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# Foulant analysis of hollow fine fiber (HFF) membranes in Red Sea SWRO plants using membrane punch autopsy (MPA)

Troy N. Green[a,b,*], Ibrahim Al-Tisan[a,b], Mahmoodur Rahman[a,b], Yaser Al-Jehani[b], Al-Munther Al-Hakamy[c]

[a]*Desalination Technology Research Institute (DTRI), Al-Jubail, Saudi Arabia, email: tgreen@swcc.gov.sa*
[b]*Saline Water Conversion Corporation (SWCC), Al-Jubail, Saudi Arabia, email: rdc@swcc.gov.sa*
[c]*King Abdullah University of Science and Technology, Thuwal, Saudi Arabia, email: almunther.alhakami@kaust.edu.sa*

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**ABSTRACT**

Membrane punch autopsy (MPA) is a procedure for quantitative foulant analysis of hollow fine fiber (HFF) permeators. In the past, quantitative autopsies of membranes were restricted to spiral wound. This procedure was developed at SWCC laboratories and tested on permeators of two commercial Red Sea reverse osmosis plants. For membrane autopsies, stainless steel hollow bore picks were penetrated to membrane cores and fibers extracted for foulant analysis. Quantitative analysis of extracted materials contained inorganic and organic foulants including bacteria. Fourier transform infrared spectroscopy analysis confirmed the presence of organic fouling functional groups and scanning electron microscopy with energy dispersive X-ray spectroscopy in the presence of diatoms and silica most likely not from particulate sand. API analysis revealed the presence of *Shewanella* and two *Vibrio* microbial species confirmed by 16S rDNA sequence library. It was observed that fouling content of HFF cellulose triacetate (CTA) membranes were more than 800 times than polyamide spiral wound membranes.

*Keywords:* SWRO; Membrane punch autopsy; SEM/EDX; Hollow fine fiber; Biofilm; Bacteria; Red Sea; Organic foulant; OPEX; CAPEX

* Corresponding author.

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