European Desalination Society in collaboration with itc INSTITUTO TECNOLÓGICO DE CANARIAS

EDS WEBINAR

Membrane Scaling & Fouling – Part 1

27. October 2022, 16:00-17:30 CET

Welcome Message: Ursula Annunziata, President EDS

Moderator: Professor Philip Davies
Professor of Water Technology
University of Birmingham - School of Engineering
See detailed Bio on last page

Abstracts / Program

Professor Maria Kennedy
Professor of Water Treatment Technology at IHE Delft
Delft, Netherlands

- **Assessing biofouling potential through seawater reverse osmosis pre-treatment systems**

Dr. Nuria Peña Garcia
Research Director, Genesys-PWT an H20-Innovation Company
Membrane Autopsy, Membrane cleaners, Antiscalants, Water treatment
Madrid, Spain

- **Membrane Cleaning Procedures, Performance of Commodities vs Formulated Cleaners**

Maria Kennedy
Professor of Water Treatment Technology at IHE Delft
Delft, Netherlands

Bio

Maria Kennedy is Professor of Water Treatment Technology at IHE Delft. She has over 28 years of experience in education, research, consulting and capacity development in water treatment. During the last 28 years, she has been involved in the supervision of over 200 MSc participants and 22 PhD research fellows in the areas of water quality, groundwater treatment, disinfection, advanced oxidation, surface water treatment, desalination and membrane related technology, natural treatment systems, water reuse, water transport and distribution and biological stability. She has more than 150 publications in peer reviewed journals (Scopus h-Index = 39), and she has edited several books/book chapters on various aspects of water treatment.

Professor Maria Kennedy has organized numerous international short courses in the field of desalination & membrane related technology e.g. in Jordan, Palestine, Oman, Bahrain, Israel, St. Maarten, Iran, Chile, Yemen, South Africa and Korea. She is or has been the director of several (large) capacity development projects in the Middle East region e.g. in Jordan, Palestine, Yemen and Iran. She was/is also involved in several large EU/Horizon 2020 research projects such as EU MEDINA, EU TECHNEAU, EUROMBRA, H2020 MIDES, H2020 India H20 (ongoing), H2020 IntelWATT (ongoing), H2020 MAR2PROTECT (newly awarded). She is also the director of the Erasmus Mundus International Master of Science in Environmental Technology and Engineering (IMETE) program.

Professor Maria Kennedy is a past president (2016-2018) of the European Desalination Society (EDS), and Chairman of the board of directors. She was also a member of the Science and Technology Board of the EU-Joint Programming Initiative (JPI), and she is a jury member of several prestigious international technology events such as the USAID Water for Food Desalination Prize (2014-2015), the Oman Humanitarian Desalination Challenge and the International Aquatech Innovation Award (2013, 2015, 2017, 2019, 2021).

Abstract: Assessing biofouling potential through seawater reverse osmosis pre-treatment systems

Seawater desalination is increasingly used as a means to augment freshwater supplies in regions of the world with high water stress, and reverse osmosis is increasingly the technology of choice because of the lower energy consumption compared to thermal systems. However, seawater reverse osmosis (SWRO) systems suffer from various types of fouling, which can increase energy consumption and the use of chemicals during SWRO operation. In practice, pre-treatment systems are put in place to reduce the particulate and biological fouling potential of SWRO feed water. However, simple, reliable and accurate methods to assess the extent to which biological fouling potential is reduced during pre-treatment are not available for seawater.

A method to measure bacterial growth potential (BGP) was developed using the native bacterial consortium in seawater. New reagents to extract and detect ATP in microbial cells were tested and optimized for seawater. The new lysis and detection reagents overcame the salt interference in seawater and allowed the detection of low concentrations of total ATP, free ATP and microbial ATP in seawater. Incorporating a filtration step increased the sensitivity of the method six fold, enabling ATP detection of ultra-low levels of microbial ATP in seawater (0.06 ng-ATP/L).

The newly developed ATP-based BGP method was applied to monitor and assess the pre-treatment of five full-scale seawater desalination plants around the world, which included dual media filtration, dissolved air flotation and ultrafiltration. A correlation was observed between BGP measured in SWRO feed water and the pressure drop increase in SWRO systems, suggesting the applicability of using the ATP-based BGP method as a biofouling indicator in SWRO. Furthermore, a safe level of Bacterial Growth Potential (<70 µg/L) is tentatively proposed for SWRO feed water in order to ensure a chemical cleaning frequency of once/year or lower. However, to validate these conclusions, more SWRO plants with different pre-treatment systems need to be monitored. In the future, on-line monitoring of ATP and BGP in SWRO feed water may further reduce the consumption of chemicals and energy and improve the overall sustainability of seawater desalination by reverse osmosis.

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Dr. Nuria Peña Garcia
Research Director - Genesys-PWT
Membrane Autopsy, Membrane cleaners, Antiscalants, Water treatment
Madrid, Spain

Bio

Dr. Nuria Pena gained her PhD in analytical chemistry from the Complutense University of Madrid, researching water and food biosensors. She has over twenty years of experience in water treatment specialising in water analysis and, mainly, in the study of fouling identification and membrane damage (reversed osmosis, nanofiltration, ultrafiltration). Nuria has published more than fifteen papers about analytical chemistry and water treatment.

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Abstract: **Membrane Cleaning Procedures, Performance of Commodities vs Formulated Cleaners**

Over the last two decades there have been important breakthroughs in new technology for the recovery of energy, new materials and different morphologies for reverse osmosis (RO), Nanofiltration (NF), Ultrafiltration (UF) and microfiltration (MF) membranes. These efforts are mainly focused on reducing costs and improving energy efficiency.

The presence of fouling on the surface of a membrane has an irrefutable effect on energy consumption and plant efficiency. Therefore, one of the main goals for water treatment with membranes is to avoid fouling. However, eventually all membranes suffer from some fouling to the point where cleaning procedures must be applied to restore membrane performance. It is critical this cleaning is effective and does not cause damage to the membranes being cleaned.

Very often, commodities are the initial choice when a cleaning procedure must be applied this choice being price driven rather than performance or research driven. There are a wide range of formulated products available but very little data comparing performance against commodities.

One of the best ways to choose the most effective cleaning product is to have an accurate identification of fouling through autopsy and to make cleaning tests with different cleaners to optimize the protocol.

The results obtained during a significant number of autopsies performed on both reverse osmosis and ultrafiltration membranes, revealed the common composite nature of fouling [1, 2]. Therefore, when considering a cleaning procedure, it is very important to use cleaners that are versatile and effective enough to ensure the greatest removal of all the fouling components from the membrane surface.

This study includes the results obtained from cleaning tests carried out during autopsies of different membranes and different foulants. The performance of both commodities and formulated cleaners are compared and contrasted.

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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.