UTSA Geological Sciences

And

Institute of Water Research, Sustainability and Policy (IWRSP)

Seminar Presentation

By

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"Enhancing Fresh Water Recovery in Brackish Groundwater Desalination by Diatom-based Photobiological Treatment"

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Abstract

Texas has more than 2.7 billion acre-feet of brackish groundwater, which can supply enough water for the entire population of Texas (~3 millions) for 8,000 years. However, the elevated concentration of total dissolved solids (TDS) in brackish groundwater requires a desalination process like reverse osmosis (RO) to be used. In Texas, there are currently about 40 brackish groundwater desalination facilities (BGDFs) with more than 85 million gallons per day or 93,000-acre feet per year of freshwater production capacity. However, the freshwater recovery by brackish water RO is typically limited to 75% to 80% and the remainder becomes a concentrate stream that needs to be properly disposed of. Concentrate management is one of the major challenges at BGDFs due to the regulatory, economic, and environmental constraints.

To overcome this problem, a new approach to treat the RO concentrate to recover more water has been developed using selectively cultured brackish diatoms such as Gedaniella flavovirens and Nitzschia communis and natural sunlight. RO concentrate samples from 9 BGDFs in Texas, California, and New Mexico have been collected and successfully tested by laboratory-scale photobioreactors with brackish diatoms using light emitting diode bulbs and/or sunlight as a light source. The initial concentrations of reactive silica, calcium, and TDS in the RO concentrate

samples were up to 170, 1,600, and 17,000 mg/L, respectively. The photobiological treatment could remove a majority (60% to 99%) of these constituents, as well as phosphate, ammonia/ammonium, nitrate, bicarbonate, iron, and manganese, with little to no addition of extra chemicals. With this photobiological technology, the additional freshwater recovery using a secondary RO will become more feasible, more cost-effective, and more environmentally friendly. Our study has demonstrated that BGDFs would be able to recover up to 95% of fresh water while reducing the volume of concentrate by more than 50% from the current operation.

Dr. Ikehata is an Assistant Professor of Civil Engineering in the Ingram School of Engineering, Texas State University, San Marcos, Texas. Dr. Ikehata received his B.Eng. in Applied Chemistry, M.Eng. in Civil Engineering, and Ph.D. in Civil and Environmental Engineering from Doshisha University, Kyoto, Japan, McGill University, Montreal, Quebec, Canada and University of Alberta, Edmonton, Alberta, Canada, respectively. Prior to coming to Texas, Dr. Ikehata taught in the Department of Chemical and Environmental Engineering at the University of California, Riverside and the Department of Chemistry and Biochemistry at California State University, Fullerton in 2018-2019. From 2009 to 2018, he was an R&D Manager at a water resources engineering firm Pacific Advanced Civil Engineering, Inc. in Fountain Valley, California. Dr. Ikehata also performed his postdoctoral research in the Department of Medicinal Chemistry at the University of Kansas, Lawrence, Kansas (2004-2005) and in the Department of Civil & Environmental Engineering at the University of Alberta (2005-2009).

Dr. Ikehata's research has been funded by the National Science Foundation, the U.S. Bureau of Reclamation, public utilities, and several global companies in the water industry. His research interests and areas of expertise include water and wastewater treatment technologies, water reuse, desalination, stormwater management, environmental microbiology and biotechnology, aquatic chemistry and biology, and xenobiotics toxicology and risk assessment. Dr. Ikehata has published more than 140 technical publications. Dr. Ikehata has been an active member of many organizations such as the American Water Works Association (AWWA), American Chemical Society (ACS), International Ozone Association (IOA), and Water Environment Federation (WEF). He is a registered professional environmental engineer in Alberta and Arizona.

Left: Brackish Groundwater Desalination Facility in San Antonio, TX; Right: Brackish Diatom Gedaniella flavovirens Psetr3