulations in further studies.



(a) (b)

Figure 1. RO and NF pilot system monitoring: (a) temperature-normalized water permeability and (b) DOC concentration of feed water (MBR treated water) and RO/NF membranes treated water.

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