CTO OUTLOOK

ROTEC sets sights on high pressure and low brine future

The Israeli high-recovery RO specialist is rapidly gaining traction with its innovative flow reversal technology, as its reference list passes 50 installations. CEO Noam Perlmuter shares where the desalination market disruptor has come from and where it is going next.

DR NOAM PERLMUTER

Chief Executive Officer, ROTEC by WFI Group

Noam Perlmuter has been CEO of ROTEC since its establishment in February 2009 as a spinoff from Ben Gurion University, where the FR-RO technology was developed. He has played a hand in all aspects of the company including technology development, commercial efforts and securing investor and government funding. Prior to ROTEC, Perlmuter was the CTO of a technology company building electrochemical industrial wastewater treatment solutions. He holds a PhD in Eco-toxicology from Tel Aviv University.

What are the key technology areas ROTEC is looking at in its R&D activity and why?

ROTEC's continued focus is on improving our existing product line based on flow reversal (FR-RO) technology to deliver high-recovery desalination systems for a variety of applications. At present, we are working to improve our brine concentration systems so that they can be incorporated into near-ZLD (zero liquid discharge) solutions.

The global push towards environmentally benign industrial processes with minimal waste is here to stay and eliminating brine waste from desalination plants is no exception. Another trend in the industry which is gaining increased validation is the push to using ultra-high pressure membranes. ROTEC has been developing flow reversal systems that can operate under ultra-high pressure conditions and will be prepared with robust solutions to meet this expected future demand.

Describe the progress ROTEC has made in the last five years with its Flow Reversal-RO technology.

ROTEC's history includes three major milestones that have been achieved. The first two years of the company's life were spent in an incubator developing the technology and refining it into a line of products that could be commercialised. From there, ROTEC began to embark on working with industry, delivering its first commercial sales, and working on small and medium-size projects in the desalination sector.

In 2017, ROTEC delivered a major project to PUB in Singapore. The capacity and the complexity of the project was our most significant challenge up to that point. We overcame many engineering hurdles, successfully navigating the massive undertaking that is delivering a large municipal project while simultaneously ensuring that we met all of PUB's strict validation requirements. In the end, we provided a system that exceeded their expectations on both our technology and our execution ability. The result was a major vote of confidence from PUB when they ultimately deployed FR-RO at their flagship Tuas facility. This successful high-profile project gained us a great deal of exposure and was one of many important milestones on the road to getting ROTEC to where it is today.

Since then, we have continued to deploy large projects across the globe, establishing a wide partner network and collaborating with leading water infrastructure developers around a variety of applications. ROTEC has also evolved into new sectors such as municipal wastewater treatment and semiconductors, while cementing our foothold in applications like industrial wastewater treatment and food and beverage product water.

What are the most common applications for your FR-RO technology currently and what is typically the key driver for installing the technology?

There are enormous opportunities for FR-RO in both the municipal and industrial sectors and in numerous applications ranging from semiconductor product water to cooling tower blowdown. Some of the most common applications we are seeing today are municipal wastewater treatment, food and beverage product water and brine concentration applications. In all of these applications, increasing the environmental sustainability of a given system or operation serves as a major impetus for using FR-RO technology.

By moving reverse osmosis systems to higher recovery rates of 90-98%, feedwater volumes can be reduced while maintaining the same amount of product water. Similarly, 20-30% more clean and usable water can be produced from the same initial volumes of feedwater.

Meanwhile, brine volumes are reduced by 50-70%, minimising the costs and environmental burden associated with their disposal. Decreased chemical consumption, maintenance costs, and downtime due to less frequent CIP (clean-in-place) events, all contribute to lower environmental impact with a very attractive ROI, making implementing FR-RO a no-brainer for most applications. ▶

How does ROTEC's current installed base break down between municipal and industrial applications and do you see those proportions changing in the future?

The breakdown between municipal and industrial applications for ROTEC's installations is about 50/50 when looking at number of projects. However, the capacities of municipal projects are much larger than anything in the industrial sector, so our installed capacity of municipal projects by water volume is much larger. With that said, ROTEC receives many more commercial opportunities from the industrial sector, characterised by shorter sales cycles, than from the municipal sector, where cycles are much longer. ROTEC is a player in both sectors and will continue to operate meaningfully in each for many years to come.

How are you currently investigating using FR-RO for brine concentration?

ROTEC is actively building FR-RO projects for brine concentration. We saw the growing need to further treat the brine from desalination systems and began developing this application utilising the principles of our innovative flow reversal technology almost seven years ago to meet that demand. The ability to treat brine is also useful in installations where the retrofitting of an existing system to increase recovery rates is not possible. Our brine concentrators can treat waste streams with extremely high levels of silica and other sparingly soluble salts.

Are you looking into the possibility of applying FR-RO on seawater? If so, what is your progress there?

ROTEC's FR-RO system is particularly useful in the second pass of seawater RO (SWRO) units. The first pass in SWRO typically results in high levels of boron, an element that is harmful to a large variety of crops. Because of this, many SWRO plants are forced to implement a second pass RO array to further reduce boron levels. These systems are operated at high pH and have an increased potential to suffer from scaling which limits their recovery rates.

Due to the very high cost of permeate water produced in the first pass, there is an economic incentive to increase recovery rates in the second pass to the highest possible levels to prevent losses of such valuable water. ROTEC recently demonstrated our ability to increase the recovery rate from 90% to 98% on a second pass SWRO system. We are now executing a retrofit of an entire SWRO plant in Southern Israel to increase the recovery rate of the plant's second pass boron removal array.

How does FR-RO compare with semi-batch RO processes such as closed circuit desalination?

ROTEC's focus on flow reversal has always been centred around increasing recovery rates within the framework of existing RO plant design. From my understanding, semi-batch is an entirely new configuration for RO plants, and likely faces hurdles when it comes to implementing retrofits. It also seems to be challenging for semi-batch systems to be deployed to large plants, so it may be better suited to small and medium-sized applications. On several occasions, flow reversal technology has been evaluated against semi-batch systems, with ROTEC being awarded the project and proving to be the customer's preferred solution.

The use of digital tools to optimise membrane systems is very in fashion. What is ROTEC developing in this space?

ROTEC has developed a custom-built digital tool, dedicated to remotely monitoring every system that we have in operation globally. The tool was primarily developed to serve as our virtual R&D lab, enabling us to constantly learn from the systems we have deployed and better improve our product line going forward. This technique involves an automated analysis that is conducted in real-time to ascertain the status and behaviour of every system. Looking across operational parameters such as recovery rate, flux, pressure differentials, temperature, salinity, and pH, as well as overall status, operation, and any critical event occurrences, the data is automatically processed and on-site operators are alerted if there is a problem. The added benefit of this digital tool allows real-time monitoring and preemptive maintenance for our customers which is a key part of the support we provide.

What do you think will be the next game-changing technology in desalination or brine concentration?

From our perspective, brine concentrating technologies, in particular operating under ultra-high pressure conditions, is a major area of opportunity where we hope to be a player. Also, the ability to monitor the operation of an RO system in-situ will be a big opportunity as well.

In the desalination space, perhaps the most impactful advances will be in the realm of AI and machine learning. The ability to precisely measure data at every single point and component of a given system, e.g. on the surface of the membrane itself, and to then turn that data into actionable insights across a variety of parameters will be extremely powerful. Enabling things like pre-emptive maintenance and the capability to intelligently and autonomously respond to changing conditions in real-time will be transformative to the desalination sector and to the water sector at large. ■

GOING AGAINST THE FLOW

In FR-RO, the flow direction is alternated every few hours, with the synchronised change sequence (opening and closing actuated valves) taking about 60-90 seconds. The procedure takes advantage of the initial slow stage of most chemical reactions that lead to scale formation, meaning a system can operate to higher recoveries and reach higher brine concentration levels.

Source: ROTEC