WATER DESALINATION REPORT

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SIWW

MICROBIOLOGIST RECEIVES WATER PRIZE

Professor Rita Colwell, an American environmental microbiologist has been presented with the Lee Kuan Yew Water Prize 2018 at this week's SIWW. She was recognized for her pioneering insights into microbial water quality surveillance and her contributions in translating these insights into concrete practices and policies to better manage waterborne diseases and protect public health.

Professor Colwell's discoveries and innovations have changed the way the world thinks of water microbiology. During her lecture to SIWW attendees, she reviewed her work on cholera research, including the identification of viable but nonculturable (VBNC) bacteria and the realization that *vibrio cholorea* can lay dormant outside the human body and then later resume normal infectious functions when conditions are again favorable.

Lee Kuan Yew Prize Laureat Professor Rita S. Colwell

She also provided an update on her current work at California's Orange County Water District on the use of next generation DNA sequencing as a tool in analyzing the microbial communities at various points within the treatment process at potable water reuse plants.

Professor Colwell founded CosmosID, a Maryland-based company focused on the use of its microbial genomics platform to rapidly and accurately identify pathogens and their virulence and antibiotic-resistant genes in clinical applications. The company was the winner of the Technology Idol event at GWI's 2018 Paris GWS Summit.

SIWW

3D PRINTED MEMBRANES: FROM HYPE TO REALITY

One of this week's most interesting SIWW technology-related stories could not be found at the conference center, and wasn't listed on the conference program. Instead, your correspondent had to take a 30-minute taxi ride from the Marina Bay Sands conference center to an office park in Tuas, about three miles up the road from Tuas seawater desalination complex.

It is there, on the third floor of a brand new office building, that NanoSun Pte Ltd has located its headquarters *and* the manufacturing facilities, and is quietly going about its business of designing and manufacturing 3D additive printed microfiltration and ultrafiltration (MF/UF) membranes.

In 2014, when *WDR* first wrote about company—a spinout of Singapore's Nanyang Technological University (NTU)—it seemed to be just another ambitious company founded by a scientist with some interesting, and overly optimistic ideas. NanoSun's co-founders, NTU Associate Professor Darren Sun and Wong Ann Chai, an Oxford educated ex-investment banker, had just raised over S$10 million (US$7.5 million) from private investors, NTU and corporate venture funds, with Singapore's Economic Development Board lending support to get to a more sustainable scale.

"Our goal was to develop a UF membrane that you could print just as easy you would print a Word document. You would simply insert the right printer cartridge in the printer and press a button to produce a finished document, or in our case, a membrane sheet. Conventional methods require 13 different chemicals to manufacture hollow-fiber UF membranes. Our engineering aims to do it with none. No solvents. No wastewater. No smell. So simple and environmentally friendly that you could do it inconspicuously, on the third floor of an office building like this one," Sun explained.

The company's flat-sheet membrane consists of PVDF nanofibers that are 3D printed on a backing material and compressed into a paper-thin membrane sheet. A membrane sheet is then attached to each side of an injection molded, ABS plastic septum, or substrate, to form a membrane

Tom Pankratz, Editor, P.O. Box 75064, Houston, Texas 77234-5064 USA
Telephone: +1-281-857-6571, www.desalination.com/wdr, email: tp@globalwaterintel.com

module. The entire manufacturing, assembly, testing and packaging process is done automatically, and untouched by human hands, on computer-controlled equipment designed by NanoSun.

NanoSun's AC Wong (l) and Darren Sun (r) in the company's membrane manufacturing facility

Sun said that the membrane operates at a flux that is about five times higher than current polymeric membranes. He envisions that the design will soon evolve to one that will enable the membrane itself to be a consumable industrial product, predicting that the membrane will be so inexpensive that when fouled, the membranes can be 'torn' off the support and replaced with new ones.

"We will do away with CEBs [chemically enhanced backwashes] altogether, and all the costs associated with chemical cleaning water and its disposal. In fact, we have ideas that may allow us to further reduce costs and eventually eliminate the membrane septum itself," said Sun.

Despite this newspaper's original skepticism, the company seems well on its way to doing what it set out to do. It now has over 10 industrial and municipal installations, primarily in the semi-conductor and textile industries, and the largest of which produces 20,000 m^3/d (5.3 MGD) of filtrate. Wong told *WDR* that the company now employs a staff of 18 engineers, with plans to increase it up to 80, and that its production capacity is currently able to supply about five such projects per year.

He said that the company is now conducting a Series B funding round to increase sales, production, product development and innovation capabilities, and envisions a public listing in the next three or four years, adding, "We expect to be profitable by the end of the year and are excited by the performance of our membrane and the positive response we have received from our clients."

Company News

Will Sorek 2 have 16-inch membranes?

IDE Technologies told *WDR* that it is preparing to bid for the 150-200 million m^3/y (109-145 MGD) Sorek 2 seawater desalination plant despite suggestions that its dominance of

the Israeli desalination market raised competition issues. Amir Lang, who together with Avshalom Felber controls IDE through their Alfa Partners vehicle, said, "Sorek 2 is something that we are preparing for, and we are going to bid. We don't see any restriction whatsoever that was published, hinted or said. The company is going to be there for the bidding process and will hopefully win it."

If IDE is pursuing the project, the next important question is whether it will use the vertical-oriented 16-inch membrane configuration that it used in the first Sorek plant. That project is the first and, to date, the only major desalination plant in the world to use 16-inch elements in a vertical configuration, but early problems with the membranes led to a dispute over warrantees.

IDE split the order for the membranes between Dow and Nitto Hydranautics, and while Dow accepted liability and replaced its membranes, the Japanese company dragged its feet. Visitors to the plant last year would have noticed large quantities of membranes stacked up around the plant as the dispute wore on.

Lang said the large-diameter, vertical configuration was nonetheless successful, adding, "It has demonstrated its advantages, in terms of footprint, etcetera, and it won the bid last time. In this regard, we don't yet know yet what the design will be, but this is, of course, an option."

Gal Zohar, who is responsible for IDE's project portfolio, remains very positive about the performance of the membranes, despite the dispute. "In general Sorek 1 is a very successful project. I believe that eventually we will reach an agreement [with Nitto]. The question is not 'if', not 'how much', it is only 'how' we should arrange the compensation."

Lang added that IDE's approach has always been to bring some new innovation to each plant the company builds, and the recent hiatus in the large projects market had meant that CTO Boris Liberman had had time to develop some significant innovations, which are yet to be revealed.

Lower portion of Sorek's vertical RO pressure vessels

OpEd

Is it time to sell membranes by the gallon?

Is the membrane industry moving inevitably towards a service model? It is easy to imagine why it might. Membrane manufacturers compete on price and promise performance, but the customer must bear the risk of a product failing to live up to the supplier's promises. The solution might be to buy membranes according to the volume of permeate produced, rather than by the membrane surface area, in the same way that Xerox sells photocopiers on the basis of the number of copies made.

This might sound far-fetched, but the pieces are beginning to fall into place. We have already seen longer warranties on membranes: Dow and Hydranautics were reportedly asked to guarantee the membranes they supplied to IDE's Sorek plant for the length of the plant's off-take agreement. Digital monitoring and control will take things a step further, allowing membrane suppliers to ensure that the membranes are used appropriately, and replace defective or worn out elements, as required.

Ultimately, membrane users don't want to own membranes, they want them to produce permeate. That suggests that passing on the membrane performance risk to the suppliers makes sense to end-users—especially if they want to benefit from innovation.

If the change is going to happen, it will likely be driven by companies like NanoSun (see previous story) who want to change the membrane filtration paradigm, but realize that the membrane sales paradigm stands in the way.

Company News

3 MWDs to replace UF membranes

Scinor Water America has been awarded three contracts to supply replacement UF membrane modules at the following plants, each of which was originally furnished by different suppliers. None of the projects involved the use of a universal membrane rack. The projects are:

Ground Water Replenishment System (GWRS) – Orange County (California) Water District will replace 684 existing UF membrane modules with Scinor UF modules. As the GWRS expands its capacity by introducing effluent from a different wastewater plant, it will require improved UF membrane performance upstream of the RO. According to Scinor's Michael Grossman, based on the performance of the company's membranes at West Basin MWD, The District will replace some of its existing membranes to demonstrate that the lower quality wastewater effluent can be successfully treated, prior to the full expansion.

South Coast Water District (SCWD) – Scinor will replace a competitor's existing UF modules at the Aliso Creek Water Reclamation Facility, near Laguna Beach, California. The three-train UF system will pretreat wastewater effluent ahead of an RO. Grossman told *WDR* that the existing modules have been in operation for four years, but the operator has been struggling to produce enough water to feed the downstream RO for some time. Based on a single module pilot test, SCWD selected Scinor's pure TIPS PVDF fiber over the original supplier.

Wochholz Regional Water Recycling Facility (WRWRF) – California's Yucaipa Valley Water District (YVWD) will replace the 96 UF modules in one of five trains as the modules reach their service life. Grossman said, "Scinor was selected for this replacement because, unlike their existing membrane supplier, our membranes have certified virus removal credits on our NSF 419 listing, and YVWD anticipates the need for this certification in the future."

SIWW

Energy Recovery returns to its roots

Energy Recovery threw a party to introduce its new CEO Chris Gannon to the international water industry on Monday evening. Gannon was confirmed as CEO and President of Energy Recovery in May this year, having been acting CEO since the sudden departure of Joel Gay in February, amidst concerns that the company's expansion into the oil and gas sector with its VorTeq was failing to meet milestone performance targets.

CEO Chris Gannon and VP Corporate Development Emily Smith

Gannon told *WDR* that he wanted the company to return its focus to its core desalination business. Emily Smith has been appointed vice president for corporate development to assist Gannon in growing those interests.