Water Desalination Report

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California

Consultant sought to replace EDR with RO

The City of San Diego, California, has issued an RFP for civil engineering services for its South Bay Water Reclamation Plant (SBWRP). The project's scope of work includes the replacement of an existing, trailer-mounted 2.7 MGD (10,160 m^3/d) EDR system with a new, slab-mounted MF/UF and RO system, including the reutilization of the existing infrastructure, and assisting in preparing the operational performance test procedures and operation and maintenance manuals.

The replacement is necessary to avoid repeated equipment failures of the existing EDR units due to corrosion and leaks, and to reduce maintenance requirements. Currently, the plant has been experiencing Title 22 discharge permit exceedances for sodium and chloride, and therefore needs a reliable TDS removal method.

The estimated design fee range is $700,000-$950,000, and proposals are due on 18 February, with the selection and notification of the successful bidder expected in May. For more details, go to: https://tinyurl.com/y68d5tbs.

Research

Produced water RFP issued

New Mexico Water Resources Research Institute and New Mexico Produced Water Research Consortium have issued an RFP for bench-scale, pilot-scale, and field-scale R&D and demonstration projects for the treatment and use of oil & gas produced water for applications outside the oil and gas sector.

The Consortium plans to support 4 to 10 projects, with the maximum funding expected to be $50,000 to $75,000 per award. The maximum project duration is one year, although projects that can be completed in six to nine months are encouraged. Funding will be handled on a cost-reimbursement basis.

Proposals must be submitted by 8 February and the planned project start date is 1 April. For more information, including the priority Areas of Interest, the RFP can be download at: https://tinyurl.com/y5k3gstv.

Mississippi

Evaporator treats landfill leachate

After nearly one year of operation of the leachate concentration system at Three Rivers Regional Landfill in Pontotoc, Mississippi, *WDR* checked in with Heartland Water Technology's CEO, Earl Jones, for a status update. Heartland furnished a 25,000 gpd (95 m^3/d) evaporator for the 207-acre (84 ha) facility, which receives 900 tons of waste daily from the surrounding counties.

Three Rivers had been transporting up to 24,000 gpd of leachate to a local wastewater treatment plant at costs that had risen to $0.09/gallon ($0.024/L) when they learned that the plant might stop accepting leachate. With the cost of the next closest disposal option exceeding $0.20/gallon ($0.053/L), Three Rivers initiated a proposal process to consider onsite leachate management options, before selecting a Heartland 25,000 gpd Hybrid CoVAP Concentrator.

The Heartland Concentrator is a direct-contact evaporator which mixes hot gases directly with wastewater, eliminating the need for heat-exchangers. For Three Rivers, Heartland takes thermal energy from two sources simultaneously: exhaust heat from an existing 1MW engine in a co-generation configuration they call CoVAP, as well as hot gas from a landfill gas flare. In this case, Jones said that the 875° to 900°F (468°-482°C) temperature of the gas engine's exhaust can evaporate 5,000 gpd (19 m^3/d) of leachate, with the balance of heat provided by the 1,800°F (982°C) flare.

"An air tempering valve uses ambient air to cool the flare gas to maintain the 875°F required by the evaporator. It's a simple integration, and there's no backpressure on the engine, ensuring that it is a safe and trouble-free arrangement," Jones explained.

When *WDR* asked why an RO pre-concentration step was not added ahead of the evaporator, Jones said, "We love RO at Heartland. Our Concentrator is uniquely suited to evaporate RO concentrate from any wastewater source, and we have several plants that evaporate RO concentrate from landfill leachate. Landfill leachate concentration is a significant portion of our business and what we've found is that the economic case for RO pre-concentration ahead of evaporation starts becoming attractive as leachate volumes

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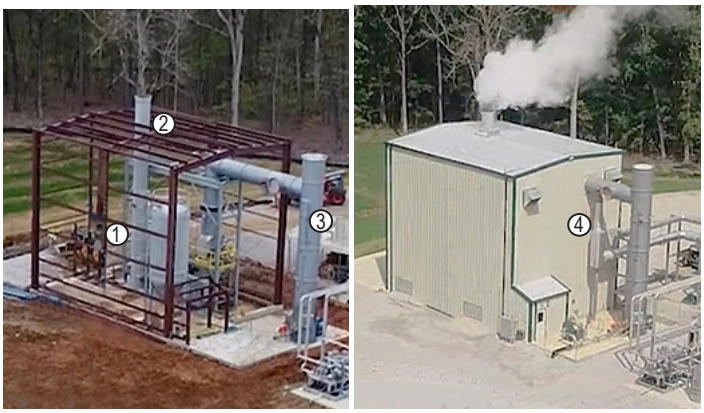


Three Rivers Concentrator during (left) and after (right) construction

1. Evaporator zone 2. Exhaust 3. Gas flare 4. Engine exhaust integration

exceed 100,000 gpd [378.5 m^3/d], as RO can add a level of complexity that is harder to justify on smaller applications. Leachate is a challenging wastewater that requires a leachate RO specialist to do correctly."

Since its commissioning, the Three Rivers' Concentrator has treated an average of over 23,000 gpd, providing a volume reduction of over 96 percent, at an up-time of more than 90 percent. Three Rivers estimates the total cost, including operations and capital recovery, to be under $0.06/gallon. Perhaps more importantly, it provides long-term cost-certainty, and gives them control of their leachate treatment.

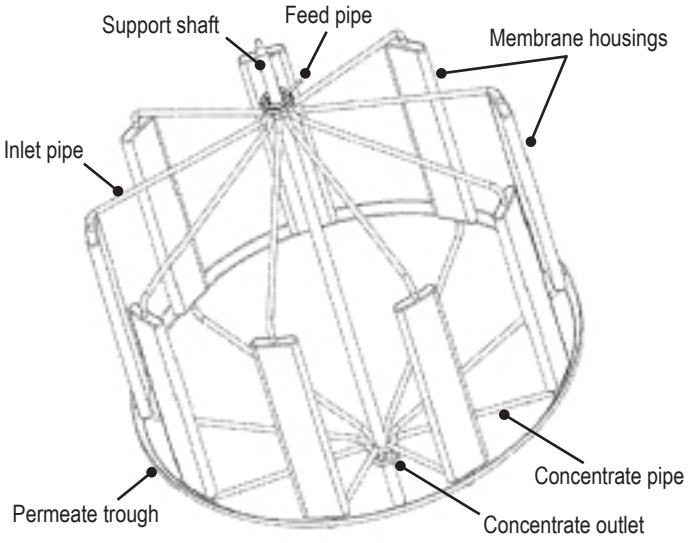
Company News

Startup to "bring desal into 21st century"

In mid-December, Utah-based Eden Technologies LLC was granted a patent for its "reverse osmosis centrifuge", an RO system that relies on centrifugal force instead of a pump and energy recovery device to pressurize feedwater that then drives the RO process. The patent award followed the company's June 2020 announcement that it had secured a $100,000 investment to fund the construction of a fully functional prototype of its technology.

Hunter Manz founded the startup last year, while he was a mechanical engineering student at Dixie University in St George, Utah. Since receiving the investment, the company has built at least two prototypes, the largest of which has successfully desalted 36 gpm (196 m^3/d) of artificial seawater using commercially available membrane elements.

The patent describes a device that may be six feet (1.8m) in diameter and eight feet (2.4m) tall, with vertically oriented, flat-sheet membrane housings installed at the periphery of a caged structure, which rotates on a vertical axis. Feedwater enters through individual tubes at the top of each membrane housing, while concentrate discharges through a tube at the bottom of each housing, and permeate is discharged into a permeate trough. The drawing, below, has been taken from the patent, and doesn't provide a lot of detail. *WDR* understands that the patent diagram is not necessarily representative of the prototype device currently being tested.



RO Centrifuge from Eden Tech patent

After reviewing the patent, *WDR* had more questions than answers, but for the time being, Manz had to refrain from commenting on anything technical outside the scope of the patent. However, the company's website doesn't shirk from suggesting its technology's capabilities, claiming:

- "The desalination industry is plagued with old and inefficient reverse osmosis systems."
- "[Eden's] system can desalinate water more efficiently than any other system on the planet."
- "[RO] has seen little innovation since the 1970s. Luckily, Eden Tech has solved this decades-long problem and has brought the desalination industry into the 21st century."

Nowhere is the company's level of confidence more apparent than in its tagline: Building Paradise. In addition to the usual staff positions and advisers that you would expect of a pre-revenue startup, Eden's team already includes a government relations person, a head of humanitarian projects, a patent attorney and an IP strategist.

WDR joins the rest of the desal community in anxiously awaiting more information on Eden's innovations.

Technology

A brief history of Centrifugal RO

Though centrifugal force is often referred to as 'fictitious force', anyone who has been ejected from a spinning merry-go-round on a childhood playground might argue otherwise. In fact, centrifugal force has very real effects on objects

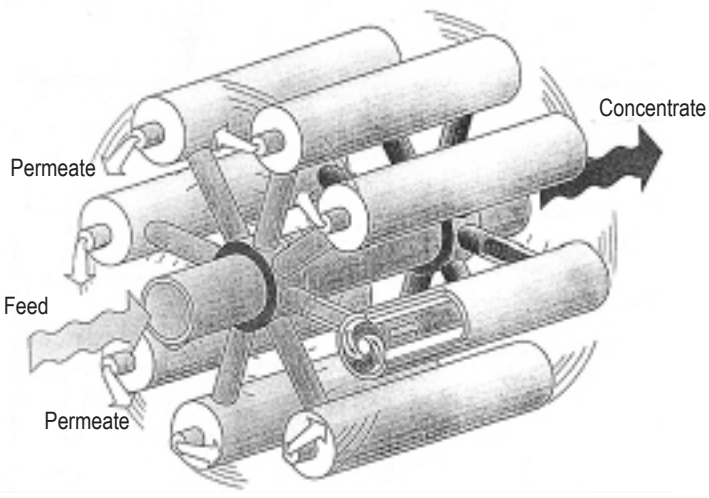
in a rotating reference frame. Since the 1960s, a series of inventors have explored various ways of using this 'fictitious' force to create the driving pressure necessary to accomplish RO desalination.

In 1961, a patent was granted for the use of centrifugal force as an energy source for membrane dialysis, and in 1968, another inventor received a patent for a device that employed centrifugation as a means of overcoming the "disadvantages of a pump" in pressurizing RO feedwater. The early patents considered relatively small devices, but patents soon were issued for devices built around commercial hollow-fiber or spiral-wound membrane elements.

In a 1982 patent, the elements were vertically orientated and mounted in a caged structure that rotated on a vertical axis, with feedwater flowing radially, through the membranes. The device was knows as a HydroFuge, and was promoted vigorously for more than a year, before it disappeared from the scene.

A 1989 patent described the use of commercial membranes that would be horizontally-mounted within a structure that rotates around a horizontal axis, with the rotor speed controlled so as not to exceed 1,000 psi (69 bar). At a 1991 desalination conference in Washington, D.C., Canadian inventors Peter Wild and Geoffrey Vickers, presented a paper describing the device as follows:

> The radial passages at either end of the rotor can be thought of as a "pump stage" at the inlet end, and a "turbine stage" at the outlet end. The "pump stage" elevates the feed seawater to system pressure, while the "turbine stage" recovers the energy in the exhaust brine as it returns it to low pressure. The energy of the exhaust brine is, thus, recovered without the addition of an auxiliary turbine.



RO Centrifuge from Wild/Vickers patent

A 7.5 m^3/d (2,000 gpd) seawater RO prototype of the Wild/Vickers unit operated for over 2,000 hours of combined land-based and shipboard operation without failures. The 81cm (32-inch) rotor was fitted with sixteen 6.35cm (2.5-inch) diameter spiral-wound RO membranes, and had a rotational speed of 3,000 rpm. The specific energy consumption was 5.63 kWh/m^3 (21.3 kWh/kgal), and it was noted that the energy consumption reduces with increasing rotor diameter.

In a 1994 comparative analysis of centrifugal RO versus a conventional RO, Wild projected that a 172,000 gpd (651 m^3/d) centrifugal system could desalt seawater at a cost 25.9 percent lower, and at an energy consumption 39 percent lower, than a conventional system. However, the evaluation was based on a 20 percent recovery and a conventional SWRO system energy consumption of 7.47 kWh/m^3 (28.3 kWh/kgal).

When more details can finally be provided, it will be interesting to see how Eden Tech's system (see previous story) measures up to today's RO systems, which operate at much higher recoveries and have much lower energy requirements.

AMTA
New Board seated

Last week, the American Membrane Technology Association (AMTA) announced the results of its recent election, during which 10 of its 21 Board of Directors' members, and the 2021 Board Officers were selected. The new board members and officers are:

Division I – Public Agencies, Industrial Users, Regulatory Agencies and Water Suppliers to End User

- *Randal Braker,* Duck River Utility Commission, Tennessee
- *Jill Miller*, City of Bozeman, Montana
- *John Nichols*, Brunswick County Public Utilities, North Carolina
- *Eric Owens*, Water Replenishment District, California

Division II – Company/Corporate (Manufacturers, Suppliers, Consultants, Engineers & Architects)

- *Brent Alspach*, Arcadis, California
- *Buddy Boysen*, CDM Smith, Texas
- *Steven Coker*, DuPont Water Solutions, Texas
- *Julie Nemeth-Harn*, Harn R/O Systems, Florida

Division III – Associates (Individuals, Additional Affiliate of Div. I or II/University & College Professors)

- *Samantha Black*, HDR, Inc., Florida
- *Christine Owen*, Hazen and Sawyer, Florida

Board Officers

- *President* – Jill Miller, City of Bozeman, Montana
- *1st Vice President* – Julie Nemeth-Harn, Florida

- *2nd Vice President* – Greg Madden, H2O Innovation, Minnesota
- *Secretary* – Rebecca Wilder, Town of Jupiter, Florida
- *Treasurer* – Randal Braker, Duck River Utility Commission, Tennessee

In brief

An EPC team comprising Abengoa, Veolia's Sidem and SEPCOIII announced last week that it had exceeded 85% progress in the construction of the 600,000 m^3/d (158.5 MGD) **Rabigh 3 IWP** in Saudi Arabia. The SWRO project, which is being developed by ACWA Power-Saudi Brothers consortium, will supply water at \$0.53/m^3 (\$2.00/kgal) to the Mecca-Jeddah region. It will begin operation in early 2022.

The city council of Antioch, California, voted unanimously to award Shimmick Construction an \$86.7 million contract to construct a 6 MGD (22,710 m^3/d) BWRO plant, which will include a new river intake pump station, a new 3,000 foot (915m) raw water pipeline, and a new 4.3 mi (6.9km) brine disposal pipeline. *WDR* has learned that Shimmick has nominated California-based Biwater as the RO system supplier. Carollo Engineers is responsible for the plant design, and CDM Smith will provide construction management services. The plant is scheduled to be online in early 2022.

Saudi Arabia's **Saline Water Conversion Corporation** has identified the seventh consortium invited to submit a proposal in the privatization of the 1,025,000 m^3/d (271 MGD) Ras Al Khair power and water project. Previously, the consortium was identified as "Unnamed strategic Asian consortium". That group as how been identified as China Huadian Hong Kong Co./Beijing Enterprises Water Group. The winning consortium will own 60% of the project company and will take over the plant's management, operation and maintenance activities.

Seventeen potential investors conducting due diligence on Singapore's **Hyflux** now have one week—until 31 January—to submit non-binding offers to participate in the second stage of the bidding process. Borrelli Walsh Pte Ltd, the judicial managers appointed to oversee Hyflux's restructuring, is expected to develop a shortlist of participants by about 15 February. Hyflux filed for court protection from its creditors in June 2018.

Sulzer, the Switzerland-based pump specialist who supplied 289 pumps for multiple Saudi Arabian satellite desal projects over the past 18-months, has signed a binding agreement to acquire Sweden's **Nordic Water** for \$144.8 million. Nordic offers a range of water and wastewater treatment products, which Sulzer says will allow it to grow its wastewater treatment business. The deal is expected to close in the next two months.

Saudi's SWCC said that 44 companies have submitted expressions of interest in participating in the upcoming tender for its 300,000 m^3/d (79.3 MGD) **Ras Mohaisen IWP** project, which is to be located 300km (185 mi) south of Mecca. The SWRO project, which will be delivered on a 25-year BOT contract, is scheduled to come online in 2024.

Events

The **2021 WateReuse Symposium** will be held virtually on 15-25 March. The 36th annual event will be organized around the theme Resilience Redefined. For more information, visit https://tinyurl.com/yxapqqcy.

CalDesal will hold its **Virtual Annual Conference** on 10-11 February. The event will span Wednesday afternoon and Thursday morning, and will include a live audience Q&A session. To view the conference agenda and register, visit http://www.caldesal.org.

The American Water Works Association (AWWA) will hold its **Virtual Summit** on Sustainable Water, PFAS and Waterborne Pathogens on 10-11 February. For information, visit https://tinyurl.com/yyaejxcc.

People

Editor's note: Last week's issue contained the incorrect email addresses for both of the following people:

Kim Shugar has been appointed as the executive director of the American Membrane Technology Association (AMTA). She will be based in Tallahassee, Florida, and may be contacted at kim@amtaorg.com.

Nicole Zimmerman has been appointed to be the events and membership manager for AMTA. She will be based in Nebraska, and may be contacted at nicole@amtaorg.com.

Jobs

QUA is searching for a *Product Sales Representative* to champion its membrane technologies in North and South America. Proficiency with the Spanish language is a plus. For more information, and to apply, please send your resume to: sales@quagroup.com.