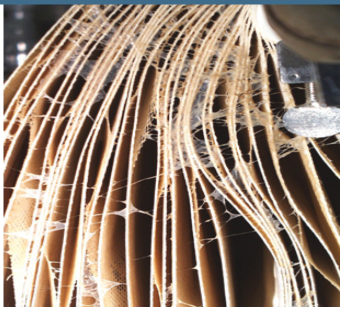
Tech Fact

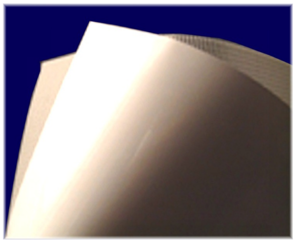
Three Steps to Control Biofouling in Reverse Osmosis (RO) Systems



Biofouling is one of the most commonly encountered fouling types in large and small scale RO installations treating surface-, waste- or seawater. If left uncontrolled, it can be a significant and persistent operational challenge with substantial economic consequences. Pre-treatment alone can not prevent biofouling and the need for methods employed in the RO stage itself arises.

Three Proposed Techniques

1. New extra fouling resistant membrane chemistry
2. Optimization of the feed spacer configuration by varying the spacer thickness
3. The use of non-oxidative biocide: DBNPA



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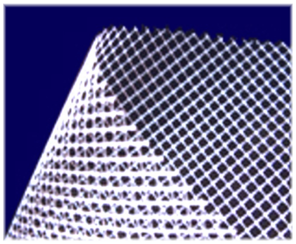

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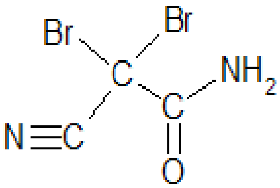

The impact of these techniques on the rate of biofouling in RO systems was investigated in pilot scale experiments with small elements subjected to high fouling feed, secondary treated municipal effluent.

Fouling Resistance

The first generation of fouling resistant DOW FILMTEC™ membranes date back more than a decade. Currently there are two types of fouling resistant chemistry membranes available, FR and XFR (extra fouling resistant). FR-Membranes have an established track record of treating waters with high biological fouling potential. The XFR membrane is the newest refinement in TFC membrane chemistry, offering the best biological and organic fouling resistance in the industry today.

A small scale side-by-side pilot experiment compared two different membrane chemistries. Following conclusions can be made:

- Throughout the whole experiment the BW30 membrane showed a higher degree of fouling when compared to new BW30XFR membrane
- Flux loss at the end of the experiment was 14% for XFR and 22 % for BW30.

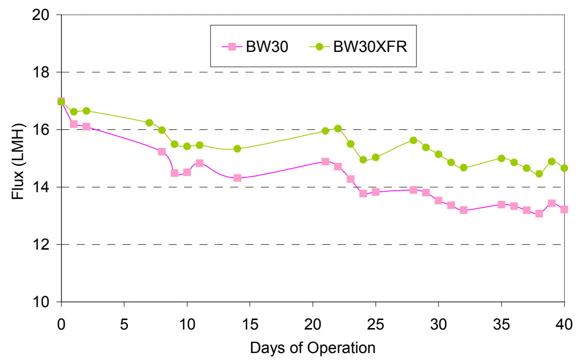

Figure 1. Normalized permeate flux during 40 days operation with municipal wastewater

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Impact of Feed Spacer Thickness

An increase in differential pressure at constant flow rates is usually due to the presence of foulants or scaling within the feed spacer. Feed spacer configuration can be optimized for high fouling potential or challenging feed conditions, and variation of the feed spacer thickness is one of the recognized modifications. A thicker feed spacer will mitigate fouling and provide a reduction in pressure drop across the element.

A small scale side-by-side pilot experiment compared two different feed spacer thicknesses. Following conclusions can be made:

- The 34-mil spacer demonstrated lower initial Δp and lower Δp increase during episodes of fouling.
- The positive effect of the cleaning was much stronger for the 34 mil spacer element

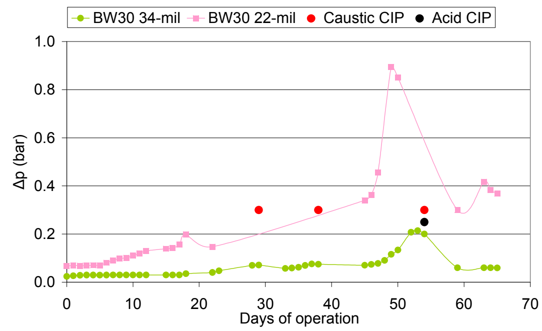

Figure 2. Normalized Δp during 65 days operation with municipal WW

Impact of Non-Oxidative Biocide (DBNPA)

DBNPA is a rapid kill biocide efficient against fungi and bacteria. It is fully compatible with all materials of an RO element and thus can remain active throughout the RO membrane stage.

A small scale side-by-side pilot experiment compared DBNPA treated (20 ppm active) and reference element. Following conclusions can be made:

- The DBNPA treated element demonstrated lower Δp increase and lower flux loss indicating significantly less fouling.
- The positive effect of the cleaning was much stronger for DBNPA treated element
- Frequent dosing allows good control of biofouling

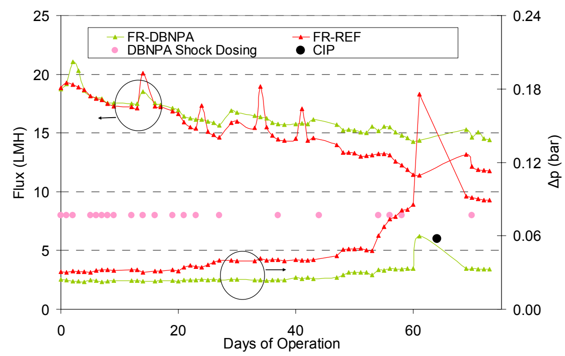

Figure 3. Normalized Δp and normalized permeate flux during 73 days operation with municipal WW

Summary

Pilot scale data demonstrated the benefits of the individual biofouling control techniques. A recommended path forward is to use an integrated approach for biofouling control rather than relying on stand-alone fouling control strategies. A fouling resistant membrane combined with an optimized feed spacer is recommended whenever a high potential for biofouling is seen. The introduction of targeted biocides upstream of the RO will result in improved fouling prevention and will help to ensure long term trouble free operation.

Reference

K. Majamaa, J.E. Johnson, U. Bertheas: Three Steps to Control Biofouling in Reverse Osmosis Systems, MDIW conference, June 2010, Trondheim, Norway

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