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# membrane TECHNOLOGY

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## Water Planet spins out PolyCera Membranes as a separate wholly-owned subsidiary

**US-based smart membrane products company Water Planet has spun out its PolyCera® membranes product line into PolyCera Membranes – a separate subsidiary operating company.**

In the planning stages for the past 12 months, this development includes closing an initial tranche of a US$8.75 million Series A financing round for the wholly-owned subsidiary.

In addition, Simon Marshall – former partner at Amane Advisors – has joined PolyCera Membranes as its new CEO. Water Planet says that he brings to the company proven commercial and entrepreneurial acumen, having consistently delivered significant revenue, profit and market share growth working for corporate and consultancy organisations over the past 25 years.

Eric Hoek, CEO, Water Planet, commented: 'We are excited about bringing Simon on as the new CEO for PolyCera Membranes. He and I have known each other for years, and he was my first choice for the position. He brings to the company an exceptional business mindset and strong management experience that will be essential as we scale the business.'

Marshall added: 'I am excited about the opportunity to work with Eric and the amazing team at PolyCera, and to lead PolyCera's commercial growth phase. It is a truly differentiated membrane technology that is enabling our customers to treat the most challenging waters with membranes, whereas that could not be done economically before.'

Earlier in his career, Marshall held senior management positions at Ultura, Severn Trent and Eurofins. He possesses extensive international experience, having led operations in North and Central America, the Far East, including China, Hong Kong and Malaysia, the Middle East and throughout Europe. He holds a degree in Mechanical and Production Engineering from the University of Wolverhampton.

Hoek continued: 'The plan to establish PolyCera Membranes as a separate entity evolved from the success of both PolyCera and IntelliFlux technologies as commercial products – each with dozens of installations around the world by now.'

'We found the two products required radically different operating models, selling strategies and execution capabilities, and decided in early 2017 to form two separate business divisions within Water Planet, with me as the acting leader of PolyCera and Subir Bhattacharjee (Water Planet's co-founder and CTO) as the acting leader of IntelliFlux.'

'We began to see increased customer traction, improved team dynamics and enhanced execution on a project basis. In fall 2017, we spun out IntelliFlux as IntelliFlux Controls with Subir as the CEO, and its success, along with that of our other spin-out MembranePRO, gave us the confidence to convert the PolyCera division into a wholly-owned subsidiary. That enabled us to raise capital for direct investment into PolyCera Membranes.'

Hoek will remain CEO of Water Planet and will continue to provide support for its companies on high-level strategic and technical matters.

He added: 'We are confident that this business model maximises opportunities for continued growth of our membrane technology businesses. This new structure also enables me to support the operating businesses, whilst continuing the original vision for Water Planet as the place where innovation happens.'

Robust and easy to clean, PolyCera membranes are proven to extend the range of ultrafiltration performance beyond conventional ceramic and polymeric membranes, says Water Planet.

The PolyCera product line includes PolyCera Hydro for drinking water treatment, and PolyCera Titan for the treatment of industrial wastewater, including wastewater containing oil, and characterised by extreme pH, high organics and/or a high temperature.

For further information, visit: www.waterplanet.com & http://polyceramembranes.com

## Contents

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# Microdyn-Nadir expands RO product line

**Microdyn-Nadir, a supplier of membrane products, and the water treatment business unit of Mann+Hummel, has expanded its recently launched Microdyn reverse osmosis (RO) line of products.**

The product range was launched in 2017 with the Microdyn RO 8040-BW-400 brackish water membrane element.

During the first quarter of 2018 the company added 440 $ft^2$ (41 m2) high, active area elements, low energy elements and 4040 elements to the Microdyn RO product line.

The firm says that the expansion of this product line enables it to now offer brackish water RO products for nearly all industrial water purification requirements featuring high solute rejection.

Its product portfolio also includes nanofiltration, ultrafiltration and microfiltration membranes

**For further information**, visit:
www.microdyn-nadir.com/en/products/microdyn-ro

# Recent contracts strengthen Fluence's market position

**US-based provider of water and wastewater treatment systems Fluence Corp Ltd reports that between the beginning of the year and March it has received US$8 million in new contracts. These include three NIROBOX™ orders announced on 1 March 2018.**

The new contracts extend across the company's growing global footprint and further strengthen its market position in designated industries and geographies.

Commenting on Fluence's start to 2018, Managing Director and CEO Henry Charrabé said: 'The diversity of project sizes, scopes, industries and geographies speak to Fluence's role as a solutions provider for the complete water cycle across the globe. The mix of new and repeat customers reflects the quality of our products and services, and our focus in being a true partner to our customers.'

According to Fluence, an important repeat customer in the agro-industry has once again entrusted its operations in Italy with the task of designing and implementing an upgrade and expansion of its aerobic treatment line.

This is the twelfth project that Fluence Italy has won from this client since 2006, reflecting the reduction of costs achieved with the company's technologies and expansion of capacities for the client. Discussions are already on going with this client as it plans its next project with Fluence, to be implemented in 2019.

Fluence Argentina will design and deliver to Aguas Bonaerenses, SA, amongst the largest municipal utilities in Buenos Aires, a reverse osmosis (RO) system as an expansion of 3000 $m^3$/day to its existing installation, with added filtration and treatment systems to aid arsenic removal (a prevalent health issue in the area).

Fluence Brazil is designing and delivering a turn-key wastewater treatment plant for industrial process reuse to Brazil's largest national pharmaceuticals group. It selected Fluence to provide this system – using RO and ultrafiltration amongst other technologies – to supply process water to its operation in São Paulo at 7.5 $m^3$/h.

Another repeat customer, a renowned food and beverage industry client, has entrusted Fluence USA's equipment to upgrade its aeration process for an additional two lagoons, following last year's order, which introduced it to firm's Tornado® surface aspirating aerator/mixer.

Fluence says that the highly reliable nature of its equipment and the service it provided enables this client to comply with local regulations in an efficient and cost-effective manner.

(Also see 'NIROBOX deployment continues to gain momentum worldwide', *Membrane Technology* March 2018, page 7.)

**For further information**, visit:
www.fluencecorp.com

# De.mem secures orders worth A$340 000 and makes strong revenue forecast

**De.mem recently received purchase orders worth A$340 000 from customers in Singapore and Australia. The water and wastewater treatment company also forecasts strong revenue growth for calendar year 2018.**

The firm says that the contracts relating to the purchase orders received include the delivery of:

- a containerised water treatment plant to El Questro Wilderness Park, Queensland, Australia;
- additional equipment and spare parts

to Bechtel Australia Pty Ltd – related to the order received from Bechtel in early December 2017; and
- a membrane-based water treatment system to Aromatec Pte Ltd, a company located in Singapore.

Andreas Kroell, CEO, De.mem, said: 'The new purchase orders are very rewarding and immediately add to our revenue base. The contracts also illustrate our growing market visibility in both Australia and Asia.'

'It is pleasing to see sales materialising in Singapore, a market that holds lots of potential for De.mem, and we are equally encouraged by the increase in the scope of supply to Bechtel Australia. It gives us excellent exposure in a large sector and shows the appeal of our products to engineering, procurement and construction companies such as this, which have a global footprint.'

'Our project pipeline in Australia and Asia is growing and more revenue-generating contracts will materialise shortly. The outlook for the year is strong.'

In fact, in separate news, De.mem reports that forecast revenue for calendar year 2018 will be between A$8 million to A$10 million, compared with revenues of A$2.9 million for 2017. This represents a year-on-year increase of up to 245%.

The company says that the execution of existing long-term contracts – build, own and Operate (BOO), or operations and maintenance (O&M) projects – already contracted to De.mem, as well as additional project awards likely to be received during 2018 in Australia and Asia underpin this revenue growth.

Revenues from existing or revolving BOO or O&M contracts alone are expected to generate about A$3 million for the year. A full-year contribution from the Akwa-Worx business acquired in September 2017 is also a contributing factor.

The company started 2018 with a cash balance of about A$3.3 million, and says that it is sufficiently funded to execute on its current growth objectives. It is also assessing opportunities to accelerate its growth with a number of additional organic growth and acquisition-focused growth initiatives under consideration.

Kroell commented: 'Since our IPO in April 2017 De.mem has continued its rapid expansion with important growth milestones achieved. These include the entry into the highly lucrative Australian market through the acquisition of Akwa-Worx on 18 September 2017, the commencement of our membrane manufacturing plant in Singapore on 12 July 2017, the successful completion of pilot trials on our new nanofiltration membrane in February 2018 (also see page 5) and the recent in-licensing of forward osmosis technology for certain industrial wastewater treatment applications.

'De.mem is well funded with a healthy cash balance, and together with a reduced cash burn and a growing revenue base, we are strongly positioned to become cash flow positive in the near term,' continued Kroell.

'The board continues to assess growth opportunities in the water and wastewater technology sector, a space which is still highly fragmented and has considerable scope for consolidation. Whilst organic growth is a priority, we will also assess opportunistic acquisitions that make an immediate contribution to earnings.'

**For further information,**
visit: http://demembranes.com & http://akwaworx.com

# Xylem opens facility in Warsaw as part of ongoing investment in Poland

**Global water technology company Xylem Inc has opened a new 1100 $m^2$ (11 840 $ft^2$) commercial facility in Warsaw as part of its ongoing investment in Poland.**

This new plant, which includes office space, a service and maintenance hub, and a warehouse, brings Xylem's total investment in Poland to more than zł67 million. The company currently employs almost 350 people at sites in Strzelin and Warsaw. Further recruitment at the new Warsaw facility, where 45 employees are based, is expected in the coming months as the company enhances its sales, marketing and business development capabilities.

Rafał Bonter, Managing Director, Xylem, Poland, said: 'Our new facility in Warsaw, as well as the additional talent we plan on recruiting this year, will mean that our customers in Poland, and across Europe, will benefit from our closer proximity, which will deliver stronger customer relationships and tailor-made solutions. Our new facility, complete with service and maintenance capabilities, will also provide an enhanced aftermarket offering for our customers.'

'We see a strong role for Xylem in relation to Poland's new Water Law Act, supporting communities to build their resilience in the event of extreme weather events, such as flooding, as well as ensuring they have a consistent, sustainable water supply in the event of drought, for example. We will continue to invest in our Polish operations and we see a bright future for us, our employees and our customers here.'

Alessandro Bertuzzo, Regional Director, Eastern Europe, Xylem, added: 'The Polish market is one

## In Brief

### Biwater launches social channels aimed at 'bringing water to life'

Biwater, which focuses on providing clean water and treating wastewater, has launched new Twitter and Instagram accounts to increase the company's online presence, as well as its engagement with stakeholders spanning the globe. The overarching theme of the new channels is 'bringing water to life'.

**More information:** www.biwater.com
Twitter: @BiwaterTweets
Instagram: @BiwaterPhotos

### Porvair acquires Keystone Filter

Porvair Filtration Group recently reported that it has acquired Keystone Filter, a division of CECO Environmental Corp. It has acquired the goodwill, business and trading assets of the firm for cash. Keystone designs and manufactures a range of filter cartridges and housings for the food and beverage, drinking water and chemical process markets in the USA. Ben Stocks, Chief Executive, Porvair Plc, said: 'The acquisition of Keystone increases our presence in the USA, broadening our markets and providing a range of cross-selling opportunities. Keystone brings sales expertise, distribution and a broad customer-base for whom Porvair's wider product range will be attractive.'

### SPX Flow appoints board member and vice president, business development

US-based SPX Flow Inc, which engineers, designs, manufactures, and markets products used to process, blend, filter, dry, meter and transport fluids, has appointed Majdi Abulaban as an additional independent member of its board of directors. 'Majdi brings significant operational, commercial and transactional experience to the board,' commented Robert Hull, Chairman of the Board. In other news, Vusa Mlingo has joined the company as Vice President, Business Development. Mlingo will be responsible for facilitating the development and execution of the company's enterprise strategy and business development initiatives.

### WaterTAP board announces call for directors

In Canada, the Nominating and Governance Committee of the Water Technology Acceleration Project (WaterTAP) has announced a call for nominations for candidates for its board of directors. The board is seeking directors to fill at least three positions. All directors will be elected for a three-year term (September 2018 to September 2021). The deadline for applications is 18 May 2018.

**More information:**
www.WaterTAPontario.com

of the fastest growing in Europe, with a vibrant, young population of 40 million and we enjoy a strong market presence here due to our comprehensive portfolio and extensive expertise.'

'We are experiencing strong demand across the three primary market segments we operate in – industrial, public utility and building services.'

The new facility in Warsaw follows major investment in Poland by Xylem during 2014/2015, when the company doubled the size of its factory located in Strzelin to more than 17 000 $m^2$ (182 987 $ft^2$). The factory, which manufactures large, wet rotor circulators and a range of other high efficiency and smart Lowara-branded pumping systems, has been designed as a 'centre of excellence' in water engineering technology.

The plant adopts a Lean Six Sigma approach and a continuous improvement culture, with a focus on consistently meeting customer needs, product quality, durability, delivery time and reduced waste.

**For further information**, visit: www.xylem.com

## 3M Petrifilm Rapid *E. coli*/coliform count plate reduces testing time

**3M Food Safety has developed the Petrifilm™ Rapid *E. coli*/coliform count plate. Described as a two-in-one indicator test, it gives customers both an *E. coli* and total coliform count in 18–24 hours.**

In addition to possessing all of the simple, reliable and sustainable conveniences of the 3M Petrifilm brand, the plate quickly distinguishes *E. coli* from other coliform bacteria for a wide variety of food samples, enabling processors to operate more efficiently and ship their products sooner.

'Our aim, always, is to develop highly accurate tests and technologies that result in less waiting and increased efficiency for our customers,' said 3M Food Safety marketing manager Chris Somero.

'This new plate is an all-in-one, easy-to-use chromogenic solution that can immediately boost productivity and accelerate their products' time to market.'

According to 3M Food Safety, customers from around the world were impressed with the product upon seeing a preview. They said that they found it easy to use, and the benefits of not having to incur the time and hassle of manually preparing agar, or using special equipment to enumerate, were just some of the advantages of the plate.

**For further information**, visit: www.3M.com/foodsafety/RapidPetrifilmSolutions

## SSB supports ABL in completing viral vector GMP capacity expansion

**Sartorius Stedim Biotech SA (SSB), a provider of equipment and services for the development, quality assurance and production processes of the bio-pharmaceuticals industry, has been selected by ABL Europe as its primary supplier of single-use systems.**

Through a supply partnership with SSB, ABL Europe has successfully increased and brought online new viral vector manufacturing capacity at its European facility in Strasbourg, France.

A subsidiary of ABL Inc, ABL Europe provides dedicated viral vector GMP manufacturing services for oncolytic, vaccine and gene therapy projects in all stages of clinical development through to commercial launch.

SSB reports that it has delivered a comprehensive GMP viral vector manufacturing package that includes single-use bioreactors and an automation platform for normal flow filtration, tangential filtration and mixing. These have been installed at the facility, which is now in the process of manufacturing batches of viral vector products for ABL's clients.

SSB's end-to-end process systems in single-use format have helped ABL expand its existing drug substance capacity, with a fully disposable manufacturing capability for different viral vector product types produced in non-adherent cell lines.

Amélie Boulais Raveneau, Marketing Manager, Vaccine Platform, SSB, commented: 'We are proud to have been selected by ABL Europe to supply single-use process technologies and analytics specifically designed for use throughout ABL's viral vector manufacturing process train.'

'It is a significant endorsement of SSB's platform for viral vector processing and the single-use design capabilities of the Sartorius Integrated Solutions engineering team. Our process development consultants share their expertise with clients to ensure optimal implementation of our technologies and overcome challenges in viral vector applications.'

Patrick Mahieux, General Manager, ABL Europe, added: 'The introduction of non-adherent cell culture capacity complements our existing adherent cell culture viral vector production technologies. It is the only pure-play, dedicated viral vector production site capable of manufacturing drug substance and drug product materials for toxicological studies, all clinical phases and even commercial launch. Everything from process development, manufacturing and QC release testing is performed under one roof.'

**For further information**, visit: www.sartorius-france.fr, www.sartorius.com & www.institut-merieux.com/en/innovation/abl-inc

## Veolia upgrades wastewater treatment plant in Stellenbosch, South Africa

**Veolia Water Technologies South Africa has been contracted by the Stellenbosch Municipality to upgrade the mechanical and electrical works in the region's only wastewater treatment plant.**

The upgrade, including all initial civil works, will increase the plant's operating capacity to 35 million litres (9.3 million gallons) per day – ensuring that the increasing sewage is adequately treated and surrounding waters are not polluted.

At an operating capacity of 20 million litres (5.3 million gallons) per day the wastewater treatment plant, which is over 90 years old, is currently operating at well below the region's demand. As a result, poor quality effluent is being discharged into the nearby Veldwachters River, in addition to creating odour problems in the tourist-popular area of western Cape Town.

Working in conjunction with the designs from consulting engineers Aurecon, Veolia has commenced installing a range of technologies to increase the plant's operating capacity to 35 million litres.

The upgraded plant will feature a full biological and nutrient-removal facility using a membrane biological reactor (MBR) and will also cater for future growth in the area. Veolia is using innovative, low footprint membrane and ultraviolet (UV) disinfection technology to treat the effluent, so that it complies with discharge specifications, before entering the local river. This final UV clarification step removes all remaining harmful contaminants from the wastewater.

'These technologies ensure that treated wastewater will be of a SANS-approved (South African National Standards) potable quality, which is vital as the plant outflow will discharge into the Veldwachters River, which is used to irrigate local

crops,' said Peter Avenant, Process Engineer, Veolia Water Technologies South Africa.

The plant is also located in a highly dense and popular area and Veolia has also been commissioned to install modular type biotrickling filters and bioreactors in the inlet system to address the town's odour concerns.

The first phase of this project has been completed and Veolia is currently commissioning the plant. The second – the refurbishment of the existing works – commenced in October 2017.

**For further information**, visit:
www.veoliawatertechnologies.com &
www.veoliawatertechnologies.co.za

# De.mem successfully completes commercial trials of NF membrane

**Water and wastewater treatment company De.mem recently successfully completed an initial round of commercial-scale testing projects of its nanofiltration (NF) membrane technology in Singapore and Vietnam.**

The technology was in-licensed from Nanyang Technological University in Singapore (NTU Singapore) in June 2016 and delivers significantly lower operating costs and reduced investment relative to other conventional water treatment technologies, says the firm.

As announced in October 2017 (*Membrane Technology*, November 2017, page 14), the first water treatment system was deployed at a municipal facility in Vietnam, which has been successfully filtering river water from the Mekong River. A second pilot trial has also been completed in a manufacturing facility in Singapore.

Andreas Kroell, CEO, De.mem, said: 'The successful conclusion of these commercial pilot projects marks the beginning of the commercialisation phase for De.mem's new membrane technology. Our first commercial sale is pending and we will now be aggressively marketing the technology throughout Asia and Australia where we will look to establish a healthy tendering pipeline. We are encouraged by the prospects for the technology and its broad commercial application across multiple sectors.'

'The results of the successful pilots reflect our promise to produce high-quality treated water using our hollow-fibre nanofiltration membranes at low pressure and a low operating cost. We now have the foundation in place to firmly establish De.mem as a well recognised and technology-led water and wastewater treatment company with the most advanced systems available on the market today.'

De.mem Director, Manufacturing, David Chua, added: 'Thanks to the strong support of NTU and the dedicated work of our team, we have been able to complete the set up of our membrane production and initial validation of our membrane technology in record time. We look forward to seeing this membrane now in the commercial market.'

The company's trial in Vietnam confirms that the new membrane technology boasts superior rejection performance. The rejection of certain key parameters, such as bacteria was confirmed at '6-log', which implies that out of one million bacteria, less than one is able to pass through the membrane, which is vastly superior to other hollow-fibre membranes available, says the firm.

Other key criteria for the treated water, such as turbidity or total dissolved solids (TDS) also fell within World Health Organisation (WHO) drinking water standards throughout the trial. These outcomes have both been achieved by using De.mem's membrane as a single treatment step, whilst running the membrane at a comparatively low pressure of between 1 bar and 2 bar.

The Singapore trial was performed on-site at the factory of a multinational corporation from the electronics sector – treating the client's wastewater. Its objective was to confirm the potential to use the new membrane for applications in industrial wastewater treatment and recycling.

Key criteria which measure the strength of industrial wastewater, such as chemical oxygen demand (COD), turbidity or TDS, could be reduced substantially, to below discharge requirements imposed by the Singapore government. Furthermore, the customer confirmed that the treated water can be recycled for reuse in its production, significantly reducing operating costs. The membranes have been run at a low operating pressure of 1.5 bar.

**For further information**, visit:
http://demembranes.com

# Acquisition adds ozone disinfection technology to Evoqua's portfolio

**Evoqua Water Technologies Corp, which specialises in water and wastewater treatment products, systems and services, has acquired privately held Pacific Ozone Technology Inc, a manufacturer of ozone disinfection systems, testing products and support services for a wide range of industrial applications.**

The acquisition adds a new technology – ozone disinfection – to the Evoqua portfolio and

## In Brief

### Biwater and Wood establish partnership to improve Iraq's water infrastructure

A strategic partnership has been established between Biwater and John Wood Group Plc that will see the firms working together in Iraq to address acute water shortages – beginning with the supply of water to the Basrah region. This important agreement between two major UK infrastructure firms, demonstrates the scale of international interest and support in Iraq's extensive infrastructure reconstruction efforts, and follows the signing of a memorandum of understanding between the government of Iraq and UK Export Finance (UKEF) in March 2017, to underwrite £10 billion of infrastructure projects in Iraq over the next 10 years.

### GEA's CEO is not seeking to renew his contract

The long-standing CEO of GEA Group Aktiengesellschaft, Jürg Oleas, has informed Dr Helmut Perlet, the chairman of the firm's supervisory board that he is not seeking to extend his term of office beyond 31 December 2019. Dr Perlet commented: 'I deeply regret Jürg Oleas' decision, but at the same time I respect this step. The suggested timeframe guarantees that the ongoing implementation of the company's strategic objectives will continue to be advanced during the current fiscal year, whilst at the same time Jürg Oleas will be able to ensure an orderly transition.'

### Pentair sets up US innovation centre

Global water company Pentair, which focuses on smart, sustainable water and fluid treatment technology, recently announced plans to build an innovation centre in Apex, North Carolina, USA. The company intends to occupy a 4645 $m^2$ (50 000 $ft^2$) research and development site on Pinnacle Center Drive and will create more than 50 jobs. It is scheduled to open in August.

### LiqTech announces public offering of its common stock

LiqTech International Inc, a clean technology company that manufactures and markets specialised filtration technologies, has commenced a public offering of its common stock. The pricing of its underwritten public offering of 16 911 765 shares of its common stock is US$0.34 per share. In addition, LiqTech has granted the underwriter a thirty-day option to purchase, at the public offering price, up to an additional 2 536 764 shares of its common stock to cover over-allotments, if any.

further underscores the company's industry-leading capabilities in the water treatment market place. Terms of the deal were not disclosed.

Pacific Ozone Technology serves the beverage, food-processing, high-purity, textile, ground remediation and aquaculture markets globally. It supplies ozone generator systems, ozone test-kits and field service support.

The company's Floating Plate Technology produces reliable and efficient ozone generation in an economical, air-cooled system. It will become a part of Evoqua's Products segment, which specialises in water disinfection technologies, and global service and support.

'We are excited to welcome Pacific Ozone to the Evoqua family,' said Ron Keating, CEO, Evoqua.

'The addition of ozone technology to our current offering of disinfection technology and products is consistent with our acquisition strategy to broaden our technology offerings and fill current product portfolio gaps. We are excited to market Pacific Ozone as an Evoqua brand to our industrial customer base.'

The brand will join Evoqua's stable of disinfection brands which includes Wallace & Tiernan® systems, and ETS™, Barrier® and Delta® UV products.

Pacific Ozone is based in Benicia, California, in the North Bay area of San Francisco. It has approximately 25 employees and 5000 installations across the globe.

The acquisition of Pacific Ozone marks the second transaction by Evoqua in 2018 and the tenth acquisition by the firm in the past two years.

Earlier this year it also signed a definitive agreement to acquire privately held Pure Water Solutions, a US-based provider of high-purity water equipment and systems, service deionisation and resin regeneration, with service operations in suburban Denver and Santa Fe.

Pure Water Solutions serves the ultrapure pharmaceuticals and laboratory, medical, commercial, industrial and agriculture markets throughout Colorado and New Mexico. It serves its customer base with a variety of products, including reverse osmosis, deionised water systems and ultrafiltration.

**For further information**, visit: www.evoqua.com, http://pacificozone.com & www.purewatersolutions.us/

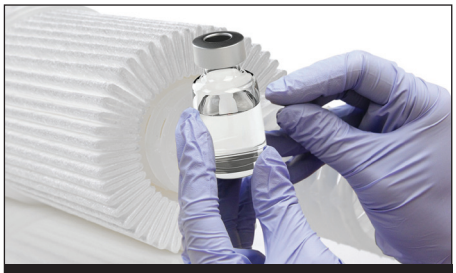
# Sterile filter helps veterinary pharmaceuticals company process batches faster

**Edited by Simon Atkinson**

**This brief news focus highlights the way in which the SupaPore VPBA sterile filter cartridge, from Amazon Filters Ltd, is enabling a veterinary pharmaceuticals manufacturer to quickly process batches of its liquid vitamin solution, whilst still maintaining the quality of the final product.**

A liquid vitamin solution, manufactured for animal consumption, required a final filtration process to ensure complete sterility of the final product.

This product is manufactured using a batch process, which means that achieving a fast processing time is paramount to profitability. Whilst the customer was achieving the required results using filters it already had in place, it did not have the capacity to process the full batch in a single run, resulting in downtime and loss of production.



The SupaPore VPBA sterile filter cartridge from Amazon Filters Ltd is helping a veterinary pharmaceuticals manufacturer to speed up the rate at which it process batches of a liquid vitamin solution, whilst still maintaining the quality of the final product *(photograph courtesy of Amazon Filters Ltd).*

However, changing the final critical filter in this process, in order to improve productivity and profitability, was of considerable concern to the customer.

## PES membrane

Amazon Filters – a UK manufacturer and supplier of a range of microfiltration filter cartridges and filter housings for critical liquid and gas applications – ran trials with the customer using its SupaPore VPBA filter cartridge.

Comprising a polyethersulphone (PES) membrane and an integral pre-filter layer, the SupaPore VPBA quickly demonstrated that it could provide the required level of filtration, whilst also offering outstanding service life because of the presence of a pre-filtration layer.

The proposed approach, using the SupaPore filter cartridge, provided the customer with the required filtration quality, which allayed its fears about switching critical final filters. Beneficially, the SupaPore VPBA filter also enabled a higher flow rate to be achieved. This enabled the batch to be processed almost 30% faster than was achievable by the company's existing system.

## Product quality

Within the pharmaceuticals industry it is important that products are microbiologically stabilised prior to packaging, to prolong shelf life. This is achieved without affecting the nature of the product.

Minimising the cost of stabilisation, whilst maintaining product quality remains a constant driver. SupaPore VPBA – an advanced PES membrane filter cartridge with an integral pre-filter layer – is designed to meet these requirements.

This provides enhanced throughput, especially for processes where long on-stream life is vital.

Amazon says that its SupaPore VPBA cartridges can be *in-situ* steam sterilised and offer superior chemical resistance, which enables them to be repeatedly cleaned for a longer service life.

**For further information**, visit: www.amazonfilters.com/products/filter-cartridges-and-capsules/membrane-filters/supapore-vp-biological-filters

*(This news focus is based on press material issued by Amazon Filters Ltd.)*

# Speciality group is formed with expertise in filtration and catalysis technologies

**Edited by Simon Atkinson**

**A speciality group has been formed that offers expertise in filtration and catalysis technologies. ALSYS, which has based its headquarters in France, combines unique abilities across a diverse range of industries and applications, as this brief news focus reveals.**

Recently formed ALSYS designs, manufactures and supports the installation of advanced materials, industrial equipment and process engineering. With expertise in technologies for water and air preservation, such as filtration and catalysis, it says that its vision is to meet the technological, economic and environmental challenges of the factory of the future.

Its ambition is to serve high-stakes markets such as the water, oil and gas, chemicals, energy and power-generating, gas emissions control, and food and animal feed sectors.

## Organic growth and acquisitions

The creation of ALSYS Group is the result of over 30 years of experience. Organic growth and international development have been supplemented with the acquisition or creation of subsidiaries in strategic regions, including North America and China.

The founding company CTI, based in Salindres, near Alès, France, was created in 1990, and is known for its expertise in advanced ceramics and catalytic materials. Since 2010 the company has rapidly developed through several acquisitions:

- Orelis (2010) – with its membrane technology and filtration processes for industrial liquids;
- EnerCat, formerly known as IRMA, (2013) – based in Lorient, France, is a major player in catalytic formulations and advanced materials technologies;
- ClearBakk (2016) – based in Calgary, Canada, provides full turnkey fluid management and environmental technology, from design and engineering to installation, commissioning and operating; and
- CeraMem® (2017) – acquired from Veolia Water Technologies, is based in Boston, Massachusetts, USA, and specialises in membrane technologies for the oil and gas industry.

## Proactive approach

'Our proactive approach of constantly integrating new skills and new expertise enables us to offer our customers an ever more complete range of products and services, as well as a fully integrated value chain,' commented François Garcia, President, ALSYS.

***'...its vision is to meet the technological, economic and environmental challenges of the factory of the future.'***

With operations in Europe, North America (USA and Canada) and Asia (China and India), ALSYS has 150 employees and an annual revenue of €30 million. The group is aiming to maintain its dynamic growth and exceed 10% per annum. Its structure comprises three business units:

### Water & Membranes

- ceramic membranes – KLEANSEP™ and CeraMem;
- polymeric membranes – PLEIADE®;
- filtration skids – KLEANSEP and CeraMem; and
- water, wastewater and process water treatment plants, using membranes or other processes, such as ozonation, hydration/flocculation (ClearBakk).

### Gas & Catalysis

- treatment of nitrogen oxides (NO, $NO_2$ and $N_2O$);
- capture and elimination of catalyst toxins (for example sulfur and carbon compounds);
- treatment by catalytic oxidation and reduction of toxic or environmentally harmful gases (CO and VOCs);
- filtration of hot gases of ceramic materials; and
- catalytic processes for power generation (hydrogen and methane).

### Specialty Materials

- high-performance filters for molten metals;
- refractory materials for high-temperature applications; and
- antimicrobial minerals with antibacterial, antifungal properties.

ALSYS says that it applies its strategy in line with its markets' long-term needs:

- *sustainability* – by using robust management and ambitious R&D programmes to increase industrial performance, whilst developing sustainable materials, processes and equipment;
- *dealing with water scarcity* – by developing membrane materials and equipment for better recycling;
- *eco-responsibility* – by helping to reduce the environmental impact of the oil and gas, and power-generating industries;
- *healthcare and food* – by developing innovative separation and purification processes, and a range of materials, with, for example, high-performing antimicrobial, antifungal properties; and
- *environmental regulation* – by helping to anticipate and develop alternative energies.

**For further information**, visit: www.alsys-group.com

*(This news focus is based on press material issued by ALSYS Group.)*

# Saltworks introduces Flex EDR following successful pilot project

**Edited by Simon Atkinson**

**Following a successful pilot project in the USA, Saltworks Technologies has launched its Flex EDR electrodialysis reversal system. Taking advantage of the firm's next-generation ion-exchange membranes it reduces the amount of pretreatment required, tolerates oils and organics, selectively removes ions and uses fewer chemicals.**

The launch of Saltworks' Flex electrodialysis reversal (EDR) system follows a successful pilot project at a chemical plant in the USA. The company says that it achieved economic zero liquid discharge (ZLD) whilst treating challenging saline wastewater to 99.9% recovery.

The chemicals facility engaged Saltworks to rapidly deliver a pilot programme that would remove salt from its effluent – helping to meet a discharge cap on total dissolved solids (TDS).

## Concentrated stream

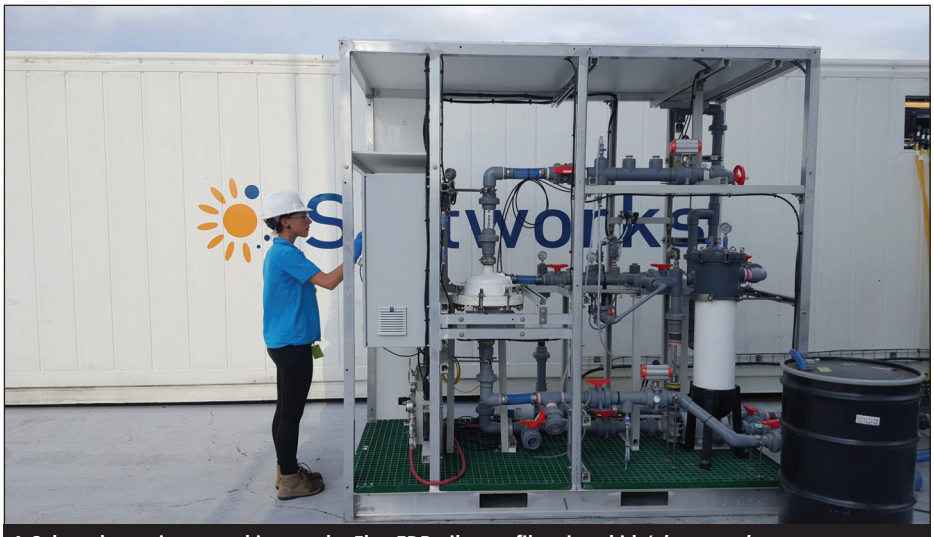
The team targeted the highest salinity stream in the plant for salt removal. Reverse osmosis (RO) was poorly suited to this concentrated stream, which also contained high organics and biological growth potential.

Project leader Derek Mandel commented: 'RO is the workhorse of desalination and we use it widely, however, the RO membrane fouling risk was too high with this wastewater. Extensive and uneconomic pretreatment would have been required. This is why we worked with the client to test the second most popular membrane desalter – EDR.'

EDR is an established water technology with more than half a century of industrial applications.

***'Flex EDR successfully extracted 89% of the salt load, surpassing the 75% goal.'***

Flex EDR successfully extracted 89% of the salt load, surpassing the 75% goal. According to Saltworks, this de-risks the plant's water balance and permit obligations. Downstream of Flex EDR, the concentrated brine was treated with the SaltMaker evaporator crystalliser to achieve 99.9% net water recovery in a modular package that produced solid byproduct. The solids were sent to non-hazardous landfills for safe, low-cost disposal.



A Saltworks engineer working on the Flex EDR pilot prefiltration skid *(photograph courtesy of Saltworks Technologies).*

This pilot demonstrated the economic and process advantages of targeting concentrated streams for salt removal.

## Three innovations

Saltworks says that its Flex EDR introduces three essential innovations for EDR end-users: increased resilience via the firm's IonFlux ion-exchange membranes, which withstand turbid waters and frequent bleach cleans to prevent biological growth; no need for chemical softening because of a patented hardness blocker protecting electrodes; and advanced process controls that achieve higher recovery and optimise performance when facing variable inlet water conditions.

## Flex EDR product line

Saltworks Technologies' Flex EDR product line – the next generation electrodialysis reversal technology for challenging waters – comprises:

- Flex EDR Organix – a system that desalinates produced water and wastewater with high concentrations of organics, whilst removing the need for extensive pretreatment.
- Flex EDR Selective – which pulls out monovalent ions with 98% selectivity, making it possible for users to tune water chemistries to suit their treatment needs and extract salts that deliver value.
- Flex EDR Ammonia – described as a membrane treatment system for reliable wastewater ammonia removal, where biological systems struggle to meet requirements.

**For further information**, visit:
www.saltworkstech.com/technology/flex-edr-advanced-electrodialysis-reversal-system

*(This technology focus is based on press material issued by Saltworks Technologies).*

# RESEARCH TRENDS

## Comparing the performance of OMBR–RO and conventional MBR–RO

This study systematically compares the performance of osmotic membrane bioreactor–reverse osmosis (OMBR–RO) and conventional membrane bioreactor–reverse osmosis (MBR–RO) for advanced wastewater treatment and water reuse. Both systems achieved effective removal of bulk organic matter and nutrients, and almost complete removal of all 31 trace organic contaminants investigated. Both were able to produce high-quality water suitable for recycling applications. During OMBR–RO operation, salinity build-up in the bioreactor reduced the water flux and had a negative impact on biological treatment by altering biomass characteristics and microbial community structure. In addition, the elevated salinity also increased soluble microbial products and extracellular polymeric substances in the mixed liquor, which induced fouling of the forward osmosis (FO) membrane. Nevertheless, microbial analysis indicated that salinity stress resulted in the development of halotolerant bacteria, consequently sustaining biodegradation in the OMBR system. By contrast, biological performance was relatively stable throughout conventional MBR–RO operation. Compared with conventional MBR–RO, the FO process effectively prevented foulants from permeating into the draw solution, thereby significantly reducing fouling of the downstream RO membrane in OMBR–RO operation. Accumulation of organic matter, including humic-like and protein-like substances, as well as inorganic salts in the MBR effluent resulted in severe RO membrane fouling in conventional MBR–RO operation.

W. Luo, H.V. Phan, M. Xie, F.I. Hai, W.E. Price, M. Elimelech and L.D. Nghiem: *Water Research* **109** 122–134 (1 February 2017).
*https://doi.org/10.1016/j.watres.2016.11.036*

## Arsenic removal from water by coupling photocatalysis and complexation–ultrafiltration

This research investigates the removal of inorganic arsenic (As) from contaminated water using off-line coupling of photocatalysis and complexation–ultrafiltration (CP–UF). Although some improvement is still needed, it shows that this combined process is capable of almost completely removing arsenic from the treated water. Two commercial polymers, poly(dimethylamine-coepichlorohydrin-coethylenediamine) (PDEHED) and poly(diallyl dimethyl amnmonium chloride) (PolyDADMAC) were tested in the CP–UF process. The operating conditions (pH and polymer/As weight ratio) for As(V) complexation were determined, with values of 7.5/20 and 9.2/30 for PDEHED and polyDADMAC, respectively. The UF tests were performed by continuous diafiltration, and diafiltration with volume-reduction modes. The latter method enables the volume of washing solution to be saved during polymer regeneration. As(III) was not complexed (operating under the As(V) complexation conditions), thus a pre-oxidation step, using the photocatalytic approach was carried out to remove As(III) species. As(III) conversion to As(V) was evaluated by As speciation using the CP–UF process for analytical purposes. Photocatalytic oxidation was successfully performed under UV radiation, using $TiO_2$ (0.05 mg $l^{-1}$), $O_2$ and pH = 9. The oxidation was very fast during the first 10 min following zero order kinetics (k = 0.83 mg $l^{-1}$ $min^{-1}$), reaching 90% As(III) oxidation. A conceptual scheme, coupling photocatalysis and CP–UF and some criteria for the operation of the CP–UF process are also reported.

R. Molinari and P. Argurio: *Water Research* **109** 327–336 (1 February 2017).
*https://doi.org/10.1016/j.watres.2016.11.054*

## The role of bacteriophages in membrane-based water treatment processes

Membrane filtration processes have been widely applied in water and wastewater treatment for many decades. Great attention has been paid to concerns that relate to the effectiveness of membrane treatment, service life and fouling control. To achieve sustainable membrane operation with regard to low energy and maintenance cost, monitoring membrane performance and applying suitable membrane control strategies are required. As the most abundant species in water and wastewater, bacteriophages have shown great potential in membrane processes as indicators to assess membrane performance, considering their similar properties to human pathogenic waterborne viruses; surrogate particles to monitor membrane integrity, because of their nano-sized nature; and biological agents, to alleviate membrane fouling, through their antimicrobial properties. This study aims to provide a comprehensive review of the roles of bacteriophages in membrane-based water and wastewater treatment processes. It focuses on their use for examining membrane performance, membrane integrity monitoring and membrane biofouling control. The advantages, limitations and influencing factors for bacteriophage-based applications are reported. The challenges and prospects of bacteriophage-based applications in membrane processes for water treatment are also highlighted.

B. Wu, R. Wang and A.G. Fane: *Water Research* **110** 120–132 (1 March 2017).
*https://doi.org/10.1016/j.watres.2016.12.004*

## The effect of spacer orientation on cake formation during membrane fouling

Spacer design plays an important role in improving the performance of membrane processes for water and wastewater treatment. This work focuses on a fundamental issue of spacer design – that is, investigating the effect of spacer orientation on the fouling behaviour during a membrane process. A series of fouling experiments, with different spacer orientation were carried out to characterise, *in situ*, the formation of a cake layer in a spacer unit cell, using 3D optical coherence tomography (OCT) imaging. The cake layers formed at different times were digitised for the quantitative analysis of the variation in the cake morphology as a function of time. In particular, the local deposition rates were evaluated in order to determine the active regions where the instantaneous changes in deposit thickness were significant. The characterisation results indicate that varying the spacer orientation could substantially change the evolution of membrane fouling by particulate foulants and, thereby, result in a cake layer with various morphologies. The competition between growth and erosion at different locations would instantaneously respond to the micro-hydrodynamic environment that might change with time. This work confirms that OCT-based characterisation is a powerful tool for exploring novel spacer design.

X. Liu, W. Li, T.H. Chong and A.G. Fane: *Water Research* **110** 1–14 (1 March 2017).
*https://doi.org/10.1016/j.watres.2016.12.002*

## Membrane fouling characterisation based on infrared mapping

The authors of this paper describe a synchrotron-based infrared (IR) microscopic method to characterise the fouling layer induced by organic foulants and colloidal silica in membrane distillation (MD). This technique – using the ultra-high brightness of the synchrotron IR source – enables the creation of spectra, with a high signal-to-noise ratio, from micrometre-sized samples. The results show that synchrotron IR mapping was able to resolve the foulant spatial distribution in combined fouling in MD. It shows the spatial distribution of binary foulant (colloidal silica with alginate, bovine serum albumin (BSA) or humic acid, respectively) of the cross-section of the MD

membrane fouling layer. The well-resolved synchrotron IR mapping is also able to quantify the foulant distribution along the cross-section of the fouled MD membrane, providing detailed information regarding the transportation and accumulation of specific foulant. This is of paramount importance to elucidate fouling mechanisms. The authors' results demonstrate that synchrotron IR mapping is a powerful method and has significant potential for both qualitative and quantitative characterisation of the membrane fouling layer.
M. Xie, W. Luo and S.R. Gray: *Water Research* **111** 375–381 (15 March 2017).
*https://doi.org/10.1016/j.watres.2017.01.020*

## Recovery of ammonia and phosphate minerals from swine wastewater

Gas-permeable membrane technology is useful for recovering ammonia ($NH_3$) from liquid manures. In this study, phosphorus (P) recovery via $MgCl_2$ precipitation was enhanced by combining it with $NH_3$ recovery through gas-permeable membranes. Anaerobically digested swine wastewater, containing approximately 2300 mg $NH_4^+$-N $l^{-1}$ and 450 mg P $l^{-1}$, was treated using submerged membranes, plus low-rate aeration, to recover the $NH_3$ from the liquid and $MgCl_2$ to precipitate the P. The experiments included a first configuration where N and P were recovered sequentially and a second configuration involving simultaneous recovery. The low-rate aeration reduced the natural carbonate, increased pH and accelerated $NH_3$ uptake by the gas-permeable membrane system which, in turn, benefited P recovery. Phosphorus removal efficiency was in excess of 90% and P recovery efficiency was about 100%. With higher $NH_3$ capture, the recovered P contained higher $P_2O_5$ content (37–46%, greater than 98% available), similar to the composition of the biomineral newberyite ($MgHPO_4{\cdot}_3H_2O$).
M.B. Vanotti, P.J. Dube, A.A. Szogi and M.C. García-González: *Water Research* **112** 137–146 (1 April 2017).
*https://doi.org/10.1016/j.watres.2017.01.045*

## Effects of chemical cleaning on RO membrane inorganic, organic and microbial foulant removal

Of all of the strategies used to control reverse osmosis (RO) membrane fouling, chemical cleaning is indispensable. To study the effects of chemical cleaning on membrane foulant removal, a comparative analysis of RO membranes, before and after common alkaline and acid cleaning, was conducted by dissecting lead and terminal RO membranes used in a full-scale municipal wastewater reclamation plant. Most foulants on the membranes were removed by chemical cleaning processes. Calcium was the major inorganic component of the foulants because of its highest concentration in the feed water. Aluminium and iron were also abundant elements on the membranes because of their high deposition ratios and low removal efficiencies. Hydrophilic neutrals (HIN) and hydrophobic neutrals (HON) were the two largest dissolved organic matter (DOM) fractions on the membranes before cleaning. HIN and hydrophilic acids (HIA) were not effectively removed. Chemical cleaning removed 94% and 90% of the total bacteria on the lead and tail membranes, and considerably changed the structure of the microbial communities. Bacteria excessively producing extracellular polymeric substance (EPS), such as *Pseudomonas* and *Zoogloea*, were much more resistant to the chemical cleaning process. After cleaning, the membrane microbial community structures were more similar to those in the feed water than the structures on the membranes before cleaning. These results shed light on the effects of cleaning in a full-scale RO plant, improve our understanding of the removal of foulants and provide potential research directions for cleaning methods and RO pretreatment processes.
T. Yu, L. Meng, Q.-B. Zhao, Y. Shi, H.-Y. Hu and Y. Lu: *Water Research* **113** 1–10 (15 April 2017).
*https://doi.org/10.1016/j.watres.2017.01.068*

## Fouling in membrane bioreactors: an updated review

The goal of this article is to update new findings in membrane fouling and emerging fouling mitigation strategies reported in recent years (post 2010), as a follow-up to the authors' previous review – 'Recent advances in membrane bioreactors (MBRs): Membrane fouling and membrane material', *Water Research* 43(6) (2009), pages 1489–1512. According to a systematic review of the literature, membrane bioreactors (MBRs) are still actively investigated in the field of wastewater treatment. Notably, membrane fouling remains the most challenging issue in MBR operation and attracts considerable attention in MBR studies. In this review, the authors summarise the updated information on foulants composition and characteristics in MBRs, which greatly improves our understanding of fouling mechanisms. Furthermore, emerging fouling control strategies (for example, mechanically assisted aeration scouring, *in-situ* chemical cleaning, enzymatic and bacterial degradation of foulants, electrically assisted fouling mitigation and nanomaterial-based membranes) are reviewed. As a result, it is found that the fundamental understanding of dynamic changes in membrane foulants during a long-term operation is essential for the development and implementation of fouling control methods. Recently developed strategies for membrane fouling control indicate that the improvement of membrane performance is not the ultimate and only goal – reduced energy consumption and green or sustainable ways of controlling fouling are also promising areas that are to be developed and applied in the future. Overall, such a literature review not only demonstrates current challenges and research needs for scientists working in the area of MBR technologies, but also provides useful recommendations for industrial communities, based on related application cases.
F. Meng, S. Zhang, Y. Oh, Z. Zhou, H.-S. Shin and S.-R. Chae: *Water Research* **114** 151–180 (1 May 2017).
*https://doi.org/10.1016/j.watres.2017.02.006*

## Improved performance of gravity-driven membrane filtration for sea-water pretreatment

In this study, a pilot, submerged, gravity-driven membrane (GDM) reactor (with an effective volume of 720 l) was operated over a 250-day period and the permeate flux stabilised at 18.6 ± 1.4 l/$m^2$h at a hydrostatic pressure of 40 mbar. This flux was higher than that in the laboratory-scale GDM reactor (16.3 ± 0.2 l/$m^2$h, with an effective volume of 8.4 l) and in the filtration cell system (2.7 ± 0.6 l/$m^2$h, with a feed-side volume of 0.0046 l) when the same flat-sheet membrane was used. Interestingly, when the filtration cell was submerged in the GDM reactor, the flux (17.2 L/$m^2$h) was comparable to that of the submerged membrane module. Analysis of cake layer morphology and foulant properties indicated that a thicker, but more porous cake layer – with less accumulation of organic substances (biopolymers and humics) – contributed to the improved permeate flux. This phenomenon was possibly associated with longer residence time of organic substances and sufficient space for the growth, predation and movement of the eukaryotes in the GDM reactor. In addition, the permeate flux of the submerged hollow-fibre membrane increased with decreasing packing density. It is thought that the movement of large-sized eukaryotes could be limited when the space between the hollow fibres is reduced. In terms of pretreatment, the GDM systems effectively removed turbidity, viable cells and transparent exopolymer particles from the feed sea-water. Importantly, extending the reactor operation time produced permeate with less assimilable organic carbon and biopolymers. Thus, the superior quality of the GDM permeate has the potential to alleviate subsequent reverse osmosis membrane fouling for sea-water treatment.
B. Wu, T. Christen, H.S. Tan, F. Hochstrasser, S.R. Suwarno, X. Liu, T.H. Chong, M. Burkhardt, W. Pronk and A.G. Fane: *Water Research* **114** 59–68 (1 May 2017).
*https://doi.org/10.1016/j.watres.2017.02.022*

# PATENTS

## Microbial fuel-cell

*Applicant:* **Kemira Oyj, Finland**
This invention relates to a microbial fuel-cell. It comprises a cell reactor; a cathode, arranged on the cathode side of the cell reactor; and an anode, arranged on the anode side of the reactor. The cathode and anode are connected to each other through an external circuit. In addition, the reactor includes a proton permeable membrane, which is arranged between the anode and cathode, and divides the reactor into the anode and cathode sides. The membrane has a core with a pore size of ≤ 10 nm and/or divalent rejection ≥ 50%. A hydrophilic polymeric surface layer is formed on at least one side of the membrane core and attached permanently to the core. The associated patent also describes the use of the microbial fuel-cell.
*Patent number:* WO/2017/103339
*Inventors:* M. Hesampour, H. Havansi, S. Halttunen, J. Ruotsalainen, A. Anghelescu-Hakala and J. Pelto
*Publication date:* 22 June 2017

## Method for producing biomethane by purifying biogas from non-hazardous waste storage facilities

*Applicant:* **Waga Energy, France**
A method has been developed for producing biomethane by purifying biogas from non-hazardous waste storage facilities. It involves: compressing the initial gas flow; introducing the flow of gas to be purified into at least one adsorber, loaded with adsorbents capable of reversibly adsorbing volatile organic compounds (VOCs); subjecting the VOC-depleted gas flow exiting the adsorber (loaded with adsorbents capable of reversibly adsorbing the VOCs) to at least one membrane separation step in order to partially separate the $CO_2$ and $O_2$ from the gas flow. The retentate from the membrane separation step is introduced into at least one adsorber, loaded with adsorbents capable of reversibly adsorbing the major portion of the remaining $CO_2$. The $CO_2$-depleted gas flow, exiting the adsorber (loaded with adsorbents capable of reversibly adsorbing the major portion of the remaining $CO_2$) is subjected to a cryogenic separation step in a distillation column in order to separate the $O_2$ and $N_2$ from the gas flow. The $CH_4$-rich flow is then recovered from the cryogenic separation step. This invention also relates to a facility for implementing the method described.
*Patent number:* WO/2017/109305
*Inventors:* G. Prince, M. Lefebvre, P. Briend and N. Paget
*Publication date:* 29 June 2017

## Porous membrane and method for producing it

*Applicant:* **Hurrah Sarl, Luxembourg**
One aspect of this invention provides details of a membrane comprising polyvinyl chloride (PVC) and, at least one inorganic filler (embedded in the porous membrane). This filler comprises sulfuric acid precipitated silica. Preferably, the viscosity of the PVC is at least $K_{wert}$ = 60. The viscosity is measured according to ISO 1628-2. The PVC is selected from the group comprising suspension PVC, microsuspension PVC and emulsion PVC. Another aspect of this invention provides details of a method for manufacturing the porous membrane. It involves a series of steps. Initially, a powder blend is formed that comprises a thermoplastic polymer material and at least one inorganic filler that contains pores. A first solvent is added so that it is absorbed by the pores of the inorganic filler. This solvent is chosen from the group of ketones such as cyclohexanone or methyl ethyl ketone or diacetone alcohol, or a mixture of these. A second solvent – water – is then added, so as to displace the first solvent from the pores of the inorganic filler. The powder is then extruded and/or calendered to obtain a raw membrane, and the porous membrane is formed through liquid phase extraction of the solvents. In a further step, at least one surface of the membrane is, optionally, subjected to deformation in order to obtain a corrugated or ribbed structure.
*Patent number:* WO/2017/108534
*Inventor:* C. Laine
*Publication date:* 29 June 2017

## Composite semipermeable membrane with high acid resistance

*Applicant:* **Toray Industries Inc, Japan**
This invention addresses the problem of creating a composite semipermeable membrane which has a practical level of water permeation performance and high acid resistance. The composite semipermeable membrane described has a support structure and a separation function layer arranged on this support. A characteristic of this membrane is that the separation function layer contains a cross-linked aromatic polyamide and has a pleated structure comprising protruding and depressed parts. The proportion of protruding parts – each having a height of 100 nm or more – in the pleated structure is 80% or more. The separation function layer contains an amino group, a carboxy group and an amide group, in accordance with the formula $y/x \leq 0.81$, where $x$ represents a (carboxy group)/(amide group) molar ratio and $y$ represents an (amino group)/(amide group) molar ratio.
*Patent number:* WO/2017/111140
*Inventors:* K. Ogawa, H. Shimura and T. Sasaki
*Publication date:* 29 June 2017

## Membrane separation device with reduced manufacturing costs and improved maintenance

*Applicant:* **Meidensha Corp, Japan**
The purpose of this invention is to reduce the manufacturing costs of a membrane separation device and improve its maintenance. The associated patent provides details of a membrane cassette, for immersion into the water that is to be treated, which has been supplied in a solid–liquid separation process. The cassette is provided with a plurality of membrane elements; a header receiver, to which headers of the plurality of membrane elements are connected; and a footer receiver, for disposing footers of the plurality of membrane elements, such that the membrane elements are parallel. Furthermore, the membrane cassette is provided with a pair of side covers, attached to the header receiver and the footer receiver, and a holding member attached to the pair of side covers in a state such that the headers or the footers, for the plurality of membrane elements, are pressed and held in place.
*Patent number:* WO/2017/110283
*Inventors:* N. Yoshino, T. Narita and S. Ishimoto
*Publication date:* 29 June 2017

## Apparatus for collecting carbon dioxide and recovering hydrogen from steel-making byproduct gas

*Applicant:* **Korea Research Institute of Chemical Technology, Korea**
This patent describes a method for collecting carbon dioxide and recovering hydrogen from steel-making byproduct gas. The method and apparatus described have specific advantages in that by using a hollow-fibre separating membrane and an absorbent the process is simpler than prior art technology, say the inventors. In addition, the apparatus can be made smaller, and has low installation and operating costs. Even in the case of gas which has not undergone a water–gas shift (WGS) reaction, and contains moisture and other impurities, carbon dioxide can be stably separated and hydrogen can be recovered, claim the inventors. In this

way, the burden of pretreatment is reduced and energy efficiency is increased.
*Patent number:* WO/2017/111503
*Inventors:* P.S. Lee, Y.I. Park, S.E. Nam, H. Park, A. Park, S.J. Kim, J.S. Chang and Y.K. Park
*Publication date:* 29 June 2017

## Water treatment method and system

*Applicant:* **Sumitomo Electric Industries Ltd, Japan**
The water treatment method detailed by this patent, separates – by means of a membrane – oil from water that contains oil and ferrous ions. The method involves a step for oxidising the ferrous ions in the water that is to be treated, and a filtration step for filtering (using the membrane) the water obtained after the oxidisation step. The pH of the water to be treated is adjusted to 6–9 and the redox potential is adjusted to 450–750 mV at the oxidisation step.
*Patent number:* WO/2017/110288
*Inventors:* K. Ikeda, K. Ida and T. Morita
*Publication date:* 29 June 2017

## Method for modifying a polymer separation membrane by means of ultrasonic *in-situ* polymerisation

*Applicant:* **Guizhou Material Industrial Technology Institute, China**
This patent describes a method for modifying a polymer membrane by means of ultrasonic *in-situ* polymerisation, and a polymer separation membrane prepared using this method. According to the inventors, nearby polymer macromolecules, or micro-molecules, are cracked to generate free radicals by means of the cavitation effect of ultrasonic waves, thereby initiating monomers to be grafted onto the surface of a base membrane and undergo an *in-situ* polymerisation reaction to form a copolymer modified thin layer. The polymerised monomers selected are conventional, easily available and relatively inexpensive. Moreover, the preparation method is simple, the operation process is controllable and the membrane material obtained using the modification process has stable and long-lasting hydrophilic performance and, therefore, has a good separation effect when used for water treatment.
*Patent number:* WO/2017/107317
*Inventors:* S. Qin, H. Shao, F. Wei, B. Wu, D. Luo, K. Zhang, M. Zhang, Y. Yao, J. Yang and Z. Cui
*Publication date:* 29 June 2017

## Preparation method for a molecular sieve membrane support body

*Applicant:* **Shandong Guiyuan Advanced Ceramics Co Ltd, China**
A preparation method for a molecular sieve membrane support body forms the subject of this patent. According to the patent's abstract, a nano-composite sol is prepared from magnesium, aluminium, silicon and a lanthanum sintering aid using a sol–gel method, and adheres to a dispersed micron-grade cordierite powder surface. The sol is converted into a nano-composite oxide by means of pre-sintering, and the powder is mixed with a binder and water to create what is described as "mud material". This is extruded and sintered into a cordierite support body. A thin film of zirconium oxide aqueous dispersion is coated onto the outside of the cordierite support body and sintered in order to obtain a molecular sieve membrane support body composed of a cordierite main support layer and a zirconium oxide thin-film layer. The method described creates a double-layer composite support body and the base layer thin-film of the support body on which the molecular sieve grows, having uniform pores and high porosity. The molecular sieve membrane grown on the thin film is uniform, has a relatively short growth period and contains no defects.
*Patent number:* WO/2017/107478
*Inventors:* F. Meng, Z. Fan, J. Zhang and C. Zhang
*Publication date:* 29 June 2017

## Membrane assembly with bonding layer

*Applicant:* **Plansee Se, Austria**
This invention relates to a membrane assembly for permeative separation of a fluid from fluid mixtures. It comprises a porous, fluid-permeable, metal carrier substrate; a membrane formed on this substrate that is selectively permeable to the fluid to be separated; and a coupling part, which is made, at least superficially, from a fluid-tight metal material. The carrier substrate is integrally connected along one edge section to the coupling part, and a ceramic, fluid-permeable, porous first intermediate layer is formed between the carrier substrate and the membrane. At least one ceramic bonding layer is formed directly on the coupling part and the integral connection, extending at least over the integral connection and a neighbouring section of the coupling part. The first intermediate layer extends over the bonding layer and has a larger average pore size than that of the bonding layer.
*Patent number:* WO/2017/106886
*Inventors:* M. Haydn, S. Hummel and M. Brandner
*Publication date:* 29 June 2017

## Composite membrane

*Applicant:* **Toray Industries Inc, Japan**
The composite semipermeable membrane detailed by this patent is provided with a support membrane and a separation function layer. In the membrane, the separation function layer contains an aromatic polyamide that contains a nitro group as a functional group, which is bound to an aromatic ring. When the total number (which is represented by A) of nitrogen atoms, derived from the nitro group in the aromatic polyamide, and the total number (which is represented by B) of nitrogen atoms in the aromatic polyamide are analysed by X-ray photoelectron spectroscopy, the separation function layer satisfies the formula $C–D \geq 0.010$, where C represents an A/B value obtained when X-ray is emitted from one surface of the separation function layer and D represents an A/B value obtained when X-ray is emitted from the other surface of the separation function layer – the other surface of the separation function layer is in contact with the support membrane.
*Patent number:* WO/2017/110898
*Inventors:* K. Sato and T. Sasaki
*Publication date:* 29 June 2017

## Non-cross-linked, high molecular weight, polyimide polymer containing a small amount of bulky diamine

*Applicants:* **Chevron USA Inc**, and **Georgia Tech Research – USA**
One of the methods described by this patent relates to making a membrane comprising a non-cross-linked high molecular weight polyimide polymer with a small amount of bulky diamine. Also detailed is a hollow-fibre polymer membrane that is composed of a non-cross-linked high molecular weight polyimide polymer with a small amount of bulky diamine. The polyimide polymers include monomers comprising dianhydride monomers, diamino monomers without carboxylic acid functional groups, and optionally diamino monomers with carboxylic acid functional groups, wherein 2–10 mole % of the diamino monomers are bulky diamino compounds and the ratio of diamino monomers with carboxylic acid functional groups to diamino monomers without carboxylic acid functional groups is 0 to 2:3. These non-cross-linked high molecular weight polyimide polymers, with a small amount of bulky diamine, are useful in forming polymer membranes with high permeance and good selectivity, which are useful for the separation of fluid mixtures.
*Patent number:* WO/2017/111990
*Inventors:* S.J. Miller, W.J. Koros, N. Li and G. Liu
*Publication date:* 29 June 2017

## Method for preparing a membrane and associated filter element

*Applicant:* **General Electric Co, USA**

This disclosure concerns a method for preparing a membrane and associated filter element. The method involves creating a porous substrate that has a plurality of pores; and applying a pre-filler solution to at least partially occupy the pores in the porous substrate. The membrane comprises a porous substrate and a filter layer formed on the porous substrate. The filter element comprises a core tube, and the membrane prepared as described, which is rolled around the core tube.

*Patent number:* WO/2017/112555
*Inventors:* L. Yang, P. Wang, S. Lu, Z. Liu, Y. Peng and L.C. Costa
*Publication date:* 29 June 2017

## Spiral membrane element

*Applicant:* **Nitto Denko Corp, Japan**

The purpose of this invention is to produce a spiral membrane element that is capable of increasing the effective area of a composite semipermeable membrane. In addition, it is able to suppress a reduction in the blocking rate caused by the deformation of the membrane, whilst securing a sufficient flow of permeated liquid passing through the permeation-side flow-path. The element consists of a laminate, including the composite semipermeable membrane, a supply-side flow-path material and a permeation-side flow-path material. The latter material is formed from a tricot fabric that has a plurality of ridges (each formed from loops linearly repeated in a longitudinal direction) and a plurality of grooves, present between these ridges.

*Patent number:* WO/2017/115653
*Inventors:* M. Nishi, Y. Okazaki and M. Echizen
*Publication date:* 6 July 2017

## Support mounting for a permeable membrane

*Applicant:* **Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Germany**

According to the inventors listed in this patent, mountings for permeable membranes – for separating suspended or dissolved materials in a fluid (crossflow membrane filtration) – can exhibit poor pressure stability when the degree of porosity is good and vice versa. The structure of the membrane mounting detailed by this patent is characterised in that connection braces are arranged between a cylindrical tube wall, with a central longitudinal axis, and a central cylinder along the central longitudinal axis, in a radial manner about the central cylinder, in a uniform symmetrical distribution. The connection braces end in foot points at the tube wall. The pores in the tube wall are arranged in a specified distribution. The membrane mounting described ensures high-pressure stability with, simultaneously, a high degree of porosity. It can be used, for example, in an underwater mass spectrometer with a high degree of measurement sensitivity and precision, which is designed for deep-sea applications (involving pressures up to 400 bar). An optional device located in the central cylinder improves the crossflow behaviour through homogeneous heating with a small controllable energy input. The membrane mounting can be produced in a reproducible manner using 3D printing. Along with the use of the membrane mounting in measuring devices and osmosis methods, yet another preferred application is electrolyte separation methods.

*Patent number:* WO/2017/114522
*Inventors:* C. Hamm and T. Gentz
*Publication date:* 6 July 2017

## System for detecting microorganisms in large-volume samples

*Applicant:* **3M Innovative Properties Co, USA**

A system for detecting microorganisms forms the subject of this patent. The system described includes a lysate collection vessel, a plurality of cell-disrupting particles, a filter unit and a closure element. The lysate collection vessel has an open end that is configured to receive a sample; a closed end; and a cavity that tapers from a wider portion proximate to the open end to a narrower portion proximate to the closed end. The filter unit includes a housing that has a first end, a second end comprising an outlet and a fluid pathway, extending from the first end to the outlet. A membrane filter is disposed in the fluid pathway. The closure element forms a barrier to prevent passage of microorganisms into the filter unit through the outlet. A method of using this system is also discussed.

*Patent number:* WO/2017/116694
*Inventor:* R. Rajagopal
*Publication date:* 6 July 2017

## Method for recovering metals and sulfur from feed streams containing metal sulphides and polysulfides

*Applicant:* **Field Upgrading Ltd, Canada**

A system has been developed for removing sodium and sulfur from a feed stream containing alkali metal sulfides and polysulfides in addition to heavy metals. The system includes an electrolytic cell that has an anolyte compartment housing an anode in contact with an anolyte. The anolyte includes alkali metal sulfides and polysulfides dissolved in a polar organic solvent. The anolyte includes heavy metal ions. A separator includes an ion-conducting membrane and separates the anolyte compartment from a catholyte compartment that includes a cathode in contact with a catholyte. The catholyte includes an alkali ion-conductive liquid. A power source applies a voltage to the electrolytic cell that is high enough to reduce the alkali metal and oxidise sulfur ions to enable recovery of the alkali metal and elemental sulfur. The ratio of sodium to sulfur is such that the open circuit potential of the electrolytic cell is greater than about 2.3 V.

*Patent number:* WO/2017/117373
*Inventor:* J.H. Gordon
*Publication date:* 6 July 2017

## Hollow-fibre membrane module and method for operating it

*Applicant:* **Toray Industries Inc, Japan**

This invention pertains to a hollow-fibre membrane module that can effectively resolve the accumulation of suspended solids within its structure, lower running costs and also operate stably. The module described has a cylindrical case with a first end and a second end in the direction of its height; a plurality of hollow-fibre membranes accommodated within the cylindrical case; and a first potting part accommodated within the cylindrical case and group (attach) together the plurality of hollow-fibre membranes such that their end parts, at the first end side of the cylindrical case, are open. The hollow-fibre membranes possess a breaking strength of 23 MPa, and the membrane module has a membrane area per unit volume of 800–3700 $m^2/m^3$. The filling fraction for the hollow-fibre membranes in a cross-section orthogonal to the direction of the height of the cylindrical case is 25–38%.

*Patent number:* WO/2017/115769
*Inventors:* S. Shimura, K. Iwai, M. Hanakawa, T. Kitade, M. Kimura, A. Kobayashi and A. Nishio
*Publication date:* 6 July 2017

*These patent summaries are based on materials from the World Intellectual Property Organization's Patentscope database https://patentscope.wipo.int.*

# EVENTS CALENDAR

13–16 May 2018
**MELPRO 2018**
(International conference focused on membrane and electromembrane processes)
*Prague, Czech Republic*
**Contact:** CZEMP, Česká membránová platforma z.s., Mánesova 1580, 470 01 Česká Lípa, Czech Republic
Tel: +420 724 865 177
Email: conference@czemp.cz
www.czemp.cz & www.melpro.cz

27–31 May 2018
**The 15th IWA Leading Edge Conference on Water and Wastewater Technologies – Technological Innovations for Improving Water Security**
*Nanjing, China*
**Contact:** International Water Association, Alliance House, 12 Caxton Street, London SW1H 0QS, UK
Tel: +44 207 654 5500, Fax: +44 207 654 5555
http://iwa-let.org

9–13 June 2018
**NAMS 2018 – 27th Annual Meeting**
*Lexington, Kentucky, USA*
**Contact:** North American Membrane Society, University of Arkansas, Ralph E. Martin Department of Chemical Engineering, 3202 Bell Engineering Center, Fayetteville, AR 72701-1201, USA
Tel: +1 479 575 3419, Fax: +1 479 575 7926
Email: Isabel.Escobar@uky.edu
www.membranes.org/2018/index.html

10–13 June 2018
**8th International Colloids Conference**
*Shanghai, China*
**Contact:** Elsevier Ltd, The Boulevard, LangfordLane, Kidlington, Oxford OX5 1GB, UK
Tel: +44 1865 843000
Email: conferenceinfo@elsevier.com
www.elsevier.com/events/conferences/international-colloids-conference

17–20 June 2018
**1st International Conference on Water Security**
*Toronto, Canada*
**Contact:** Elsevier Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, UK
Tel: +44 1865 843000
Email: conferenceinfo@elsevier.com
www.elsevier.com/events/conferences/water-security-conference

8–12 July 2018
**Singapore International Water Week**
*Singapore*
**Contact:** Singapore International Water Week Pte Ltd, 40 Scotts Road 22–02, Environment Building, Singapore 228231
Tel: +65 6595 6303
Email: info@siww.com.sg
www.siww.com.sg

9–13 July 2018
**Euromembrane 2018**
*València, Spain*
**Contact:** Technical Secretariat , Universitat Politècnica de València, Centro de Formación Permanente, Edificio Nexus (6G), Camino de Vera s/n, València, 46022, Spain
Tel: +34 963 877 751
Email: congresos@cfp.upv.es
http://euromembrane2018.org

29 July to 2 August 2018
**African Membrane Society**
**2nd International Congress (AMSIC-2 2018)**
*Johannesburg, South Africa*
**Contact:** Nanotechnology and Water Sustainability (NanoWS), UNISA Science Campus, Corner of Christian de Wet and Pioneer Avenues, Florida, Gauteng, 1709, South Africa
Tel: +27 11 670 9716
Email: nanows@unisa.ac.za
www.sam-ptf.com/index.html

29 September to 3 October 2018
**WEFTEC 2018 – 91st Annual Technical Exhibition & Conference**
*New Orleans, Louisiana, USA*
**Contact:** Water Environment Federation (WEF), 601 Wythe Street, Alexandria, VA 22314, USA
Tel: +1 571 830 1545, Fax: +1 703 684 2492
www.weftec.org

22–26 October 2018
**Ontario Water Innovation Week**
*Toronto, Canada*
**Contact:** Water Technology Acceleration Project (WaterTAP), 20 Adelaide Street East, 13th Floor, Toronto M5C 2T6, Ontario, Canada
Tel: +1 416 593 0303
www.watertapontario.com

14–15 November 2018
**Aachener Membran Kolloquium**
*Aachen, Germany*
**Contact:** Aachener Verfahrenstechnik – Chemical Process Engineering, RWTH Aachen University, Forckenbecktstr. 51, D-52074 Aachen, Germany
Tel: +49 241 80 29942,
Fax: +49 241 80 92252
Email: amk@avt.rwth-aachen.de
www.amk.rwth-aachen.de

## AkzoNobel and Evonik start membrane electrolysis operation

**AkzoNobel Specialty Chemicals and Evonik Industries AG have formed Neolyse Ibbenbüren GmbH – a joint venture set up to produce potassium hydroxide solution, chlorine and hydrogen at a site in Ibbenbüren, Germany.**

The plant, which uses the latest membrane technology, has an annual capacity of 120 000 metric tons of potassium hydroxide solution and 75 000 metric tons of chlorine and hydrogen. Operated by AkzoNobel, the facility strengthens the respective leading positions of both firms, says Evonik.

AkzoNobel commercialises chlorine and hydrogen, whilst Evonik distributes the locally produced potassium hydroxide solution and processes parts of it into other products, such as potassium carbonate, potassium bicarbonate and potassium formate at its Lülsdorf site.

Commenting on the joint venture, Werner Fuhrmann, the chairman of AkzoNobel Specialty Chemicals' executive board, said: 'The Ibbenbüren facility sets a completely new standard for the chlor-alkali industry. It enables us to secure the supply of our customers in the long term whilst further improving our company's sustainability profile and operational efficiency.'

According to Evonik, the new production process at the site improves the ecological footprint of every metric ton of chlorine produced in Ibbenbüren by 25–30% – resulting in lower energy consumption and $CO_2$ emissions.

Dr Harald Schwager, the deputy chairman of Evonik's executive board, added: 'We demonstrated throughout the course of the project that two experienced partners can contribute their diverse experience to intelligently shape their business environment. We complement each other very well and look forward to continuing our collaboration, which benefits our customers and, therefore, ultimately also the market for potassium hydroxide.'

For further information, visit: www.evonik.com & www.akzonobel.com/about-us/ specialty-chemicals