Spring 2022

IDA GLOBAL CONNECTIONS

Unconventional Water Resources:

A New and Promising Approach to Desalination in the United Nations System

By Mr. Carlos Vázquez and Mr. Eduardo Orteu

Gomez Acebo & Pombo. Members of the IDA International Committee on Legal Affairs

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MESSAGE FROM THE SECRETARY GENERAL

Dear Members and Colleagues,

I hope you're enjoying this beautiful Spring!

It's my pleasure to congratulate the newly elected Term 20 IDA Board of Directors, who will begin during the 2022 IDA World Congress, October 9-13, in Sydney, Australia. Announcements of the incoming officers and appointed Affiliate Directors also happen at the World Congress. There was outstanding voter participation in this election; thank you to all members who took the time to vote. The collective excellence this vast group of industry, public sector, and academic luminaries will bring to the IDA is exciting for our association.

When discussing luminaries and the greats from our water community, we credit the technical experts, speakers, and sponsors that made the first IDA-SWCC-DTRI International Ocean Brine Mining Conference held in March 2022 at Al Khobar, Saudi Arabia, a success.

Our cover story features the prominent news of the United Nations' recognition of the use of desalination and other non-conventional solutions as an emerging opportunity to offset global water scarcity. Carlos Vázquez and Eduardo Orteu Gomez of Acebo & Pombo present the impact of this new position.

This issue of IDA Global Connections magazine includes thought-provoking articles from leaders of the sector. Mr. Fady Juez, Managing Director of Metito, offers his Executive Viewpoint about how floating desalination plants provide flexibility in meeting the demand for more water supplies as alternative options to consider in the vital need to bridge the gap between water demand and supply.

Mr. Pedro Almagro, General Manager of Lantania Desalination, addresses another non-conventional challenge and opportunity – desalination brine mining. Throughout the article, Almagro looks at the environmental impact and the competitive extraction of minerals from high saline effluents.

Erik Roesink, Founder and CTO of NX Filtration, presents a unique viewpoint on how we can ensure that there are fewer pharmaceuticals in our world's rivers. He concludes that new technologies must focus on the safe use of surface water and the reuse of biologically treated effluent as additional high-quality water sources to close the water supply gap.

Further discussing reuse is Johnny Obeid, Vice President of Veolia Water Technologies; his contribution focuses on how their BARRELL and smart connectors widen the field of water reuse. Mr. Frédéric Dugré shares his analysis of the growing interconnectivity in water-energy-food and the importance of using reclaimed water for irrigation to ensure food security.

As part of the IDA strategy to expand engagement with the stakeholder community, the President and I are excited to welcome H.E. Eng. Khaled Al Qureshi, CEO of Saudi Water Partnership Company, to hold the Chairmanship of the IDA Public and Private Utility Advisory Committee. His contribution will most certainly enrich the role of this IDA initiative. We are also pleased to announce his role in moderating a dynamic session in the IDA Leaders Summit at our upcoming World Congress.

Speaking about innovation in desalination, the IDA Innovation Forum is new to the World Congress, and the nomination process is currently open. Additionally, the nomination period for IDA Industry and Sustainability Awards is open until 30 June, and we encourage everyone to send recommendations.

I take this chance to thank all the contributors and sponsors of the forthcoming IDA World Congress, which includes world-renowned sponsors and exhibitors. We are excited to confirm many more companies and organizations to join us in making this event the great success that it always is. Registration is open, and we welcome you to participate in the many forums, discussions, knowledge sharing opportunities, networking events, and just all-around fun that the IDA World Congress brings.

We hope to see you at our upcoming specialty conference on Innovation in Desalination held in partnership with SWCC-DTRI at the end of May in Jeddah. Until then, please enjoy the Spring issue of IDA Global Connections.

Best wishes,
Shannon McCarthy

MESSAGE FROM THE PRESIDENT

Dear Colleagues,

I want to begin this message by congratulating and thanking the incoming members of IDA's Board of Directors for Term 20. They are all top professionals with a long history in the water sector, which will provide our organization with leadership to continue our vital work and mission. IDA continues to grow, both in interest and new members, making it an increasingly participatory association.

I would also like to thank and highlight the Advisory Boards (AB) we created at the beginning of this board term, which adds significant value to our association. Recently this included the incorporation of HE Eng. Khaled Al Qureshi as Chairman of the IDA Public and Private Utility Advisory Committee, which will strengthen the exchange of experiences, viewpoints, and activities among IDA utility members. In addition, his professionalism, talent, and leadership will serve as a strong draw for all of us and undoubtedly for new partners in the future.

I would also like to highlight the cover story by Mr. Eduardo Orteu and Mr. Carlos Vázquez, partners and Chairmen of the IDA Legal Firm Special Advisory Committee. They eloquently explain the significant change of the United Nations regarding desalination and reuse due to the escalation of extreme droughts in many parts of the world and the enormous challenge of alleviating growing water scarcity on the planet. The UN points out that non-conventional water resources are an essential solution to help achieve SDG

6 (Water and Sanitation for All) to combat climate change. IDA will work to strengthen this 180º reversal, which will significantly impact members of the IDA.

At the end of May, we will hold the International Specialty Conference on Innovation Driven Desalination, together with our partners Saline Water Conversion Corporation and the Desalination Technology Research Institute (DTRI) in Jeddah, Saudi Arabia. Under the sponsorship of Saudi Arabia's Ministry of Environment, Water, and Agriculture, the event will bring together leading experts in desalination and the sector's top companies to discuss technology, innovation, and projects. We hope that this conference will be as well-received as the first International Specialty Conference on Ocean Brine Mining held last March in Al Khobar.

Lastly, I'd like to thank all IDA members for their support and interest in the IDA 2022 World Congress: Charting Resilient Water Solutions to be held 9-13 October in Sydney, Australia. Thank you to our sponsors and exhibitors, members of the IDA Technical Committee for reviewing the abstracts submitted, the IDA team for the overall Congress organization, and the institutional and media partners. They are doing a great job preparing an extraordinary event for the entire water industry. I encourage you to continue contributing to ensure a successful Congress week. We welcome you to register for the program and look forward to discussing the present and future of our industry.

Enjoy the Spring edition of IDA Global Connections.

Best regards,

Carlos Cosín
IDA President

COVER STORY

Unconventional Water Resources: A New and Promising Approach to Desalination in the United Nations System

By Mr. Carlos Vázquez and Mr. Eduardo Orteu.
Gomez Acebo & Pombo.
Members of the IDA International Committee on Legal Affairs.

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Gómez-Acebo & Pombo

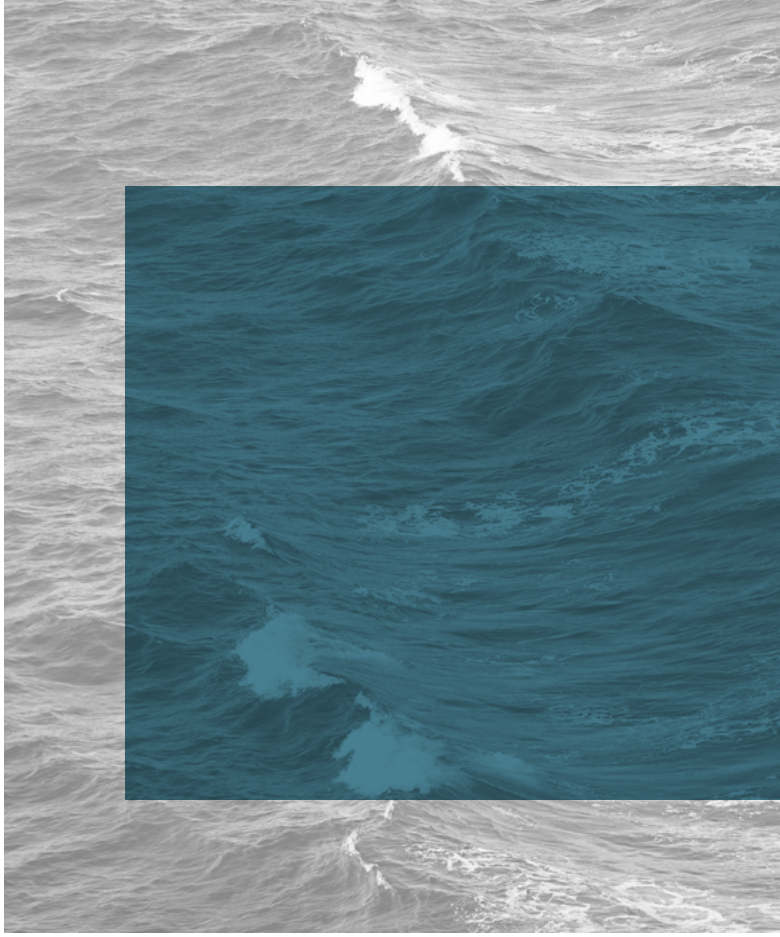
The United Nations has made clear that the international community is lagging behind in achieving SDG 6 on water and sanitation. The situation is exacerbated by ever-increasing challenges associated with water scarcity, in part due to the negative impacts of climate change. According to the UN "*60% of the global population lives in areas of water stress where available supplies cannot sustainably meet demand for at least part of the year. As water scarcity is expected to continue and intensify in dry and overpopulated areas, the world at large is in danger of leaving the water scarcity challenge to future generations who will be confronted with the consequences of today's practices.*" Conventional water resources have proven to be insufficient to tackle this challenge. "*Considering the water-related sustainable development challenges in arid regions, utilizing unconventional water resources are an emerging opportunity to narrow the water demand-supply gap*[1]" This is one of the conclusions laid down in "Unconventional water resources", an analytical brief released by UN Water in June 2020.

It is worth noting that the UN System has changed its approach to unconventional water resources, particularly, to the use of sea water desalination over the last years, as a consequence of the escalating magnitude of the water scarcity challenge. The UN Agenda 30 and the SDG 6 call for more efficient use to address water scarcity (target 6.4) but there is no reference to the use of unconventional resources. Although water reuse is covered by this goal (target 6.2), the call to substantially increase recycling and safe water reuse is aimed at improving water quality.

> A clear change towards a more supportive use of unconventional resources as a means to tackle water scarcity is now starting to be perceived in some of the latest official reports released by various UN Programs and Agencies.

All in all, by the time Agenda 2030 was adopted, unconventional resources were not considered part of the solution to the water scarcity challenge. Desalination was especially disregarded for three main reasons. First and foremost, because a demand-side approach – based on maximising the efficiency of existing water resources - rather than an offer-side approach - based on bringing more water into the system - has been the driving force behind the UN's recipe to address water management. Second, because of the negative environmental

1| https://www.unwater.org/app/uploads/2020/08/UN-Water-Analytical-Brief-on-Unconventional-Water-Resources.pdf



impacts associated with desalination processes (marine environmental pollution caused by brine wastewater, which may increase sea salinity and temperature, together with high Co2 emissions generated as a result of energy consumption by desalination utilities); and third, due to economic reasons (desalinating sea water is still unaffordable for many developing countries).

A clear change towards a more supportive use of unconventional resources as a means to tackle water scarcity is now starting to be perceived in some of the latest official reports released by various UN Programs and Agencies.

Environmental impact assessments of desalination production processes call for more advanced technologies to avoid or minimize negative wastewater impacts (including the possibility of recovering minerals from brine) together with renewable energy supply systems and new technological advancements (energy recovery systems based on pressure-exchangers or higher efficiency reverse osmosis membranes) which will decrease the energy required for desalination and will cut Co2 emissions generated in the process. As stated by the United Nations Environmental Program – UNEP- in 2021, *"seawater desalination can extend water supplies beyond what is available from the hydrological cycle, but innovation in brine management and disposal is required"* [2]

The aforementioned report, "Unconventional water resources", states that desalinated water provides *"a climate-independent and steady supply of high-quality water"* explaining how the current *"steady downward trend of desalination costs coupled with increasing costs of conventional water treatment and water reuse driven by more stringent regulatory requirements are expected to accelerate the current trend of reliance on the ocean as an attractive and competitive water source. These trends are likely to continue and to further establish seawater desalination as a reliable drought-proof alternative*

2| https://www.unep.org/news-and-stories/story/five-things-know-about-desalination

for coastal communities worldwide in the next 15 years". This argument has been incorporated into the "UN World Water Development report 2021: Valuing water[3]" where, in addition, desalination is presented as *"one of the technological options that can provide an additional source of freshwater for irrigation, especially in water-stressed coastal areas"*, underlying how thanks to decreasing costs, *"the supply of desalinated water for agriculture is most likely to be cost-effective in a tightly controlled environment, using agricultural practices with the most efficient water use, crops with high productivity, and renewable energies".*

In 2019, the World Bank had already made clear that water supply management options, including desalination production, could help to alleviate scarcity, developing a comprehensive guideline for policy makers to assess the feasibility of desalination-based solutions to achieve water security[4].

Next year, the UN General Assembly will host the UN 2023 Water Conference in New York, a key multilateral gathering to boost the international water agenda and to provide clear political guidelines on how to advance SDG 6 implementation. It will also be an opportunity to bring

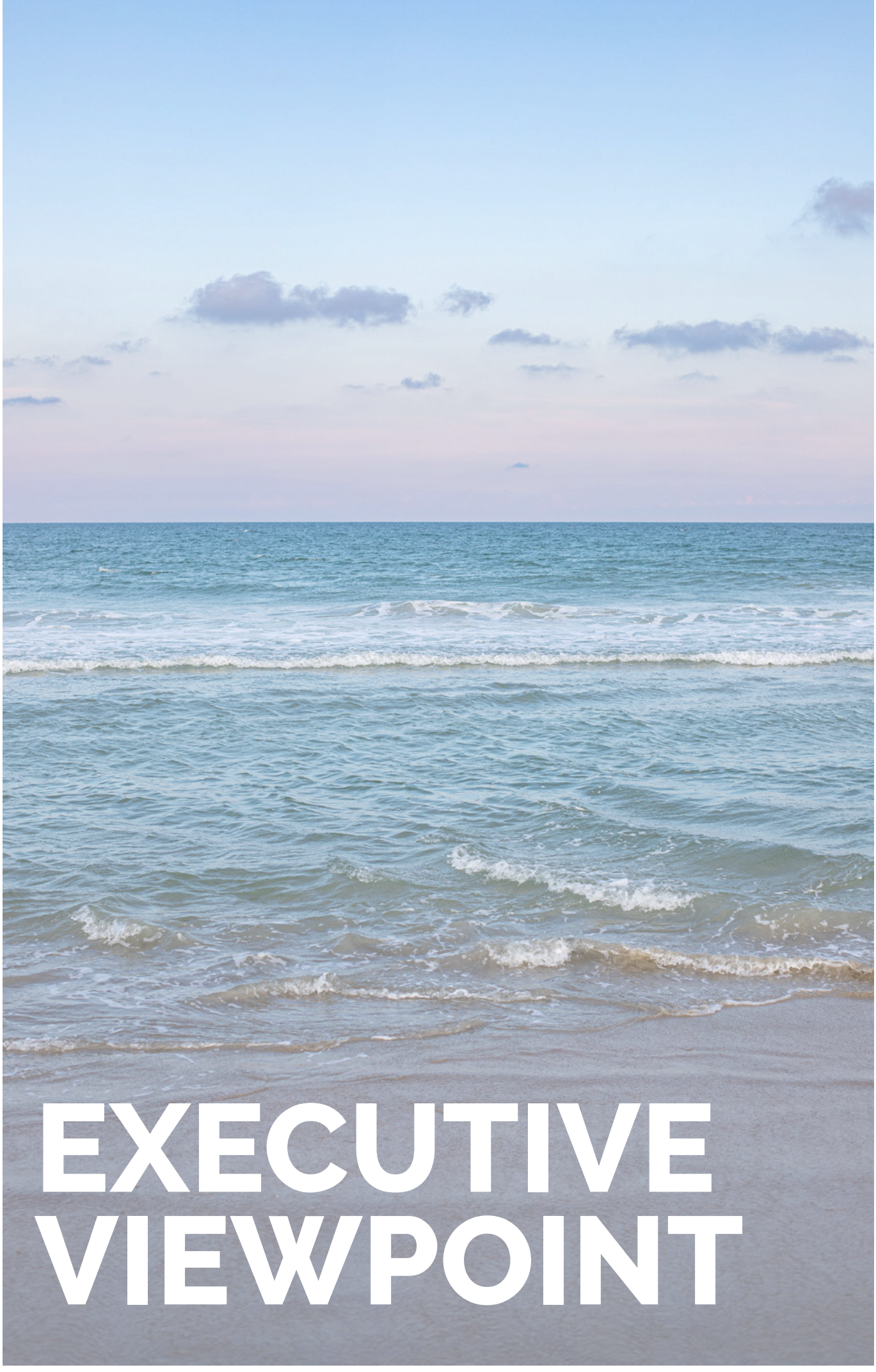
3| https://unesdoc.unesco.org/ark:/48223/pf0000375724
4| https://idadesal.org/wp-content/uploads/2019/04/World-Bank-Report-2019.pdf

into the official UN language the recognition and acknowledgment of the key role desalination can play to fight water scarcity and to deliver a mandate to mobilize public and private funds towards a technology that is currently more affordable, more environmentally sustainable and more needed to ensure water security in a world that is thirstier than ever for solutions to water scarcity.

About the Authors

Mr. Eduardo Orteu: Senior Official in the Spanish Civil Service since 1999. Graduate in law of the Complutense University of Madrid, master on European Union Policies from the Maastricht European Institute of Public Administration and university studies on financing development at the New York Public University (2011). He graduates on National Security Policy in 2016 at the Madrid High Studies Center for National Defense. Legal and policy advisor on sustainable development public policies and water public policies with 20 years of experience. Based in New York from 2008 to 2012 as Counsellor for Sustainable Development at the Mission of Spain to the United Nations, he joined the Spanish Water Directorate in September 2012 as Head of Support Unit, serving as policy advisor on water management at the international, European and national level.

Mr. Carlos Vázquez is head of Public Law and Regulatory at Gómez-Acebo & Pombo. He specialises in administrative law, specifically, energy, infrastructure, procurement and concessions, water, environment and tax law. He holds a Law Degree from the Complutense University of Madrid. He belongs to the Senior Corp of State Tax Inspectors and to the Senior Corp of State Insurance. He was an adjunct Inspector of the National Inspection Office (Oficina Nacional de Inspección), in Barcelona and Inspector coordinator of financial companies in Madrid. He also served as Technical General Secretary of the Ministry of Environment. Carlos is recognised in various prestigious legal directories - including Chambers & Partners and Legal 500- as a leading legal professional in Energy & Natural Resources, Environment, Public Law and Projects and Energy.



EXECUTIVE VIEWPOINT

FLOATING DESALINATION PLANTS: A NEW LEVEL OF FLEXIBILITY FOR WORLD WATER SUPPLY

By Mr. Fady Juez, Managing Director, Metito

The Growing Gap Between Water Supply and Demand

The global population has tripled from 2.5 billion in 1950 to over 7.9 billion in 2021. The United Nations (UN) predicts that this figure will continue to rise to an estimated peak of 11 billion in 2,100[1]. With industrialization, climate change, and urbanization, water needs are rapidly growing and the need for more sustainable adaptive solutions is at an all-time high.

An evolving circular economy means that lack of access to clean, safe water, and sanitation in any region has implications on the global ecosystem and its impact is far-reaching, beyond borders. Whilst water covers 70% of our planet, only 3% of it is fresh, and whilst 7% of the world's population calls the MENA region home, the region only hosts 1% of the world's freshwater resources. This showcases why water security is particularly salient, and a matter of national security, in arid regions such as the MENA region.

Moreover, MENA has seen the fastest growing urban population in the world over the past 50 years, with the Gulf now being one of the most highly urbanized parts of the world[2]. This rapid development, combined with the impact of climate change and the region's dry environment, has critical implications for water demand and necessitates critical prioritization of the water agenda among national priorities and leadership visions.

A New Take on Desalination

To sustainably tackle water shortages and ensure water security at the national level, governments in the MENA region, which hosts vast coastal areas, have been investing in desalination facilities since

1| https://www.un.org/en/desa/population-growth-opportunity-action-sdgs-climate-un-desa-report-says
2| https://www.pwc.com/m1/en/publications/megatrends/pdf/megatrends-in-me-rapid-urbanisation.pdf

the 70s. However, this go-to, tried, tested, and trusted solution remains to be capital, energy, and land-intensive and requires significant civil and infrastructural work to reach farther locations from the plant site.

Today, there are more than 20,000 desalination plants around the world[3] and in the Kingdom of Saudi Arabia exists the world's largest user of desalinated water, the Saline Water Conversion Corporation (SWCC). Metito is attuned to such growing demand and with innovation and pioneering new solutions at the heart of what we do, we have been studying a mobile concept for Sea Water Reverse Osmosis (SWRO) desalination plants for some time. A solution that can provide the same benefits as on-shore desalination plants but can offer economies of scale and secure more competitive Capital Expenditure (CAPEX) and Operating Expenditure (OPEX), increased flexibility, and the advantage of mobility.

Drawing upon our sixty-plus years of experience, renowned high-value engineering, and Metito's institutionalized access to global technical and financial resources, we successfully delivered the world's largest floating desalination barges for the Kingdom of Saudi Arabia. This is the first of three barges with a total capacity of 150,000m3/d, to be located 4km off the coastline of the Red Sea city of Shuqaiq, with SWCC being the end user for this flagship project.

The project enables SWCC to meet the Saudi Vision 2030 commitment to providing a 24/7 water supply efficiently and cost-effectively. It aims to contribute sustainably to the supply of high-quality potable water in compliance with all applicable international and local codes and standards and using the most advanced treatment technology, Integrated Ultra Filtration. It also protects householders from extended water outages during peak demand or as supply constraints loom.

> This innovative solution allows governments to meet surging water demand due to pressing environmental challenges, and local requirements in regions where economic growth is rapid and/or where demand varies significantly with seasons.

Innovation, Sustainability, Impact

While desalination facilities are usually built onshore, floating desalination barges provide the same benefits but stand several advantages. The cost of transferring seawater to the plant offshore (feed-water

3| https://www.esi-africa.com/industry-sectors/water/water-security-from-desalination-a-story-of-technology-innovation/

intake) and the price of the area holding the plant are significantly lower while there is the added advantage of having them easily moved (towed) to other locations – as needed. Floating barges also carry lower environmental footprints with waste liquid being further diluted onsite using existing seawater, thus offering additional protection to marine life.

Furthermore, the high degree of the modularized design and delivery based on the pre-assembled plant modules minimizes the workforce required at the shipyard. It also reduces the installation and commissioning time leading to commercial operation. Due to the plant being mobile, the floating barges don't face typical marine and soil project risks usually resulting from brownfield activities.

This innovative solution allows governments to meet surging water demand due to pressing environmental challenges, and local requirements in regions where economic growth is rapid and/or where demand varies significantly with seasons. Ultimately, water can be deployed to any location on the coastline when needed and backup supplies for contingency planning and emergency salutations secured in a timely manner.

Integrating the barge desalination units with power generators results in quick mobilization, expedited construction timelines, fewer marine works, and reduced adverse impacts of climate change. Metito's floating desalination barges are equipped with in-house power generation facilities that produce power of up to 21 Mega Watts (MW) with full redundancy facilities. Additionally, each barge is designed meticulously with a complete marine system to ensure that it can last for project duration without dry-docking and to maintain safe operations.

> The impact of securing safe water supplies is immense in an evolving circular economy and its imperative that we continue investing in research and development of sustainable, flexible, and eco-friendly solutions to support this within our ecosystems and beyond.

This flagship project was developed on a fast-track basis covering the design, engineering, construction, operation trials, and the provision of floating barges to sail the desalination plants – complete with the power generation system – to their current location in the Kingdom.

Future Outlook

The impact of securing safe water supplies is immense in an evolving circular economy and its imperative that we continue investing in research and development of sustainable, flexible, and eco-friendly solutions to support this within our ecosystems and beyond. Metito believes that the concept of offshore mobile desalination has a significant future as the need to timely secure varying water supplies is a growing trend, while governments experience immense pressure to prioritize their water agendas. Especially for remote areas, where scarcity of power and water co-exist, mobile desalination may become the most viable solution, particularly now that it has been tried, tested on a large scale, and the first project successfully commissioned.

About the Author

With over 37 years of experience in the global water sector and specific long-term success in the Asia markets, **Mr. Fady Juez** has successfully established high-level contacts with leading governmental entities, international utility companies, consultants, and contractors, reflecting positively on Metito's business growth in the wider water sector.

Fady holds the positions of Metito Managing Director, High Commissioner Metito Indonesia, Director Thailand, and Director India. Fady's key contributions cover the engineering, technical, technology, and expansion programs, the promotion and development of the franchise portfolio, the public and private partnerships, and the management of joint projects with leading international organizations.

He is an active IDA Board member and an avid speaker in public forums, industry events, and a go-to media expert for all water-related subjects. Fady has been promoting water desalination, recycling, and reuse on international platforms for many years.

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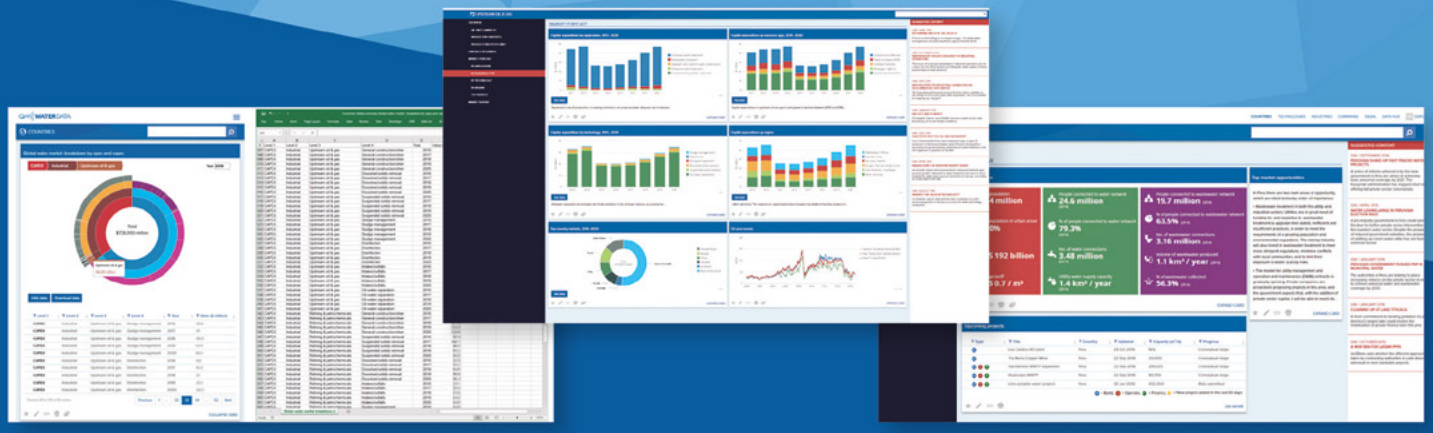

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EXECUTIVE VIEWPOINT

DESALINATION BRINE MINING CHALLENGE

By Mr. Pedro Almagro, General Manager, Lantania Desalination

The shortage of water supplies for drinking and irrigation purposes has intensified the use of non-conventional technologies like seawater (SW) and brackish water (BW) desalination.

Today, reverse osmosis (RO) is the leading technology for new desalination installations, with a 77% share in world desalting production capacity and an 88% share in over 20,000 desalination plants installed worldwide, and this technology continues to grow. In fact, in recent years, numerous large-scale desalination projects (over 250 MLD) have been launched despite the COVID-19 impediment. The Middle East has become the leader in mega seawater desalination plants. The trend in North Africa is similar, considering water shortage in countries like Algeria, Morocco, Libya, and Egypt.

And at this point arises a two customary questions which have always worried scientists: what should be done with the brine rejection? How can we manage it?

Brine disposal is generally deeply evaluated in the preliminary studies of each project, by developing environmental impact assessment (EIA) studies to determine the best location for the discharge to minimize any significant impact on the receiving environment. Currently, there are no worldwide standards that specifically apply to seawater-generated brines, and sometimes the Tenders set the discharge thresholds, for each specific project, regarding parameters like salinity, turbidity, temperature, and some dissolved chemicals.

> Nevertheless, the most promising alternative is brine mining, which consists in internal valorisation (brine reuse in the desalination plant), and/or external valorisation (brine conditioning for other industries).

So far, the most common practice for brine disposal consists in assuring a good dispersion of the residual brines using several diffusers in the outfall. Nevertheless, taking into account the substantial number of desalination plants installed worldwide and their increased capacity, experts, researchers, technological platforms, and companies with a large track record in the

field of desalination are looking for viable alternatives to make desalination more sustainable, while taking advantage of the economic potential of the generates brines/ valuable products contained in this brine effluent. In this sense, the IDA, SWCC and DTRI are making notable efforts to explore desalination brine mining opportunities.

The common concepts considered for brine management cases are focussed on 1) limiting or avoiding brine discharge by introducing substantial changes in the process with the aim to reach zero liquid discharge (ZLD) or near ZLD and on 2) brine mining or brine valorisation.

The first approach, usually based on thermal processes to reach ZLD, generally requires high investment. This way would make sense for effluents from brackish water desalination plants but could not be applied, especially in the near future for seawater desalination, mainly because of the techno-economical barrier.

Nevertheless, the most promising alternative is brine mining, which consists in internal valorisation (brine reuse in the desalination plant), and/or external valorisation (brine conditioning for other industries).

Considering the physicochemical properties of the generated brines, this concentrate can be used for direct or indirect recovery of valuable byproducts. Various types of salts and especially magnesium and bromine could be recovered in a selective way. Many approaches are aligned with this route by trying to reduce the volume of the Reverse Osmosis (RO) concentrate by implementing hybrid membrane configurations and/or high recovery RO and to improve the quality of the water produced using minerals from the generated brine.

Recent strategic lines for brine management are focused on brine conditioning for other industries and especially for the chloralkali industry. In terms of energy, producing the brine for the chloralkali industry, starting

from a RO concentrate, requires less energy to concentrate NaCl than starting from seawater. However, the presence of high content of divalent ions in the RO brine requests investment in capex and opex, which are not economically attractive, considering the low price of the sodium chloride.

When it comes to brines from inland desalination plants, the salinity is a serious and significant environmental problem and the legislation is more stringent with these saline effluents. Disposal costs for inland desalination plants are even higher than those for plants discharging brine into the sea. Some of the options for brine disposal from inland desalination plants are deep well injection, evaporation ponds, discharge into surface water bodies, disposal to municipal sewers, concentration into solid salts and irrigation of plants tolerant to high salinity.

Recent strategic business lines for brine management focus on the accomplishment of the ZLD concept and the recovery of valuable byproducts through the combination of different technologies (i.e. hybrid systems), while trying to make the desalination process environmentally more sustainable. One of the biggest challenges is to develop innovative brine management alternatives combining low energy consumption and competitive extraction of minerals from high saline effluents.

About the Author

Mr. Pedro Almagro has over 20 years' experience in the water business and nowadays is General Manager in Lantania Desalination.

Pedro has been Abengoa Agua's CEO over the past 5 years. In this period, he leaded the award and execution of some of the world's largest desalination plants, doubling the desalination contracted capacity of the company.

Industrial Technical Engineer by profession, he started in the water sector in 1998 as a proposal engineer developing his career lately in different positions as International Proposal Department Manager, China´s Country Manager and USA General Director.

lantania

EXECUTIVE VIEWPOINT

THE SOLUTION FOR WATER SCARCITY AND LESS PHARMACEUTICALS IN OUR WORLD'S RIVERS

By Mr. Erik Roesink, Founder and CTO, NX Filtration

Climate change is causing more extreme weather situations, such as strong local rainfalls or longer periods of droughts. In many places in the world the availability of groundwater is getting more and more restricted. Even in a country like the Netherlands, where water is traditionally abundant, water utility companies are struggling to supply to new industries and for a growing population.

> It is paramount to realize on a global scale 80% of all the wastewater, including pharmaceutical residues, is discharged in the environment without being treated at all. And the effluent of the 20% that is treated, typically biologically, still contains alarming amounts of pharmaceutical drugs and resistant bacteria.

Locally available alternative water sources for groundwater are surface water or biologically treated effluent from wastewater utilities. However, these sources contain significantly higher concentrations of contaminants and necessitate intensive treatment to meet industrial or potable water qualifications. This gives rise to a need for technologies that address these issues in a robust, energy friendly manner with a low environmental footprint.

Recently, the World Economic Forum pointed out (http://ow.ly/P1wa50HXFL4) that pharmaceutical drugs are present on dangerous levels in almost all world's rivers, posing a threat to the environment and human health. One should realise that the origin of these drugs in these rivers is primarily from normal use by humans, and secretion of human waste through municipal sewage systems. The highest

concern of the World Health Organisation is the threat of antimicrobial resistance, which is expected to cause 10 million of deaths annually by 2050 (https://healthpolicy-watch.news/no-time-to-wait-amr-could-cause-10-million-deaths-annually-by-2050-warns-un-report/). Still, the unwanted consumption of pharmaceuticals will further increase due to population growth and economic development. In that light, it is paramount to realize on a global scale 80% of all the wastewater, including pharmaceutical residues, is discharged in the environment without being treated at all. And the effluent of the 20% that is treated, typically biologically, still contains alarming amounts of pharmaceutical drugs and resistant bacteria.

If we limit ourselves to Europe, we see that politics are focussing strongly on preventing micropollutants at the source and less on removing them from biologically cleaned effluent. Though I am fully supporting the prevention approach, we must also realize that this route will not avoid the predicted effects by WHO, as e.g., the enormous number of deaths caused by AMR in 2050. Only in the Netherlands more than 200 tons of residual medicines are disposed in surface waters through municipal wastewater effluent, and since this number is based on officially registered sales of medicines, the realistic total number is probably much higher, as leaching by diffuse sources and animal medicines and illegal drugs have not been considered. Elimination and prevention, though important, will not be the complete solution and take too much time, so removal technologies need to be implemented as well.

> Good news is that efficient technology to mitigate these additional challenging pollutants is available, as the newest generation of membrane technology can remove all these challenging components producing a direct re-usable permeate quality.

In most European countries, there is no legislation that regulates disposing pharmaceuticals, or broader, chemicals of emerging concern (CEC), or organic micropollutants (OMPs). Today, the only country with legislation in place on regulating CEC is in Switzerland. As a result of this legislation many wastewater treatment plants in Switzerland are (being) upgraded using either oxidation (O3), and/or adsorption (activated carbon) to remove (partly) OMPs. Though we do see less disposal of OMPs, the resulting product is not ready for re-use, since AMR, viruses, bacteria, nano and microplastics, PFAS, and still OMPs are present in the effluent.

Good news is that efficient technology to mitigate these additional challenging

pollutants is available, as the newest generation of membrane technology can remove all these challenging components producing a direct re-usable permeate quality. Hollow fiber nanofiltration membranes as a direct treatment or in combination with advanced oxidation processes (AOPs) have tremendous potential due to their (combined) extreme low energy and chemical consumption.

Legislation could be an enormous opportunity and inspiration to stimulate the water boards to speed up the improvement of their wastewater treatment plants across Europe, e.g., by implementing the newest generation of membrane technology to avoid disposing almost all earlier mentioned treating components. Next to the environmental and health benefits another very important advantage is that the treated effluent is then ready for high quality re-use applications, and do not pollute the surface, anymore. Of course, re-use is not a new concept. It is already effectively done in California, Singapore and many other places around of the world. But in Europe only 2% of the municipal effluent is re-used, leaving this an enormous potential water source unused today. When realizing that in many places in Europe further economic growth is already struggling with the availability of water, we should also realize that water reuse is also important to unleash this economic potential, which is still not always on the political agenda.

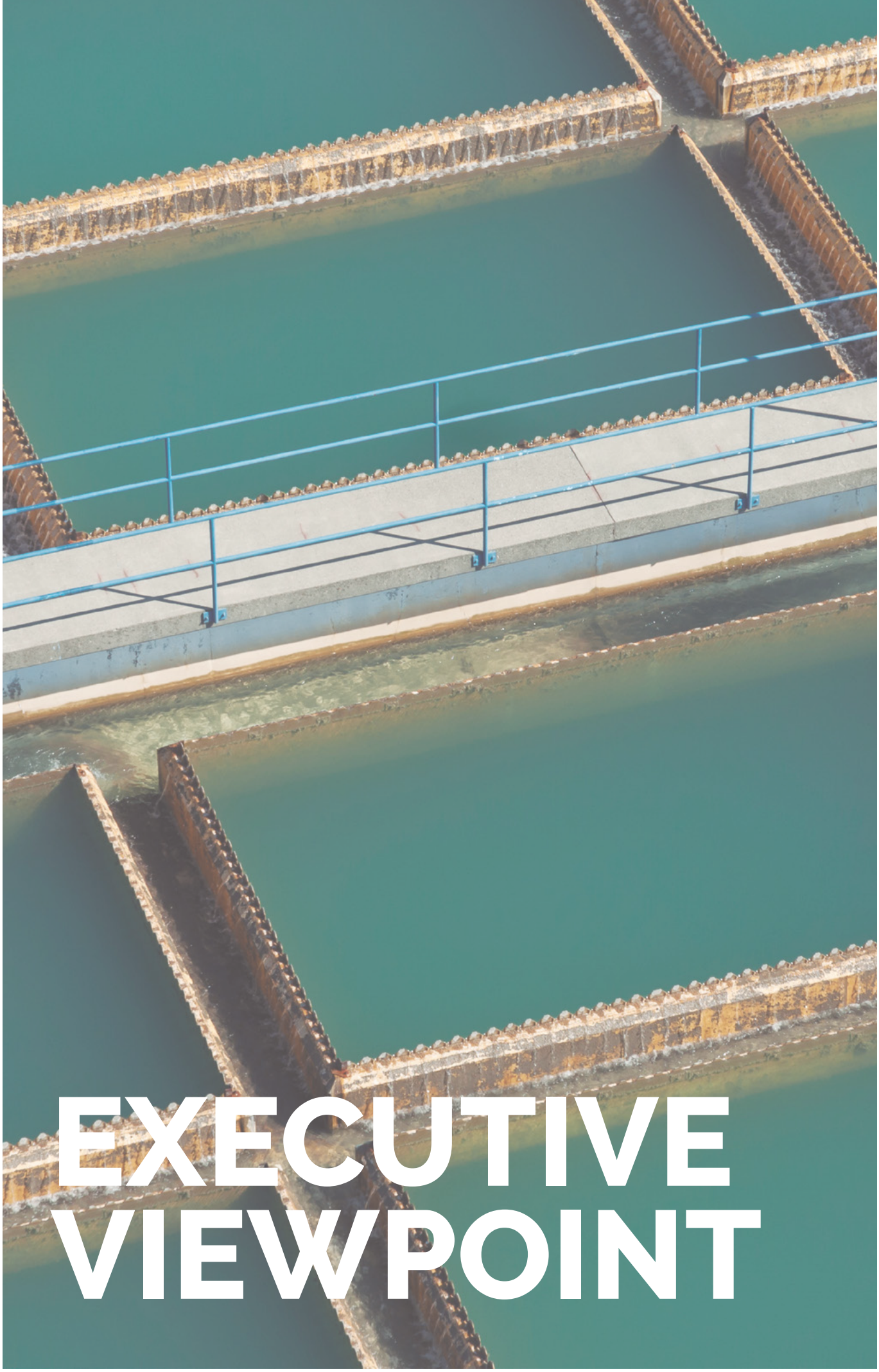
Currently, we are investing billions of dollars in the energy transition to speed-up the transition from fossil to more sustainable energy sources to cope with the challenges of climate change caused by the strong increase in temperature rise. However, the attention for and the importance of the water transition is neglected completely in this perspective. As for energy we have several alternatives, however there is no alternative for water! If we do not start investing in wastewater reuse regulation changes and technology to make surface water safe, all the efforts in energy transition will be wasted, because water shortages will limit economic development and signifyingly effect the health of our population.

We are entering in the so-called "water transition", as we are in a "water crisis" already, meaning that the use of groundwater as the sole source for high quality water is behind us. We must focus on the efficient and safe use of surface water and the re-use of biologically treated effluent as sources for high quality water. The full-scale application of new technologies such as the new generations of membrane filtration, cannot wait until politics has agreed on legislation. We need to act now for the best water quality and sufficient quantity of water!

About the Author

Mr. Erik Roesink started his membrane career already in the seventies at the University of Twente, where he did his PhD in the late eighties. This work on development of hydrophilic hollow ultrafiltration membranes, formed the basis of X-Flow, of which Erik was one of the co-founders. In 2013 Erik was then appointed as a part-time professor membrane technology of the University of Twente. During that time, he started to work on the development of new generation hollow fiber nanofiltration membranes. These nanofiltration membranes are highly selective for low molecular weight organics, so-called micropollutants, but allow certain minerals to pass, so high operation pressures and also remineralization are avoided. Due to the tubular nature of these nanofiltration membranes the hydrodynamics are very well controlled resulting in a simpler process set-up and a lower energy consumption compared to conventional membrane technology. Due to the strong low fouling character and the tubular geometry low chemical consumption during operation is required. Based on this technology he founded NX Filtration in 2016.

nx filtration



EXECUTIVE VIEWPOINT

WIDENING THE FIELD OF WATER REUSE POSSIBILITIES WITH THE BARREL AND ITS SMART CONNECTORS

By Mr. Johny Obeid, Vice President of Veolia Water Technologies in the Middle East subsidiary of Veolia Environment

VWT: innovations provider

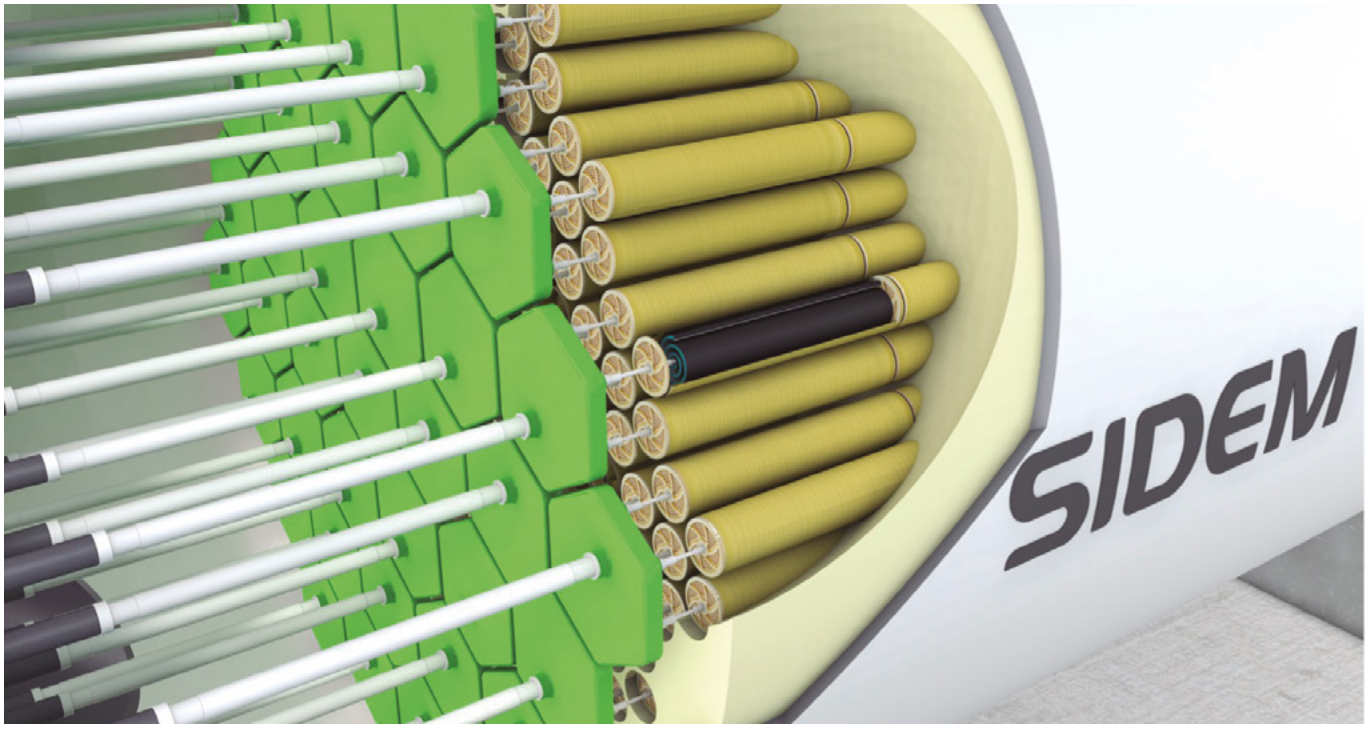
With more than 1,500 patented technologies, 4 research centers and 800 innovation experts and researchers, Veolia water technologies is constantly seeking to meet the challenges of our planet. And not a day goes by without these multiplying, growing and getting worse. The latest issue of IDA magazine mentioned the subjects of water stress and access to water as factors of economic and social peace, subjects to which we can also add new micropollutants which can, in certain places, complicate the whole water treatment process lines.

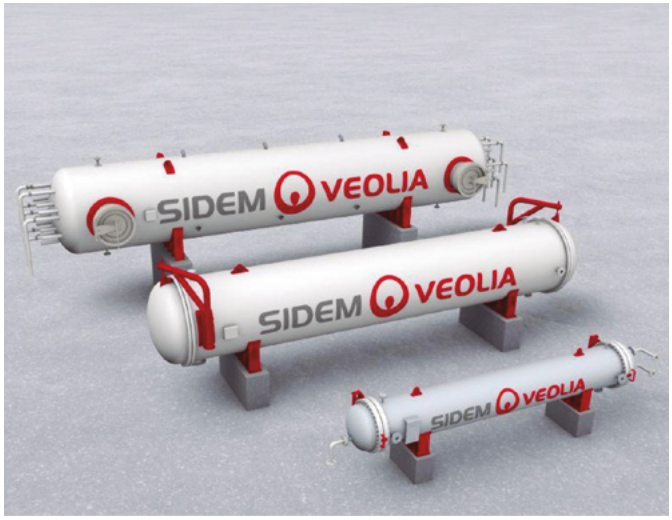
In 2019, while new reports on water stress were published, SIDEM presented the BARREL at IDA world congress as a major innovation for seawater desalination. At that time, the focus was made on desalination but we soon realized our technology could perfectly respond to the challenges of water Reuse. The BARREL indeed has all the assets to be a benchmark for water recycling projects.

BARREL's principle

The BARRELTM is a reverse osmosis (RO) or nano filtration (NF) multi-element vessel that allows the membrane process implementation to be strictly identical to that of current pressure vessels. It therefore ensures fresh water is produced in compliance with treated water quality standards.

The BARRELTM is made of painted carbon steel. It is a large pressure vessel designed to withstand the pressure required by the process. The shell is a regular ASME vessel





while the inside is coated with high-grade epoxy paint (food grade compliant paint can be used according to the project's specifications).

An internal, resin-made honeycomb structure houses the membranes. The membranes can be any type of conventional 8-inch spiral wound membranes. They are easily inserted via dedicated maintenance manholes at both ends of the shell.

Removable manifolds are used to collect the permeate for each group of 7 tubes, which replace the usual manifolds installed on conventional solutions. The same simplifying approach stands on feed and brine collection where the vessel replaces the usual manifolds.

Low pressure permeate is collected outside the shell and sent to the next step of the process. The risk of high pressure leakage is greatly reduced as no more high pressure coupling is used. It makes the BARREL a lot safer compared to conventional arrangement.

Thanks to its modular design, the BARRELTM is available in different capacities ranging from 400 m3/day for the smallest model to 50,000 m3/day in its largest configuration.
In the Low pressure version (suitable for low

pressure reverse osmosis and nanofiltration) the BARREL can enclose up to three stages to reach very high recovery rates.

Smart Connectors: the "must-have" feature for water recycle projects

In order to have a permanent vision of the permeate quality production, as well as the condition of each membrane, smart connectors are installed within the permeate tube, next to standard interconnectors, while loading the membranes.

These passive devices can communicate with antennas molded in the resin structure and provide the monitoring system with local conductivity and temperature of the produced permeate, creating a full mapping of the BARREL™'s permeate network.

Thanks to these revolutionary devices, the performance of each membrane is monitored and recommendations regarding optimum operation modes can be made, bringing value to clients over the complete lifetime of the plants.

The smart connector is a stand-alone product. It transforms the BARREL™ from a simple mechanical arrangement for

membranes into a digital process device providing transparency and security on the performance of each membrane element.

The Barrel and the recycle water projects

Several municipalities in Africa and South East of Asia have paved the way for municipal reuse and have demonstrated, over the past few years, the benefits of that application. A step ahead would be now to have a technology capable of being easily installed at site, compact, safe and capable of reassuring the operator and consumers about the quality of what will be delivered to them. That is exactly what the BARREL is.

Using the municipal wastewater as a new water source to feed drinking water treatment plants can be, thanks to the BARREL, considered as the new "evidence".

About the Author

Mr. Johnny Obeid has been the Vice President of Veolia Water Technologies in the Middle East subsidiary of Veolia Environment since September 2000, responsible for business development.

Over the past 10 years, Mr. Obeid has managed some of the major projects in desalination (RO / Thermal) in the Middle East for Veolia and Sidem. Some of the major projects he was responsible for developing are Umm Al Quwain (UAE), Rabigh (KSA), Al Dur (Bahrain), SUR (Oman), Fujairah (UAE), Zour South (Kuwait), Sadara (KSA) and Shell (Qatar).

His objective is to contribute in promoting the role and image of the desalination business in the Gulf region where desalination is a crucial element for the development of the region.

Previously (from 1991 to 2000), Johnny worked with Philip Holzman International as area developer for the Indian West Indies.

He has been a Director of the International Desalination Association since October 2013.

He obtained his BE in Civil Engineering (1982-1988) from the American University in Beirut, and an Executive Masters in Business Administration (2006) from INSEAD business school.

VEOLIA
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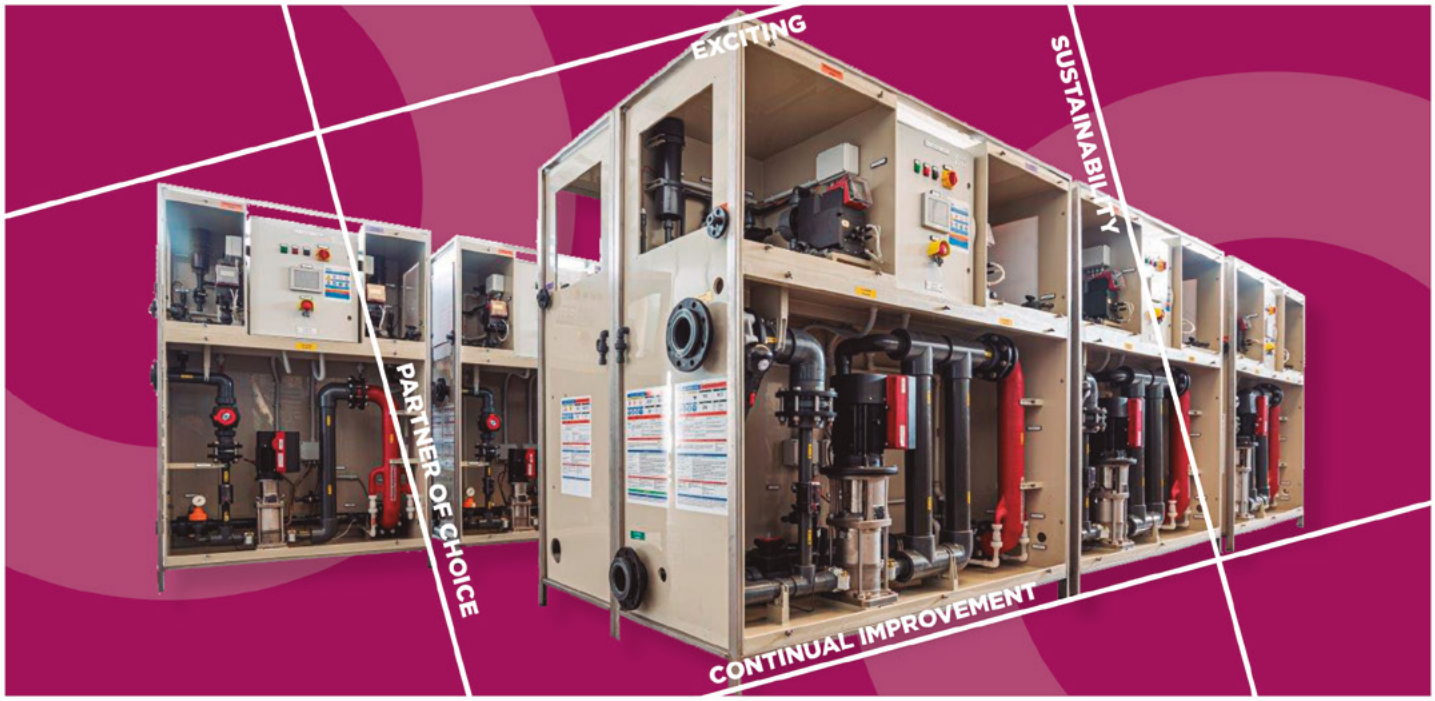

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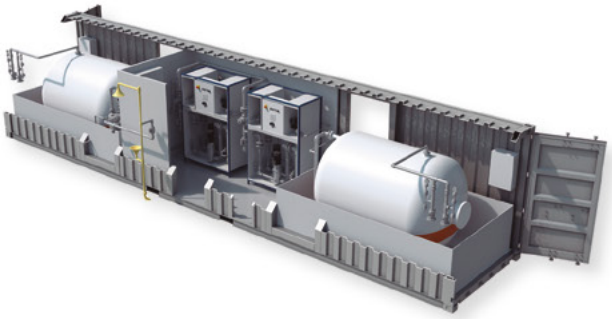

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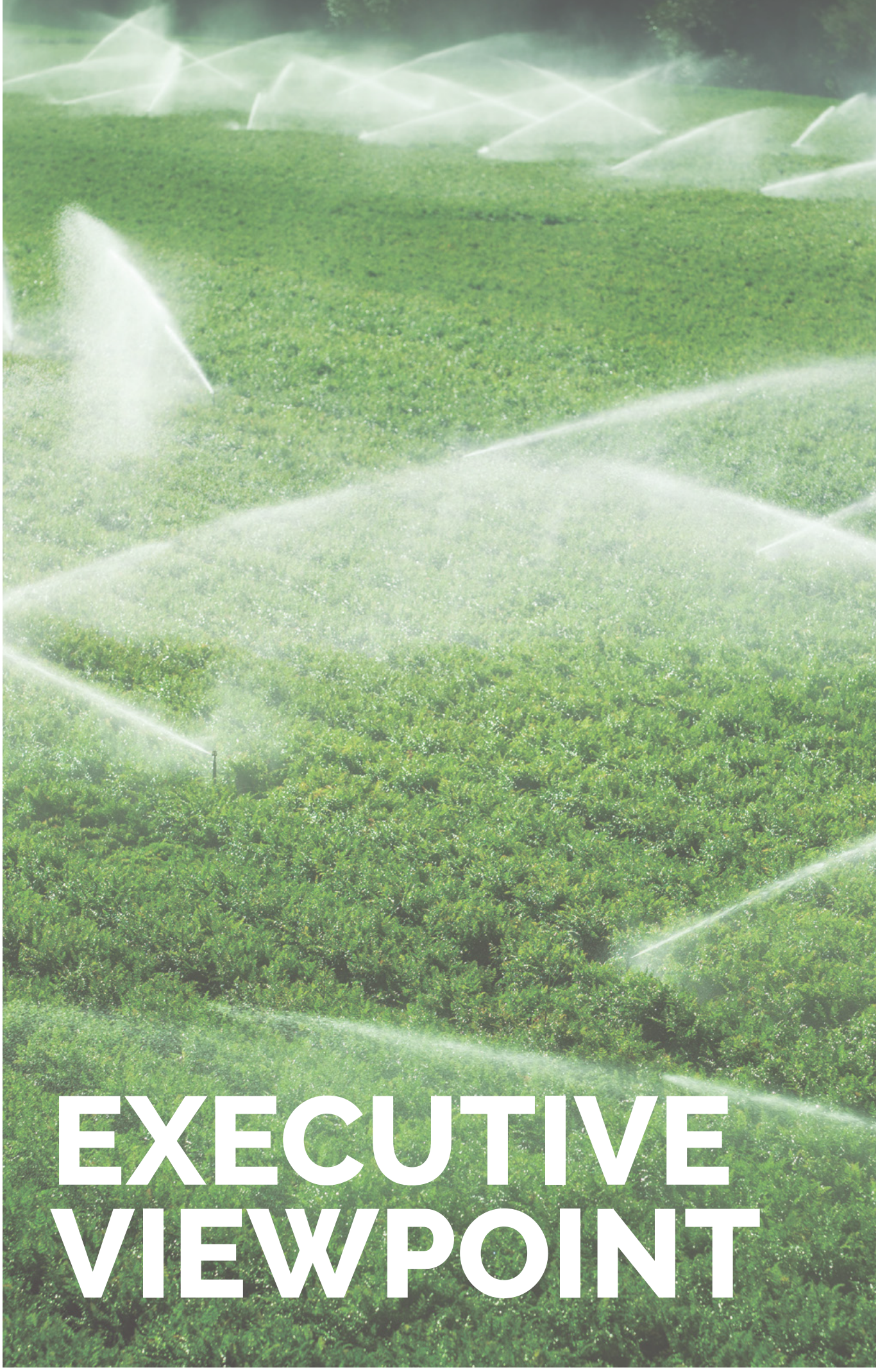


EXECUTIVE VIEWPOINT

DESALINATION AND REUSE DRIVING THE FUTURE OF DECENTRALIZED DESERT FARMING

By Mr. Frederic Dugré, President & CEO, H2O Innovation

The only way we can feed 10 billion people by 2050 is to reimagine how we use water. As the world focuses on drastic measures to slow down global warming, like at the recent COP26, there is an emerging challenge between water, energy, and agriculture that has not been addressed yet. The growing scarcity of fresh water is forcing us to look at non-conventional water resources for agriculture. Underlying this concept is the challenge of how to make farming and food industries more sustainable.

The interdependence between water, energy, and food security is a nexus that concerns many, including the Food and Agriculture Organization (FAO) of the United Nations. Water security, energy security, and food security are very much linked to one another, as actions in any one area will have consequences on other areas.

Energy and water are intricately connected in agriculture. Food production and supply chain consumes about 30% of total energy consumed globally, and agriculture accounts for approximately 70% of global freshwater withdrawals. According to the FAO, roughly one third of the globe's land surface suitable for crop production is currently being used for that purpose. There is a widespread perception that there is no more, or very little, new land to bring under cultivation. The world must find ways to improve water and energy usage and create pathways to more sustainable farming.

One concept that has been considered is the idea of terraforming deserts, transforming them to support life. While terraforming the Sahara Desert could potentially increase CO2 absorption thereby reducing greenhouse gasses, the sheer cost and scope of a project like that, as well as the potential environmental domino effects, are too great to make it feasible. Instead,

we should spread our greening out through decentralized agriculture.

Transportation is the largest contributor toward global warming, by some accounts producing up to 20% of global greenhouse gas emissions every year. Indoor-farm-grown products have a smaller environmental footprint because of the elimination of pesticides, reduction in water use, and decrease in transportation. Non-conventional sources of water, like desalination and water reuse, play a fundamental role in the expansion of decentralized agriculture.

While most farming in Canada is accomplished without the use of irrigation, 80 % of the irrigation takes place in arid or semi-arid regions like Alberta or Saskatchewan. Better management of water resources in Alberta focuses on four drivers, including pipelines, balancing reservoirs, automation, and measurement. Implementing water reuse for agricultural irrigation would further improve Canada's contribution to the United Nations sustainable development goals, especially SDG6.

Using unconventional resources like desalination and reuse water for agricultural irrigation must be considered as a part of the solution. The competitive cost of desalination for irrigation of agricultural crops has resulted in increasing adoption of this technology. For water reuse applications, the ability to facilitate decentralized agriculture supply and municipal reuse would further improve the economics, making it much more competitive.

> In some countries, Spain in particular, the cost of using reclaimed water can be recovered up to seven times in favorable crops. The case can be made that the benefit of using reclaimed water for irrigation lies equally in the positive environmental impact as well as the profitability as an investment.

Membrane technology, specifically reverse osmosis (RO), has proven to be an effective way to treat both seawater and wastewater. Application in agricultural irrigation is not without its challenges, including cost of production and quality of the treated water. It has been shown that the cost of producing irrigation water from wastewater, seawater, or brackish wells is competitive for many fruits and vegetables such as tomatoes, cherries, lemons, and oranges. In the case of crops which require more water to produce and carry a lower market value, such as rice, cotton, or almonds, there is no cost benefit of using reclaimed water for irrigation. In

some countries, Spain in particular, the cost of using reclaimed water can be recovered up to seven times in favorable crops. The case can be made that the benefit of using reclaimed water for irrigation lies equally in the positive environmental impact as well as the profitability as an investment.

The second obstacle is that the quality of water being produced needs to be managed appropriately. Water quality requirements for agricultural use depends on the type of crop being grown. Treated wastewater and desalinated water, with the appropriate pre- and post-treatment technologies can produce water that is suitable for use in agriculture. With continued research, seawater and wastewater desalination for agriculture may become less expensive, and more environmentally friendly.

Food demand is expected to increase anywhere between 58% to 98% by 2050. The impact of water and energy cannot be overlooked. Farmers need to increase crop production in sustainable ways that make the best use of water and energy and reduce the environmental impact of transportation. Desalination and water reuse must play their part in improving food security.

About the Author

Mr. Frédéric Dugré graduated in 1996 from Laval University in Quebec City with a Bachelor in Mechanical Engineering. In 2000, he co-founded H2O Innovation with the goal of taking part in the consolidation of the water treatment industry. Mr. Dugré has more than 20 years of experience in the management, financing and business development of publicly traded companies. His expertise in financing and marketing of clean technologies and his passion for the water treatment industry were instrumental for H2O Innovation's growth. Among the different business recognitions that H2O Innovation received through the years including the award of Water Company of the Year in 2020 by the GWI, Mr. Dugré was named twice among the top 25 Water Leaders in 2017 and 2021 by the WaterWorld Magazine. During 5 years, M. Dugré has served as board member of the Canadian Sciences & Technologies Museum in Ottawa. Since 2016, he is supporting entrepreneurship and innovation through the crowd-funding platform the "Ruche Québec" as a Board of Director.

IDA favorite PAPERS

What is your personal favorite paper from the desalination literature? Here we have two very interesting discussions from respected and experienced members of our community. In each case, the discussion centers around lessons learned and how that can influence our future thinking. So, do we irrationally wait for rain with little acknowledgement of risk management, or do we use a sensible mix of traditional and innovative water supplies? Do we become complacent and not take the bold steps people were taking 30 years ago? Let us know your thought processes by volunteering your favorite paper from past IDA World Congresses, affiliate meetings, or the ever expanding journal literature.

Kevin Price

Eng. Kevin Price started his career in 1981 working on an Office of Water Research and Technology project studying ultrafiltration pretreatment for the 73 (originally 100) milliongallon per day reverse osmosis Yuma Desalting Plant in Arizona. He spent 30 years with the U.S. Bureau of Reclamation as a researcher, later managing water treatment engineering and research, and retiring as the coordinator of the Advanced Water Treatment Research Program. He has been a strong advocate for research and innovation including service on the boards of the IDA and AMTA, on the WateReuse Research Foundation's Research Advisory Committee, on NWRI's Research Advisory Board, on the steering committee for the WHO Guidance Document on Desalination for a Safe Water Supply, and working with European, Middle Eastern, North African, and Asian countries. He is currently the Senior S&T Advisor for the Middle East Desalination Research Center and sits on the Industry Advisory Council for the National Alliance for Water Innovation.

The Mayor of London's Challenge to the Beckton Desalination Plant

Author: Dr. Graeme K Pearce
IDA World Congress 2009 Dubai UAE 7-12 Nov 2009 Ref IDAWC/DB09-107

I am Australian. From 1997 – 2010 Australia suffered the "Millennium Drought" – the worst and longest since colonisation in 1778. From 2007 – 2013 Australian water utilities built six major seawater desalination plants in all mainland state capitals to ensure water security. While Western Australia continued to suffer a significantly drier climate (starting in 1970), the drought broke in 2011 in Eastern Australia. Some of the desalination plants were then mothballed or operated on "hot standby" at a fraction of their capacity. The politics surrounding decisions to construct seawater desalination facilities was intense. There were many vocal critics after it started raining who had the benefit of hindsight, but who also had little understanding of risk management.

I heard Graeme Pearce's presentation at the Dubai World Congress in 2009 and was deeply impressed by Graeme's clarity of thought on the controversy surrounding Beckton Desalination Plant in London. It was a great story. The essence of the controversy was a decision by Thames Water to build a brackish water desalination plant at the site of the Beckton Wastewater Treatment Plant on the River Thames. The clever design included pumping water from the Thames estuary to holding tanks for three hours before low tide to minimise feed water salinity.

The 140 MLD plant was first proposed in 2002. However, the then Mayor of London ("Red Ken" Livingstone) was an opponent of privatisation of English water utilities which occurred in 1989.

Greater London Council refused planning consent on the grounds that desalination was too expensive and energy intensive and Thames Water should have considered alternatives such as another dam and repairing the leakage in their distribution system (which amounted to some 25% of water supplied).

Thames Water appealed the decision to refuse planning permission and following an inquiry this was overturned in 2007. The desalination plant was constructed and commissioned by 2010 – in time for the London Olympics in 2012.

I found the paper immensely valuable as a frank and objective discussion of the merits of desalination in the face of emotive and sometimes irrational arguments that are used to oppose the technology. We certainly had plenty of emotion in Australia and as leader of the National Centre of Excellence in Desalination Australia from 2010 to 2017, I was in the thick of it.

Perhaps the most impressive outcome was in Melbourne which prides itself on being one of the world's most liveable cities. Periodic draconian water restrictions spoilt this image. The Victorian

Desalination Plant, at 450 MLD Australia's biggest, remained largely unused for 5 years following its commissioning in 2012 with a chorus complaining of the cost and its "white elephant" status. However, since 2017, it has operated at 80% capacity and water restrictions in Melbourne are a thing of the past.

A sensible mix of traditional climate dependent and innovative climate resilient water supplies provides a solution to water security. Graeme's paper was one of the first to articulate this clearly as he presented the case study of Thames Water and the Beckton Desalination Plant.

About the Nominator

Eng. Neil Palmer has degrees in civil and public health engineering. His career spans 45 years in the Australian water industry, 20 years in Government, 19 years in the private sector and 6 years in research leadership.

His experience as a professional engineer from 1975 – 2022 includes the South Australian Engineering and Water Supply Department, the Fiji Public Works Department, the South Australian EPA, United Utilities Australia, Osmoflo, the National Centre of Excellence in Desalination Australia and Tonkin Consulting.
Neil is an Honorary Life Member of the Australian Water Association, a member of the Institution of Engineers, Australia and a former Director of the International Desalination Association.

He was awarded the SA Premier's Water Medal in 2006 in recognition of his service to the SA Water industry, and was recognized in January 2015 and again in 2017 by Water and Wastewater International Magazine as one of the world's top 25 influential water leaders.

Neil's wide and varied experience in many facets of the SA, Australian and international water industry, both public and private, uniquely equip him as person to get things done. He is an acknowledged and respected source of vision and wisdom.

A Comparison of Two Membrane Types Operating Under Identical Conditions in Gulf Sea Water

Authors: A Linstrum, G C Mulholland, C Greenhalgh, (Weir Westgarth) and J Kallenberg (Ropur AG).

I started my career as a field technician in 1980 for Specific Equipment Co. in Houston. By 1983 I had joined MECO and moved to Abu Dhabi where I stayed for 10 years, initially supporting almost 250 MECO thermal and membrane installations in the region. By the time I left Abu Dhabi, I had been involved in selling, designing, project managing, constructing, commissioning, and operating some of the first SWRO units in the region using DuPont and Toray membranes. In 1993 I returned to the US working for MECO in a range of capacities from international sales, to working with the US Navy and developing and managing a marine product line. In 2001 I joined the Weir Group managing their sales and operations in the Americas. In 2005 Veolia acquired Weir's water treatment group and I became responsible for desalination and reuse in the Americas. In 2011 I joined Water Standard and in 2016 I started my own consulting business, Water Cycle.

In the early 1990's I was involved in selling, installing, commissioning and then operating the 1,325 m3/Day SWRO unit mentioned in this paper. The plant was to be temporary and removed after the LNG plant was built, -- about 14 months. MECO, as a DuPont Licensee (as was Weir Westgarth) selected DuPont's B10 Twin hollow fine fiber (HFF) permeators, one of the first B10 Twin installations for MECO and DuPont. It was also one of the first turbo charger installa-

tions. At that time there were no spiral wound seawater RO membranes that could meet the requirements of the project (<200 ppm Cl in the permeate) in a single pass. When we were awarded the project, we mobilized a test ROWPU (Reverse Osmosis Purification Unit) unit that had been developed for the US Military. The unit had 1,500 psi. pressure vessels, DuPont B10 HFF permeators, with media and cartridge filtration and a positive displacement pump. The unit was needed for construction of the LNG plant while we installed and commissioned the new SWRO unit. The ROWPU operated at 50% recovery with no chemical pre-treatment, and it made the quality and quantity of water required for over 2 months. The unit was installed in a remote part of the island and once a day somebody would go by to make sure it was operating and to backwash the media filter. I learned a lot from my MECO and DuPont colleagues, Jim Stewart, Kim Klein, George Gsell, Mark Powell, Scott O'Connor, Ali Ben Hamida, Fareed Salem, Irv Moch and Kamran Chida, and have many fond memories of the project. For the first year of operation the plant ran well and maintained the water quality, <200 ppm Cl, and didn't need to be shut down and cleaned. One of the many things we learned was that we could clean the HFF permeators online using the PTB pump. We would inject citric acid and watch as the reject would turn dark brown and when it started to clear up, we'd add PTB (tannic acid), at the right pH, and after about 15 minutes the system would be fully recovered.

Based on my experiences on Das Island, I had become an avid supporter of the HFF permeators and was disappointed when

DuPont withdrew their permeators from the market years later.

My initial reaction to the paper was that it had misleading points, such as operating the Dupont membranes at 35% recovery versus 50% recovery and that, wow, that plant was still operational! However, the paper has stuck with me over the years for multiple reasons.

First, I was envious that somebody else had taken over the plant. It didn't help that WESCO, Weir's service arm, took over the O&M contract I had helped MECO's Abu Dhabi agent secure. What it did demonstrate was that Weir had taken the opportunity to install a new membrane, much like MECO had done a few years before, with limited references, on a remote site on extremely challenging seawater with support from the membrane supplier using their membrane projection software. Over time, and after joining Weir, I came to realize that spiral wound membranes were the future. In my opinion, the spiral wound market quickly moved to a commodity market once the FilmTec '344 patent lawsuit issue was resolved. As soon as one of the spiral wound companies would increase the membrane surface area per 8" element, improve the salt rejection, or some other incremental change, the others would soon follow. This ultimately brought the overall cost of the membranes down, allowed for standardization, reduced the membrane cost of the system, and helped launch the mega plants we have now.

After all these years, it's finally dawned on me that we've become complacent and not taken the bold steps that people were willing to take those 30 years ago. With advent of higher-pressure membranes and pressure vessels, the focus needs to turn to higher system recoveries using spiral wound membranes. This needs to be facilitated by process engineers that are willing to take a leap of faith to maximize the membranes performance while staying within the membrane manufacturers membrane projection software. This should be closely supported by the membrane suppliers and allow us to move to higher recovery systems. Let's regain some of the momentum we lost those 30 years ago!

The original plant, or what was left of it, was finally removed after 25 years of operation.

About the Nominator

Mr. Paul Choules started his desalination and water treatment career over 40 years ago. Since then, he has worked in the areas of business development, permitting, start-up, commissioning, project management, and operating of reverse osmosis and thermal desalination plants around the world with industrial and municipal clients.

In 2016, Mr. Choules stared Water Cycle LLC offering consulting, advisory, representation and business development services. Since it's inception Paul has assisted in developing marketing plans for multiple startup companies, put together a team to supervise and manage the startup and commissioning of the only seawater desalination plant in Texas. Paul has also served as a technical expert on large scale desalination plants in the Middle East and the Caribbean.

Highlights of his career:

- Lived in Abu Dhabi for 10 years and was responsible for supporting over 250 desalination plants in the region.

- Managed offices regional offices in Saudi Arabia, Indonesia, Egypt, Brazil, and the US.

- Identified as one of desalination's expert "Desalters" by Global Water Intelligence in August 2011.

- Helped start the Caribbean Desalination Association "CaribDA" in 2008 and has been a board member since inception.

- Helped start the Texas Desalination Association 2013 and served as the President until 2019 and remains on the board of directors.

INNOVATION FOR CHEMICAL FREE DESALINATION

By Dr. Ahmed Al Amoudi, Dr. Byungsung Park, Dr. Seungwon Ihm, and Eng. Nikolay Voutchkov, Desalination Technology Research Institute (DTRI), Saline Water Conversion Corporation (SWCC)

Recent desalination industry shifts toward chemical-free desalination and recovery of valuable minerals and rare metals from concentrate are expected to transform desalination into one of the most environmentally sound and sustainable water supply alternatives of the 21-st century.

At present the desalination industry uses chemicals for: (1) intake bio-growth control; (2) coagulation and flocculation of source seawater; (2) prevention of membrane scale formation; (3) membrane cleaning; (4) and desalinated water post treatment. Latest two key industry trends aimed at reducing and ultimately eliminating chemicals used for production of desalinated water are: (1) treatment process optimization to reduce chemical demand and, (2) use of green chemicals – generation of chemicals from seawater and brine.

Intake Bio-growth Control

At present, most desalination plants worldwide use sodium hypochlorite for intermittent injection in the desalination plant intake area to suppress growth of shellfish along the source water conveyance pipelines. Majority of the desalination plants worldwide have adopted generation of sodium hypochlorite from seawater thereby eliminating the use of commercial chemical. Recent trend is the development and use of systems for generation of high-purity chlorine dioxide from brine for biogrowth control. Latest generation chlorine dioxide systems do not generate any oxidants harmful for the reverse osmosis membranes, thereby eliminating the use of sodium bisulfite for dichlorination. Since chlorine dioxide is generated from bine – the intake bio-growth control chemicals are green and their production is sustainable.

Coagulation and Flocculation

Ferric chloride is the most commonly used coagulant for pretreatment of seawater at present. Recently, the desalination industry has adopted an automated monitoring of seawater quality and automated adjustment of the coagulant dosage proportionally to the actual content of suspended solids in the

water. This operational strategy, has reduced the use of coagulant to less than one half of what it once was. For example, the Ras Al Khair desalination plant in Saudi Arabia had implemented an online system which automatically adjusts the coagulant dose as a function of several source seawater parameters (see Figure 1). This system, developed by researchers from DTRI, has been in use successfully for over 2 years.

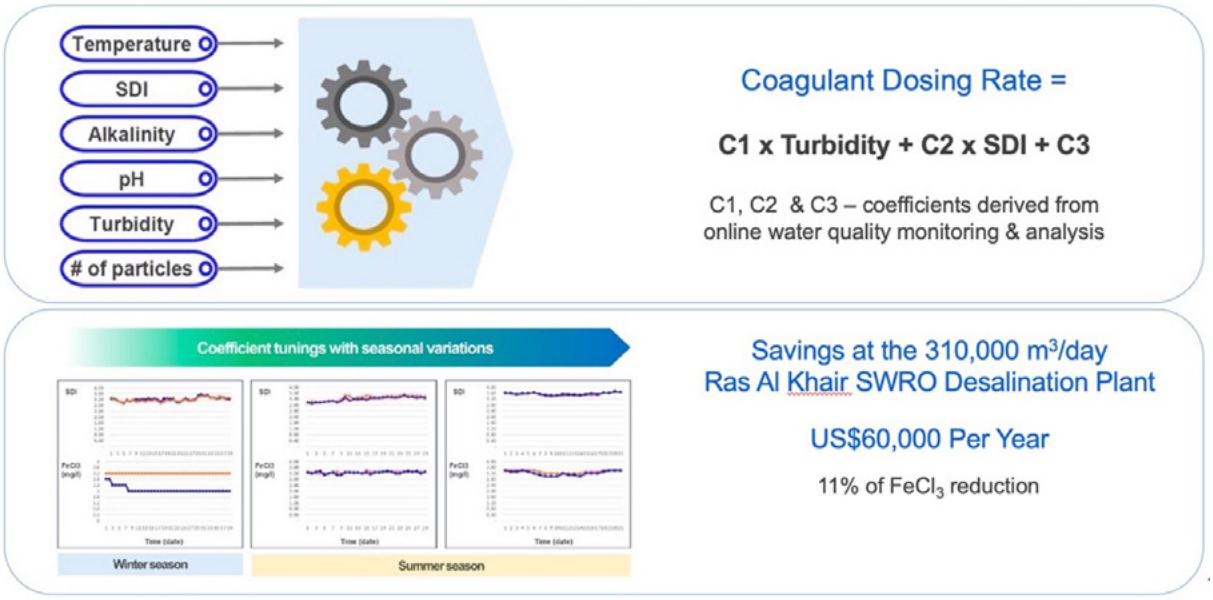


Figure 1. Reduction of Coagulant by Process Optimization at the Ras Al Khair Desalination Plant

The DTRI researchers of the SWCC have developed and tested a technology that allows to replace one of the costliest commercial chemicals used at desalination plants worldwide (ferric chloride) with a coagulant generated from brine (magnesium hydroxide) – see Figure 2. Use of magnesium hydroxide not only reduces the cost of chemicals for production of desalinated water but also turns brine from waste into beneficial product and reduces the volume of brine discharged to the sea.

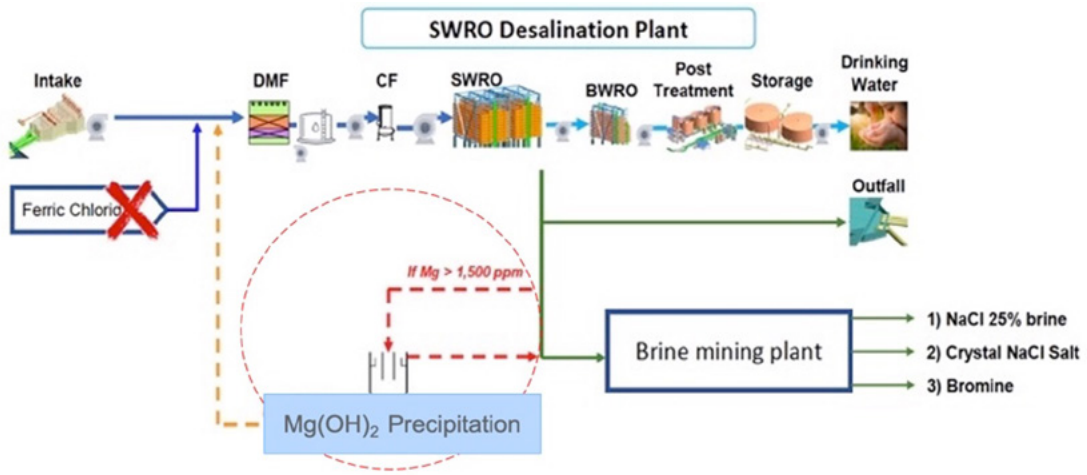


Figure 2. Production of Magnesium Hydroxide Coagulant from Brine

Prevention of Membrane Scale Formation

The applied researchers of DTRI have discovered that when the ratio of magnesium to calcium in the source seawater is below 3, the magnesium and calcium ions have stochiometric ratio that allows them to work as antiscalants of each other thereby not allowing scale to form. Practical experience with the waters of the Arabian Gulf and Red Sea shows that usually the Mg : Ca ratio is less than 3 over 80% of the time and therefore, antiscalant is not needed. Using the magnesium-to-calcium ratio based control strategy developed by DTRI, the SWCC operators have reduced the annual demand for antiscalant over 4 times. At present, the DTRI scientists are developing strategy to remove magnesium during the times when the Mg : Ca ratio exceeds 3 in order to completely eliminate the use of commercial antiscalants.

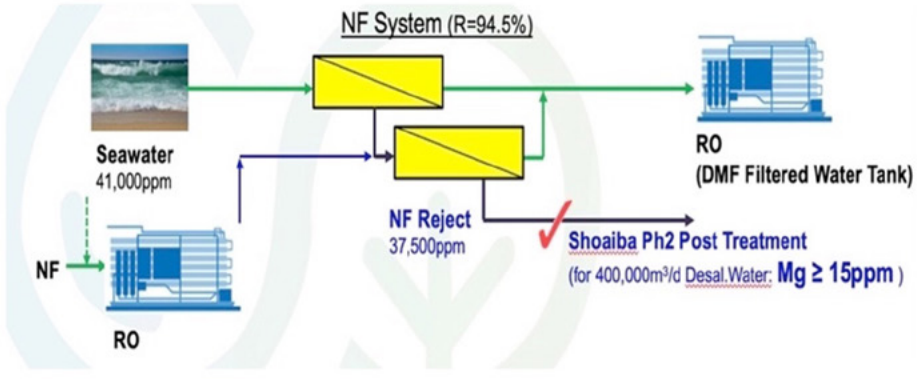
Membrane Cleaning

Many desalination plants have adopted reverse flow membrane cleaning, membrane flushing with permeate and flow pulsation techniques to minimize membrane cleaning chemicals. Practical experience shows that frequent membrane flushing can extent the time between two cleanings several times, thereby drastically reducing the use of cleaning chemicals.

Desalinated Water Post-treatment

The latest trend in desalination plant post-treatment is to derive the chemicals needed for disinfection (sodium hypochlorite or chlorine dioxide) and these for corrosion and human health protection (calcium and magnesium minerals) by generating them on site from seawater or brine.

A patented multi-stage nanofiltration (NF) technology developed by DTRI scientists (see Figure 3), extracts calcium and magnesium from brine and applies it to supplement the drinking water produced by the SWCC's Shuaiba seawater desalination plant for less than US 2 cents/cubic meter of fresh water. According to a recent medical study, magnesium enriched drinking water has shown to abate Diabetes 2 in all age groups and to promote cardiovascular health.



[ppm]	Desalinated Water	Desalinated Water + 0.3% NF reject	WHO
pH	8.7	7.3	NL
TDS	114.8	283.0	≤ 1,000
Ca	16.5	29.1	(Ca+Mg) ≥ 40 as CaCO3
Mg	1.8	18.5	
Na	15.3	30.5	NL
K	0.6	2.2	NL
HCO_3	49.0	41.9	NL
SO4	4.3	92.8	NL
Cl	27.3	63.3	No Health-based guideline
B	0.0	0.06	≤ 2.4

Figure 3. Magnesium and Calcium Post treatment Facility at the Shuaiba Desalination Plant in KSA

Conclusion

The desalination industry as a whole is constantly developing and adopting new chemical-free, renewable energy-based technologies. The ultimate industry goal is to generate all chemicals needed for the desalination process from seawater or brine.

About the Authors

Dr. Ahmed Al Amoudi is the Director General of the Desalination Technologies Research Institute (DTRI) of the Saline Water Conversion Corporation. Dr. Al Amoudi has over 30 years of experience in applied research and development of technologies for advanced membrane and thermal desalination. Under his leadership the DTRI has developed landmark innovative technologies for brine concentration and mineral mining. A veteran of the SWCC, Dr. Al Amoudi's experience encompasses desalination plant design, operation and troubleshooting.

Dr. Byungsung Park is working at DTRI as senior desalination expert of pretreatment systems in SWRO desalination plant. He worked at DOOSAN Water Research & Development Center, Al Khobar as Director General for 3 years and worked in DOOSAN Heavy Industries and Construction, Korea as senior researcher for 11 years. He specialized in the designs of Dissolved Air Flotation and Dual Media Filter. He designed DAF system with 50m/h of hydraulic loading rate on Doha East SWRO plant (Kuwait). He is focusing on the operation and maintenance improvements of SWRO plants to increase water production and cost savings.

Dr. Seungwon IHM received his Ph.D in Seoul National University, Korea, majored in Mechanical and Aerospace Engineering. After 10 years of career as a senior research engineer in Doosan Water R&D Center on desalination and power-water cogeneration, he joined SWCC-DTRI, Saudi Arabia in 2018. As a senior expert in SWCC-DTRI, his current research interests are on the development of innovative membrane systems for brine concentration and mineral recovery.

Eng. Nikolay Voutchkov has over 35 years of experience in the field of seawater desalination, and water and wastewater treatment. He is an independent technical advisor and a former chief technology officer for Poseidon Resources Corporation - a private company specialized in development, financing and implementation of water and wastewater projects in the USA and worldwide. Eng. Voutchkov has published over 40 technical articles and co-authored 11 books in the field of desalination, water and wastewater treatment, and reuse. He is one of the principal authors of the American Water Works Association's Manual of Water Supply Practices (AWWA M46) on Reverse Osmosis and Nanofiltration, the Australia Guidelines for Pretreatment for Seawater Desalination Plants and of the World Health Organization Guidance for the Health and Environmental Aspects Applicable to Desalination. At present, Eng. Voutchkov is a member of the Faculty of the IDA Desalination Academy and a lecturer of the Heriot-Watts University teaching Master of Science Class on Water Technology and Desalination.

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IDA ANNOUNCES H.E. ENG. KHALED AL QURESHI, CEO OF SAUDI WATER PARTNERSHIP COMPANY, AS CHAIRMAN OF THE IDA PUBLIC AND PRIVATE UTILITY ADVISORY COMMITTEE

Last April 7, 2022, IDA announced that H.E. Eng. Khaled Al Qureshi, CEO of Saudi Water Partnership Company, will serve as the Chairman of the IDA Public and Private Utility Advisory Committee. This special committee of the IDA Board of Directors works to increase engagement among the utilities related to desalination and water reuse solutions and exchange best practices for current and future facilities.

"At SWPC, we believe in continuous growth and improvement, and this is an excellent opportunity to capitalize on the knowledge and expertise gathered through this unique IDA platform.

Saudi Water Partnership Company's scope expanded in recent years, and our portfolio of "Triple P" projects now covers most of the value chain within the water sector in the Kingdom. Within the last five years, SWPC was responsible for tendering 11 mega projects with an average timeframe of only 20 months (from EoI to F.C.). As a result, SWPC has become the leading tendering agency in the Kingdom and the MENA region. Our blueprint is being followed now in many neighboring countries, and we are the first to extend our services and knowledge for others to benefit.

As the Kingdom's principal buyer and the water sector's procuring arm, SWPC considers ESG a main pillar and a critical element in enabling our strategy and the Kingdom's vision.

Environmentally speaking, with the launch of the Saudi Green Initiative (SGI) and more than 60 programs announced under SGI to contribute to the growth of the green economy. We at SWPC have been focusing on Water Reclamation in recent years. In addition, we have been working to reduce the carbon footprint and have achieved to reduce of 112KT of CO2, and this number will continue to grow in the upcoming years.

Read more on IDA's website

AMTA: MEMBRANE SYSTEM SAFETY AND RELIABILITY GUIDELINE

Information Gathering Survey by the American Membrane Technology Association

How do we as an industry know when our membrane systems pose a potential risk of catastrophic failure and related harm and what can we do to prevent such conditions?

The American Membrane Technology Association (AMTA) in North America, in consultation with manufacturers, component suppliers, OEMs, industry experts, consultants, and membrane users, is developing guidelines that could help provide consistently safe membrane system operation for the benefit of the industry at large. As each guideline is published, AMTA will act as a shepherd organization for each document to ensure it evolves to meet industry needs.

AMTA is currently developing a *Membrane System Safety and Reliability Guideline* to help minimize and address the risks involved in the operation of membrane systems throughout the life of the system. It will address safety and reliability incidents with pressure vessels and other system components including membrane housings, flexible couplings, piping tolerance issues, and facility maintenance that resulted in equipment failures. A letter from the AMTA Guidelines Committee further explains the need for the guideline.

Consultation with and input from the wider industry is needed to ensure recommendations are based on the best available information. The first phase of developing the guideline involves an online survey to gather information on incidents related to pressure equipment, known failure modes, and precautionary processes adopted for prevention of failures. Every submission will be completely confidential. Any images or information submitted will only be attributed to the person or company submitting the information where permission is expressly granted. Please consider contributing to the survey (open until May 18, 2022). Your contribution is vitally important to assist in improving the safety and reliability of our industry.

AMTA
American Membrane Technology Association

THE INTERNATIONAL DESALINATION ASSOCIATION ANNOUNCES ELECTION RESULTS FOR THE 2022-2024 BOARD OF DIRECTORS

The International Desalination Association (IDA) is pleased to announce the election results for the 2022-2024 Board of Directors. The new Board will begin its term during the 2022 IDA World Congress, October 9-13, Sydney, Australia. The 2022-2024 Board Term slate of officers and appointed Affiliate Directors will be announced during the World Congress.

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Middle East

Mr. Mohamad Jaroudi
Managing Director, Future Pipe Qatar

Middle East

Mr. Imad Makhzoumi
Chairman & CEO, ENOIA

Middle East

Mr. Mounib Hatab
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Middle East

Mr. Gavin van Tonder
Head of Water, NEOM

Middle East

Eng. Abdullah Alzowaid
Deputy Governor for Production and Transmission Affairs, Saline Water Conversion Corporation (SWCC)

Middle East

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Mr. José Díaz-Caneja
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Europe

Mrs. Marta Verde Blazquez
CEO, GS Inima Environment, SA

Europe

Dr. Gonzalo Delacámara
Director, Centre for Water Security & Climate Change Adaptation, IE University

Europe

Mr. Miguel Angel Sanz
Director of Strategic Development – Treatment Infrastructure Division, SUEZ International

Asia Pacific

Mr. Fady Juez
Managing Director, Metito Overseas Ltd.

Asia Pacific

Mr. Youqing Li
CEO and Senior Engineer of Professor Level, Harbin ROPV Industrial Co., Ltd.

Asia Pacific

Dr. Hoon Hyung
President, LG Water Solutions

Asia Pacific

Mr. Victor Verbeek
Head of Technical Development, Asia Pacific, and Australia & New Zealand General Manager (ANZ GM), Toray Membranes

Latin America

Mr. Alejandro Sturniolo
Global Head of Water Reuse & Strategic Partnerships, H2O Innovation

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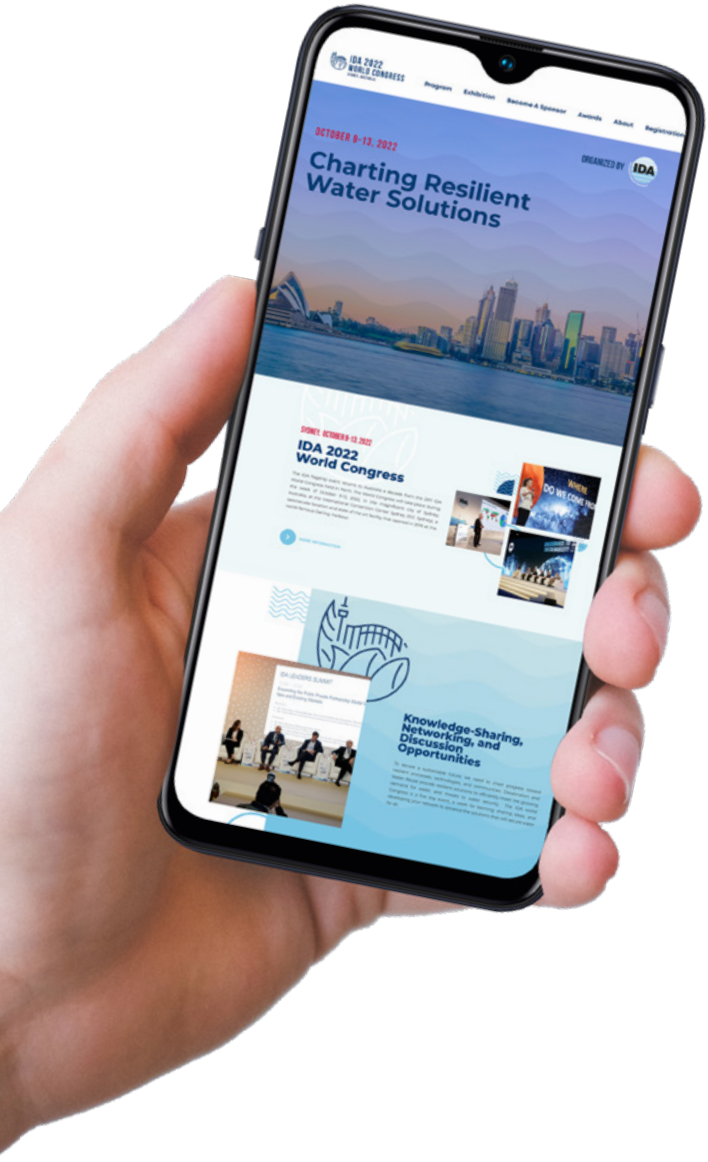

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Official hashtag: **#IDAWC2022**

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Tuesday, October 11th

IDA presents the 2022 IDA World Congress Leaders Summit - an exceptional one-day event held on Tuesday, October 11th in parallel with the Technical Program. This is an exclusive opportunity to interact with peers from across the sector. Special registration required. More details about the program will follow.


IDA LEADERS SUMMIT
16:45 – 17:45
Innovation in the Advanced Water Treatment Market
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suez
14:30 – 15:30
Bankability of Mega Water Projects: How to Increase the Appetite of Lenders and Financial Development Institutions?
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Trends in the EPC Market: Is Competing on Cost vs Quality Sustainable?
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Innovation Driven Desalination

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Held under the patronage of the Ministry of Environment, Water, and Agriculture of the Kingdom of Saudi Arabia, this Specialty Conference will include presentations by renowned international keynote speakers that will provide an overview of the latest developments in crucial desalination industry topic areas, recent scientific and technological breakthroughs, and new trends aiming to break the cost and energy barriers of desalination.

The conference will include a site visit to the Shoaiba Desalination Plant and Magnesium Enrichment Facility. The preliminary conference program can now be viewed at idadesal.org and we welcome you to register today.

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Thanks to all sponsors, participants, attendees, and partners. The first edition of the International Conference on Ocean Brine Mining has been a great success. Below you will find a video and a selection of images of the three days of the event.

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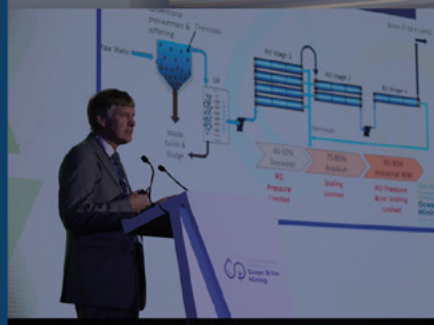


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May 11, 2022
Zoom Webinar

GLOBAL WATER SUMMIT
May 16-18, 2022
Madrid, Spain

IDA BOARD MEETING
May 19, 2022
Madrid, Spain

INTERNATIONAL SPECIALTY CONFERENCE ON INNOVATION DRIVEN DESALINATION
May 30- June 1, 2022
Jeddah, Saudi Arabia

EDS DESALINATION FOR THE ENVIRONMENT: CLEAN WATER AND ENERGY
June 22-23, 2022
Las Palmas de Gran Canaria, Spain

CARIBDA 2022 BIENNIAL CONFERENCE & EXPO
June 28-July 1, 2022
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Sydney, Australia

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2ND BOARD MEETING OF TERM 20
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XIII AEDYR CONGRESO INTERNACIONAL
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