

## EDS WEBINAR

# Membrane Scaling & Fouling – Part 2

Thursday 26. January 2023, 16:00-17:30 CET

Welcome Message: Ursula Annunziata, President EDS



**Moderator: Felix Broens**

CTO at Convergence BV

University of Twente - Master in Membrane Science and Technology

### Bio

I studied chemical engineering at the University of Twente in The Netherlands. My specialization in membrane technology was done in the group of Prof. Matthias Wessling in 2008-2009.

After my studies I founded Convergence, a company that focuses on making automated pilot units for a wide range of membrane applications, including RO processes. I have the function as CTO in Convergence and will continue in this position for the coming years.

Since 2010 I have attended all EUROMED/EDS conferences, with the first one being the EUROMED # 5 in Tel Aviv. Since 2020 I have joined the EDS board.

## Abstracts / Program

**Nuria Adroer**

R&D Director – Adiquimica S.A.

Barcelona, Spain

- ❖ **STRATEGIES FOR DESIGNING THE BEST ECONOMIC AND SUSTAINABLE SOLUTION FOR CLEANING REVERSE OSMOSIS MEMBRANES**

**Almotasembellah ABUSHABAN**

Researcher/lecturer at the International Water Research Institute (IWRI)

Mohammed VI Polytechnic University, Benguerir, Morocco

- ❖ **Monitoring and assessing fouling potential along the pre-treatment of an SWRO desalination plant in the Middle East.**



**Nuria Adroer**  
**R&D Director – Adiquimica S.A.**  
**Barcelona, Spain**

#### **Bio**

Education:

PhD in Chemical Sciences by Universitat Autònoma de Barcelona . 1992  
Chemistry by Universitat de Barcelona. 1984

I have more than 25 years experience in water treatment field. Joined ADIQUIMICA in 1996 as R&D director. I am a member of AEDyR, EDS and Aquaespaña. I presented several papers in IWA, IDA, EDS and AEDyR congresses. Author of studies published in research journals.

My research interests are focused on: Reverse osmosis antiscalants, Membrane cleaning products, Membrane integrated systems (MBR and RO/NF), Microbiological control in water applications, Control of Legionella in cooling systems, Scale and corrosion inhibitors for cooling systems.

#### **Abstract:**

### **STRATEGIES FOR DESIGNING THE BEST ECONOMIC AND SUSTAINABLE SOLUTION FOR CLEANING REVERSE OSMOSIS MEMBRANES**

Membrane fouling is a persistent problem throughout reverse osmosis systems that reduces plant efficiency and economics. Both cleaners and cleaning procedures play a key role in restoring the membrane performance. Membrane autopsy is the best method and reliable technique to identify the nature of foulants and the cause of poor membrane performance.

In this presentation, a methodology based on membrane autopsies has been successfully applied to determine the most cost-effective and sustainable solution for cleaning reverse osmosis membranes. The methodology used to identify and characterize the composition of foulants deposited on a membrane surface consists in using a combination of several techniques. Membrane autopsies were performed on reverse osmosis elements derived from two different plants: a reverse osmosis seawater membrane and a reverse osmosis membrane used for leachate treatment. Both membranes surface, were covered by a thick gelatinous deposit layer.

After determining the fouling behavior and mechanisms involved in membrane fouling for each element, our study focused on selecting the best cleaning procedure and the most successful cleaners for restoring the membranes performance. Environmental and economic criteria were taken into consideration to design the cleaning membrane strategies. Comparative analyses of membranes before and after cleaning procedures were conducted using CLMS, ATR-FTIR and SEM-EDX techniques. The results demonstrated that powdered cleaners used in combination with non-oxidizing biocide restored both membranes performance to design specifications and removed bacteria and biofilm from membranes surface.

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**Almotasembellah ABUSHABAN**

**Researcher/lecturer at the International Water Research Institute (IWRI)  
Mohammed VI Polytechnic University, Benguerir, Morocco**

#### **Bio**

Dr. Abushaban is a Lecturer/Researcher in Water Desalination at the International Water Research Institute (IWRI) - Mohammed VI Polytechnic University, Morocco. Moreover, he is the Regional Coordinator of the Young Leader Program (YLP) for the Middle East and Africa at the International Desalination Association (IDA), USA. Abushaban has a PhD in Water Management from Delft University of Technology, The Netherlands and MSc in Municipal Water and Infrastructure from UNESCO-IHE, The Netherlands.

Abushaban's research interests lie broadly in water purification and desalination technologies, process optimization, water quality monitoring, controlling membrane fouling, pre-treatment, development of monitoring methods and tools, and wastewater reuse. He has carried out several research projects with industrial companies worldwide such as Suez in France, Promega in USA, Grundfos in Denmark, Evides in The Netherlands, Veolia in Australia, etc. His work included monitoring, assessing and optimizing numbers of seawater/brackish water desalination plants in Australia, Jordan, The Netherlands, Oman, and United Arab Emirates.

Dr. Abushaban has more than 12 publications in international journals (h-index 9) and 2 book chapters. He is currently co-supervising 4 PhD students and has supervised 7 MSc students and 5 BSc students internationally. Moreover, it has received several prestigious awards, including the Innovation Award of IDA at the International World Congress 2017.

**Abstract:**

**Monitoring and assessing fouling potential along the pre-treatment of an SWRO desalination plant in the Middle East**

In full-scale seawater reverse osmosis (SWRO) desalination plants, membrane fouling continues to be a major challenge which has often resulted in unforeseen operational costs and loss of production. The focus of many full-scale SWRO plants has been on maintaining low silt density index (SDI) values in the SWRO feed to control particulate fouling. However, organic and biological fouling are being occurred more frequent. To improve SWRO performance, strategies to control biological and organic fouling need to be developed. Recently, several methods to monitor organic and biological foulants have been developed such as assimilable organic carbon (AOC) and bacterial growth potential (BGP) methods.

In this presentation, the pre-treatment of an SWRO plant located in the Middle East is monitored in terms of turbidity, microbial ATP, particulate fouling potential (SDI, MFI-0.45), and biological/organic fouling potential (BGP, total organic carbon (TOC) and florescence excitation-emission (FEEM)). The pre-treatment processes of the SWRO plant includes dissolved air floatation (DAF) with addition of FeCl<sub>3</sub> as coagulant, inline coagulation (1 mg FeCL<sub>3</sub>/L), two stages of dual media filtration (DMF) and cartridge filtration.

Overall, the monitored water quality parameters along the pre-treatment of the SWRO plant showed excellent removal of turbidity, particulate fouling indices, and microbial ATP. However, partial removal of organic fouling compound was observed.

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## Biography, Professor Philip Davies

Philip qualified with a BSc (First Class Honours) in Mechanical Engineering from Imperial College in 1984. He gained industrial experience as a graduate apprentice at W. H. Allen Ltd, Bedford, before going on to study for a DPhil in biomedical engineering at the University of Oxford.

In 1990, he was awarded a bursary from the European Commission to carry out research at the Institute of Solar Energy, Polytechnic University of Madrid, enabling him to develop research interests in the field of renewable energy. In 1993, he was employed as Project Engineer by Light Works Ltd to develop the first prototype seawater greenhouse in Tenerife. He continued to gain industrial experience until 2003, during which period he contributed to the development of commercial products in the telecommunications, energy and medical sectors – some of which are still marketed today.

In 2003, Philip was awarded an Industry Fellowship from the Royal Society, enabling him to continue research work on seawater greenhouses – including renewable energy and desalination technology – in collaboration with Seawater Greenhouse Ltd, London, and hosted by University of Warwick. Philip resumed a full-time academic career when he was appointed in 2005 as Lecturer at Aston University, progressing later to Senior Lecturer and Reader, also serving as Associate Dean of Research and as of Head of Group (Mechanical Engineering and Design). He has taught courses in Sustainable Product Design, Engineering Design & the Natural Environment, Renewable Energy, and Water Treatment Technologies.

In 2018, Philip was appointed Professorial Research Fellow at the School of Engineering, University of Birmingham, where he is pursuing research topics and innovations in the areas of water technology and the water-energy-food nexus.