



International Specialty
Conference on

Ocean Brine Mining

March 21-23, 2022

Le Meridien Hotel,
Al Khobar, Saudi Arabia

UNDER THE PATRONAGE OF

وزارة البيئة والمياه والزراعة
Ministry of Environment Water & Agriculture



ORGANIZED BY



المؤسسة العامة لتحلية المياه المالحة
Saline Water Conversion Corporation (SWCC)



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International Specialty Conference on Ocean Brine Mining

Held under the patronage of H.E. Eng. Abdulrahman Abdulmohsen A. AlFadley, Minister of the Environment, Water and Agriculture of the Kingdom of Saudi Arabia, this conference has been organized by the International Desalination Association (IDA) and the Desalination Technologies Research Institute (DTRI) of the Saline Water Conversion Corporation (SWCC) and with the leadership of H.E. Eng. Abdullah Ibrahim Al-Abdulkarim, Governor, Saline Water Conversion Corporation.

The Value of Brine from Desalination Plants

Brine from desalination plants contains valuable minerals. Desalination brine mining can surpass earth mining as a source of rare earth metals such as lithium, strontium, cesium, rubidium, barium, and others, and brings a new era of exploration of the vast water resources of the planet. This conference opens a venue for presenting and discussing the latest advanced technologies for extracting minerals and rare metals from desalination brine.

Conference Focus

A forum for expert scientists, applied researchers, practitioners, and innovators in the field of desalination brine mining to share their latest technologies and experience of mineral and metal extraction.

Emphasis has been given to membrane-based ocean brine concentration and advanced extraction methods and technologies which combine low energy use and competitive production of rare metals and minerals.

The presentations focus on technologies and systems that advance to the point of proof of concept and beyond, that can yield minerals and rare metals at a cost lower than that of earth mining and conventional production methods. Case studies for demonstration or fullscale implementation of brine concentration and mineral extraction technologies will also be presented.

Messages from the Conference Hosts

H.E. Eng. Abdulrahman Abdulmohsen A. AlFadley

وزارة البيئة والمياه والزراعة
Ministry of Environment Water & Agriculture



It is my great pleasure and privilege to welcome you to the first of its kind International Specialty Conference on “Ocean Brine Mining” jointly organized by the International Desalination Association (IDA) and the Saline Water Conversion Corporation (SWCC) under the patronage of the Ministry of the Environment, Water and Power of Saudi Arabia (MEWA). This conference is a unique international event dedicated to opening a new page in the history of desalination – a pathway for turning brine from a waste byproduct of seawater desalination into a valuable source of industrial commodities and rare metals. We look forward to hosting you in the beautiful city of Al Khobar on the Gulf coast of Saudi Arabia between March 21 and 23, 2022, and your valuable contribution to the success of the conference.

Messages from the Conference Hosts

H.E. Eng. Abdullah Ibrahim Al-Abdulkarim, Governor of the Saline Water Conversion Corporation (SWCC)



المؤسسة العامة لتحلية المياه المالحة
Saline Water Conversion Corporation (SWCC)



As a co-organizer of the Ocean Brine Mining Conference with the International Desalination Association, I would like to thank you for your interest and attendance at this premier industry event and to wish you a successful and beneficial experience

at the conference. We aim to amalgamate the creative essence and entrepreneurial spirit of the industry to chart a path toward the beneficial reuse of brine by harvesting the sea's mineral richness. This path will help us reach environmentally sustainable desalination and zero liquid discharge. The development and deployment of clean energy technologies and sustainable products, processes and manufacturing industries of the 21st century will require large amounts of critical metals and valuable elements, including platinum group metals, lithium, copper, cobalt, silver, and gold. Desalination brine mining opens the opportunity to tap into the ocean for such valuable commodities. SWCC's vision is to harness the value contained in seawater brine and use it to subsidize desalinated water production. This achievement will lower the water cost down to zero and transform desalination into the lowestcost technology for freshwater output in the world.

I wish you an enjoyable stay in the Kingdom of Saudi Arabia.

Message from DTRI



Dear fellow conference participants,

Welcome to the first of its kind international event exclusively focused on the beneficial use of brine generated by desalination plants. Brine mining is trailblazing a new desalination industry path of Zero Discharge & Zero Cost Desalination.

This specialty conference aims to provide a unique forum for expert scientists, applied researchers, practitioners, and innovators to share their latest technologies and experience of brine concentration and extracting valuable minerals from brine. This high-quality content-rich conference focuses on leading-edge technologies that convert cost-effectively brine into mineral products and extract rare metals of strategic importance for advanced future industries such as lithium, cesium, rubidium, and barium. The 3-day conference includes a pre-conference workshop on advanced technology for the extraction of high purity sodium chloride and bromine from ocean brine followed by 1.5 days of technical presentations and a half-day of site visits of advanced brine concentration demonstration facility in the city of Jubail and one of the largest desalination plants in the world – the 1 million m³/day Ras Al Khair desalination facility.

Best wishes for fruitful and beneficial participation at the conference, and enjoy your stay in our beautiful city of Al Khobar. We welcome you and thank you for your valuable participation in making this conference a success.



Dr. Ahmed Al Amoudi
Director General, DTRI of SWCC



Eng. Nikolay Voutchkov
Senior Expert, DTRI

Message from IDA



Dear Distinguished Delegates,

On behalf of the Board of Directors of IDA, it's our sincere pleasure to welcome you to the First Specialty Conference on Ocean Brine Mining held under the patronage of H.E. Minister Al Fadley, the Minister of Environment, Water, and Agriculture of the Kingdom of Arabia, and hosted by H.E. Eng. Abdullah Ibrahim Al-Abdulkarim, Governor, Saline Water Conversion Corporation.

It has been our pleasure to jointly organize this conference with the dynamic technical team at the Desalination Technology Research Institute (DTRI) of SWCC, under the leadership of our colleague Dr. Ahmed Al Amoudi, Executive Director of the DTRI and the DTRI - IDA Technical Program Committee led by Mr. Nikolay Voutchkov.

This innovative conference provides a unique forum to share knowledge and experience on leading-edge technologies that cost-effectively convert brine into mineral products and extract rare metals of strategic importance for advanced industries, including lithium, cesium, rubidium, barium.

Over three decades, desalination technology evolution has broken barriers in flux, energy consumption, scale, and flexibility to adapt to new contract and financial models. IDA commends these important changes and transformations and will continue supporting development. Mineral recovery from Brine discharge is a key innovation topic. The partnership with SWCC and DTRI is part of our mission to expand IDA activities and stakeholders to support technical evolution for a better world.

A tremendous amount of diligent work has been conducted to bring this pioneering conference to life. We thank all involved for their volunteer contributions of time and expertise.

We greatly appreciate the sponsors of this conference, who have enabled the IDA and our partners to create this valuable knowledge-sharing event. Our special thanks go to WETICO, our Silver Sponsor, Suez, AJMC, FEDCO, and FTSH20, Bronze Sponsors.

Welcome to the Kingdom of Saudi Arabia and welcome to Ocean Brine Mining!



Mr. Carlos Cosin
IDA President



Ms. Shannon K. McCarthy
Secretary General of IDA

Technical Committee

Conference Chairman:


 Dr. Ahmed S. Al-Amoudi, Director General

Conference Technical Program Committee Chairman:


 Eng. Nikolay Voutchkov, Senior Expert

Conference Technical Program Committee:

 Dr. Christopher Fellows, Senior Expert


 Mr. Fritz Alt, Senior Expert


 Dr. Basel Al Sharkh, Senior Expert

 Dr. Seungwon Ihm, Senior Expert


 Eng. Youngwook Yoo, Senior Expert

 Mr. Borja Blanco, CEO, Aqua Advise, Spain

 Mr. Devesh Sharma, Managing Director, Aquatech, USA

 Mr. Miguel Angel Sanz, Director of Strategic Development, Suez, France

 Mr. Silvio Oliva, CEO, Fisia Italimpianti S.p.A., Italy

 Mr. Victor Verbeek, General Manager for Australia & New Zealand
Regional, Toray Membrane Australia

 Dr. Domingo Zarzo, Technical and R&D Manager, Sacyr Water, Spain

 Dr. Miriam Balaban, Desalination and Water Treatment Journal, Editor-in-Chief



Day 1

Monday, March 21st

Technical Workshop – Ocean Brine Mining for Sodium Chloride and Bromine

Transport from Le Meridien to DTRI (90mins) 7:30 am pickup

- 09:30-09:45** **Introductions**
Dr. Ahmed Al Amoudi, Director General, DTRI of SWCC, KSA

- 09:45-10:30** **Overview of DTRI System for Brine Mining of NaCl and Br**
Program Moderator and Speaker: Eng. Nikolay Voutchkov, SWCC, KSA

- 10:30-11:00** **Coffee Break**

- 10:30-11:00** **Scope of Work of 2 Million Tons/Year NaCl and Br Project**
Speakers: Dr. Seungwon Ihm, & Dr. Christopher Fellows, SWCC, KSA

- 12:00-13:00** **Lunch Break**

- 13:00-13:30** **Hydranautics NF, SWRO & UHPRO Systems w/ Turbocharger**
Speakers: Dr. Craig Bartels, Hydranautics, USA & Mr. Rory Weaver, FEDCO, USA



- 13:30-14:00** **SUEZ NF System**
Speaker: Dr. Neil Moe, SUEZ, France
- 14:00-14:30** **FTS Membrane Brine Concentration System**
Speaker: Mr. John Tracy, Fluid Technology Solutions (FTS), USA
- 14:30-15:00** **Coffee Break**
- 15:00-15:30** **Toyobo Membrane Brine Concentration System**
Speaker: Mr. Takahito Nakao, Toyobo, Japan
- 15:30-16:00** **Suez Brine Crystallization System**
Speaker: Mr. Karel Vratny, SUEZ, France
- 16:00 – 16:30** **Project Questions & Answers Session**
- 16:30-17:00** **Visit to SWCC Brine Concentration System**
- 17:00** **Workshop Adjourned and Transport to the Le Meridien Hotel - arrival estimated 19:00.**
- 16:00 – 20:00** **Conference Registration Open at the Le Meridien Hotel, Al Khobar**
- 19:30 – 21:00** **Welcome Reception —Le Meridien Hotel, Al Khobar**



Day 2

Tuesday, March 22nd

Morning Session

08:30-09:00 Welcome Remarks

- Master of Ceremony Dr. Ahmed Al-Amoudi, Director, DTRI of SWCC, Conference Chairman
- H.E. Eng. Abdullah Ibrahim Al-Abdulkarim, Governor, SWCC
- Ms. Shannon McCarthy, Secretary General, IDA

Theme 2.1: Innovation in Desalination Brine Concentration and Mining

Session 2.1.1 – Advanced Technologies for Membrane Brine Concentration

- **Chairman: Prof. Mohammed Albeirutty, King Abdulaziz University**
- **Co-Chair: Eng. Nikolay Voutchkov, DTRI/SWCC**

09:00-09:30 Challenges and Advancements for Ultra High Brine Recovery

Author and Presenter: Dr. Craig Bartels, Hydranautics, USA



- 09:30-10:00** **High Performance RO Membranes and Membrane System for High Concentration Seawater Desalination**
Author and Presenter: Mr. Hussein Almughrabi, Toray Membrane Middle East, KSA
- 10:00-10:30** **Dual Pretreatment-Concentration Hybrid Process of Salty Water Feed of Desalination Plants**
Author and Presenter: Dr. Aiman Al-Rawajfeh, Tafila Technical University, Jordan
- 10:30-11:00** **Coffee Break**

Session 2.1.2 – Brine Concentration and Treatment - Challenges and Solutions

- **Chairman: Mr. Hussein Almughrabi, Toray Membrane Middle East, KSA**
- **Co-Chair: Prof. Sangho Lee, Kookmin University**

- 11:00-11:30** **New Concept of Minerals Extraction**
Author and Presenter: Mr. Tariq Ghassan Alghaffari, SWCC, KSA
- 11:30-12:00** **High Recovery Reverse Osmosis Water Systems**
Author and Presenter: Mr. Rory Weaver, FEDCO, USA
- 12:00-13:00** **Lunch Break**



Afternoon Session

Theme 2.2: Innovation in Brine Concentration and Mining

Session 2.2.1 – Integrated Brine Concentration and Mining

- **Chairman: Prof. Enrico Drioli, ITM-CNR**
- **Co-Chair: Dr. Seungwon Ihm, Saline Water Conversion Corporation**

- 13:00-13:30** **Brine Utilization from Seawater Desalination: An Integrated Concept for the Recovery of Valuable Minerals From Seawater**
Author and Presenter: Mr. Sherif Elsayed, K-UTEC AG Salt Technologies, Germany
- 13:30-14:00** **On the Gaps and Needs to Achieve Ultra-High Pressure Reverse Osmosis Desalination**
Author and Presenter: Dr. Arian Edalat, Pacifica Water Solutions, USA
- 14:00-14:30** **Coffee Break**
- 14:30-15:00** **Workhorse Membrane Technologies For Ocean Brine Mining**
Author and Presenter: Dr. Neil Moe, SUEZ, France
- 15:00-15:30** **SEArcularMINE: Feasibility study of the Integration of a Desalination Plant Upstream of Saltworks**
Authors: Eng. Daniel Baaklini, A. Hannachi, D. Pastorelli, F. Vicari, R. Cucchia- ra, SUEZ, France
Presenter: Eng. Delia Pastorelli, SUEZ, France



Session 2.2.2 – Case Studies for Membrane Brine Concentration

Chairman: Dr. Arian Edalat, Pacifica Water Solutions

Co-Chair: Dr. Basel Abusharkh, DTRI

- 15:30-16:00** **Long-Term Operating Results of an Osmotically Assisted Reverse Osmosis Brine Concentration System Integrated with a Seawater Reverse Osmosis Desalination Plant**
Author and Presenter: Mr. John Tracy, Fluid Technology Solutions (FTS), USA
- 16:00-16:30** **Development of Membrane for Concentrating Brines – Innovative Solution for Valuable Mineral Recovery**
Author and Presenter: Mr. Takahito Nakao, Toyobo, Japan
- 16:30-17:00** **Energy and Exergy Analysis of the NF-RO-BC System**
Author and Presenter: Dr. Seungwon Ihm, SWCC, KSA
- 17:00-17:30** **Strategy to Resolve Operational Challenges of Nanofiltration Plants in Seawater Brine Valorization**
Authors: Mr. Pablo Cañada Garcia, Dr. Neil Moe, Mr. Manel Soria Tendillo, SUEZ WTS, Italy
Presenter: Mr. Pablo Cañada Garcia, SUEZ WTS, Italy
- 19:30-22:00** **Conference Awards Dinner – Le Meridian Hotel, Al Khobar**



Day 3

Wednesday, March 23rd

Morning Session

Theme 3.1: Brine Mining for Minerals and Metals

Session 3.1.1 – Advanced Technologies for Mining of Brine for Rare Metals

- **Chairman: Mr. Silvio Oliva, CEO, Fisia Italmimpianti S.p.A., Italy**
- **Co-Chairman: Mr. Fayyaz Mubeen, President, PakDA, Pakistan**

08:00-08:30 **Characterization, Thermal Properties, Removal of Metal Cations and Metal Electrodeposition**

Authors: Prof Abir Abdel-Naby and Dr. Jwaher Al-Ghamdi, Imam Abdulrahman Bin Faisal University, KSA

Presenter: Prof Abir Abdel-Naby, Imam Abdulrahman Bin Faisal University, KSA

08:30-9:00 **Commissioning and start-up of the Shoaiba NF Desalination Plant for Product Water Quality Enhancement with Magnesium**

Authors: Mr. Juan Ramon Ruiz, Mr. Roberto Leon, Mr. Jose Manuel Sánchez, Mr. Javier López, WETICO, KSA

Presenter: Mr. Javier López, Engineering Director, WETICO, KSA

09:00-9:30 **From Waste to Value - Overview of EU Programs for Brine Mining**

Author and Presenter: Dr. Miriam Balaban, Desalination and Water Treatment Journal, Editor-in-Chief



9:30-10:00 **Future Mining of Valuable Metals and Minerals from Brine for Microelectronics, Pharmaceutical and Chemical Industries**
Author and Presenter: Mr. Shahram Shafie, EFD Corporation, USA

10:00-10:30 **Coffee Break**

Session 3.1.2 – Mining of Brine for Mineral Salts

10:30 -11:00 **Economics of Brine Mining for Sodium Chloride**
Author and Presenter: Dr. Basel Abusharkh, SWCC, KSA

11:00-11:30 **Challenges and Opportunities for Brine Recovery in Seawater Desalination Plants**
Author: Dr. Naiara Hernandez, Aqualia, Spain
Presenter: Mr. Sarmad Hameed, HAAISCO-Aqualia, KSA

11:30- 13:00 **Lunch Break**

Afternoon Session

Theme 3.2. – The Future of Brine Mining

- **Chairman: Dr. Ahmed Al Amoudi, Director General, DTRI of SWCC**
- **Co-Chair: Mr. Devesh Sharma, IDA First Vice President, Managing Director of Aquatech International**

13:00-13:30 **Full Recovery Desalination for Sustainable Materials Production: Water and Minerals for the Future**
Author and Presenter: Mr. Paul Wallace, Enviro Water Minerals, USA



- 13:30-14:00** **Valorization of Seawater Concentrate**
Author and Presenter: Dr. Christopher Fellows, SWCC, KSA
- 14:00-14:30** **Carbon Footprint of Various Brine Concentrators In Zero Liquid Discharge Process**
Author and Presenter: Eng. Youngwook Yoo, SWCC, KSA
- 15:00-15:30** **Closing Ceremony**
- 15:30 – 19:30** **Visit to Brine Concentration Pilot Plant in Jubail**
(transport time approx. 1 hour and 30 minutes each way)

Day 4

Thursday, March 24th

- 08:00** **Visit to Ras Al Khair SWRO Plant (transport time approx. 2 hours and 30 minutes each way)**

With this QR code, all delegates can access the conference proceedings.



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