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November/December 2013
Volume 32 No. 6
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Sonobond Ultrasonics Equipment Assembles High Efficiency and Specialty Filtration Products

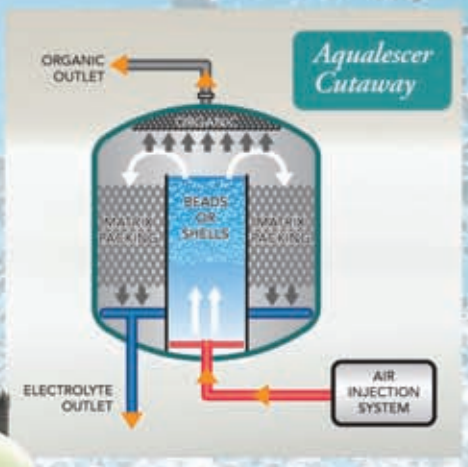
Show Reports:
-AFS Fall Conference
-Filtech 2013

Membranes:
-Choosing the Right Technology
-Membrane Systems Chemistry

Coalesce Your Way to Lower Costs with AQUALESCER™

by SpinTek

Central Asia Mining Kazakhstan



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- **Improve performance of dual-media filters**
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- **Reduce backwash frequency; minimize costs**
- **Improve final effluent quality**

SpinTek's new **Aqualescer®** for hydrometallurgy applications provides effective coalescence of entrained organic to improve performance of dual-media filters and lower costs.

FIELD TESTING The system was shown capable of operating pressures under 140kPa and obtained entrained organic removal of up to 95% for both electrolyte and raffinate streams.

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Filtration Media and Membranes in Focus at AFS Fall Conference

AFS Fall Meeting on Filtration Media and Membranes

The 2013 AFS Fall Conference on the subject of Innovations in Filter Media and Membranes was held in Cincinnati, Ohio, October 14-16. Filtration media is the heart and soul of the filtration industry with membranes the most widely produced, and by far the largest use of media in the industry in terms of market dollar value. Global membrane media production is approaching $4.5 billion annually with North American-based producers supplying the lion's share of the world market. Synthetic nonwoven fabrics follow with approximately $2.3 billion globally and as high as $3.5 billion, if wetlaid cellulose and glass are added. The conference was well attended and one of the widest array of innovative new filtration media introductions and updates in recent years. The conference co-chairs and organizers were George G. Chase, George Lu and Peter Tsai.

As with all AFS conferences (spring and fall), the Fall Conference began with an offering of nine short courses lasting either 4 or 8 hours, each presented by a leading industry expert on topics including: Introduction to Liquid Filtration; Microfiltration Membranes; Filtration & Separations Media Use and Markets; Nanofiber Technology in Filtration; Liquid Filtration Testing Basics; Ultrafiltration Membranes, Theoretical and Experimental Aspects of Designing Media and Filters for Air Filtration; Filter Media Design for Liquid Filtration; and Reverse Osmosis System Design. These C.E.U. credit courses are designed for both industry newcomers and journeymen who seek to sharpen their skills and knowledge base.

The main conference began with Steffen Schuetz of Mann + Hummel providing a plenary presentation on the Development and Application of Ceramic Hollow Fiber Membranes. This was followed by six sessions with four presentations each for the remainder of the day on topics including: Challenges in Fuel/Water Separations (two sessions), Membrane/Filtration of Produced Water and Water Treatment, Membrane Technologies for Water and Wastewater Applications, New Development of Nonwovens in Filtration and

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Jerry Lynch of ITFS offers testing advise at the Fall Conference.

Attendees had plenty of opportunities to network.

Industrial Process Filtration and Separations.

Following the main conference sessions on the first day, the Corporate Sponsors met and were updated on a new four-hour educational course on the subject of the Basics in Liquid Filtration, a recently distributed 150 page Market Landscape Report on Global Markets for Nonwoven Fabrics and a number of additional exclusive benefits provided by the AFS to all Corporate Sponsors. Following the meeting, an open networking reception was held for all conference attendees.

The final day's plenary speaker was R. Vijayakumar of Aerfil, who gave an insightful presentation on his work and progress with NASA in creating air filtration systems for the International Space Station (ISS) and NASA's planned five year trip to Mars and back. Six technical sessions followed, including: Innovations in Filter Media Technologies, Membrane and Filter Testing, Recent Trends in Liquid Filtration, Extreme Environments and Nano Scale, Self-Cleaning and Metal Filters, and Recent Developments of Micro and Nano Fibers.

Peter Cartwright of Cartwright Consulting gave a compelling keynote presentation titled Water for Everyone – What Does the Future Hold?

At the AFS Board of Directors meeting, the following officers were installed for 2014: Mark Willingham, Purolator-Facet as Chairman; Chris Wallace, Filtration Technology Corporation as First Vice Chairman; and Klaas De Waal, International Filtration News as Second Vice Chairman. New Board members for 2014/2015 were John Barbee, Hollingsworth & Vose; Ed Gregor, Edward C. Gregor & Associates, LLC; Kirsten Kirk, Filtration & Separation Technology; Felicia Littlejohn, Pentair; Wilson Poon, W.L. Gore & Associates; and Christine Sun, Textile Research Associates.

The 2014 AFS Spring Conference will be held March 24-26 at the Houston Marriott, Westchase, Texas, on the subject of Oil, Gas & Chemical Processing. Abstracts are due by January 24 with an early discount registration deadline of January 30.

The American Filtration & Separation Society is the largest Filtration Society in the world and the principal educator of the industry. For more information on corporate or individual membership, visit the AFS website: www.asfsociety.org or phone Ms. Lyn Sholl, AFS Executive Manager: 615-250-7784.

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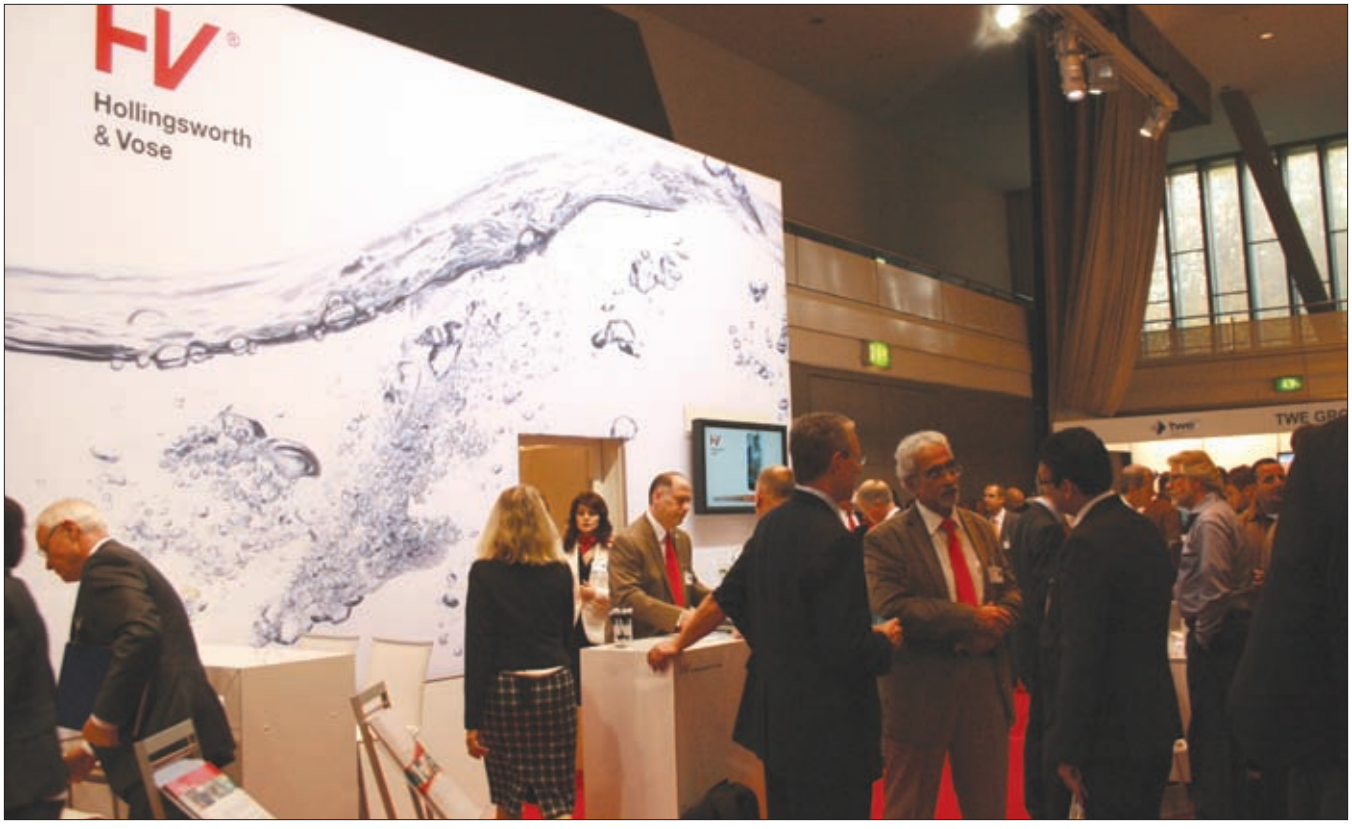
Growing with the Industry

The Filtech conference and show goes from strength to strength, with a larger venue planned for the next edition

By Adrian Wilson, European Correspondent



The busy stand of Hollingsworth & Vose at the show.

Exhibitors at Filtech 2013 were unanimous in endorsing the show as the leading event on the calendar for meeting those vital decision makers within the ever-growing filtration industry. However, in the immediate future, picturesque Wiesbaden will no longer serve as the event's backdrop – the city's exhibition center is to be demolished, to make way for a replacement three times its size. The next Filtech will now be held at the much bigger Messe in Cologne from February 24-26, 2015 – illustrating the event's growing stature.

Over 200 papers were presented during the conference between October 22-24 of this year, while some 450 exhibitors from 37 countries took part – up 20% from the last event in 2011.

NANOWAVE EXPANSION

Taking center stage in Hall 1 at Filtech 2013 was Hollingsworth and Vose, one of the key players in nonwoven-based filter media, with manufacturing sites in the Americas, Europe and Asia.

The company announced that it now plans to add NanoWave filtration media production capability at its plant in Hatzfeld, Germany, to support the rapid growth in demand for high performance filter media.

NanoWave is an extended surface area, multi-layer filtration media for HVAC applications. Using nano and coarse fiber layers, it is said to deliver 2.4 times the surface area of normal flat sheet media. The waved nanofiber layer allows for maximum mechanical efficiency with very low resistance, while more than doubling dust-holding capacity compared to standard synthetic media.

The Hatzfeld production line is expected to start operations by mid 2015. H&V currently manufactures NanoWave media in the U.S. at its plant in Floyd, Virginia.

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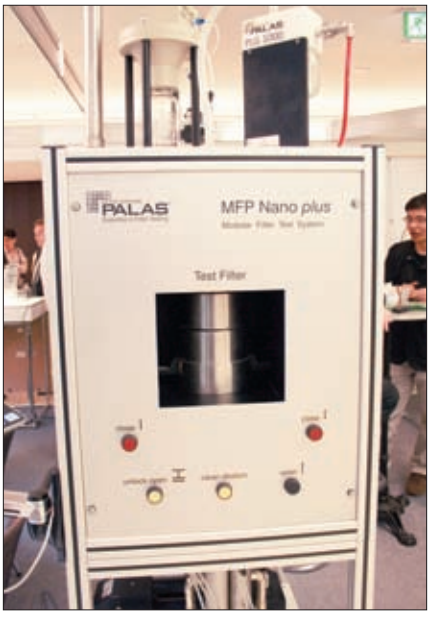
Bindu Muralidharan and Anubhav Verma of India's a2z demonstrate their technology.



The new Palas MFP Nano Plus

"In addition to the European capacity expansion, further performance improvements and next generation product developments will result in increased service levels for our European customers," said Jochem Hofstetter, vice-president and managing director, Europe, Middle East and Africa Region (EMEA).

FLOW2SAVE

Another leader in filter media is Helsinki-headquartered Ahlstrom, which introduced its new Flow2Save product for high efficiency air (HEA) filtration applications.

The patent-pending media is based on a gradient structure combining different advanced technologies and provides high filtration efficiency to improve indoor air quality, which is especially important in public buildings such as hospitals and schools, and to help alleviate Sick Building Syndrome (SBS).

SBS causes skin irritations, headache, and respiratory problems, and thought to be caused by indoor pollutants, microorganisms or inadequate ventilation.

"Flow2Save has significantly better pressure drop characteristics than other commercial HEA filtration media, meaning it is much easier for the ventilation system to push air through the filter," explained Fulvio Capussotti, EVP for Ahlstrom Advanced Filtration. "This allows significant energy savings throughout the life time of the filter. As such, its sustainability credentials are compelling – cleaner indoor air quality, lower energy consumption and lower costs."

PIGMENT RECOVERY

Lydall announced that it has teamed up with Limburg Filter, based in Maastricht, Netherlands, to co-develop a best-in-class filtration solution for the recovery of fine pigment powder.

This combines Lydall's Solupor membrane with Limburg's Leaktite filtration technology.

Solupor is a porous, durable and chemical resistant, ultra-high molecular polyethylene membrane that produces very high-filtration efficiencies with low-pressure loss. Its current applications include liquid filtration in medical, biopharmaceutical and water purification environments.

Leaktite is a newly developed filtration technology suitable for removal of liquids from slurries using a chamber filter press. It was first proven in the filtration of aqueous graphite dispersions followed by many other applications in the chemical industry.

One of the major filtration issues in the recovery of pigments is that traditional filtration technologies require filtrate recycling – or so-called reflux – until a filter cake has been built up, resulting in a relatively inefficient process. By using the Solupor membrane, the Leaktite filter is now able to provide a single-pass filtration option and increase the efficiency for the recovery of expensive pigments, eliminating the need for reflux.

POREX ACQUISITION

It was also announced during Filtech that the Chicago-headquartered Filtration Group is to acquire Porex Corporation, based in Fairburn, Georgia, from Los Angeles investment firm Aurora Capital.

Founded in 1961, Porex is a global leader in the development and manufacturing of porous polymer products – including plastics, nonwovens and glass-based media. It experienced strong growth during its partnership with Aurora, strengthening its market-leading position through a number of strategic initiatives and streamlining growth through industry-leading innovation.

At Filtech, Porex Vice President and General Manager Jeff Williams demonstrated the Porex 61 tube crossflow fil-

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Swiss precision was demonstrated in the form of JCEM's digital CNC-controlled blade pleating technology.

Vaughan Williams and Debbie Christoff of Dexmet Corporation

tration module, which consists of 61 half-inch diameter tubes providing some 45.75 square feet of high solids-concentrating surface area per module.

It features unique structural membrane tubes, with the membrane substantially anchored in, or chemically fused to the sintered porous plastic substrate tube.

"The modules are designed for crossflow filtration in the microfiltration and ultrafiltration range," Mr. Williams explained.

"This patented membrane/substrate composite resists damage from scratching and abrasion as well as tolerating high pressure in forward and reverse flow conditions. The resulting composites feature broad chemical, temperature and abrasion resistance."

Applications include water and wastewater, lime softening, pre-RO, heavy metals removal, fluoride removal and oil water separation.

PEEK STRENGTH

Another U.S. company, Dexmet, of Wallingford, Connecticut, promoted the advantages of Victrex PEEK polymer in film form.

"Applications requiring high temperatures to filter caustic gases or fluids, such as in the semiconductor, chemical processing and petrol/gas industries typically employ expanded PTFE, PFA and ECTFE as a support material," explained Product Manager Debbie Christoff. "All of these materials provide excellent temperature and chemical resistance but none match the mechanical strength provided by PolyGrid Aptiv PEEK films."

The advantages include dimensional stability on opening size under high flow/high pressure situations, with the increased strength ensuring media integrity and pleat spacing under dynamic flow. The ability to utilize thinner support materials allows the working surface area of the filter to be increased too.

SUPERABSORBENT

An interesting material with wide potential in filtration is SAF – superabsorbent fiber – promoted by the U.K.'s Technical Absorbents.

SAF is the key component in media designed for the removal of water and particulates from aviation fuel, automotive diesel and a wide range of oils to reduce problems associated with water contamination.

"A significant reason for the majority of oil and fuel system failures is the presence of high water levels in dissolved, dispersed and free water," said the company's General Manager Dave Hill. "SAF-based filter media fabrics can remove both dispersed and free water to very low ppm levels at industry leading rates."

The company has also developed monitor cartridges, which incorporate a multi-layer SAF-containing nonwoven composite.

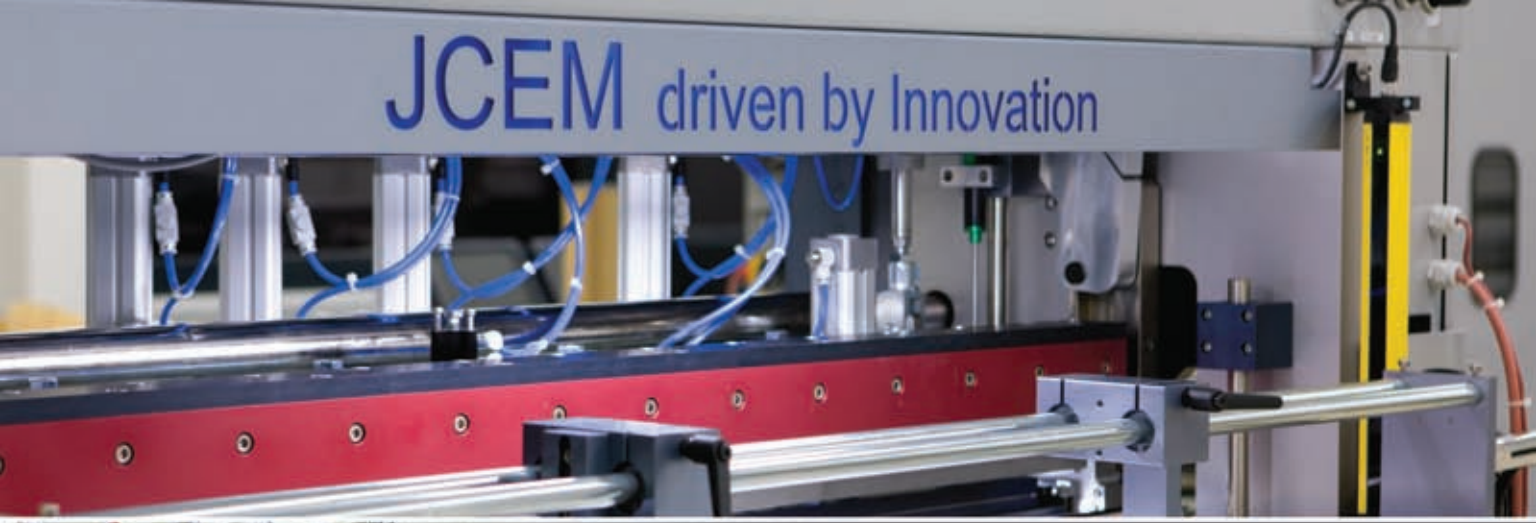
The cartridges have been designed to reduce particulates to less than 0.3mg/liter of solids in effluent and reduce free and dispersed water to less than 5 ppm in effluent. The system flow is halted when the media is hit with a localized slug of water and a gel block is formed. The presence of water/solids in the incoming fuel gives rise to an increase in pressure differential, or a decrease in the flow rate, as the cartridges reach their maximum capacity for solids, water or a combination of both.

The company supplies cartridges for both automotive diesel and hydraulic oil.

TECHNOLOGY

On the testing technology front, Palas introduced the MFP Nano Plus and at the conference, Martin Schmidt explained that because nanoparticles are increasingly becoming the focus of scientific research in respect of the environment and toxicology, the minimization of emissions in the nanometer range and the properties of filter media are gaining in importance.

JCEM driven by Innovation



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Porex vice-president and general manager Jeff Williams demonstrates the company's latest 61 tube crossflow filtration module.

As a consequence, the recently introduced ISO 29463 standard includes more filter classes compared to the commonly used EN 1822 and the range of a single filter class has been made narrower.

This calls for more sensitive and reproducible test equipment that must also be flexible enough to accommodate DEHS (di-ethyl-hexyl-sebacat) droplets or salt aerosols in addition to fibers.

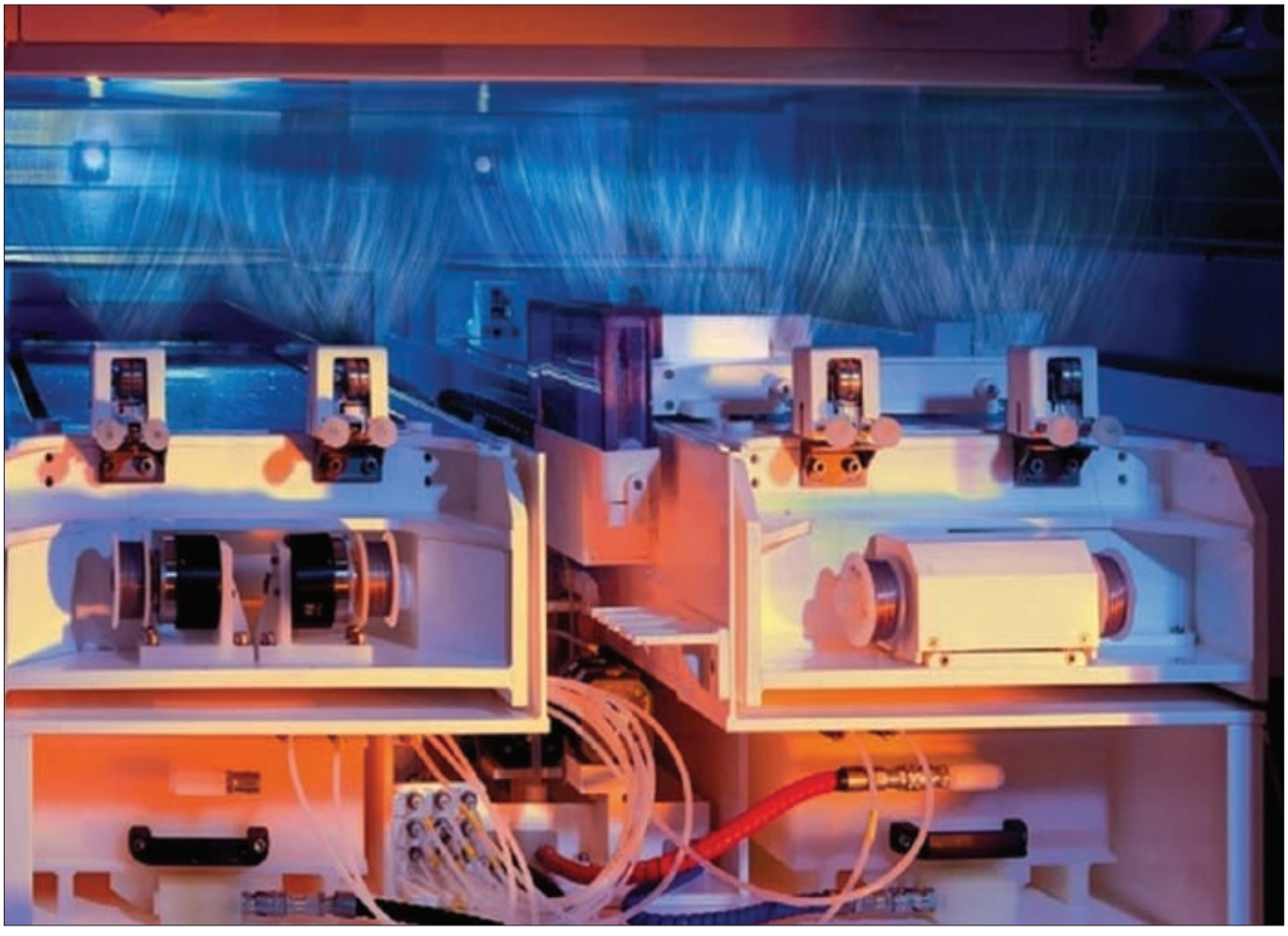
The Palas MFP Nano Plus has been developed to quickly and reliably test the MPPS (most penetrating particle size) of flat sheet media. As such, it is equipped with the UGF 2000 aerosol generator to be used for salt dispersion or for the dispersion of DEHS droplets.

Two separate dilution columns for salt or DEHS with dilution factors 10, 100, 1,000 and 10,000 allow a maximum flexibility in the test conditions. The system can also be equipped with various different optical aerosol spectrometers and as such, represents a flexible, reliable and economic filter media testing system. FN

Driving Down Filter Fineness

From World War II Russian gas masks to the latest medical implants – the technology for producing nanofibers and their many end-uses continue to evolve

By Adrian Wilson, European Correspondent



Elmarco's nozzle-less Nanospider electrospinning system exploits a natural self-organization of polymer jets.

The role of the filtration industry in developing the technology to produce nanofibers was underlined at the recent Dornbirn Manmade Fiber Conference, held in Dornbirn, Austria, from September 11-13.

In his overview of recent developments in this field, Stansilav Petrik of the Institute for Nanomaterials based at the Technical University of Liberec in the Czech Republic, explained that electrospun fibers were first developed by Russian scientists as the basis of 'Petryanov Filters' in the 1930s. By 1939, these were being mass-produced as filter elements for gas masks.

The material – dubbed BF (Battlefield Filter) – was spun from cellulose acetate in a solvent mixture of dichloromethane and ethanol. At the height of the Cold War, the output of electrospun filtration material at the factory in Tver, Russia, was claimed to be 20 million square meters annually.

In the USA, leading filtration specialist Donaldson has now been electrospinning nanofiber layers for its products for over thirty years and today hundreds of laboratories worldwide are active in further researching the electrospinning process,

developing new nanofiber materials and finding fresh applications for them.

Nanofiber nonwoven-structured layers are ideal for creating composite materials with regular nonwovens and the most developed application for such materials is in air filtration, while liquid filters and battery separators are more recent and growing markets.

Several biomedical applications have also been developed – often from biocompatible/degradable polymers like PLA, gelatine, collagen, chitosan, etc. – for applications including wound care, scaffolds and even drug delivery systems. There is also a growing interest in inorganic/ceramic nanofibers as materials for energy generation and storage, as well as catalytic materials.

LIMITATIONS

While electrospinning has been the first method for the production of such very fine submicron fibers to reach industrial production scale, it does have limitations. These are chiefly connected to the use of often-dangerous solvents, but also to relatively low productivity, which has motivated the development of alternatives in recent years.

The electrospinning process generally involves the formation of the nanofibers from a liquid polymer jet in a longitudinal electric field. The dominant mechanism is whipping elongation occurring due to bending instability. Secondary splitting of the liquid polymer streams can also occur, but the final thinning process is elongation.

Some efforts to scale up the electrospinning technology have been based on a multiplication of the jets using multi-nozzle constructions as developed by NanoStatics Corporation, based in Circleville, Ohio, and also by South Korea's Toptec, based on a design developed by Itochu in Japan.

The number of jets required to reach an economically acceptable rate of productivity, however, is very high – typically thousands. This brings into play many challenges in respect to reliability, quality consistency and machine maintenance – especially cleaning.

SPONTANEOUS JETS

Most of these problems have been solved with the advent of so-called nozzle-less electrospinning, largely due to its mechanical simplicity. This process, however, is also more complex as a result of its spontaneous multi-jet nature.

In this system, a self-organization of the jets occurs, and consequently the number and spacing of the jets is optimal, even if the technology variables – voltage, viscosity and surface tension of the solution – change. This leads to significant improvement in process stability and consistent quality of the nanofiber layers produced.

In its simplest realization, a nozzle-less electrospinning head consists of a rotating drum dipped into a bath of liquid polymer. The thin layer of polymer is carried on the drum surface and exposed to a high voltage electric field. If the voltage exceeds the critical value, a number of electrospinning jets are generated. One of the main advantages of nozzle-less electrospinning is that the number and location of the jets is set up naturally in their optimal positions.

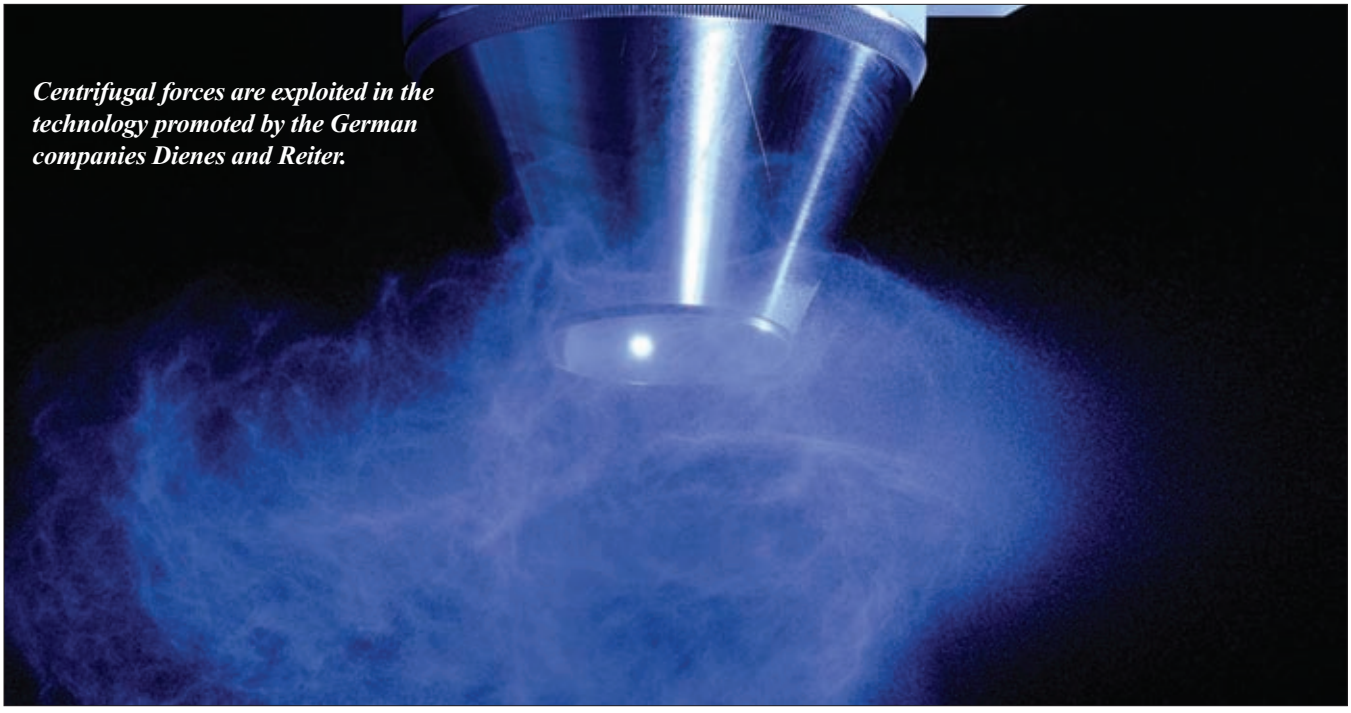
Several types of rotating electrodes for free liquid surface electrospinning for industrial machines have now been developed, but the drum type is still one of the most productive.

NANOSPIDER

Significant improvements of the nozzleless technology have been made on the commercially available Nanospider system manufactured Elmarco in the Czech Republic. The system uses stationary string electrodes supplied with polymer solution by a proprietary moving 'painting' head. This results in a dramatic decrease of solvent evaporation during the process, which has to be removed from the exhaust air released from the machine. The polymer solution concentration is also stable, enabling the system to typically run for more than 24 hours.

ALTERNATIVES

There are a number of other alternatives to electrospinning that have been developed, including a number of extrusion methods developed at Hills Inc., in West Melbourne, Florida. These include meltblowing, islands-in-the-sea technology and a process known as nanotubing.



Centrifugal forces are exploited in the technology promoted by the German companies Dienes and Reiter.

Centrifugal forces for the elongation of liquid polymer into thin fibers are meanwhile employed in the technology promoted by the German companies Dienes and Reiter. The productivity of this process is high – up to 1,000 cm3/m hr, but the fiber diameter distribution and homogeneity of the deposited nanofiber layer is not at the

levels achieved by electrospinning.

A strong commercial drive is also being made by FibeRio in McAllen, Texas, with production based on the 'force spinning' principle. This was developed at the University of Texas Pan American and is based on a high-speed rotating spinneret depositing nanofibers on a radial collector. The productivity of this process should be of an order higher than electrospinning.

The mechanical design of the equipment, however, is much more demanding with parts rotating at tens of thousands rpm, fed with liquid polymer. Radial deposition of the nanofiber materials produced could also be challenging where continuous roll-to-roll deposition of a thin layer to a substrate is required, e.g., at the nanofiber filtration media production.

LIQUID SHEAR

Shear forces in a rotating liquid containing polymer droplets are the basis of the XanoShear method developed at North Carolina State University and being commercialized by Xanofi Company, of Raleigh, North Carolina.

The liquid shear nanofabrication process subjects polymer solution droplets to simultaneous shear and anti-solvent induced precipitation in viscous liquid media. The typical lab scale process involves creation of laminar shear in viscous media using a shear impeller and injection of polymer solution droplets into it.

During the shear process, the low interfacial tension between major components of viscous media, i.e., glycerol and polymer solution, leads to infinite stretching of polymer droplets into proto fibers and simultaneous precipitation by the anti-solvent component in viscous media gives rise to solidified fibers of very thin diameter in the range 300-500 nanometers.

OPPORTUNITIES

"The high-quality low-cost production of nanofiber layers is essential to support the enormous amount of research results being obtained at many universities and research centers," said Mr. Petrik in summing up. "Some of the technologies have matured to a level where large scale production use is common, and can be modified for practically all known polymers soluble in organic solvents and water, as well as for polymer melts. This opens commercial opportunities for hundreds of ideas being developed in the academic sphere."

FibeRio production route is based on the 'force spinning' principle.

Assembling High Efficiency and Specialty Filtration Products with Ultrasonics

Left: Sonobond's SM86 SeamMaster High Profile ultrasonic sewing machine

Below: Great Lakes Filters uses Sonobond Ultrasonics' SM86 ultrasonic sewing machine to assemble liquid filter bags that withstand hydraulic pressing.

When a U.S. company needed to ensure that its industrial grade fruit and vegetable juicers could achieve maximum extraction, it went to Great Lakes Filters for a liquid filter bag assembled using Sonobond® Ultrasonics' SM86 SeamMaster™ High Profile ultrasonic sewing machine.

"The bag has to capture the pulp from the juicing process and then withstand hydraulic pressing without splitting or fraying in order to obtain the utmost amount of nutrients," explained Brian K. Balliet, CEO of Great Lakes Filters, in Hillsdale, Michigan. "Sonobond's equipment allows us to produce a bag that can do that and meet the customer's exacting standards."

That's just one example of how Sonobond Ultrasonics has helped Great Lakes Filters maintain its reputation as a customer-driven company with the flexibility and versatility to achieve product specifications and exceed customer expectations. From prototypes to major programs, the company performs a multitude of high quality converting and production jobs.

THE SONOBOND ADVANTAGE

Starting with assembly methods that included sewing, adhesives, and hot glue thermal bonding, in 1989 Great Lakes Filters began to investigate ultrasonic machinery.

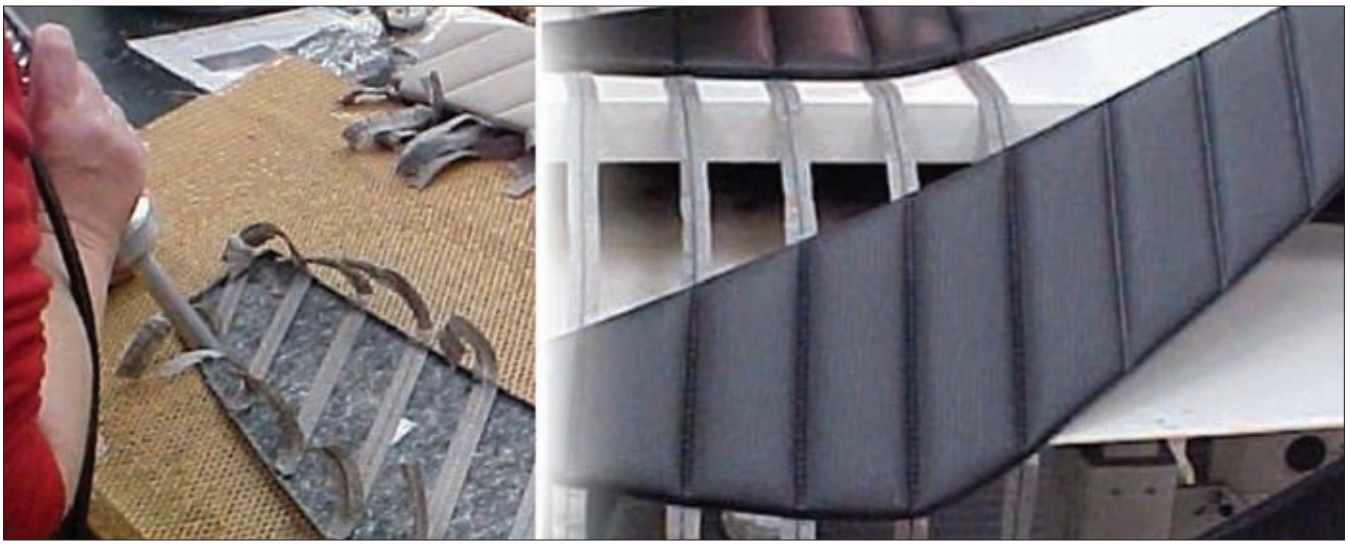
"We looked at Sonobond's SeamMaster because it's similar in design and operation to a standard sewing machine. We also appreciated Sonobond's willingness to work closely with us to determine what equipment we would require to assemble certain products," said Mr. Balliet.

Today, Great Lakes Filters uses three SeamMaster ultrasonic sewing machines to assemble its liquid filter bags – including custom and specialty bags – plus sleeves, pads, and other filtration products for the chemical/pharmaceutical, automotive, environmental, food/beverage and manufacturing industries.

"We use the SeamMasters with a variety of pattern wheels – including some custom ones – whenever sewn seams are simply not adequate or strong enough to hold up to a filter bag's end use, to eliminate fraying, or in some cases, to provide an acceptable look for the finished product," said Mr. Balliet.

ULTRASONIC ASSEMBLY

Ultrasonic bonding occurs when high frequency electrical energy – converted to acoustical, mechanical vibrations and channeled through a horn – creates a rapid heat buildup at the material contact



Great Lakes Filters' sister company, Fairway Products, uses Sonobond's handheld ultrasonic equipment to finish the ends of a synthetic seam tape that's continuously sewn to the back of vehicle door inserts. After being cut apart between the inserts, the ends of the tape are folded back onto themselves, ultrasonically sealed and then clipped, resulting in a clean and secure finish that maintains the appearance of the lines being sewn into the door skin.

point, causing the fabric between the horn and anvil – or the rotating pattern wheel in the case of the SeamMaster – to soften and fuse. In one pass, the machine seals and trims without thread, glue or other consumables, as much as four times faster than conventional sewing machines and ten times faster than adhesive methods. Yet, the SeamMaster is easy to operate and requires only minimal training.

FLEXIBLE ULTRASONIC CAPABILITY

In addition to its SeamMaster machines, Great Lakes Filters also employs a Sonobond Ultrasonics SureCut™ HC35 and four HG35 handheld devices.

"Sonobond's equipment has allowed us to fabricate and attach materials that are difficult via traditional cut and sew methods, resulting in higher quality products at lower production cost," said Mr. Balliet.

In one case, Sonobond equipment enabled Great Lakes Filters to keep production going for a firm on the brink of halting operations when an order for rolls of filter media didn't arrive on time. Using Sonobond's handheld ultrasonic devices, Great Lakes Filters spliced together production remnants into rolls wide and long enough so its customer could continue manufacturing.

Great Lakes Filters also shares its Sonobond equipment with its sister company Fairway Products, for ultrasonic assembly of automotive trim parts, door inserts and office furniture products.

For example, Fairway Products uses the handheld units to finish the ends of a synthetic seam tape that's continuously sewn to the back of vehicle door inserts and cut between the inserts. The ends of the tape are folded back onto themselves, ultrasonically sealed and then clipped, producing a clean and secure finish.

"Using the ultrasonic equipment eliminates the need for back tacks on sew lines and maintains the appearance of the lines being sewn into the panel insert, rather than being welded to a molded door skin," explained Steve Firavich, CEO of Fairway Products.

FREE MATERIALS BONDING TEST

Recognizing that companies have unique manufacturing requirements, Sonobond offers a no-cost, no-obligation Ultrasonic Bonding Viability Test, producing sample assemblies with potential customers' own nonwoven or synthetic fabrics to insure that Sonobond equipment is right for their applications. Also, Sonobond works closely with its customers, providing service and technical support before, during and after equipment delivery and installation.

DEVELOPING NEW PRODUCTS

Great Lakes Filters is currently exploring high efficiency liquid filter bags made from proprietary nanofiltration media. The bags are designed to filter in the submicron range, handling flow rates with minimum pressure drop and 99+ percent efficiency – requirements that usually require costly multiple pleated cartridges instead of a single filter bag.

Once again, Sonobond is working with Great Lakes Filters to provide an ultrasonic assembly method for this innovative product.

"Sonobond has already assisted us in proving that their equipment can do the job, creating a side seam and securing a plastic top for this high efficiency liquid filter bag that's totally recyclable," said Mr. Balliet. "The Sonobond staff has been and continues to be extremely helpful with testing materials, making recommendations on what wheels and settings to use with the SeamMaster, and providing excellent customer service." FN

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Great Lakes Filters
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Fairway Products
Website: www.fairway-products.com

TriSep's New Membrane Concepts

By Evan Calkins, Sales Engineer, TriSep Corporation

The first practical reverse osmosis (RO) membrane was invented in 1959 by Loeb and Sourirajan at the University of California, Los Angeles. Fifty-four years later, there are seven major manufacturers of RO membranes in the world, even more that make their own NF/UF membranes, and numerous other companies that buy membrane sheet for the purpose of fabricating commodity-type membrane elements. Even after the emergence of so many different players over half a century, there are few companies offering a diverse line of membrane chemistries that are committed to providing value-added products based on application-specific requirements.

TriSep's proprietary membrane and element technologies and ability to customize are exactly what make them the Specialty Membrane Company. TriSep™ membranes are used in a variety of applications, from sugar and protein processing to treatment of industrial and municipal water and wastewater. As a company, TriSep focuses on markets and applications wherein clients may derive the most value. Often that requires utilizing customization capabilities to make products that other companies can't.

The six main components in a spiral-wound element are the membrane, feed spacer, permeate carrier, permeate tube, outer wrap and, in some cases, anti-telescoping devices (ATDs). TriSep has the ability to use custom materials, sizes and geometries for each of these components to meet the needs of a particular application. Wider feed spacers are often used in process applications to manage pressure drop or account for high viscosity. Custom permeate tubes (length, diameter, male versus female) and element dimensions allow TriSep to match the specifications of other manufacturers' products, which comes in particularly useful when a customer requires a direct replacement to a product that has been discontinued.

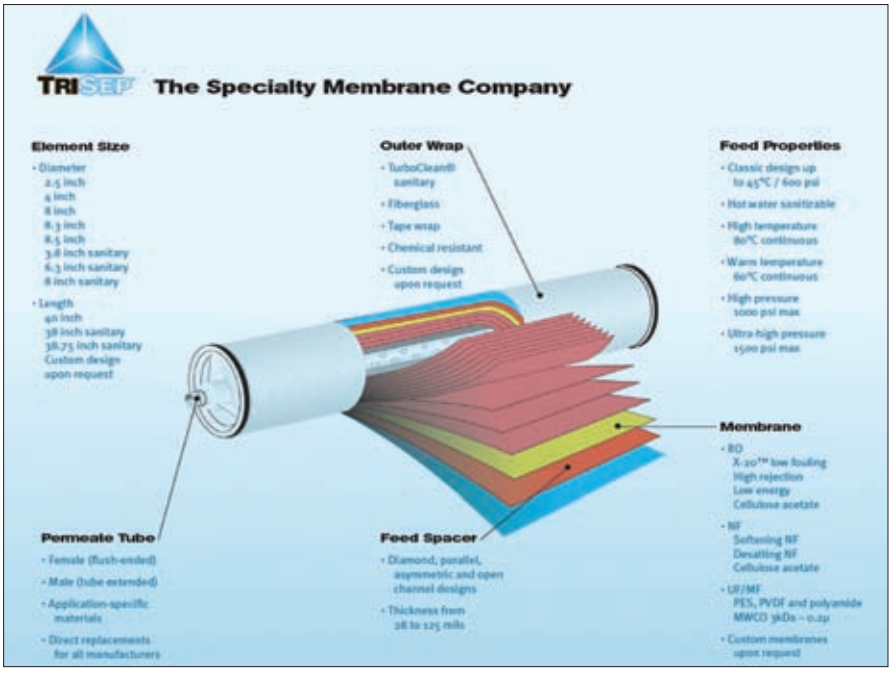

Figure 1: TriSep element design capabilities

A relatively new offering for TriSep is a line of high temperature elements for both continuous operation and periodic sanitization. Continuous high temperature operation, up to 80°C, is advantageous because it allows plants to control potential microbiological issues within their system, operate at lower pressure, or save on costs related to cooling and heat exchangers. When operating at high temperature, it is important to consider the combined effect of temperature, feed pressure and pressure differential. At high temperature, there is greater potential for the membrane to be forced or "intruded" into the permeate carrier under high feed pressure, thus causing an irreversible flow loss. Moreover, at high temperature and high differential pressure, the membrane and feed spacer are more likely to "extrude" down the element in the direction of flow, in some cases causing catastrophic failure. TriSep has developed special manufacturing methods to limit the effects of intrusion and extrusion under such operating conditions.

Another concept that has gained popularity in recent years is the use of hard shell elements in sanitary applications. Up until several years ago,

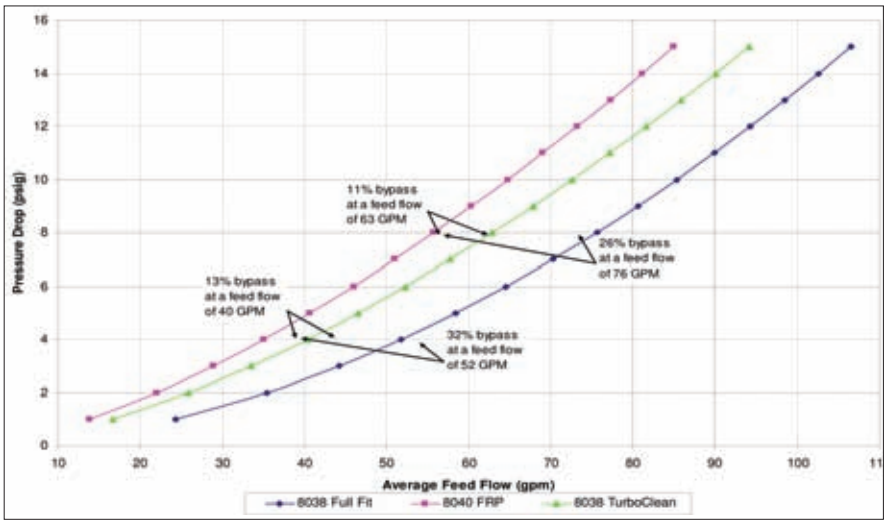

Figure 2: Pressure drop profiles for 8 inch elements

Figure 3: TurboClean versus full-fit outer wrap

the only sanitary elements used in food and dairy, pharmaceutical, and high purity applications were made with a net or open cage outer wrap. Sanitary elements are useful because they allow for bypass flow around the element to eliminate stagnant areas where biogrowth can occur, but unfortunately these designs typically allow 30-40% of the feed flow to bypass around the membrane itself wasting energy and reducing cross-flow velocity. TurboClean® sanitary hard shell elements have a controlled diameter which limits element bypass to 10-12%. The benefit of reduced bypass flow can be realized through improved performance due to higher cross flow velocity or, conversely, less energy consumption due to lower recirculation requirements.

The best way to compare the effects of reduced bypass is to examine

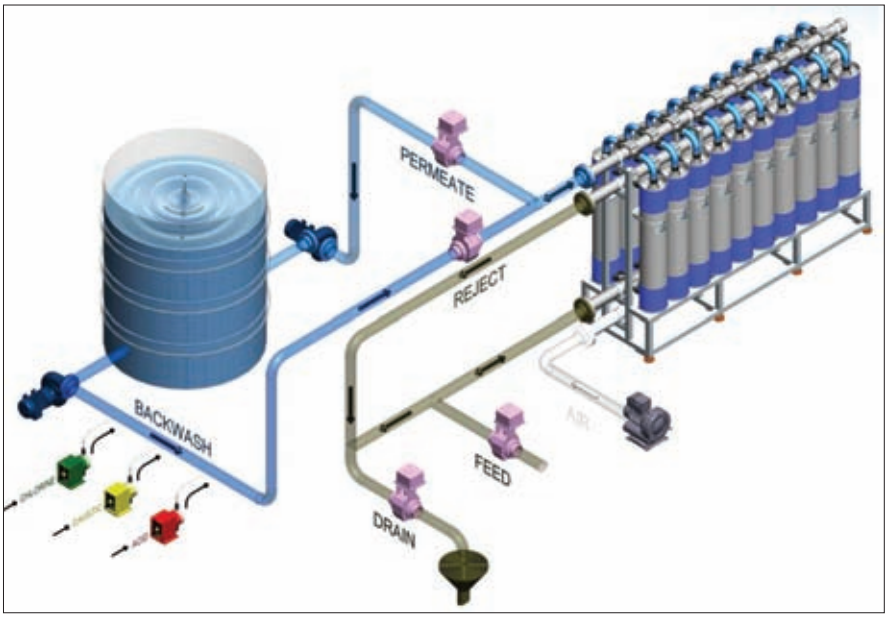

Figure 4: iSep UF Process Flow

Figure 5: iSep UF flow channels

pressure drop as a function of feed flow. For a given element diameter and feed spacer design, pressure drop is directly proportional to the cross flow velocity through the element feed channels. As seen in Figure 2, the pressure drop profile for an eight-inch diameter TurboClean element is actually closer to that of a standard element than it is to a net-wrapped (or full-fit) element.

The TurboClean shell also provides a noticeable rigidity to spiral wound elements, virtually eliminating the occurrence of "smiles" or "channeling" within the element, a common method of failure in food and dairy. Moreover, operators prefer TurboClean elements because their ease of installation and handling saves time during membrane changes.

TriSep's most unique concept when it comes to spiral-wound element design is the back-washable *i*Sep™ UF membrane. *i*Sep is the first skid mounted, submerged UF format on the market that is specifically designed to treat high fouling water and wastewater streams. Unlike conventional cross-flow configurations, water is "pulled" through the *i*Sep UF membrane using about 3 to 5 psi of vacuum pressure. Simultaneously, air is bubbled up through the element feed channels, actively scouring the surface of the membrane. As solids accumulate and trans-membrane pressure increases, the membrane backwash cycle is initiated to

remove particulate matter from the UF membrane surface. If necessary, a chemically enhanced backwash (CEB) can be performed by dosing chlorine, caustic, or acid to help remove organic or inorganic foulants.

In addition to being vacuum driven and back-washable, iSep modules utilize a 90 mil corrugated feed spacer in order to handle TSS levels of up to 1000 ppm in the feed. Moreover, due to their relatively small hold up volume, iSep modules can be drained frequently to help manage solids accumulation.

From river water pre-treatment for RO to MBR peak flow management, the high suspended solids capability of *i*Sep allows it to be used in a wide variety of applications. In MBR peak flow management, *i*Sep is used as a side stream system to remove TSS and pathogens from screened, raw municipal wastewater during peak flow events. Although raw municipal wastewater is one of the most difficult waste streams to directly treat due to high TSS and organic levels, *i*Sep performance is seamless. *i*Sep UF is ideal for river water pre-treatment due to its capability of handling seasonal variations in water quality. When a pressurized hollow fiber (PHF) UF system might be forced to shut down or run at lower flux rates during a storm event, *i*Sep will power through the event without compromising on effluent quality. From a system design standpoint, original equipment manufacturers (OEMs) benefit because *i*Sep does not require extensive pretreatment.

Another issue with PHF membranes is the mechanical integrity of the membrane itself. The rigid spiral-wound design of *i*Sep eliminates this issue by holding the membrane in place such that zero stress is placed on the membrane; there is no membrane breakage as regularly occurs with hollow fibers. For this reason, *i*Sep UF provides excellent pretreatment to reverse osmosis.

TriSep is constantly working to develop the next *i*Sep or TurboClean in order to help solve the world's most challenging water and wastewater problems. The company encourages clients to come with projects or ideas that might seem difficult or even impossible. TriSep engineers have an extensive knowledge base of membrane element and system design, application know-how, and troubleshooting solutions. If they don't have the right products or expertise to solve your problem, they will do their best to direct you to someone who can.

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Choosing the Right Membrane Technology

By Ben Movahed, President, WATEK Engineering Corporation

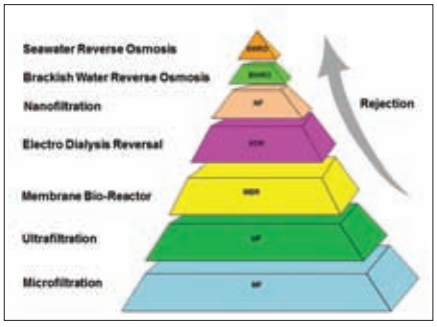

Figure 1: Membrane Technology Options

Figure 2: Example of Ultrafiltration Plant

Figure 3: Brackish Water RO Plant

Historically, the application of membrane technologies was limited due to the high cost of membranes. Over the past two decades, however, membrane application costs have decreased significantly and the increasingly stringent water quality regulations have made membrane options economically comparable and attractive alternatives to conventional treatment.

There are four basic categories of pressure membranes: microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), and reverse osmosis (RO). These categories are differentiated based on pore size of the membrane material. Referring to the figure 1, microfiltration has the largest pore size, and RO has the smallest pore size. Membrane type determines pressure requirements, which is an important factor in determining operational costs. As pore size decreases, smaller contaminants can be removed but pressure increases, thus increasing power costs.

Electro-dialysis (ED) is another membrane process, which uses electrical potential as the driving force rather than pressure as in Reverse Osmosis. In EDR, a variation of ED, the electrical potential applied by the electrodes is periodically reversed. This causes the direction of migration of the ions to reverse, and switches the functions of the flow channels so that the dilute channel becomes the concentrate channel and vice versa to flush the membrane spacers. EDR thus tends to reduce the buildup of scale and foulants on membrane surfaces.

Microfiltration (MF) and Ultrafiltration (UF) membranes (Figure 2) are effective at removing particulate matter, and have 5+ log removal capability for Giardia and Cryptosporidium.

NF has a high rejection capability for divalent ions such as iron, calcium, magnesium, etc., as well as organics, hardness and color and is therefore referred to as "membrane softening." It can also remove larger dissolved ions and compounds such as radionuclides and uranium. RO (Figure 3) is most often associated with desalination, but it is also applicable for radionuclides and other smaller contaminants such as metal ions.

Membrane Bioreactor (MBR) and tertiary treatment systems are the best available technologies for communities concerned with protecting the environment and preserving potable water supplies. Whether a community needs to improve the effluent quality from its existing conventional wastewater treatment plant, or construct a new compact and highly efficient wastewater treatment system, MBRs provide cost-effective solutions that will meet or exceed discharge standards for years to come. Effluent from these systems is of such high quality that it can be safely discharged into the most sensitive aquatic environments or reused in irrigation, industrial processes, or groundwater recharge.

Currently, seawater desalination is becoming more common around the world from the first large scale facilities that were installed in the 1970's. The key to successful operation of seawater desalination is pretreatment. Depending on the water quality, this can be accomplished typically through conventional or sometimes membrane filtration (i.e., integrated membrane system).

Seawater desalination facilities are generally located next to large-scale power plants. There are two reasons for this. The power plants provide:

1. Power to the water plant at a lower cost. Because of the high-energy need for seawater desalination, this can translate into a significantly lower O & M cost.
2. The power plant uses a large quantity of water for its cooling process. This water can be blended with the concentrate from the RO treatment plant. This blended product is typically at an acceptable water quality and TDS to be dis charged back into the ocean or bay.

Selecting the right membrane process is critical to long-term performance and project success. Some of these membranes are not chlorine or oxidant tolerant. Depending on the raw water chemistry, there is a potential for scaling and fouling, which significantly reduces the life of the membrane and increases production and membrane replacement costs. These are the biggest disadvantages of membranes and should be carefully considered for every project.

Pilot tests are often performed to compare the applicability of several membranes and determine the best membrane for the existing conditions. These tests are particularly important for surface water sources due to the variability of water quality to be treated. Groundwater sources may or may not require a pilot test, depending on the availability and reliability of water quality data, and the raw water characteristics. Pilots are sometimes required by the permitting agencies to prove applicability of the technologies.

Although most membrane manufacturers are capable of recommending an applicable membrane configuration, the engineer provides a custom design and coordination of the entire treatment system, which also includes the membrane modules/skids/cells, feed pumps, chemical feed systems, pretreatment systems, energy recovery devices, cleaning systems, and instrumentation and control systems. A knowledgeable design engineer serves as a single source of contact, responsible for coordinating all these systems and various individual components required in a treatment plant. This coordination is crucial to the compatibility of all related systems and the smooth implementation of the project.

In the last 15 years, WATEK Engineering Corporation has focused only on engineering solutions with membrane technologies. In fact, that is what the company does. In summary, one of these membrane technologies has the answer for any particular situation, with multiple full-scale global applications in:

- Drinking Water
- Municipal Wastewater
- Industrial Wastewater
- Ultrapure Water
- Recovery/Reuse
- Agriculture
- Landfill Leachate
- Pharmaceutical
- Power Generation
- Pulp and Paper
- Semiconductor
- Floating Plants

WATEK engineers with their extensive membrane treatment experience can provide clients with a cost effective, practical and reliable solution. EN

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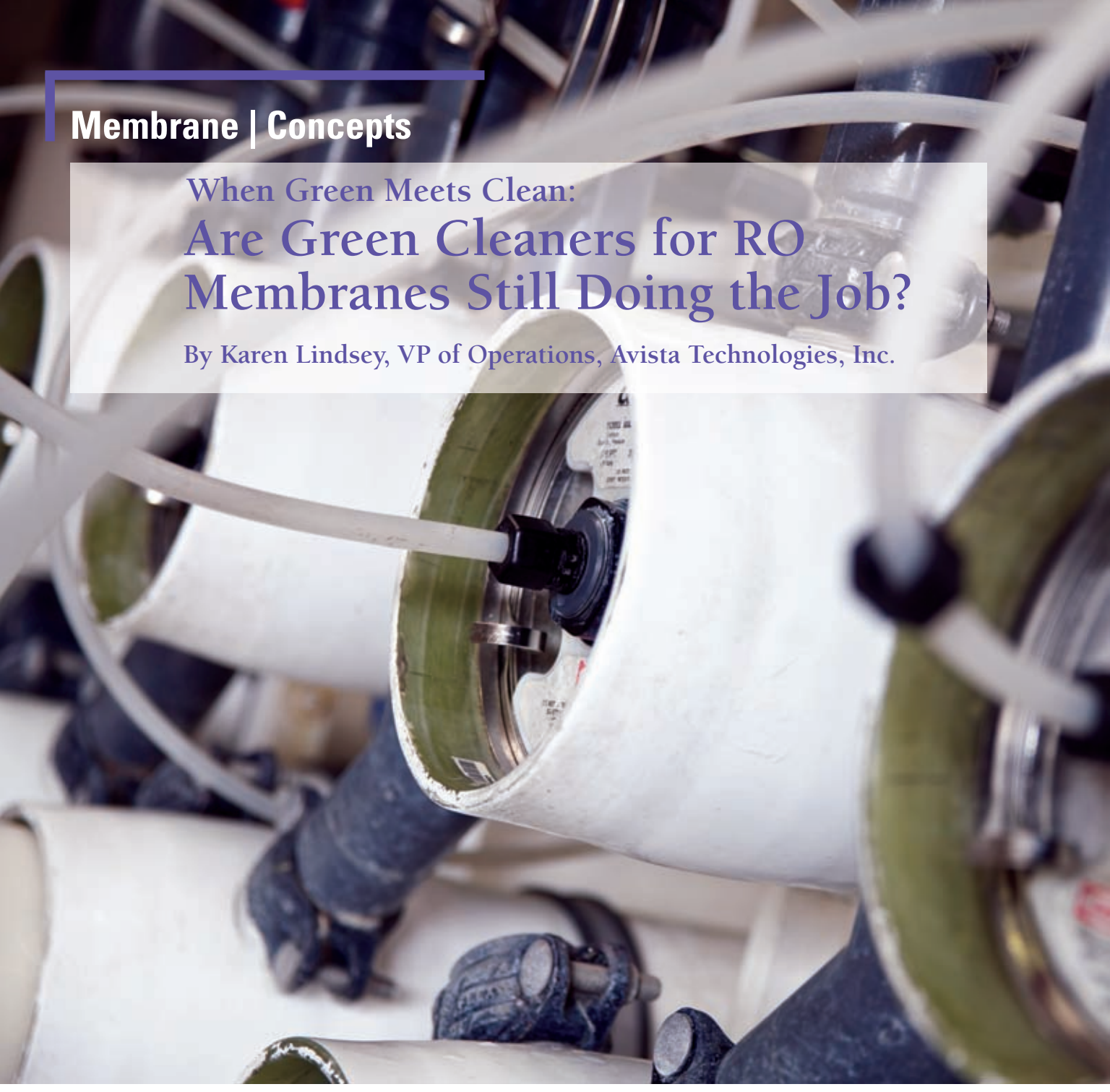

When Green Meets Clean:

Are Green Cleaners for RO Membranes Still Doing the Job?

By Karen Lindsey, VP of Operations, Avista Technologies, Inc.

After decades of successful use in municipal, industrial, and wastewater applications, reverse osmosis (RO) has proven to be a highly effective and reliable method of advanced water treatment. By its nature, RO system flow paths result in diminishing feedwater along the collective series of elements, which concentrates soluble minerals, microbes, and organic matter and eventually leads to membrane fouling. As particles come out of solution and settle on membrane surfaces, they form a barrier layer that reduces permeate quality and flow and increases the pressure required to pass water through the membrane. Fouling is inevitable, but proper cleaning can effectively restore permeate flow, increase rejection and reduce delta pressures so that treatment facilities continue to produce the desired water quantity and quality.

The demand for chemical solutions has generated a number of industry suppliers each with varying levels of expertise in membrane separations and subsequent product offerings ranging from low cost generics to sophisticated formulated chemistries.

Continued advancements in membrane technologies stymie the less sophisticated chemical vendors as RO membranes are applied to increasingly challenging feedwaters and the resulting foulants become more complex. In addition, there has

been intense industry pressure to provide eco-friendly cleaning products to satisfy strict plant discharge restrictions with the expectation that the "green" formulations will be as effective as traditional products.

ECO TREND

The eco trend has revealed several industry shortcomings including the fact that there is currently no recognized definition of what constitutes a "green" product for membrane applications. As a result, qualified chemical vendors strive to satisfy site-specific or regional restrictions instead of a sanctioned certification. There is also very little published data on "green" product efficacy, which has left many to question whether the performance of environmentally friendly products can ever be definitively compared to proven formulations.

Avista Technologies addressed this challenge with their own in-house testing. Avista is a specialty chemical provider that also offers an array of laboratory and troubleshooting services to help improve membrane system performance. In the course of this work, they evaluated a variety of cleaners that were promoted as "green" and distributed throughout the industry. Extensive trials on fouled membranes concluded that those formulations failed to provide the cleaning efficacy required by the industry to meet projected O&M costs and productive membrane life expectations.

FINDING ALTERNATIVES

Vice President of Research Dan Comstock noted: "The challenge is to substitute regulated ingredients with eco-friendly alternatives that work as well or better and achieve a target price that is acceptable to a cost sensitive customer base. But the demand for green chemicals resulted in a hasty supply of ineffective products throughout the industry. Many chemical formulators simply removed the regulated ingredients from their products without testing alternatives or the performance consequences. Ironically, membrane foulants are becoming more complex at the same time some chemical vendors are simplifying their formulations and the decline in performance is not surprising."

When faced with strict new discharge regulations, system end users applied those cleaners and found that the performance was nominal at best and, in some cases, put their membrane at risk. "If the formulator doesn't test the new compound for

Avista's hands-on approach provides their membrane customers with smart solutions for the challenges presented by diverse membrane applications and challenging feed waters.

membrane compatibility and product efficacy, then the end user becomes the beta tester, for better or worse," said Director of Product Development, Jack Mueller. "What makes Avista unique is we decided early on that we wouldn't rush to satisfy the industry demand for "green" cleaners until our products proved they could meet or exceed the performance of our other formulations. We pride ourselves on developing long term relationships with our customers and we weren't going to sacrifice that for a questionable, short term fix."

Mr. Comstock added: "The key to creating an effective green membrane cleaning product is finding synergy among an array of environmentally friendly ingredients." Regulatory pressure has prompted global chemical manufactures to develop eco-friendly raw materials, but very few of these are membrane compatible. The key is having the desire and ability to test the multitude of raw materials in order to establish not only membrane compatibility but also an advantageous synergy with other ingredients in the blends. Avista's extensive investment in laboratory equipment and technical capabilities has allowed them to pursue these time consuming studies.

"Developing effective green products is challenging and requires extensive trials," said Mr. Mueller. "We'd formulate a product that was effective and met our client's regulatory criteria, but continued internal testing showed that long term use might have an adverse effect on the membrane. That was unacceptable so we'd go back to square one."

President Dave Walker confirmed: "Failure is not an option for us and that mantra differentiates Avista. The testing initiated by our technical group was arduous but it led to a line of cleaners that we now provide with complete confidence, knowing they are membrane compatible and effective enough to go head to head with our other products."

COMPATIBILITY STUDIES

Avista conducts membrane compatibility studies throughout the formulary process to screen each of the raw materials at every phase of development. They then test compatibility of the finished compound to see if it has any detrimental effects on the membrane. These studies provide customers with peace of mind, knowing that the product is eco-friendly and will clean the membrane time after time without risk of damage.

Expert analysis, high performance products and state-of-the-art technology separate Avista as a world leader in membrane treatment.

Mr. Mueller observed that "clients send us fouled membranes and we use a variety of analytical procedures to specifically identify what constituents are on the membrane surface. We then run foulant specific cleaning trials on the membranes to identify the product or combination of products that will give us the best results in restoring membrane performance. If the customer is subject to any discharge restrictions or if spe-

cific ingredients are not allowed, we now have an effective line of green cleaners to offer."

TRUSTED SIPPLIER

Avista Technologies, Inc. was established in 1999 to develop and produce specialty chemistries specifically for the membrane separation industry. They are now a globally recognized and trusted supplier of water treatment chemicals and expert process support for membrane systems. The company provides technical support for systems including reverse osmosis (RO), microfiltration/ultrafiltration (MF/UF), and membrane pretreatment equipment including multimedia filtration (MMF).

As global population and the demand for quality water continues to grow, the use of membrane-based water and wastewater treatment systems has become a significant trend. Avista specializes in servicing the growing industry by providing clients with membrane compatible formulations that are powerful against organic and inorganic foulants and suitable for sites with discharge restrictions.

GREEN CLEANERS

The company has created a successful method of developing green cleaners, recognizing that each ingredient plays a unique role in product efficacy. By combining synergistic, multi-component green raw materials, Avista has proven to be a leader in formulating highly effective products that dissolve, disperse and remove foulants from the membrane surface.

Avista's green cleaner line includes: AvistaClean® P611, RoClean L404 and RoClean P111C. The Vitec® 8000 series is a line of environmentally friendly antiscalants and dispersants.

ABOUT AVISTA TECHNOLOGIES

Avista® Technologies is a trusted expert in membrane system chemistry and global process support, including reverse osmosis (RO), microfiltration/ultrafiltration (MF/UF) and multimedia filtration (MMF). Avista's focus is to enhance the life, performance, reliability and recovery rate of membrane systems through processes that include cleaning studies, membrane autopsies, off-site cleaning, field support, filtration studies, on-site supervision of procedures, chemical application recommendations, data monitoring and on-site troubleshooting.

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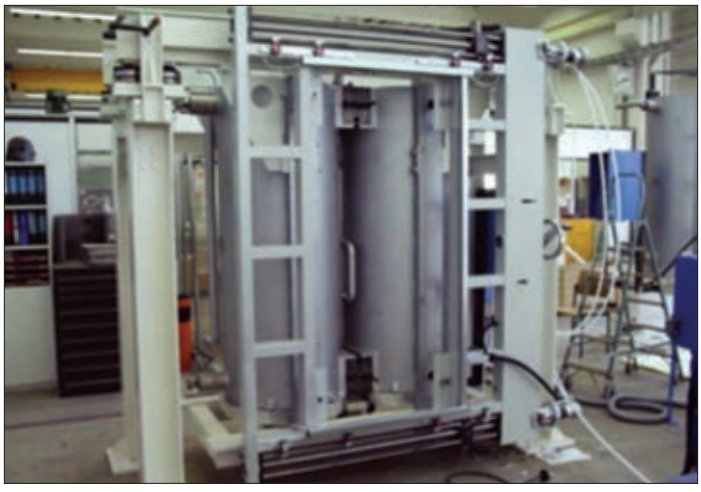


The NSF 210

In 1974 Barmag released its first polymer filter brochure. As the successor of Barmag's polymer filter activities, BBE (Barmag Brückner Engineering) is about to reach the milestone of four decades in the filtration business.

The first polymer filters were built for film plants in Eastern Germany and Belgium and for several fiber spinning lines in Europe. So right away, these designs had to show their capabilities in two very demanding processes. It was important to create rheological sound designs, leak proof housings, suitable heating methods and reliable switch-over-valves. The support of filter element manufacturers completed the activities.

Over time, design rules such as flux-rate, filtration grade, pressure drop, service life depending on the process had to be established. Today after having sold more than 1,600 installations, BBE can cover most polymer filtration applications with a wide polymer filter program.

The production began with NSF (Non-Stop-Filter) and LLF (Long-Life-Filter).

These two kinds of filters still play a major role, mainly in BO – film lines and PA6 polymerization. The largest filters nowadays are used in BOPP – lines such as LLF48 supplying up to 12 m² (filter element – pleated candle) and in BOPET - lines with up to 30 m² (filter element – 12" – disk).

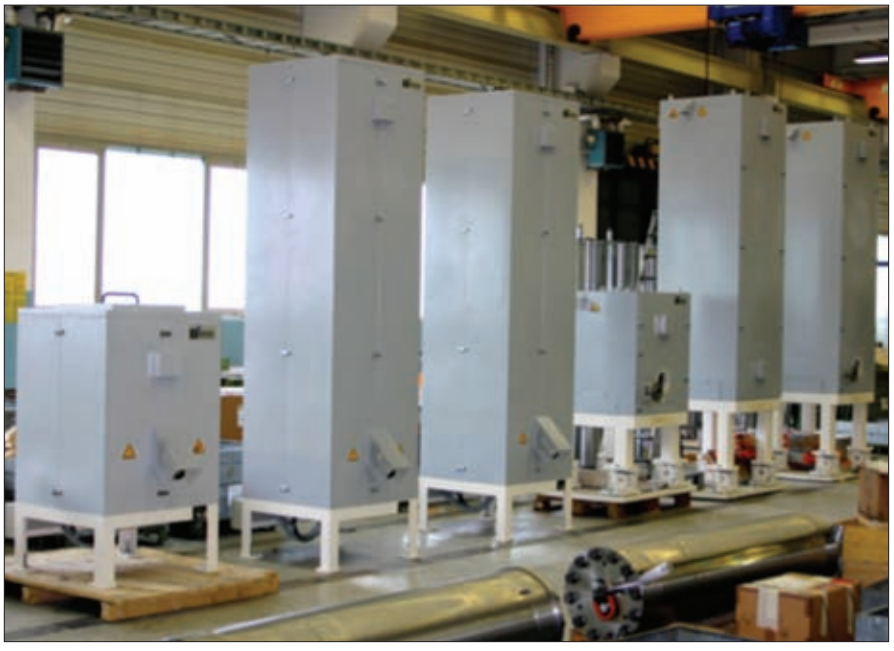
For extruder spinning lines, BBE today offers the CVFs (Continuous Vertical Filter) covering a filtration area range from 0.4 to 5 m² per side. This filter was designed in order to better fit into a spinning line manifold. BBE in this field prefers upright standing filter inserts since it is a key feature for a bumpless transfers. Perfect venting and flushing of the new filter insert to be taken into service is essential to avoid yarn breaks and avoid interruption of production.

As design principle for the switch over valves in NSF and CVF, BBE still use the spring loaded plug valve. This design has proven its rheological sound advantages since the beginning. Over the years several improvements such as different combinations of steel for plug and housing including coatings and surface treatment were implemented.

At processes where fine filtration at a low contamination level is required

HCF - Horizontal Candle Filter

the horizontally oriented single chamber filter HCF (Horizontal Candle Filter) can be the right choice. This filter was developed in 2005. With it's easy to mount quick fasteners and the integrated pre-heating-station (for the next filter insert) it is often installed in co-extrusion lines and smaller extrusion film lines. The filtration area can be between 0.1 and 1.55 m². A new version with disk type filter elements will be available soon. Very often this filter is sold in combination with a booster pump mounted on the same frame to-



Filter assembly station

gether with the HCF. In such an arrangement the pump compensates the pressure drop of the filter.

Over the years besides the development of the filters itself, complementing equipment was necessary around the filters in order to be successful in this business.

Most of the customers need appropriate auxiliary equipment, such as preheating and draining stations, devices for mounting and dismounting filter inserts, vacuum pumps or nitrogen flushing systems and bypass – filter – inserts.

Also the filter elements being the essential parts in the process filtration need to be carefully chosen. Here BBE, as they do not produce such elements by themselves, is in a favorable position by being free to choose the best for the given application from the market.

Also the ability of BBE to provide equipment in the filtration related areas, such as melt pipes, gear pumps, drain and start-up valves, heating units for liquid or vapor heating systems can be a big advantage for customers.

Today customers also expect support in the field of filter cleaning. This ranges from opening used housings to cleaning and inspection of the filter elements. Here a new extended precleaning device based on BBE's preheating and draining station is under development.

In the future the company expects that process step filtration will gain importance, because the recycling aspect becomes more and more important. Also, demanding processes, which in the past mainly processed virgin material or in-house recycled feedstock, now are urged to process post-consumer-plastic. Here, BBE often sees a combination of a screen-changer (for the large contaminants) and a large area filter (for finer contaminants) being the right choice to fulfill technical and economical tasks.

ABOUT BBE

BB Engineering GmbH was founded in 1997. It is a 50/50 joint venture of Oerlikon Barmag and Brückner Group. The knowledge of BBE is rooted in the former plastic machinery division of Barmag. Today, BBE, besides engineering services, supplies extruders, mixers and filters to the two mother companies. In 2011, BBE started to sell their products also to the open market. BBE today has about 120 employees. The annual turnover is € 30 – 40 Mio. BBE is based in Remscheid, Germany.

Monadnock Non-Wovens Offers to Move Pilot Production to Industrial Scale Production

Monadnock Non-Wovens LLC offers a "Pilot to Production" program aimed at developers of fine fiber melt blown polypropylene seeking to transition from proven R+D scale production to industrial scale manufacturing.

The program is ideally suited for developers who seek to move to the next level of practical production, typically truckload quantities, from laboratory environments. "There is a considerable difference in running melt blown media under test conditions to running heavy duty industrial quantities," said Keith Hayward Managing Director of Monadnock Non-Wovens based in Mount Pocono in NE Pennsylvania.

"Our unique combination of flexible polypropylene melt blown operations and combining technology with many years of practical experience is ideal for marketers with new products seeking process development," he added.

The principal clients would be product developers seeking characteristics or special properties in the fast growing allergen barrier, anti-microbial or odor removal applications often used in fabric, homeland security, medical devices and some consumer products.

Monadnock Non-Wovens has expertise in prototype to industrial transitions involving polypropylene melt blown with or without a wide range of additives and combined materials. The size and flexibility of the company permits relatively low cost and rapid development of roll goods media suitable for further converting or direct sale.

"The elegance of our Pilot to Production program is that once approved by the market the client has a ready made home for subsequent production with established processes and cost structures supported by an ISO9001 Quality System," said Mr. Hayward. "Pilot programs can involve renting machine time, toll converting or conventional purchase."

Monadnock Non-Wovens, a subsidiary of Monadnock Paper Mills, Inc. of Bennington, NH was established in 1999 to manufacture nonwoven material for the fast growing filtration, facemask, healthcare and homeland security markets.

For more information contact:
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January 24 – Abstract Submission Deadline

January 30 – Early Registration Deadline

March 6 – Regular Registration Deadline

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