

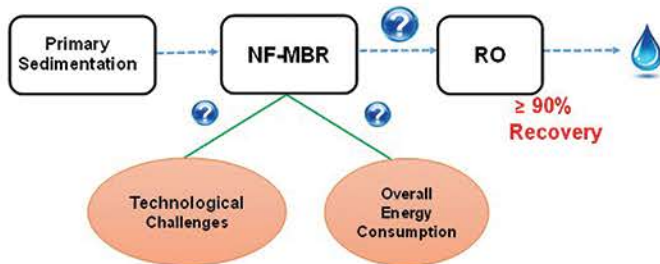


TOWARDS HIGH RECOVERY IN WATER RECLAMATION PROCESSES: HIGH PERFORMANCE NF-MBR+RO SYSTEM

ASST. PROF. CHONG TZYU HAUR E-MAIL: THCHONG@NTU.EDU.SG
PROF. WANG RONG E-MAIL: RWANG@NTU.EDU.SG

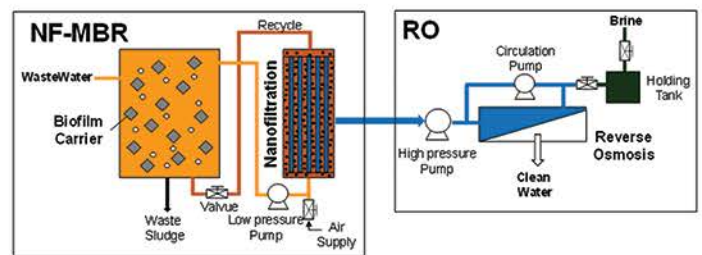
Introduction

- ❖ Common practical limit of existing MF/UF-MBR+RO technology is 75-85% recovery due to membrane fouling
- ❖ High performance NF-MBR+RO hybrid system is target to achieve $\geq 90\%$ overall recovery



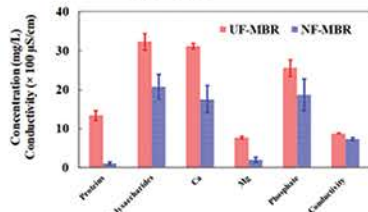
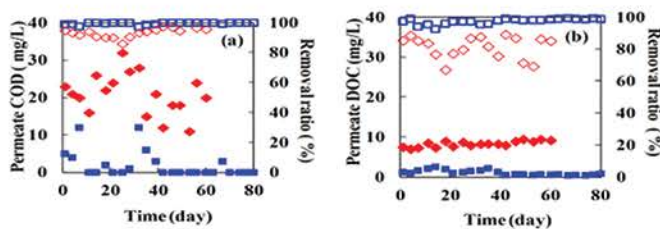
Methodology

- ❖ Lab-scale side stream NF-MBR
- ❖ Novel low pressure NF membrane: SMTC in-house fabricated hollow fiber & flat sheet membranes
- ❖ NF-MBR operating flux: 10 LMH



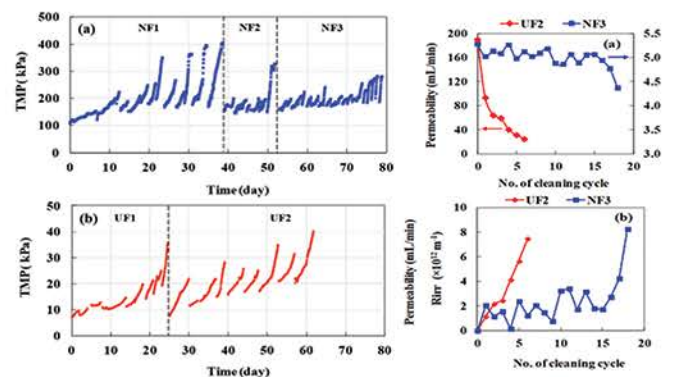
Permeate Quality of NF-MBR

■ Permeate (NF-MBR) ◆ Permeate (UF-MBR) □ Removal (NF-MBR) ◇ Removal (UF-MBR)



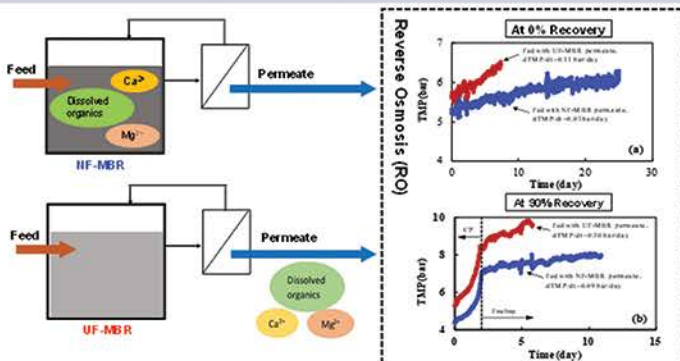
- ❖ Higher organic and inorganic removal in NF-MBR

Fouling in NF-MBR



- ❖ Reversible fouling in NF-MBR vs. irreversible fouling in UF-MBR

Permeate Quality of NF-MBR



- ❖ 30% lower fouling in RO using NF-MBR permeate as feed

Overall Energy Consumption

Description	UF-MBR+RO (75% recovery)		UF-MBR+NF+RO (90% recovery)		NF-MBR+RO (90% recovery)	
	SS/m ³	%	SS/m ³	%	SS/m ³	%
Cost						
CAPEX	0.09	19.4	0.14	21.0	0.11	20.5
OPEX	0.36	80.6	0.52	79.0	0.42	79.5
Total	0.446		0.652		0.533	
Energy						
MBR	0.326	51.5	0.271	33.3	0.387	52.4
(NF+) RO	0.306	48.5	0.545	66.7	0.352	47.6
Total	0.632		0.816		0.739	

Team Members: Wu Bing, Emile Cornelissen, Xu Huijuan, Lee Seonki, Jeong Kwanho, Li Xin, Chia Rui Yun, Tay Ming Feng
This project (1601-CRPW-T49) is funded under the Competitive Research Programme (CRP) (Water) by National Research Foundation of Singapore

For more information: Prof. Wang Rong · E-mail: rwang@ntu.edu.sg · SMTc website: <http://smtc.ntu.edu.sg>