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FILTRATION NEWS
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May/June 2013
Volume 32 No. 3
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Rosedale Products' Versatile Basket Filters

- IDEA13 - Media Makers Congregate
- Using Algae for Filtration Needs
- Releasing Additives from Filters

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by SpinTek

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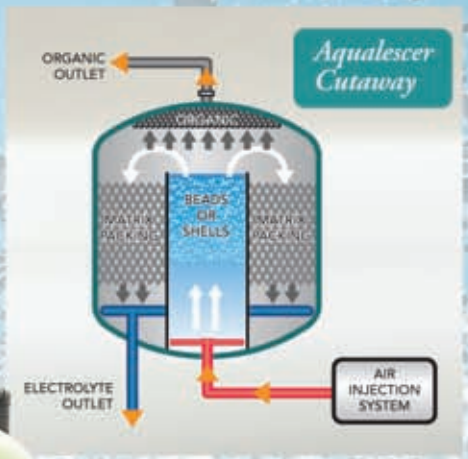

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FIELD TESTING The system was shown capable of operating pressures under 140kPa and obtained entrained organic removal of up to 95% for both electrolyte and raffinate streams.

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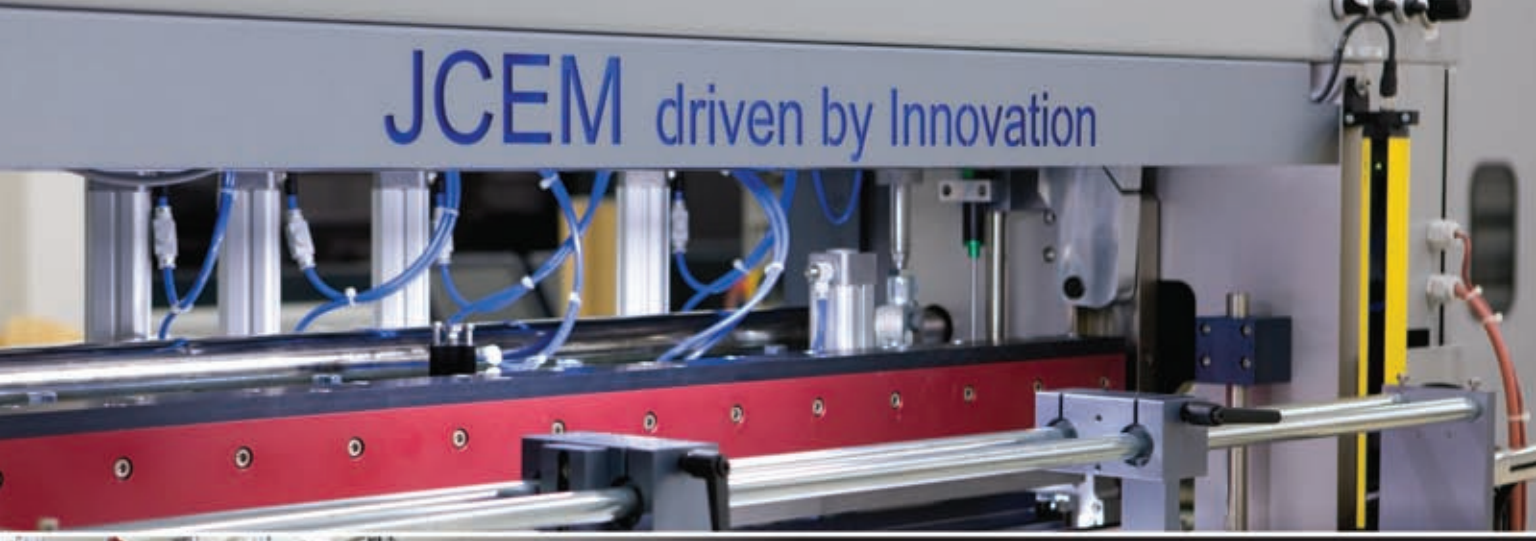

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Versatile Basket Filters

By Dan Morosky, Rosedale Products, Inc.

Rosedale Products' line of stainless steel baskets

In many applications, stainless steel baskets are a good alternative to replace filter bags and other media. Fruit juice pulp straining, coarse filtration in meat packaging plants, water intake strainers, and spray nozzle protection, have all been ideal basket filter applications. Filter baskets may seem old fashioned, but there are many design innovations to consider. Ultimately, basket selection varies greatly, depending on the application. Consider the following options:

WIRE MESH BASKETS

Wire clothed lined baskets are the tried and true strainer that all of us know. They use wire cloth as the filter medium and can be physically from the size of a coffee cup to the size of a 55-gallon drum.

The wire cloth has a mesh count or mesh size, which is the number of wires running horizontally and vertically per square inch. For example, a 10-mesh screen means it has 10 wires per square inch as noted. The resulting opening is the micron rating.

Traditionally, basket strainers have used square weave wire cloth as the filter media for coarse filtration down to 50u or openings of about 0.002 inches, and twilled weaves are for finer mesh to 5 microns (0.0002"). As a rule, wire mesh is manually cleanable in weaves coarser than 75u (200 mesh or 0.0003") and the finer grades require chemical or ultrasonic cleaning.

Wire mesh basket

NEW HIGH GRADE SINTERED MESH

These baskets have multiple layers of stainless steel wire-woven cloth, diffusion bonded together for increased strength, corrosion resistance, and long life.

One-piece construction for ease in handling, no need for a perforated basket for support, no need for a bag for filtration, the basket becomes the filter media.

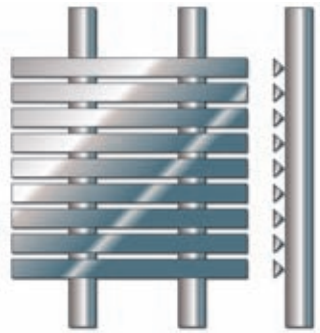
FEATURES

- All 316 stainless steel construction
- 10-150 micron ratings
- TIG welded construction for long life

Five layers of stainless steel wire-woven cloth

WEDGE WIRE STRAINER BASKETS

Wedge wire (WW) or slotted, is very durable back washable media. They are strictly limited to .001" slot or 25 micron as the lowest retention rating.



Wedge wire media

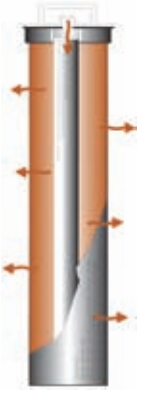
Wedge wire is particularly suited for critical low maintenance applications. As a result of their construction, they are used in many instances where manual cleaning is necessary but might damage other types of media.

SORBENT MEDIA CONTAINMENT

A combination carbon adsorption and downstream filtering unit can be ordered. Available in the larger single-basket and all multi-basket vessels, it positions the carbon-holding basket inside a larger filter bag-holding basket. A variety of filter bag media is offered.

RS Style For Recirculating Systems

Flow enters from the top, into a perforated cylinder around which is packed activated carbon. Flow moves radially through the carbon and exits through the side wall, which is perforated and lined with 100-mesh screen.



SP Style For Single-Pass (1-Time) Processing

Flow enters from the top through a perforated cover and into the activated carbon bed. Flow moves down through the carbon and exits through the bottom plate, which is perforated and lined with 100-mesh screen.

BAG TO "STICK" CONVERSION

Turn Bag Housings Into Cartridge Filters. Basket holds cartridges inside a bag housing!

Rosedale's bag filter converter can be quickly converted to a cartridge filter. Simply put, there are applications that call for a bag filter and others that call for a cartridge filter. Until now, it wasn't very easy to change between the two.

Bag to stick conversion basket

If it becomes necessary to change from bags to cartridges – install the Rosedale Converter Basket.

- Remove the original basket
- Install the new converter basket
- Load the cartridges
- Unique design prevents clean side contamination by removing basket from housing before removing cartridges from converter.

Bag to large

Users now have a cartridge filter able to utilize any standard cartridge. Baskets fit standard models 4-12, 8-15, and 8-30 housings. Construction materials are either 304 stainless or 316 stainless steel.

BAG TO LARGE DIAMETER CARTRIDGE

Existing installations can easily convert to a single housing by installing the Rosedale adaptor basket.

This is accomplished by replacing the perforated filter basket with the adaptor. The solid side basket accepts the new cartridge and directs the flow through the unit.

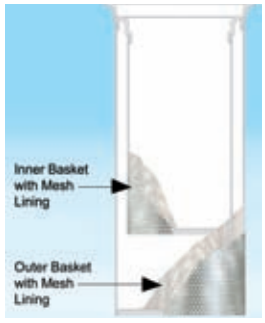
CONE BASKETS

Cone baskets are valuable when a large filtering area is needed in a small space. They are available as a basket within a basket, or a bag within a basket.

Cone baskets are widely used for filtration of solid particles in pharmaceutical, chemical, and food industries.

INNER BASKETS

Model 8 and any of the multi-basket or multi-bag units can be fitted with smaller, inner basket strainers or bag filters, through which the incoming fluid flows first, giving two-stage cleaning action. Inner baskets and bags are offered in the same construction materials and ratings as those of the primary outer elements.



Inner basket strainers or filters

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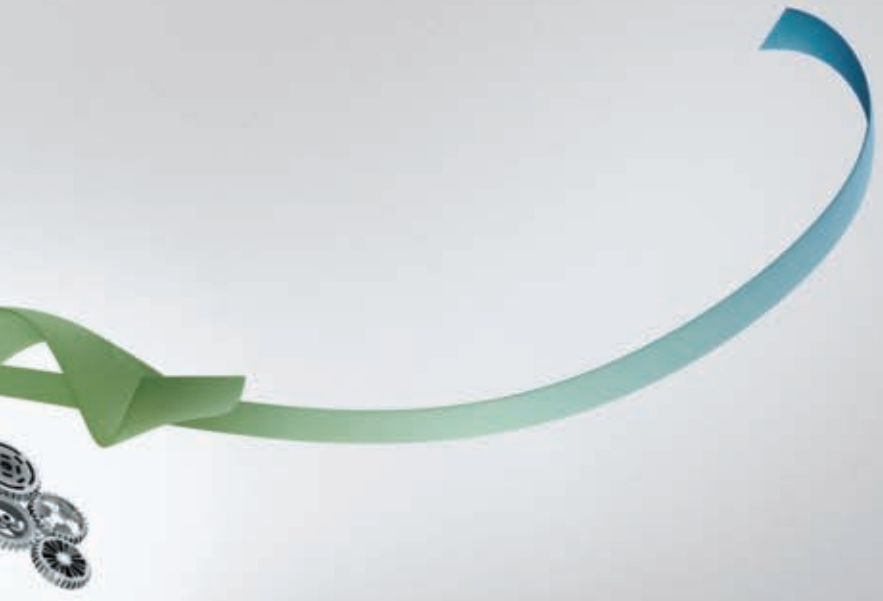

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Bright IDEA for Media Makers

By Adrian Wilson, International Correspondent

Pictured receiving their Innovation Award for NanoWave filter media are Angelika Mayman and Eric Westgate of Hollingsworth & Vose, from Dave Rousse, INDA President, (left) and Rod Zilenziger of Nonwovens Industry (right).

INDA'S 2013 nonwovens show was a platform for advanced filtration concepts across a range of industries.

Filter manufacturer Donaldson, headquartered in Minneapolis, Minn., has recently published statistics on the global filtration market which it estimates now has an annual value of $50 billion.

The market for engine protection within this – in which Donaldson has a leading position – is certainly considerable and worth an annual $8 billion. But it is eclipsed by that of water filtration, which is worth $10 billion in 2013, and likely to become very considerable indeed in the coming years. There are many nonwoven media developments currently underway in this area.

Ahlstrom, for example has just entered into a collaboration agreement with Dow Water & Process Solutions (DW&PS), a business unit of Dow Chemical, to use Disruptor nanoalumina filtration technology in drinking water applications.

DW&PS will incorporate Disruptor filter media into a new set of drinking water purification products, which provide excellent pathogen rejection while operating at high flow and low pressure.

"One of the key goals in our product development is to create products that purify air and liquids in a sustainable way," said Fulvio Capussotti, executive vice president at Ahlstrom Advanced Filtration.

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Ahlstrom Disruptor virtually removes all microorganisms that can cause sickness. Its combination of large pore size and very high electrical attraction potential enable the efficient removal of virus-sized particles at a high flow rate at very low pressure. It can be utilized in a number of drinking water applications, such as under-the-sink purification, tap water filters and water pitcher filters. It can also be used in areas with no electricity, requires no use of chemicals and does not generate wastewater.

"Global trends such as population growth and urbanization put pressure on already strained water sources," added Snehal Desai, global business director for DW&PS. "We see a real need for new innovations to expand access to clean, safe drinking water in an easy, effective and sustainable way. Our collaboration with Ahlstrom extends our product offering to people who need effective water treatment but may not have access to pumps or electricity."

AUTOMOTIVE POTENTIAL

Separately, the automotive air filtration market is worth around a further $3 billion according to Donaldson. At this year's IDEA nonwovens show in Miami in April, Dave Rousse, president

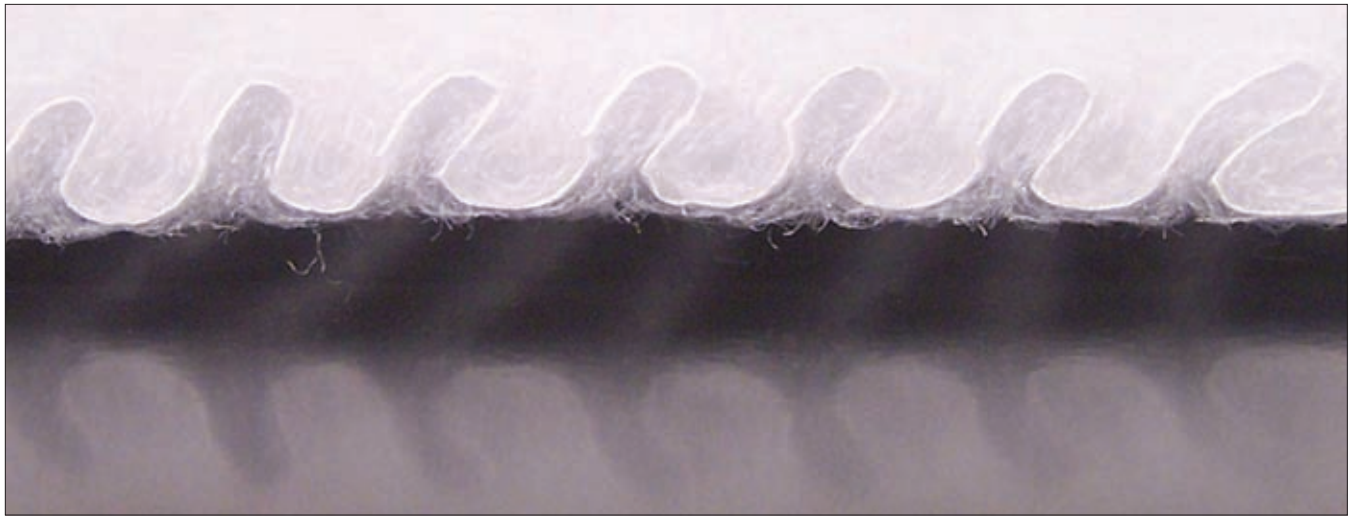
Cyphrex (large photo) successfully combines polyester and cellulose microfibers.

The Eastman Cyphrex team in Miami (above, left to right), Eastman's CTO Greg Nelson, Technology Director Mark Clark and Vice President of Innovation, Marketing and Sales Tim Dell.

of INDA – the Association of the Nonwoven Fabrics industry based in Cary, North Carolina, which organizes the IDEA shows – had some interesting observations to make about the growing potential for engineered fabrics in filter media for the automotive field.

In the U.S., double-digit sales during 2012 were reported by Chrysler, General Motors and Ford, coupled with even stronger North American growth by Toyota and Honda. This follows a resurgence in the USA in 2011, with growth of 11.5% achieved in the production of over 8.6 million vehicles, according to OICA – Organisation Internationale des Constructeurs d'Automobiles – the international organization of motor vehicles. In 2012, the U.S. produced 10.3 million cars and light vehicles, having previously reached a record in 2007 of 15 million such vehicles produced.

"The automotive sector is one of the positive drivers of the North American economy right now, along with housing," said Rousse. "Both sectors were severely impacted by the downturn, so their year-on-year improvements are steeper than other sectors of the economy, which are more tepid. We are also seeing a significant new interest in manufacturing overall in the U.S. due



The structure of H&V's award-winning NanoWave greatly enhances dust-holding capacity.

to the dramatic impact of low energy costs. The fracking of North American shale to get both oil and natural gas has been a game changer. Energy costs in North America now are about half of Europe, so even with labor costs at parity, manufacturing here is going to be on the increase for years. And our members will benefit."

He added that another significant development was the World Health Organization declaring diesel fumes carcinogenic to human health in June last year.

"This is something all of the regulatory bodies worldwide will have to react to, sooner, rather than later," said Mr. Rousse. "It's a colossal opportunity for nonwoven filter media suppliers as far as we can see, because if high performance is mandated, then the high price for products will be there too."

CAPTIMAX WITH CYPHREX

An interesting new product in this area is Ahlstrom's Captimax media for fuel filters in passenger and commercial heavy-duty vehicles and off-road machinery.

Also being evaluated for use in other applications such as hydraulic and fuel water separation, Captimax is based on Eastman's new Cyphrex polyester and cellulose microfibers.

"Eastman Cyphrex microfibers provide the potential for a unique, game-changing fiber tool kit," said Eastman Cyphrex Technology Director Mark Clark. "They offer tunable properties in respect of the size, shape and material that provide wetlaid nonwoven producers with competitive advantages that aren't currently available. They have demonstrated nearly drop-in compatibility with existing wetlaid nonwoven processes and potential initial uses are in air, water or fuel filtration, specialty papers and battery separators."

The first result from Ahlstrom is a filter media that allows manufacturers to obtain optimum micron efficiency ratings and dust holding capacity without making compromises.

Captimax provides a balance of excellent small-particle retention and the potential for longer product life. The media also lets fuel filtration system suppliers maintain existing capacity levels but reduce the product size. In addition, it can allow for increased efficiency with better options to filter fine particles to protect fuel injectors in vehicles and machines.

"Captimax media offers both high efficiency and high capacity," said Gary Blevins, vice president of marketing and commercial for Ahlstrom's Transportation Filtration business. "We're giving our customers the ability to make filters to the specifications they need, allowing them to develop products outside the standard constraints of the media."

CHINA GROWTH

Freudenberg is another key player in the nonwoven filter media market and has just announced a new $5.8 million production site in Chengdu, Sichuan Province, China, in response to the growing demand for automotive filters in that region, with its partner Japan Vilene.

"Together we will deliver state-of-the-art filtration technology to the growing automotive industry in Chengdu with companies like Volkswagen and Geely Volvo," said Dr. Jörg Sievert, member of the management board of Freudenberg Filtration Technologies, which already has plants in Changchun and Suzhou and first started production in China in 1998.

Sixty employees will work at the new site – which will produce both engine air intake filters and micron-Air cabin air filters – by the end of 2013. By establishing the new production site in Xindu, Freudenberg is scaling up domestic production capacity substantially.

Major car manufacturers including First Automotive Works Volkswagen and Geely Volvo have sited their manufacturing plants in the Chengdu area and vehicle production in the region is expected to increase substantially, from

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Mini pleat

Intermittent hotmelt pleat

Spot hotmelt pleat

a2z mini pleat blade pleaters

This model pleater has been designed to produce Mini pleat with Hotmelt.

Models: Range from 300 mm to 1500 mm and also various models with pleat depth range from 10 mm to150 mm

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INDA's outgoing President Rory Holmes received a Lifetime Achievement Award from the organization during the show.

1.8 million units in 2011 to 3 million units in 2015.

NANOWAVE RECOGNITION

In the field of HVAC – a global market Donaldson estimates is now worth an annual $5 billion – Hollingsworth & Vose received INDA's Innovation Award in the Roll-Goods category for its NanoWave filter media at IDEA.

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. Described as a 'green' product, NanoWave is composed of a single polymer and can be incinerated to regain energy. NanoWave pocket filters achieve the highest filtration performance and deliver superior air quality. Other uses for NanoWave include residential filtration, liquid filtration and gas turbine intake air filtration.

"We are especially pleased to receive the IDEA13 Achievement Award because the industry selected NanoWave after a period of online voting," said Mike Clark, H&V's HESF division president. "H&V was founded on a patent and we are honored to be recognized by our peers for our most recent innovation."

SAWASCREEN

Another Innovation Award winner was Germany's Sandler, for its Bio Textile biowipes substrate. Specifically for the filtration market, Sandler provides media for classes G3 to E11, with synthetic sawascreen pocket filter media comprising fibers of less than 1µm to achieve high efficiencies

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and high dust holding capacity.

The fine fibers create a large filtration surface, boosting mechanical efficiency that does not decrease, even after discharge.

The progressively structured filter media feature a low average pressure drop, reducing energy consumption during operation of the filtration plant.

For small installation spaces, pleatable Sandler sawascreen pleat filter media feature a uniform, lengthwise oriented fiber structure for high mechanical stability and they can be easily manufactured with all common pleating processes. The stability of the pleats is unaffected by pressure or other mechanical influences, as well as moisture.

RECORD BREAKER

IDEA13 was held April 22-25, 2013, in Miami Beach, Florida, U.S., featuring 483 exhibiting companies and drawing close to 7,000 attendees from 72 countries.

"IDEA13 was a record-breaking event and one of the most successful IDEA shows ever," said Dave Rousse. "The continued strong participation of international exhibitors and attendees is proof of the show's importance within the international nonwovens/engineered fabrics community."

In addition to attendees and exhibitors on the show floor, many more were doing business at nearby hotels and at over 50 on-site meeting rooms utilized by the leading companies for their business discussions. The well-attended conference sessions focused on regional global markets, trends and forecasts with an insightful look into the engineered fabrics markets in North America, South America, Europe, Asia-Pacific, China and India.

The IDEA Achievement Awards were presented to the best new products during the last three years, in the following five categories: Equipment, Raw Materials, Roll Goods, Short-Life End Product and Long-Life End Product.

The five winners were:

- Machinery/Equipment: ITW Dynatec – Surge adhesive applicator
- Raw Materials: Sandler AG – Bio Textile Bio-wipes Substrate
- Roll Goods: Hollingsworth & Vose – NanoWave filtration media
- Converted Product: ITW Dymon – Raptor Safe-T Wipe (substance activated fast evaluation technology)
- Long-Life Converted Product: Hunter Douglas – DuoTone Honeycomb window shade

In addition, the IDEA13 Entrepreneur Achievement Award was presented to Suominen Nonwovens and the Lifetime Achievement Award was presented to Rory Holmes, past President of INDA.

INDA will stage its Filtration International Conference and Exposition at Navy Pier in Chicago from November 12-14, 2013.

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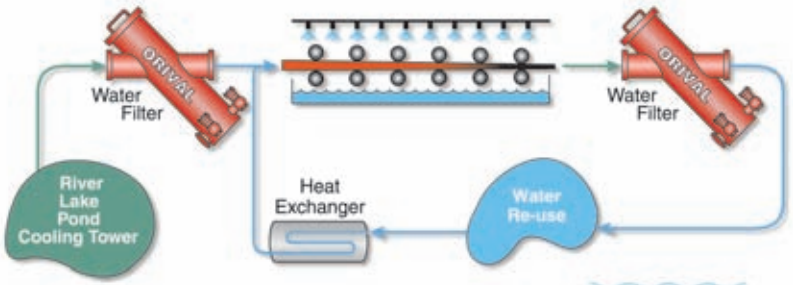

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The Future of Fuel?

By Adrian Wilson, International Correspondent

Algae are a diverse group of organisms considered simple plants since they photosynthesize, and they use carbon dioxide and water al off oxygen that fish can use to breathe.

Industrially cultivated algae may one day prove the most suitable replacement for oil. In the nearer-term, a natural filtration system developed for this burgeoning industry could be equally useful in purifying the water used in today's growing oil and gas fracking sector

Much of the world's petroleum is actually made up of algae that have decomposed over hundreds of millions of years. But extracting and burning that oil as fuel today releases carbon dioxide absorbed long ago into the atmosphere. This 'carbon positive' effect is a key contributor to global warming.

By contrast, industrially-cultivated algae is capable of absorbing CO2 from the atmosphere, or in more concentrated form, directly from CO2 sources such as power plants, factories

ong with sunlight for energy and growth. Like plants, they also give

and refineries. This is because the burning of freshly produced algae oil releases only what it absorbed in the first place. The result is a balanced 'carbon neutral' impact.

In the right environment, fresh algae cells grow and divide exponentially, doubling every few hours, while absorbing all available nutrients, CO2 and light energy. Instead of waiting hundreds of millions of years for algae

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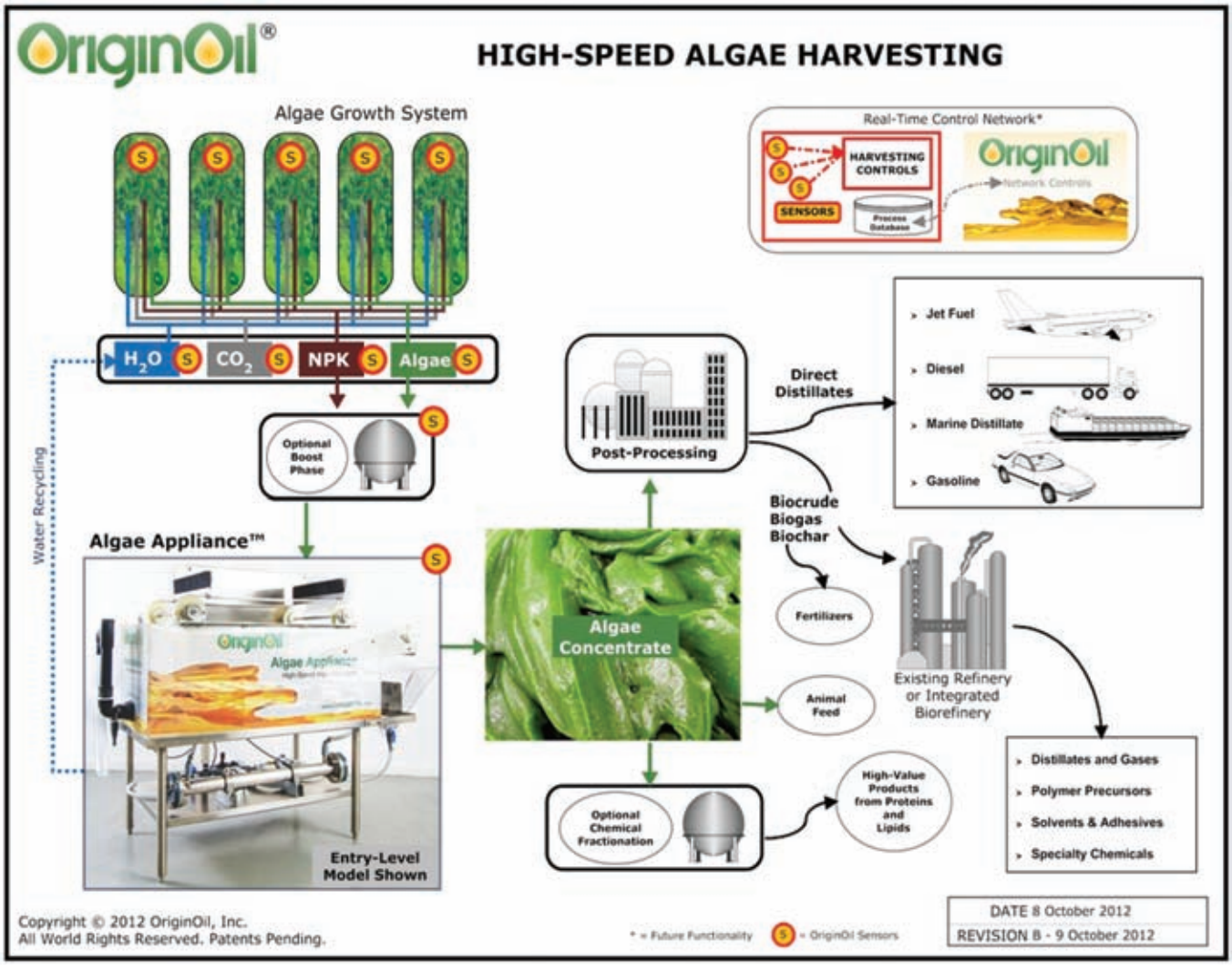


OriginOil's Single Step Extraction technology for the algae industry.

to become oil, industrial processes can transform algae into oil in a matter of days, it's now believed. And only by industrializing the manufacture of such new oil can the current and future demands of global industrialization be met, according to proponents of the burgeoning algae technology.

Biofuels derived from crops such as corn, sugarcane, rapeseed and palm, by contrast, require vast amounts of resources in terms of water and land, and also a great deal of energy for their conversion.

NASA OMEGA PROJECT

The closed life support systems used on the International Space Station that optimize the use of resources and minimize waste were what first got NASA scientists interested in the potential of algae as a fuel.

The resulting Offshore Membrane Enclosures for Growing Algae (OMEGA) system has subsequently been developed to grow algae, clean wastewater, capture carbon dioxide and ultimately produce biofuel without competing with agriculture for water, fertilizer or land.

The system consists of large flexible photo bioreactor containing fast-growing freshwater algae growing in wastewater and floating on seawater.

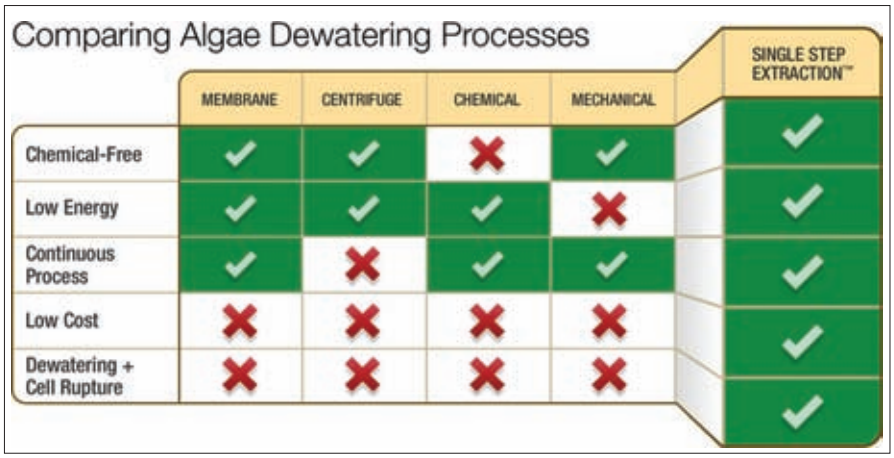
The algae draws on energy from the sun, carbon dioxide and nutrients from the wastewater to produce biomass that can be converted into biofuels as well as other useful products such as fertilizer and animal food. The algae clean the wastewater by removing nutrients that otherwise would contribute to marine dead zone formation.

NASA's project goals were to investigate the technical feasibility of a unique floating algae cultivation system and prepare the way for commercial applications. Research by scientists and engineers has demonstrated that OMEGA is an effective way to grow microalgae and treat wastewater on a small scale. The system is initially being investigated as an alternative way to produce aviation fuels, with the implication of replacing fossil fuels in the longer term.

NASA first installed a small-scale OMEGA system at the California Fish

and Game laboratory in Santa Cruz, California, and then scaled up to a 450-gallon system at the Southeast Wastewater Treatment facility in San Francisco. Potential commercial applications are now being explored with various companies.

"We've addressed some of the more daunting technological problems for implementing OMEGA," said project scientist Jonathan Trent. "Now the hope is that other organizations and industries will realize the potential of the OMEGA technology for wastewater treatment and ultimately to produce sustainable biofuels," he said.



The benefits of the Single Step Extraction algae dewatering process.

CHALLENGES

There are three primary challenges to cost-effective algae production, according to technology developer OriginOil, based in Los Angeles:

• Algae grow suspended in large volumes of water and using conventional methods, a mature culture must be concentrated before oil can be extracted from each cell. This de-watering stage is energy-intensive, and typically requires chemical additives and expensive capital equipment.

• Algae are protected by a tough cell wall, which has to be cracked – an energy-intensive process – to extract the oil. The challenge is to maximize oil yield by 'cracking' as many of the algae cells as possible with the smallest amount of energy.

• The production is energy-intensive. In order to achieve economic viability, it is critical that energy is

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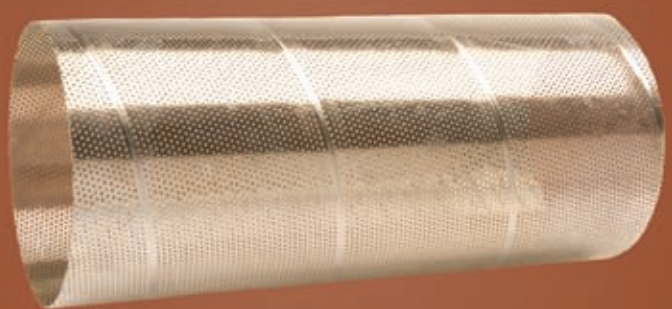

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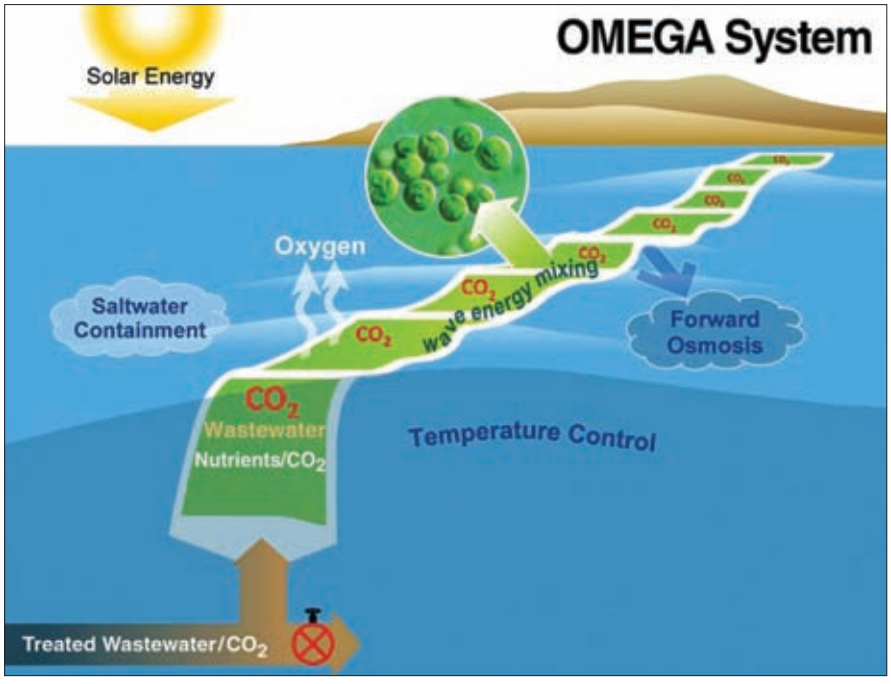


The principle of NASA's OMEGA algae cultivation system.

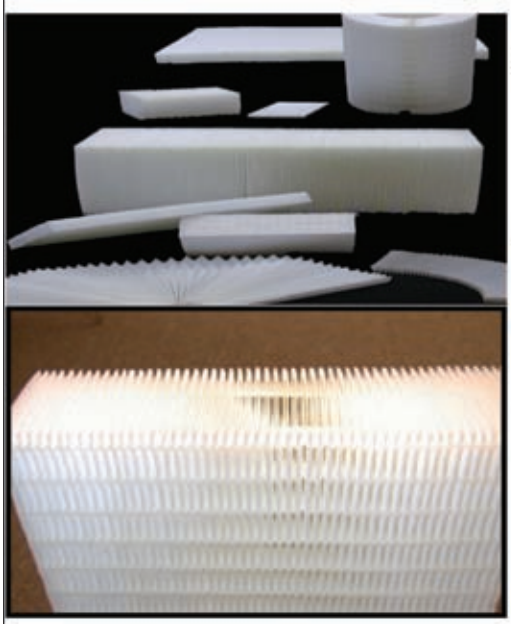
recovered in every possible way. In addition to oil and biomass, algae produce valuable gases, including hydrogen. These must be harvested to achieve the best possible energy balance.

OriginOil's suite of patent-pending technologies and process innovations intends to address these specific obstacles. The company's Single Step Extraction process is chemical-free, low-energy, high-flow and low-cost and does more than dewater – it can rupture tough algae cell walls (via a process called 'lysing') to free up the oils and other valuable cellular components that downstream processes can separate out.

The process exploits the high sensitivity of algae to electromagnetic waves and generates precisely tuned wave patterns that cause the algae to come out of solution and to rupture.

After pre-conditioning with natural metabolites, the algae travel through long, specially designed tubes as they gradually come out of solution and leave a highly concentrated algae form that can be processed. In comparison, the company points out that membrane filtration technology is capital-intensive

C P S Contract Pleating Services



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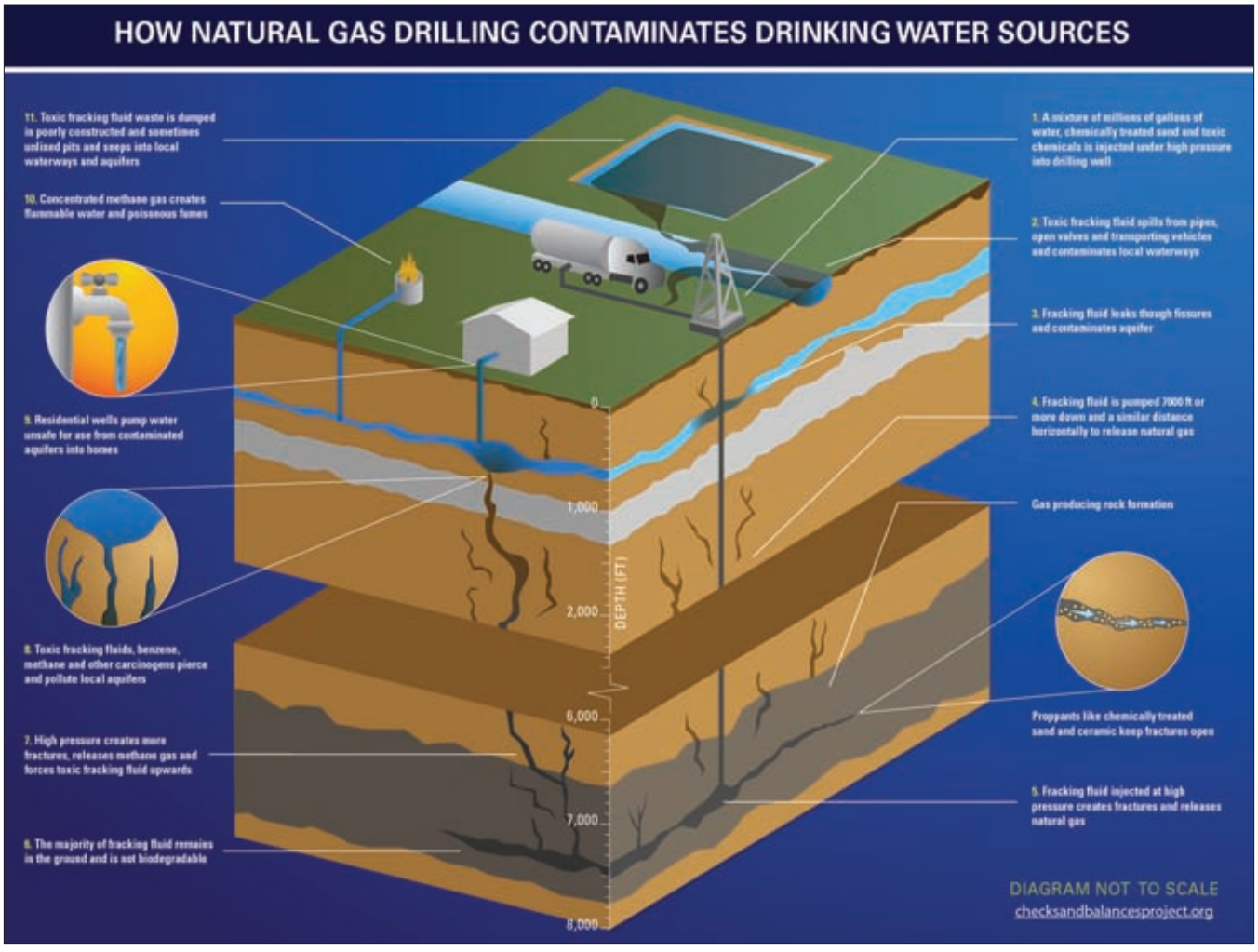


Organizations like Greenpeace oppose fracking, believing it diverts from real solutions – such as energy efficiency and renewables – and that the full effects on the environment and health have not been fully investigated or addressed. Many concerns have also been raised about its potential to contaminate water supplies. Illustration courtesy of The Checks and Balances Project, a U.S. government and industry watchdog group.

and maintenance costs can also be high. Centrifuges are also very expensive when used to dewater completely diluted algae. Chemical treatments have to be replenished and effluent water must be treated before it can be reused, while mechanical systems are also both energy and cost-intensive.

CLEAN-FRAC

Having looked to the future, however, OriginOil has realized there is a much more immediate opportunity for its Single Step Extraction technology – the removal of the carbon contaminants in the dirty frac flowback water produced by the oil and gas mining industries.

Hydraulic fracturing – fracking – involves the high-pressure pumping of a mixture of water, sand and chemicals into underground gas-bearing beds of shale rock. The effect is to shatter the shale and allow the gas to escape, and in the U.S. the technology has undergone a dramatic expansion, which has already led to a substantial fall in gas prices.

Under extreme high hydraulic pressure, frac fluids (such as distillate, diesel fuel, crude oil, dilute hydrochloric acid, water, or kerosene) are pumped down through production tubing or drill pipes and forced out again.

The pressure causes cracks to open in the formation and the fluid penetrates the formation through the cracks. Sand grains, aluminum pellets, walnut shells, or similar materials – propping agents – are carried in suspension by the fluid into the cracks. When the pressure is released at the surface, the frac fluid returns to the well but leaves behind these propping agents to keep the formation cracks open. The fluid used for penetration of the frac must be clean and cannot contain sand or other organics that may be harmful for either the process or the environment. The

used frac fluids also subsequently have to be cleaned.

WATER CONSUMPTION

Water is by far the largest component of fracking fluids. It has been estimated that an initial drilling operation itself may consume from 6,000 to 600,00 gallons of fracking fluids, but over its lifetime an average well may require up to an additional five million gallons of water for full operation.

It has been further estimated that the amount of water needed to drill and fracture a horizontal shale gas well generally ranges from between two and four million gallons, depending on the basin and formation characteristics.

The extraction of so much water for fracking has raised concerns about the ecological impacts to aquatic resources, as well as the potential dewatering of drinking water aquifers. In addition, the transportation of a million gallons of water, whether fresh or waste water, requires hundreds of truck trips, increasing the greenhouse gas footprint of oil and gas and contributing to air pollution.

CHEMICAL-FREE POTENTIAL

This is where OriginOil is sensing huge potential. Its Clean-Frac system, adapted from its Single Step Extraction technology for the algae industry, is a chemical free, continuous process that employs low-energy technologies to decontaminate produced or 'frac flowback' water. It removes oils, suspended solids, insoluble organics and bacteria as the first stage of any multi-stage water treatment system designed for recycling or purifying to drinking water.

The company's Clean-Frac Model 60K is designed to process produced or frac flowback water at a continuous flow rate of one barrel per minute or 60,000 gallons a day in continuous operation. It can be designed to be mounted in a container, on a trailer or as a fixed configuration.

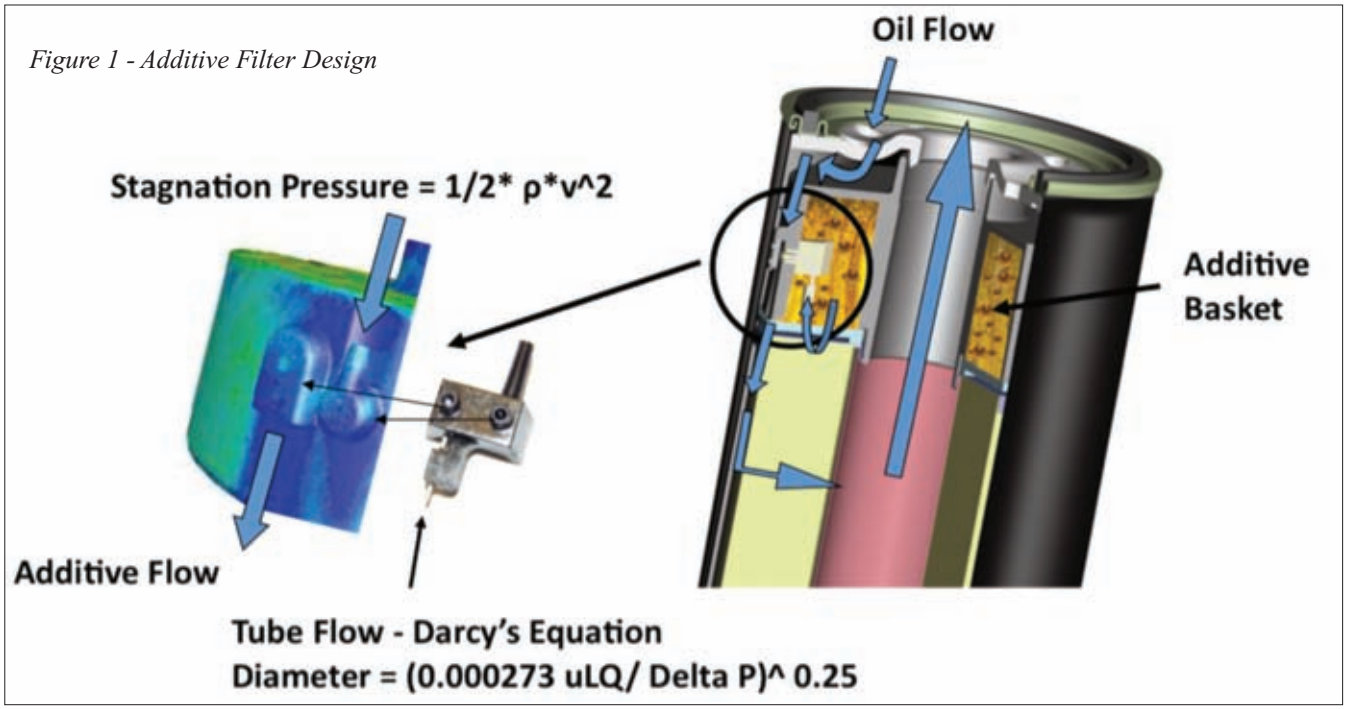
"The U.S. will overtake Saudi Arabia to become the world's biggest oil producer before 2020, and could be energy independent by 2030," says OriginOil President and CEO Riggs Eckelberry. "And with that, our country's CO2 emissions have fallen dramatically, to a 20-year low. All this is being driven by the fracking revolution. We're excited by the estimated industry numbers that show that treating water for reuse typically costs 21 to 26 cents per gallon, while even the 'cheap' option of trucking the water offsite costs 11 cents per gallon or more. By combining our high-speed process with other innovations, we believe producers could see the cost of treatment go down to just seven cents per gallon. Cheaper than trucking is quite an exciting possibility."

Testing has already proved that OriginOil's system reduces total organics as measured by Chemical Oxygen Demand (COD) by over 98% in a matter of minutes, and is ongoing.

Extending Diesel Engine Oil Changes Using a Controlled Release Additive System Integrated in the Oil Filter

By Gary Bilski, Chief Engineer, FRAM Filtration, Perrysburg, Ohio

Figure 1 - Additive Filter Design



In most large heavy-duty long haul fleets, oil analysis has been used for many years to determine the optimum oil change interval and also indentify potential engine maintenance or wear issues. With their steady duty cycle, the factor in long haul trucks that typically defines the oil change interval is an increase in the acidity level of the oil, measured by both TAN (Total Acid Number) and TBN (Total Base Number; this is reserve alkalinity to neutralize acids) and also increase in oil oxidation. By re-additizing the oil at a very controlled release rate, utilizing both overbased detergents and antioxidants, it is possible to neutralize the acid production and reduce oxidation, significantly extending the oil change interval.

The cause of oil degradation is dependent upon a number of factors, including engine design, lubricant quality, and severity of duty cycle and fuel sulfur levels. The design of the diesel engine has undergone significant changes over the past couple of decades in order to meet ever-increasing emissions regulations. Particularly in 2007, some of the combustion strategies have used high amounts of EGR to control NOx emissions. This had increased soot, oxidation, and acid levels in the oil. The CJ-4 oil category was tied to these engine design changes in order to help reduce some of the effects. More recently with the 2010 emissions requirements, SCR (Selective Catalytic Reduction) exhaust after-treatment, which utilized an ammonia based catalyst agent, is being used to control NOx along with lower percentages of EGR.

The EGR's resulting impact on the oil can have various detrimental effects on the engine. Specifically, the increased levels of soot in the oil will both increase the viscosity of the oil and can cause increased engine wear, especially at boundary lubrication areas such as the valve train. The soot may also agglomerate and cause premature filter plugging. Secondly, higher lubricant sump temperatures can increase the rate of oxidation, creating weak acids, carbon deposits and sludge that can lead to bearing corrosion. Additionally, the acidic blow-by gases increase the acidity of the oil and can cause corrosion of engine components such as cylin-

der liners, bearings, and piston rings. There are several engine dynamometer tests that oil formulators use to evaluate the lubricants for these conditions. The Mack T11, Cummins ISM, and Mack T12 are the most common tests used.

While the formulation of the CJ-4 Lubricant has addressed these effects, oil analysis did indicate that some engines with higher EGR levels still required reduced oil change intervals based on the TAN, TBN, and Oxidation levels. While simply increasing the overbased detergent and antioxidant level in the blended oil would seem the simplest solution, constraints exist due to specified maximum initial ash levels caused by the overbased detergents. Additionally, high initial levels of antioxidants may not provide linear benefits. Therefore, a filter was developed that would slowly release these two critical additives in the oil at a controlled rate to achieve the optimum benefits.

CONTROLLED RELEASE RATE DESIGN

The first mode of attaining effective additization was to use a concentrated blend of overbased detergents and antioxidants in fluid form. A method was then required that would both inject the additives into the oil stream and precisely control the extremely low additive injection rate. Two basic fluid dynamic principals were used to develop this system.

For the power source, Bernoulli's Theorem was utilized. Stagnation pressure created by oil flowing over an open tube creates pressure in the tube. This is the same principal as seen in a pitot tube; however in a pitot tube the pressure is usually measured to calculate velocity, as applied to measure speed in aircraft. This pressure will now be used to produce power and create flow.

Through the use of a simplified version of Bernoulli's equation, pressure in the tube can be calculated knowing the velocity and density of fluid flowing past the tube:

$$SP = \frac{\rho V^2}{2}$$

Where:
SP = Stagnation Pressure
ρ = density of fluid
V = Velocity of Fluid

The second fluid principal is utilized to control the release rate of additive. The dimensions of a small metering tube, used to provide the desired flow rate of additive, can be derived using Darcy's formula:

$$Q = \frac{\Delta P d^4}{\mu L}$$

Where:
Q = rate of flow (additive release rate desired)
Δ = Pressure differential across the tube (Stagnation Pressure)
d = internal diameter of the metering tube
μ = absolute (dynamic) viscosity of the additive
L = Length of metering tube

FILTER DESIGN

Utilizing these basic fluid flow principals, a design was created in which a basket containing the additive package was integrated into a standard lube filter. As shown in Figure 1, the stagnation tube is located

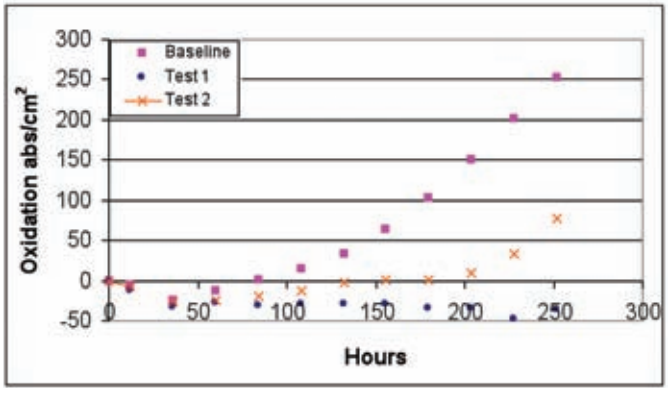


Figure 2 - Oxidation Measurements during Mack T11 test

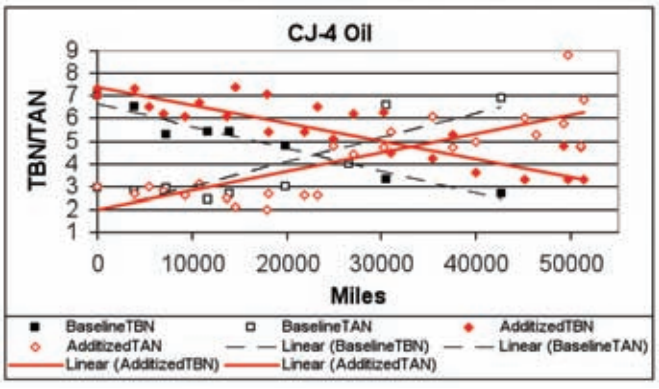


Figure 5

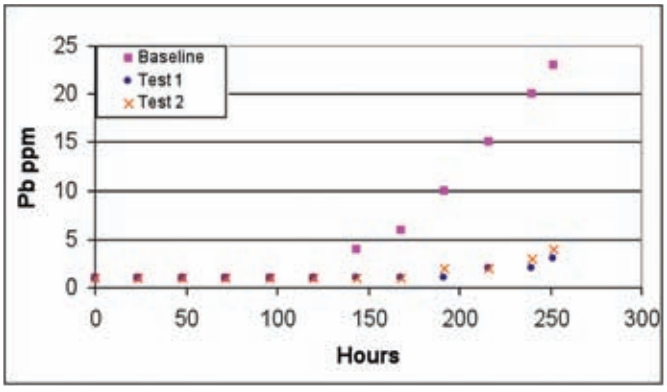


Figure 3 - Lead wear levels during Mack T-11 test

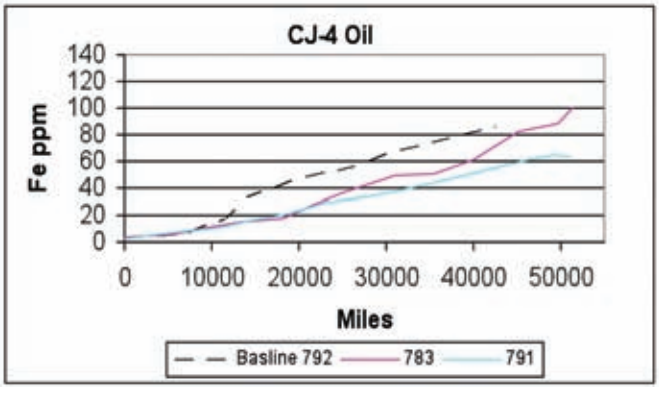


Figure 6

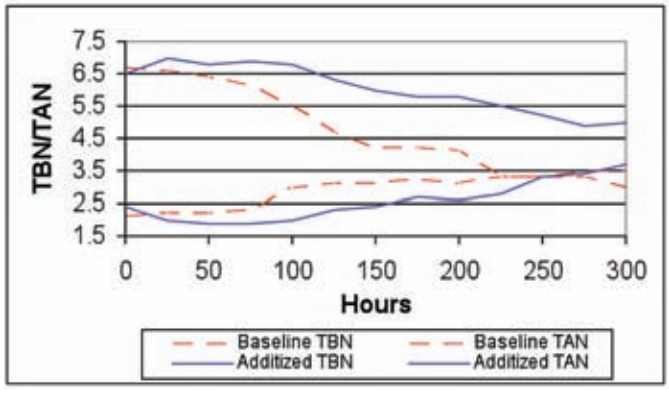


Figure 4 - ASTM D4739 TBN and D664 TAN measurements during Mack T-12 test

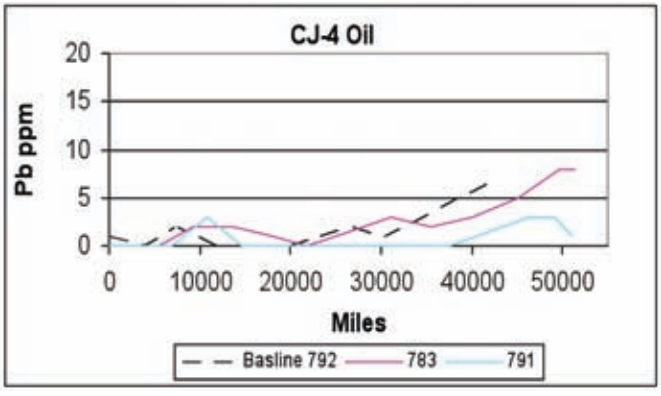


Figure 7

on the side of the basket pointing upward toward the inlet of oil flow. The clearance between the basket OD and filter body wall is determined, and by knowing the flow rate of oil through the filter, the velocity of the oil over the stagnation tube can be calculated. This can then be used to calculate the pressure created in the basket using Bernoulli's equation.

Shown in Figure 1 is a long narrow metering tube with one end open near the bottom of the basket and the other end protruding through the basket wall and shielded by a small molded cover. The pressure created in the basket by the stagnation tube pushes the additive through the metering tube and out of the basket, back into the oil flow at the desired additive flow rate. The length and ID of the tube are derived using Darcy's equation as discussed above.

The engine oil flow rate is controlled by the rpm of the engine and thus is not constant. Therefore, the stagnation pressure will likewise change, affecting the additive flow rate. Depending on the duty cycle of the vehicle, this range of engine conditions can be averaged to determine the necessary release rate over time.

LAB TEST VALIDATION

To prove the effectiveness of the controlled release of additives, both laboratory and field-testing were conducted.

The laboratory testing involved standard engine dynamometer tests, used to certify that oils meet engine manufacturers and API requirements. The Mack T11 and T12 tests were used, and measurements of oxidation, soot generation, TAN, TBN, bearing weight loss, and engine wear metals were recorded. First, baseline tests using standard CJ-4 oil were carried out. The same tests were then run utilizing the re-additization filter with the identical CJ-4 oil. Figures 2 – 4 show the comparison between baseline and re-additization tests for oxidation, lead wear rates, and TBN/TAN levels. In all cases the re-additized filter showed significant levels of improvement.

FIELD TEST VALIDATION

To validate the functionality of the re-additization system during actual vehicle operating conditions, a commercial fleet of long haul tractor/trailers using 2005 – 2006 Volvo D-12 engines was used. Approximately half of the fleet used standard filters with either CI-4 or CJ-4 oil, while the other half of the fleet used additized filters. The vehicles with standard filters ran to an oil drain interval of 40,000 miles, compared to the vehicles with the additized filters, which were run to 50,000 miles. Figure 5 shows the results of the TBN/TAN measurements at various mileage intervals during the runs for the CJ-4 oil. Figure 6 and Figure 7 display the iron and lead contents in the oil for CJ-4 oil.

CONCLUSION

The lab and field-testing demonstrated that the oil drain intervals in certain duty cycle diesel engines could be extended, with the use of this controlled release rate additive filter design. In vehicles using the additized oil filter the TBN/TAB crossover point (often used as reference point for end of oil useful life) shifted from 22,000 miles to about 34,000 miles. Additionally, the wear levels of iron and lead were lower in vehicles using the additized filter, as compared to those with the standard filter, throughout the mileage range.

These filters are commercially available and sold under the FRAM® and Luberfiner® Heavy Duty TRT™ Filter brands. They are currently being successfully used on a large commercial fleet.

REFERENCE SAE paper 2008-01-2644.

Read *International Filtration News* online at www.filtnews.com

The Evolution of Air Filtration Test Methods Employed in QA/QC Programs

By Christina Clark, Jeff Smith, Terry Williamson and John McKenna, ETS, Inc.

ETS team reviewing bag specifications and QA/QC Plan.

The first time ETS was commissioned to conduct a comprehensive, in depth, Quality Assurance/Quality Control (QA/QC) program on air filtration media and bags was in the 1970s. A very large electric utility facility elected to employ a reverse air baghouse using woven fiberglass bags. The test program included measuring permeability and strength. Ironically, filtration performance was not included. While there existed ASTM International (formerly known as the American Society for Testing and Materials) test methods for permeability and strength, no generally accepted method had been published for filtration performance testing at that time and it would be decades before one evolved. The utility baghouse was the largest baghouse system built up to that time and therefore there was a great deal at stake for both the utility and the baghouse vendor. Given the large number of bags involved and the amount of fabric required, the fabric was produced and coated in separate batches. The QA/QC program identified a bad coating batch in the middle of production. This batch was then rejected and replaced. The cost of the QA/QC program was a only a few percent of the bag set cost, thus the baghouse vendor and the utility found this program well worth including.

The tightening of the air emission codes and the focus on fine particles have driven the need for inclusion of filtration performance testing as an essential part of any fabric filter QA/QC program. In the 1990s the USA EPA developed a filtration test method based on a test method developed in Germany.[1] Subsequently, ASTM and the International Organization for Stan-

dardization (ISO) also published similar test methods. The international expansion of fabric and bag suppliers has highlighted the need for test methods which can determine the chemical content and purity of imported and domestic fabrics.

The value of a fabric and bag QA/QC program, bag installation oversight, and bag monitoring program increases as the code requirements become more stringent. The intrinsic value of the QA/QC program is driven by the fact that the failure of even one bag can cause dust contamination of the clean side of the baghouse. This in turn leads to widespread premature bag failure and/or pressure drop increases. Recent new fabric and bag QA/QC programs have detected membrane failures, out of spec strength and permeability, fabric shrinkage concerns, bag punctures and significant dimensional and construction issues.

TEST METHODS AND THEIR EVOLUTION

The following contains a brief description of test methods currently employed.

Air Permeability

The air permeability test is used to determine the amount of air that can flow through a given cloth area. Permeability is defined in ASTM Standard D737 [2] as the rate of air flow passing perpendicularly through a known area of fabric which is adjusted to obtain a prescribed air pressure differential between the two fabric surfaces.

Mullen Burst

The Mullen burst strength test, described in ASTM Standard D3786[3], is designed to show the relative total strength of fabrics to withstand severe pulsing or pressure. Fabric strength is determined by measuring the pressure required to rupture the specimen from inflation of an expandable diaphragm.

Tensile Strength

The tensile strength test provides data on fabric strength and elongation. The ASTM Standard D5035[4] provides raveled strip (woven fabrics) and cut strip test procedures (nonwoven and felted fabrics) for determining the breaking force and elongation of most textile fabrics.

M.I.T. Flex Endurance Test

The M.I.T. flex endurance test primarily measures the relative value of fabric to withstand self-abrasion from flexing by measuring the number of flex cycles necessary to break a fabric sample. The test method is described in ASTM Standard D2176[5], which is the standard method for testing the folding endurance of paper. The fabric samples are tested in both the warp and fill directions.

The M.I.T. flex test has traditionally been used to help determine the rate of deterioration of woven fiberglass bags

ETS engineer utilizing the filtration performance test apparatus.

used in coal-fired utility boilers due to the inherent abrasiveness of glass fibers. ETS has also found the M.I.T. flex test to be very useful in the evaluation of many felts and their ability to withstand flexing against a wire cage during pulse cleaning cycles. For nearly all filter bag fabric types, this test can be a leading indicator that the fabric is nearing the end of its useful service life.

Filtration Performance

The filtration efficiency media analyzer (FEMA) test apparatus at ETS, developed in Germany and currently supplied by Fil T Eq GmbH, measures filter media performance under defined conditions with regard to filtration velocity, particle size distribution and cleaning requirements, simulating actual baghouse conditions.

ASTM International

In 2002, ASTM International adopted the EPA's Environmental Technology Verification (ETV) baghouse filtration testing protocol[6] as its standard (ASTM D6830-02[7]), promoting standardization and consistency in performance evaluation of these technologies.

ISO

In 2011, the ISO, a worldwide voluntary standards organization, adopted ISO 11057:2011.[8] The main purpose of the ISO Method is to gain information about both the operational performance and the particle emission of cleanable filter media.

Fourier Transform Infrared Spectroscopy (FTIR)

FTIR is a technique that uses infrared light to observe properties of a solid, liquid, or gas. In infrared spectroscopy, IR radiation is passed through a sample. Some of the infrared radiation is absorbed by the sample and some of it is passed through (transmitted). The resulting spectrum represents the molecular absorption and transmission, creating a molecular fingerprint of the sample. FTIR analysis results are generally utilized for identification of materials of construction (e.g., fiber type, thread type) of filter bags and /or evaluation of contaminants.

Comprehensive Monitoring Programs

Long-term monitoring programs compliment QA/QC Programs. All of the strength and flow tests should be done in conjunction with each other periodically in order to develop the loss of strength and flow trend lines over time. The testing program can identify when the bags are approaching end of life and higher risk of failure, but cannot predict the exact timing of the end of life of the bag set. Permeability measurements of used bags can, by varying the amount of vacuuming, help to de-

termine if the bags are gradually blinding (losing permeability). Used bag test values are compared with original clean fabric test values to show rate and level of deterioration.

CONCLUSION

Today, the primary reasons for conducting fabric and bag QA/QC include:

1. Minimize baghouse and production downtime by insuring that the specification is met and related bag failure precluded.
2. Protect the user in the event of warranty issues by providing baseline data.
3. Provide an unbiased third party assessment of fabric and bags.

Current results of QA/QC testing have shown differences in the quality of products from various fabric and bag suppliers. Issues have included filtration performance, permeability and strength. In some cases once ETS has worked with a given supplier, their product has achieved a consistent high quality with few failed results.

Going forward, as the emission codes increase and become more stringent, the role of QA/QC testing will continue to increase in value. Additional test methods addressing added speciation and condensation products will evolve. New innovations in multi-component felted media[9] may require additional test method development as well. The cost of such programs will be additive, thus making the trade-off between reducing cost by reducing the sampling frequency vs. increasing the risk of missing faulty product locations more difficult. The challenge will be to keep the cost of a QA/QC program under 5% of the bag set costs.

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Specialized Filtration Required for Preservation Environments

By Christopher O. Muller, Technical Director, Purafil, Inc.

When one thinks of indoor air quality (IAQ), the health and well-being of people most often comes to mind. However, IAQ is not only a people issue, it is also a materials issue. Just as people can suffer due to poor air quality in a building, many different types of materials can suffer as well.

Many industrial environments contain corrosive gaseous contaminants that can destroy expensive computerized process control equipment. These contaminants, if not properly controlled, can bring production to a standstill, resulting in downtime costing tens, if not hundreds of thousands of dollars an hour. However, computers can be replaced. This cannot be said for the materials and objects being housed in museums, libraries and archives.

In museums and other "preservation environments" there are a number of factors, which can cause the degradation of materials and artifacts. Among these are temperature, humidity, particulates, and gaseous contaminants. Of these, gaseous contaminants are the most destructive.

GASEOUS CONTAMINANTS

While automotive and/or industrial emissions are considered as the largest contributors of the three main contaminant gases found throughout the industrialized world - sulfur dioxide (SO_2), ozone (O_3), and nitrogen dioxide (NO_2) - there are also many significant sources of internally generated contaminants. Materials and activities associated with restoration and conservation laboratories, many artifacts and archival materials, and employees and patrons themselves can contribute to the overall contaminant load in preservation environments.

Although gaseous contaminants are a major worldwide environmental concern, sources of gaseous contaminants, their introduction and migration through museums, and their interactions with artifacts are the least studied and least understood area of concern within preservation environments. General reviews of contaminant sources and object vulnerabilities and information and guidelines for gaseous contaminants were scarce until the 1990s.

CONTROL SPECIFICATIONS

The most commonly cited control levels for gaseous contaminants are shown in Table 1. Background concentrations and the peak urban levels for these contaminants are also listed for comparison. As can be seen, the recommended levels for several contami-

Table 1 - Control specifications for preservation environments

Contaminant/Parameter Measured	Acceptable Level		Reactivity Level[1], Å/30 days	Normal Background Concentrations	Peak Concentrations (Urban Areas)
	ppb	$\mu g/m^3$			
Sulfur dioxide	≤0.35 - 1.0	≤1 - 2.85	-	6 - 30 ppb	100 - 750 ppb
Ozone	≤2.65	≤1.8 - 24.5	-	0.4 ppb	20 - 40 ppb
Nitrogen dioxide	≤0.94 - 12.5	≤5	-	1.0 - 1.5 ppb	40 - 100 ppb
Chlorine	≤1 - 3	≤3 - 9	-	0.06 - 0.6 ppb	20 - 130 ppb
Hydrogen chloride	≤1 - 3	≤1.5 - 4.5	-	20 - 50 ppb	200 - 450 ppb
Acetic acid	<4	<10	-	4 - 10 ppb	20 - 100 ppb
Formaldehyde	<4	<5	-	3 - 15 ppb	10 - 40 ppb
Silver Corrosion	-	-	<40[a]	-	-
Copper Corrosion	-	-	<90[b]	-	-

a - with no sulfur corrosion evident, b - with no chloride corrosion evident

nants are below the normal background levels and all are below contaminant levels one would expect to encounter in urban environments.

The biggest problem today is not whether specified levels of air quality can be reached, but whether they can be accurately measured to assure compliance with any standards or control criteria. The qualitative identification and the quantitative determination of gaseous contaminants and their concentrations often make stringent demands on monitoring instrumentation and methodologies. Because of this, a number of institutions have turned to environmental classification via reactivity, or corrosion, monitoring.

ENVIRONMENTAL MONITORING

Reactivity monitoring can characterize the destructive potential of an environment. The growth of various corrosion films on specially prepared copper, silver, and/or gold (-plated) sensors (Figure 1) provides an indication of the type(s) and level(s) of essentially all corrosive chemical species present in the local environment. Both passive and real-time reactivity monitors are currently available and each can be used to gather important information on gaseous contaminants and their levels in the environment.

Based on joint research performed by Purafil, Inc.[2,3,4] the government of the Netherlands[5], and the Comitato Termotechnical Italiano (C.T.I.)[6], reactivity monitoring

Figure 1. Environmental reactivity coupons (ERC, left) and environmental reactivity monitors (ERM, right). Photo courtesy of Purafil, Inc.

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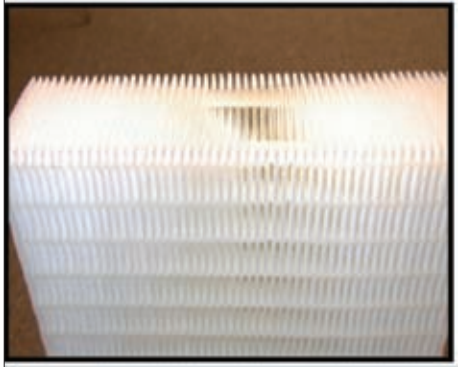

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Table 2 – Environmental classifications for preservation environments

Silver Corrosion			Copper Corrosion		
Class	Air Quality Classification	Corrosion Amount	Class	Air Quality Classification	Corrosion Amount
S1	Extremely Pure	<40Å / 30 days	C1	Extremely Pure	<90Å / 30 days
S2	Pure	<100Å / 30 days	C2	Pure	<150Å / 30 days
S3	Clean	<200Å / 30 days	C3	Clean	<250Å / 30 days
S4	Slightly Contaminated	<300Å / 30 days	C4	Slightly Contaminated	<350Å / 30 days
S5	Polluted	≥300Å / 30 days	C5	Polluted	≥350Å / 30 days

has been accepted as the preferred air monitoring method in preservation environments. It has become the standard for air quality monitoring in government archives in the Netherlands[7] and is being proposed as a European standard. These control specifications are shown in Table 2.

Reactivity monitoring makes it possible to easily identify and quantify those contaminants most dangerous to preservation environments, however, there has been little research done to determine what levels actually cause deterioration of historical artifacts and archival materials. In general, guidelines call for interior concentrations of gaseous contaminants to be maintained as low as attainable by gas-phase air filtration. This can be accomplished by the processes of physical adsorption and/or chemisorption, through the use of various dry-scrubbing air filtration media.[8]

FILTRATION SYSTEMS

The research referenced above has not only looked at gaseous contaminants and their effects and evaluated environmental monitoring methods; it has also looked at determining the best contaminant control strategies.

In terms of gaseous contaminants, it has been determined that (at least) two different dry-scrubbing media will be required[5]. One should be a sodium permanganate-impregnated alumina, such as Purafil SP media for the removal of nitric oxide, ozone, sulfur dioxide, hydrogen sulfide and formaldehyde (among others). The other should be a caustic-impregnated activated carbon/activated alumina such as Puracarb media for the removal of nitrogen dioxide, organic acids, and nitrogen and sulfur oxides (among others). Both types of media should be a requirement and anything less should not be considered.

It was mentioned above that particulates are one of the main factors, which can cause the degradation of archival materials and historical artifacts. This is particularly true where temperature and humidity are not properly controlled. Therefore, particulate filtration must also be part of any contaminant control system for preservation environments.

The optimum filtration system for museums will address as many of the potentially offending materials as possible - gaseous and particulate. The recommended system would consist of (1) a MERV 6-8 ASHRAE-rated prefilter (G4, F5); (2) a bed of Purafil SP media; (3) a bed of Puracarb media; and (4) a MERV 13-15 ASHRAE-rated final filter (F6-F8).

STANDING THE TEST OF TIME

Conservationists and preservationists are expected to provide and maintain environments sufficiently well controlled as to minimize the decay of artifacts and materials. Thus the total environment, external and internal, must be considered to accurately assess the potential for damage from environmental factors and adequate control measures must be employed for all. Anything less in a control strategy could result in the damage or destruction of materials that can never be replaced or restored.

The specialized air quality needs of museums and other preservation environments are being acknowledged and acted upon at sites all around the world. This includes both the air monitoring and contaminant mitigation aspects. Continuous monitoring of gaseous contaminants has become a requirement in order to provide accurate environmental assessments.[9] The installation of a filtration system for the removal of both gaseous and particulate contaminants is probably even more important. Some successful examples of this are listed below.

- The filtration system described above as well as reactivity monitoring is required in all government archive buildings in the Netherlands, including the General Government Archives at The Hague.

- The Italian government required the installation gas-phase air filtration and reactivity monitors as part of the restoration and renovation of the Leonardo da Vinci's Last Supper.

Reactivity monitors are also installed in the Sistine Chapel.

- The use of specialized gas-phase air filtration and reactivity monitoring are requirements for the Jewel House and Crown room in the Tower of London.
- The Shrine of the Book at the Israel Museum in Jerusalem is using reactivity monitoring to help protect the Dead Sea Scrolls.
- National archive facilities in Australia, New Zealand, and Singapore have all made gas-phase air filtration and reactivity monitoring part of their environmental control strategies.
- Gas-phase air filtration is currently in use in the U.S. National Archives, Archives II, and the state archives of Arizona, California, Georgia, Minnesota, Missouri, and Washington. The National Archives, Archives II, and the Georgia and Minnesota State Archives are using reactivity monitoring as well.

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Conductive and Heat-Resistant

R.STAT stainless steel fiber range

Fibers for Performance Markets

By Philippe Sannejan, R.STAT

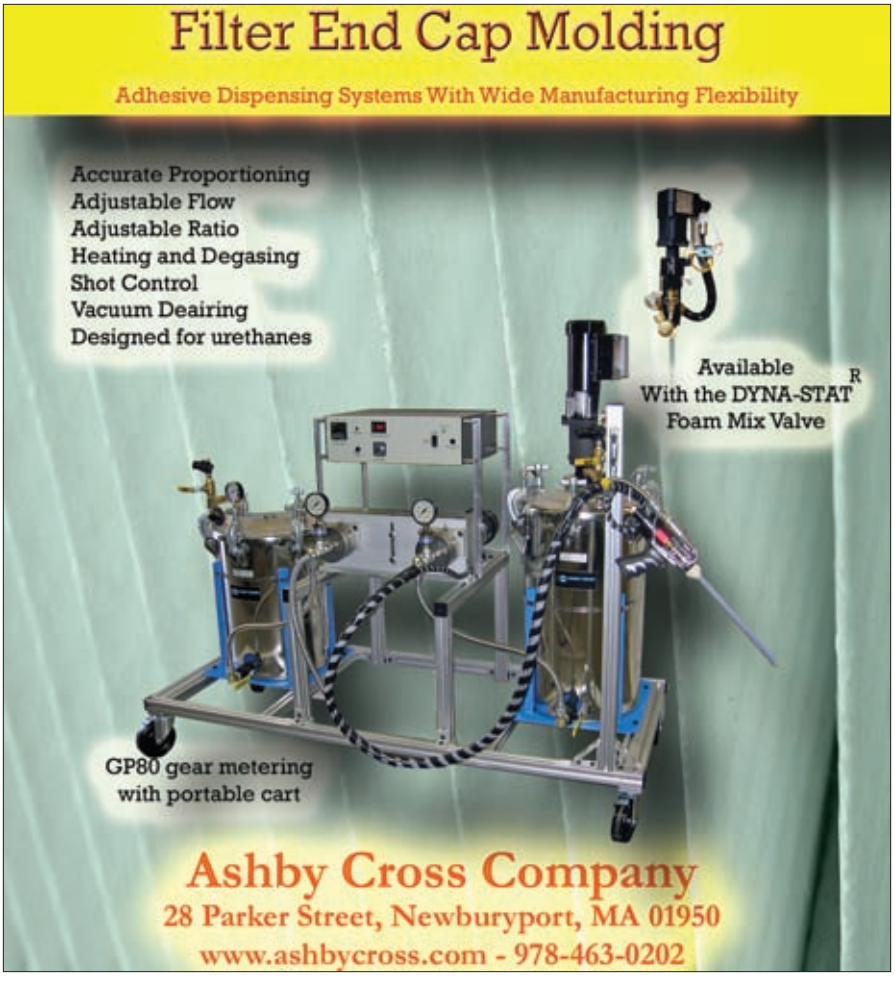
R.STAT, a specialty high-temperature resistant and conductive fibers manufacturing company, has its roots based on the original developments by Rhone Poulenc in the 1970s. For the last 40 years Rhone Poulenc, located in France, and known as R.STAT since 1997, is an independent company and industry leader that has created and perfected two state-of-the-art conductive textile grade fibers and yarns from both stainless steel and silver coated nylon.

Both fiber types are widely used in a host of specialty technical textile, apparel, home and office furnishing markets plus a variety of specialty textile constructions for industrial markets. Weavers, knitters, braiders, wetlaid and nonwoven fabric companies incorporate stainless steel and silver coated nylon fibers in numerous end markets, often unrecognized by the ultimate textile user, yet critical to the end-use application. For example, the positive effect of these conductive fibers presence silently guard office employees, guests of hotels, passengers on commercial aircraft, wood or paper pulp industry workmen, firemen and soldiers against electrical and/or triboelectric generated spark and electrical shock situations capable of causing a fire or explosion resulting from electrical discharge. Other applications include a growing dependence for protection against electromagnetic sources to applications in a host of industrial applications involving heating elements and applications where high-temperature tolerance is required, such as in heat sinks, burners, sophisticated baghouse filtration and use in harsh and corrosion resistance environments.

BROAD MARKET AND APPLICATION USES

The positive contribution of both metal and silver coated nylon fibers offer broader opportunities that most experienced professionals, even in the broad textile industry, do not readily recognize or have personal experience in. Examples of applications include uses where anti-static properties are important, such as in the contract fabric industry, including upholstery textiles in offices, hotels, casinos, cruise ships and hospitals, as well as broadloom carpet and carpet tile. In these applications, R.STAT/S (metal fibers) and SilverSTAT (silver coated nylon) antistatic properties silently stand guard in eliminating electrostatic discharge (such as seizing a knob, moving with castor chair) to prevent disruption of computers or electronic devices.

Clean room fabrics, protective apparel and work-wear clothing, as well as security shoes use conductive fibers to avoid the dangerous accumulation of electrical charges. In a microelectronics clean room, even the smallest of discharges can have a negative and even



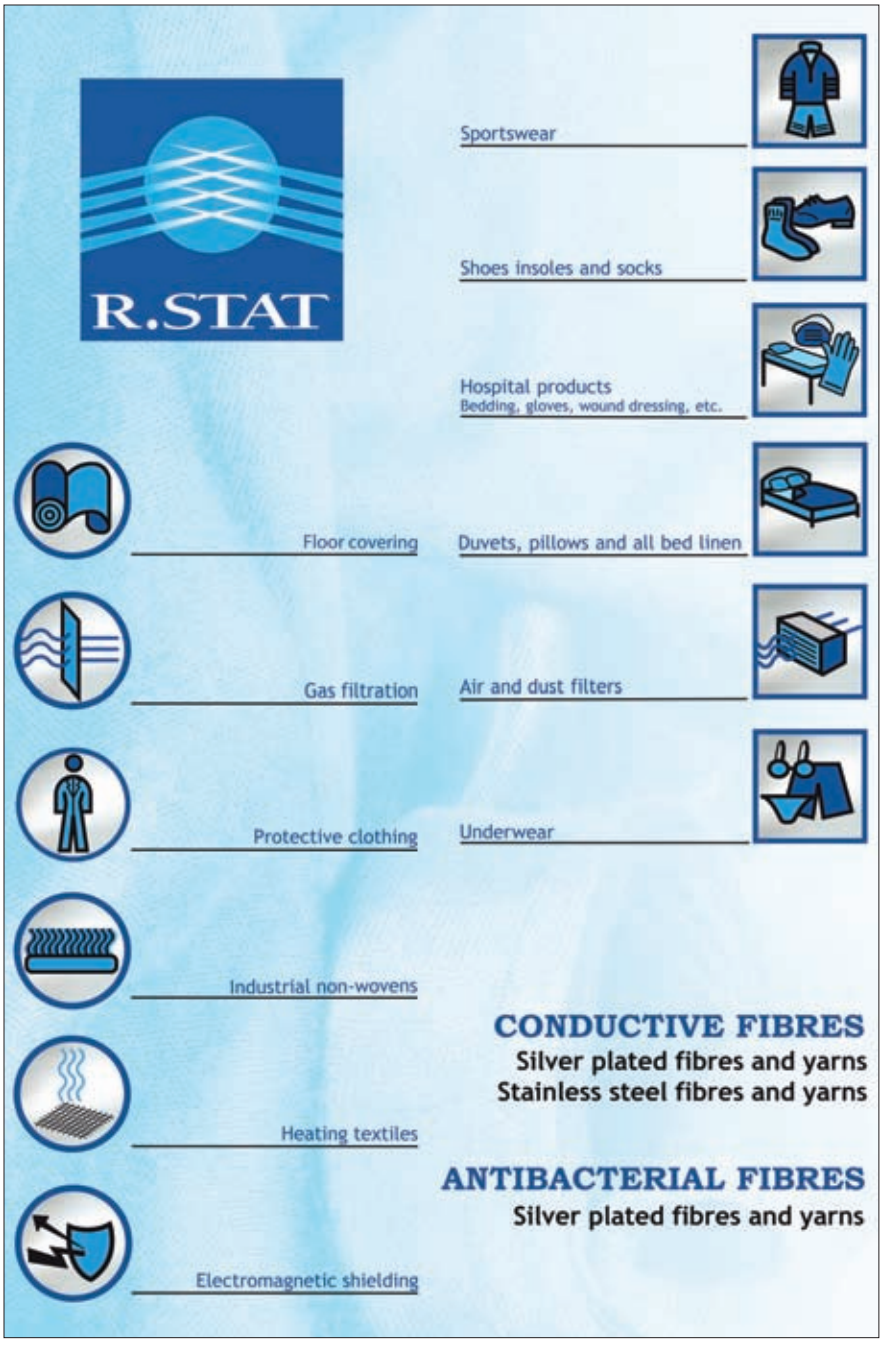


Chart of R.STAT's applications

Silverstat continous filaments

catastrophic effect on wafer and chip yield as well as the reduction of potential danger of fire in a space containing hazardous processing chemicals. Electrical linemen, natural gas, petroleum and mine workers are other specific fields of use where the danger of explosion is always present. Acknowledging safety, insurance companies now offer lower rates to employers who provide engineered protective workmen clothing to employees.

Filtration media containing a low-percentage blend of metal or silver coated nylon fiber in combination with synthetic fibers provide static protection in baghouse filters safeguarding against the risk of explosion where fine powders are present. Conductive fibers are also used as a woven conductive scrim within the structure of a needlefelt baghouse nonwoven fabric, providing greater fabric stability as well as mechanism to discharge static build-up. Examples of such uses include baghouses found in foundries, granaries, abrasive production factories, in addition to flour and sugar processing facilities.

Silverstat 30 denier staple fiber

SILVER COATED NYLON FIBER AND YARN

R.STAT has designed performance solutions for many common and advanced applications for its SilverSTAT - pure silver coated polyamide fibers and filaments. Silver metal is historically known for its numerous benefits; namely conductive (silver being the most conductive natural element on earth), as well as for its highly anti-bacterial, anti-fungi and anti-odor properties in addition to its thermo-reflecting properties. Thermo reflecting properties help reduce heat penetration from an outside source or aid in containing the loss of heat from an emitting source.

The industrial manufacturing process of SilverSTAT is a unique enabling technology allowing for a permanent bond of the company's 99.9 % metallic thin silver layer onto polyamide (nylon) fibers. SilverSTAT is available as cut flexible staple fiber from 1.5 - 30 denier, consisting of flexible pure silver sheath and is often pre-blended with other fibers, such as polyester, nylon or aramid fibers. Continuous filaments range from 20 to 220 denier in size with various dpf.

STAINLESS STEEL FIBER AND YARN

Other end-uses and customers require thermo-resistant conductive fibers and R.STAT developed a range of R.STAT/S consisting of fine diameter, highly flexible stainless steel (alloy 316L), with other alloys available upon request. Like the silver coated nylon described above, stainless steel fiber and filament are available as staple fiber, filament yarn and tow.

Stainless steel fibers are used in a wide range of applications, including:

- High electrical conductivity in electromagnetic shielding applications known as EMI shielding having the ability to provide Faraday cage

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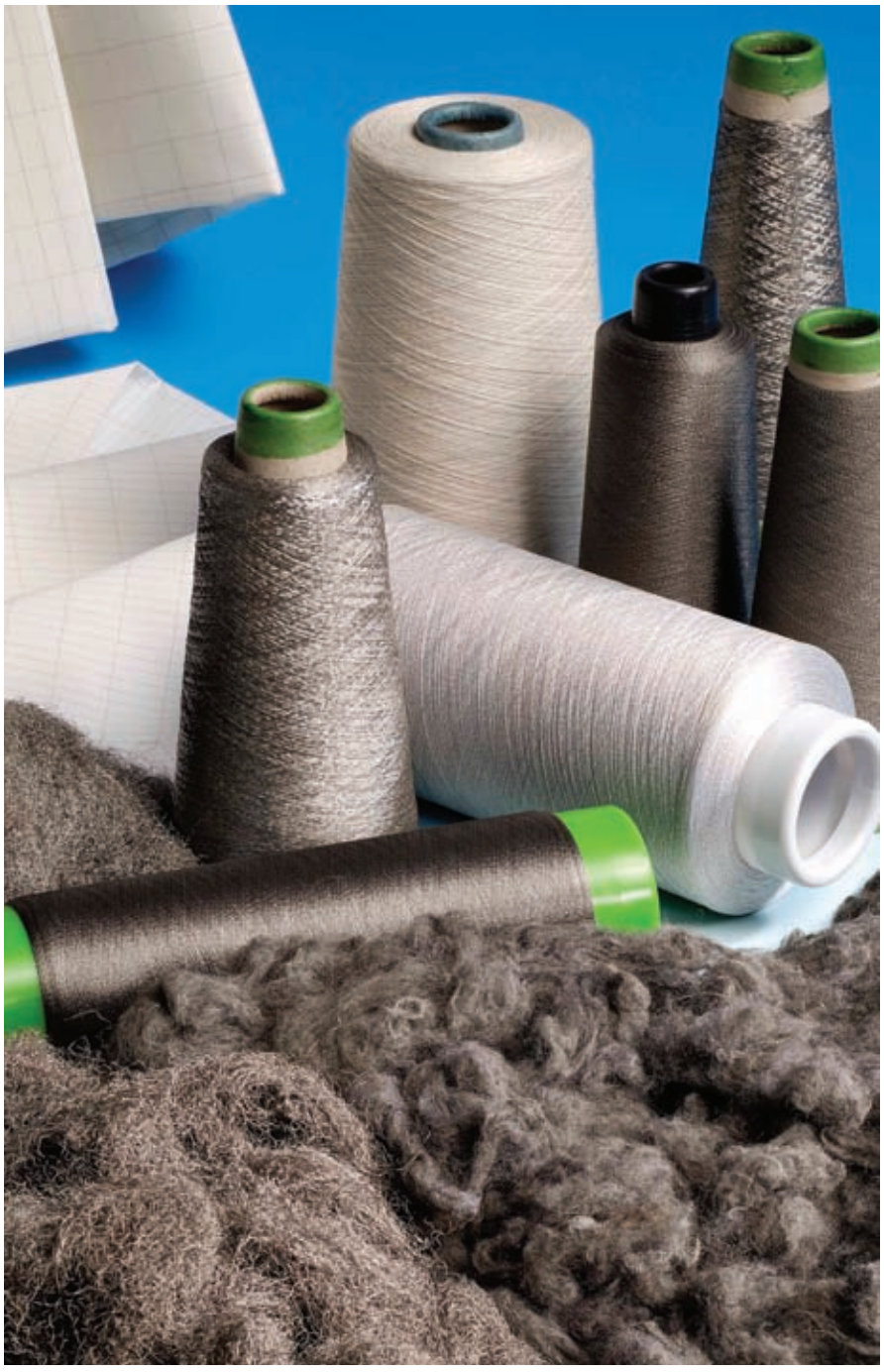

Silverstat product range

insulation common in mobile telephones.

- Thermo-resistant properties (600° C - 1100° F) in industrial oven insulation and as heat sink blankets used in automotive glass forming and specialty glassware businesses.
- Dust and baghouses routinely utilize the combination of conductive and thermo resistant properties of stainless steel fibers in hot gas/air filtration.
- Composite applications make use of fine metal fibers referred to as fiber metal felt, in combination with wire

cloth for use in polymer filtration in the production of fine synthetic staple and filament yarns as well as the manufacture of thin plastic films.

- Metals fibers and yarns are found in automotive heated seating as well as flexible braided electrical cable wrap as electromagnetic EMI shielding in military and commercial aircraft.
- Metal, as well as silver coated nylon fibers and yarns, provide easily detectable protection against counterfeiting when embedded in high-end consumer branded merchandise.

To meet the requirements of specialty performance applications R.STAT is able to provide its stainless steel fiber in a wide range of stretch-broken staple fibers (pure steel or blends with synthetic fibers), stretch-broken slivers (for spinning mills) and/or pure steel spun yarns. Fibers diameters range from 6 to 22 microns (equivalent 1.5 to 27 denier). Also, available, as a standard available item, are flexible wires, similar to monofilament synthetic yarn, in diameters of 35 and 50 microns.

R.STAT's philosophy and historical perspective is to work in close partnership with its customers to support their designs and tailor-made solutions, enabling customers to differentiate their products from competition. R.STAT further seeks to offer solutions and benefits beyond a standard fiber. The company is open to modifying its existing materials based on customer needs, including joint developments for advanced constructions available nowhere else in the market. R.STAT is pragmatic and will not hesitate to provide advice to use another technology if there is a better solution for a specific application.

Equipped with sophisticated R&D and testing laboratories, R.STAT provides its worldwide customer base extensive support, including checking and verification of electrostatic or other properties of textiles designed with R.STAT fibers in its own laboratory in order optimize products with customers before final certification by an independent laboratory.

Above all, lot-to-lot product repeatability and quality of R.STAT fibers lead the parade and remains unmatched in the industry. The company takes considerable pride in the reliability of its products knowing the critical nature and responsibility that its fibers play in engineered applications as well as customers' highest expectations of a dependable world-class supplier.

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Tips on Recovering Solids in Liquid Filtration

By Peter R. Johnston, Consultant

With slurry to be filtered comes the following questions: What filter medium might do the job to recover the solids? Is the filter cake permeable, or is it a compact mass?

Logical plots of batch-filtration results vs. time reveal the quality of the collected solids. Following those guides enables us to decide if slurry must be specially treated before designing the commercial-size filtration step, or a different filter medium must be employed.

A. FLUID-FLOW RATE

A general rule of thumb for fluid-approach velocity is one gal/min/sq ft. The important measurement is residence time. Filter media are not sieves. Small particles are captured by being drawn to the surfaces of the pores or by simple random encounters with the surfaces, to stick, sometimes only with the glue of van der Waals forces.

However, in the present case, particles in the feed stream are the items to be recovered, not the fluid.

In these cases, slurry-approach velocities may be higher, but stay in the viscous-flow range. That is, in a log/log plot of velocity (vertical scale) vs. fluid driving pressure (horizontal scale), stay within the range where the slope is 1.0. If the slope is lower (will not be lower than 0.5), inertia flow has diluted viscous flow and the fluid-driving costs are higher because of the greater driving pressure to obtain higher flow rates.

B. THE CHOICE OF A FILTER MEDIUM

This is usually a cloth, woven or nonwoven, composed of a certain material, or materials, with a specific, laminar-flow-averaged pore diameter.

That diameter is measured from the permeability, B, m^2, and the porosity, ratio of void volume to bulk volume.

$$B = \frac{u\eta z}{\Delta P} \qquad \text{Eq. 1}$$

where u = clean-liquid approach velocity, in laminar flow, m/s
η = viscosity of the liquid, Pa·s
z = thickness of the medium, m
ΔP = driving pressure, Pa

Deduce the laminar-flow-averaged pore diameter, d_{av}, via, from permeability, B, and, porosity, ε.

$$d_{av} = \frac{\sqrt{32B}}{\varepsilon} \qquad \text{Eq. 2}$$

Some sellers of filter media assign pore-size ratings on the basis of a "standard" filtration test. Ignore that rating and ask for the results of Equations 1 and 2.

C. LIFE/CAPACITY OF A FILTER MEDIUM

This measure is the time for the medium to loose permeability, having captured particles from the feed stream.

Obviously, that capacity is a function of both the liquid and the particles in the liquid, as well as the nature of the filter medium. Make these measurements via one of three different kinds of operations.

1. In constant-flow filtration, using a positive-dis-placement pump, make a plot, on log/log paper, of increasing driving pressure vs. time. Such a plot describes a curve that can usually be superimposed over one of the curves in Figure 1.

Curve		$P =$
A	Cake filtration	$1 + t$
B	Intermediate blocking	e^t
C	Standard blocking	$(1 - t/2)^{-2}$
D	Complete blocking	$(1 - t)^{-1}$

Stop filtration when the driving pressure reaches, say, ten times the starting value. The ideal curve is, obviously, Curve A. The only decrease in permeability owes to the increasing thickness of a porous bed of particles.

In some type-A curves the filter cake under increasing pressure, will compress and Curve A will bend up, instead of continuing as a straight line of slope 1.0.

Sometimes a type-D curve can be made like one of the others by using a medium with smaller pores.

Perhaps a change in the pH may

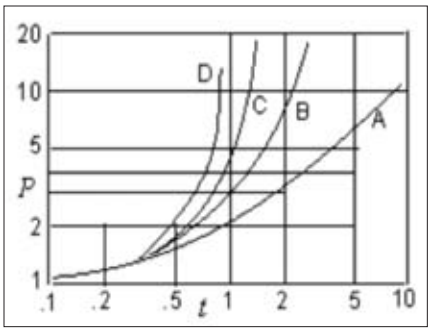

Figure 1. Math-model plots of curves in constant-flow filtration. P = fluid-driving-pressure units, t = time units

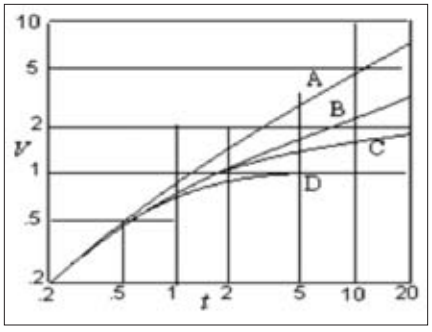

Figure 2. Math-model plots in constant pressure filtration. V = volume filtered, t = time units

make the separation easier.

Perhaps, the solids in the slurry might be made less compactable by modifying the process that produced the solids.

2. In constant-pressure filtration, employing a constant head of liquid, make a plot, on log/log paper, of cumulative volume filtered vs. time and see that the curve can be superimposed over one of the math curves of Figure 2.

Curve	$V =$
A. Cake filtration	$(4t + 4)^{0.5} - 2$
B Intermediate blocking	$\ln (1 + t)$
C. Standard blocking	$t /(t/2 + 1)$
D. Complete blocking	$1 - e - t$

The desired Cake filtration curve is also seen as a straight line in a linear/linear plot of t/V vs. V.

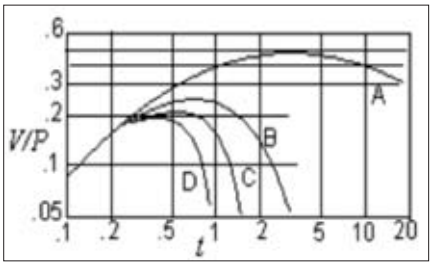

Figure 3. Curves seen when a centrifugal pump drives the feed stream. Combinations of the curves of Figures 1 and 2.

3. In employing a centrifugal pump to do the job, make a plot, on log/log paper, of the ratio: V/P, volume filtered/pump pressure vs. time as illustrated in Figure 3.

D. BACKWASHING FILTER MEDIA

After a medium loses permeability, such as the above curves B, C, and D and the large particles are scraped off, many times a backwash restores most of the original permeability. Sometimes the backwash is a portion of the filtrate. Sometimes the backwash is not a portion of the filtrate, but is a cleaning solution, which then must be washed out.

Performing one of the above batch operations provides the information to design a continuous operation, such as a moving-belt filter medium.

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Johnston, Peter R., 1998, Fundamentals of Fluid Filtration, a Technical Primer, 2d Edition, Tall Oaks Publishing.

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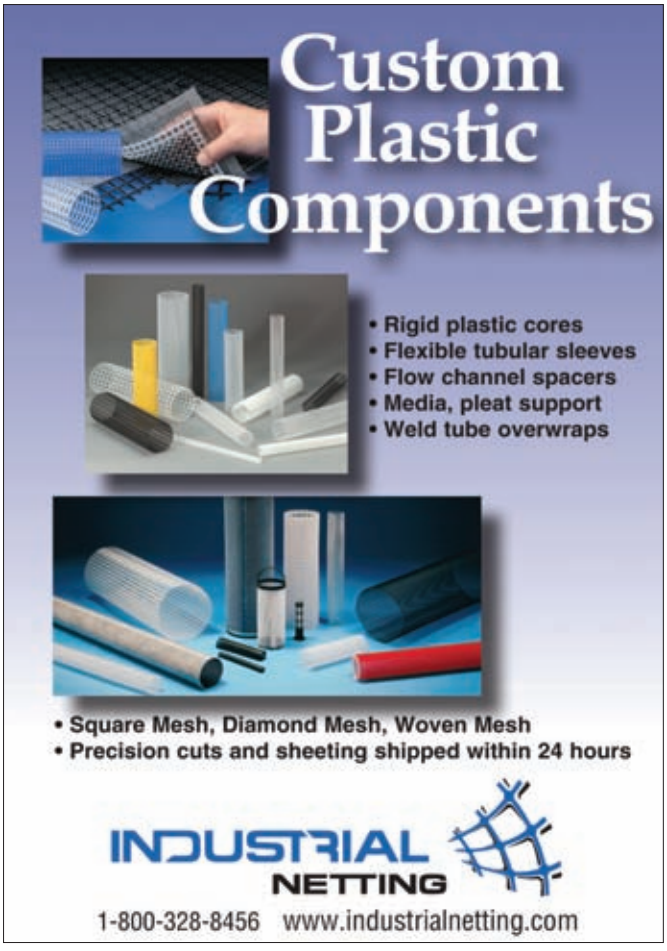

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AFS Returned to Minneapolis in 2013

2012 Award winners with AFS Officers, left to right: 2013 AFS Chairman Mathias Stolarski, DuPont; Ruijun Chen, Kaydon Filtration; Jackie Gallagher, Parker Hannifin Co.; David Raider, Clarcor, Inc.; Barry Verdegan, Cummins Filtration; Shagufta Patel, PECO Facet; Wilson Poon, W.L. Gore & Associates; and AFS Second Vice Chairman Chris Wallace, Filtration Technology Corp.

The American Filtration & Separations Society returned to Minneapolis after a four-year absence for its annual spring conference May 6-9. The conference co-chairs were Saru Dewar of Cummins Filtration and Martin J. Lehmann from Mann + Hummel. The focus of the conference was on the topics of filtration and separations in global markets, including recent technology advancements, with specific emphasis on engine and water filtration.

Held at the Minneapolis/St. Paul Hilton Hotel, the conference began Monday with both 4- and 8-hour short courses on the topics of Basics in Solid/Liquid and Basics in Solid/Air, Filtration Media Markets and Use, Microfiltration Membranes, Filter Media Design for Liquid Applications, Reverse Osmosis System Design and Ultrafiltration Filtration Membranes. The main conference – Tuesday through Thursday – consisted of three concurrent tracks broadly covering the topics of engine and water filtration with 20 sessions, 80 presentations, 5 conference sponsors and numerous exhibitors participating. The benefits for attendees at AFS conferences include the diversity of topics, in-depth short courses and insightful individual presentations from the who's who of the industry. Also, professional growth and networking opportunities are always center court at AFS events for both newcomers and journeymen alike.

Plenary speakers were: Tuesday – Dr. Behnam Pourdeyhimi from The Nonwovens Institute in Raleigh, N.C.; Wednesday – Ben Mullins from Curtin University, Perth, Australia; Thursday – M. Matti Maricq from Ford Motor Company, Dearborn, Mich.

The corporate sponsors met as a group prior to an AFS networking reception. The AFS corporate sponsors committee reviewed the many new benefits for corporate sponsors including new Webinars and Market Landscape Reports available exclusively to corporate sponsors under a pending AFS UniversityTM banner and an On-Line Campus concept; a recently installed proprietary, sponsors only, AFS website Buyer's Guide, along with a new AFS Point of View initiative, all with a focus to provide corporate sponsor visibility and to drive buyers to AFS corporate sponsors.

At the Tuesday Awards luncheon, AFS Product of the Year Awards for new products introduced in 2012 were presented to Clarcor, Inc., for the company's Poroplate® MaxPoreTM; as the leading Liquid Filter Element Award, Cummins Filtration won; in the Filter Media category for its Fleetguard NanoNet® media, Parker Hannifin Co. won; Hiross Zander Div. was the recipient in the Filter System Category with its Anteras Tandem Technology ATT product; and W.L. Gore & Associates, Inc. won for its Gore® V – Panel Filters as the best Air Filter Element. Dr. Barry Verdegan was the recipient of the Tiller Award. The Senior Scientist Award was presented to Ruijun Chen; Dr. Shagufta Patel received the Young Scientist Award. The Student Poster Awards went to – First Place: Abdulwahab Aljuhani, and Runner-up Kitchaport Nartetamrongsutt, both from the University of Akron, and Runner-up Vincent Kandagor from the University of Tennessee.

The next AFS conference is October 14-16, 2013, in Cincinnati on the topic of Innovations in Fiber Media.

The AFS is the largest Filtration Society in the world and the principal educator of the industry. For additional information, visit www.afssociety.org or call Lyn Sholl, AFS Executive Manager at 615- 250-7784.

Purolator Advanced Filtration Awarded AFS New Product of the Year

At its annual spring conference in Bloomington, MN, in May, the American Filtration and Separation Society (AFS) awarded Purolator Advanced Filtration its New Product of the Year award for the Poroplate® MaxPore™ extended area filters.

Poroplate MaxPore filter baskets are constructed from stainless steel (or higher alloys) sintered wire cloth laminated media (Figure 1). This media has a 40+ year proven service record in a variety of high temperature, high pressure, and corrosive applications, and is available in ratings as low as 2µ nominal. The media consists of multiple layers of woven wire cloth which are diffusion bonded (sintered) in a furnace to create a highly permeable filter laminate with a permanently fixed pore size. The media can be configured as a surface media, or as a progressive pore size media which yields up to 4x higher dirt holding capacity. Both configurations can be backwashed/back-pulsed to regenerate the media.

Poroplate MaxPore baskets are constructed as a series of concentrically oriented cylinders. Each of these cylinders consists of an inner and outer cylinder, open on one end and joined together by a solid ring at the other. A flow channel is created between the inner and outer walls of each cylinder, similar to the flow path of a wall flow filter. This dual- sided arrangement further increases filter surface area. In its final form, the Poroplate MaxPore extended area basket has up to 23 ft.^{2} of filter area and fits into a basket housing that would normally hold a single filter basket with only 4 ft.^{2}. This advantage in effective filter area can be used in several ways to reduce the number of filter housings/valves/piping needed in new installations, to increase filter life, to reduce pressure drop, and to increase the flow rate through the filter.

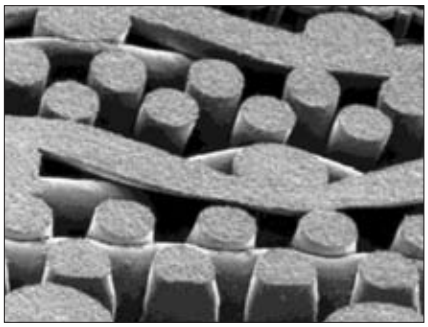

Figure 1- Poroplate sintered wire cloth media

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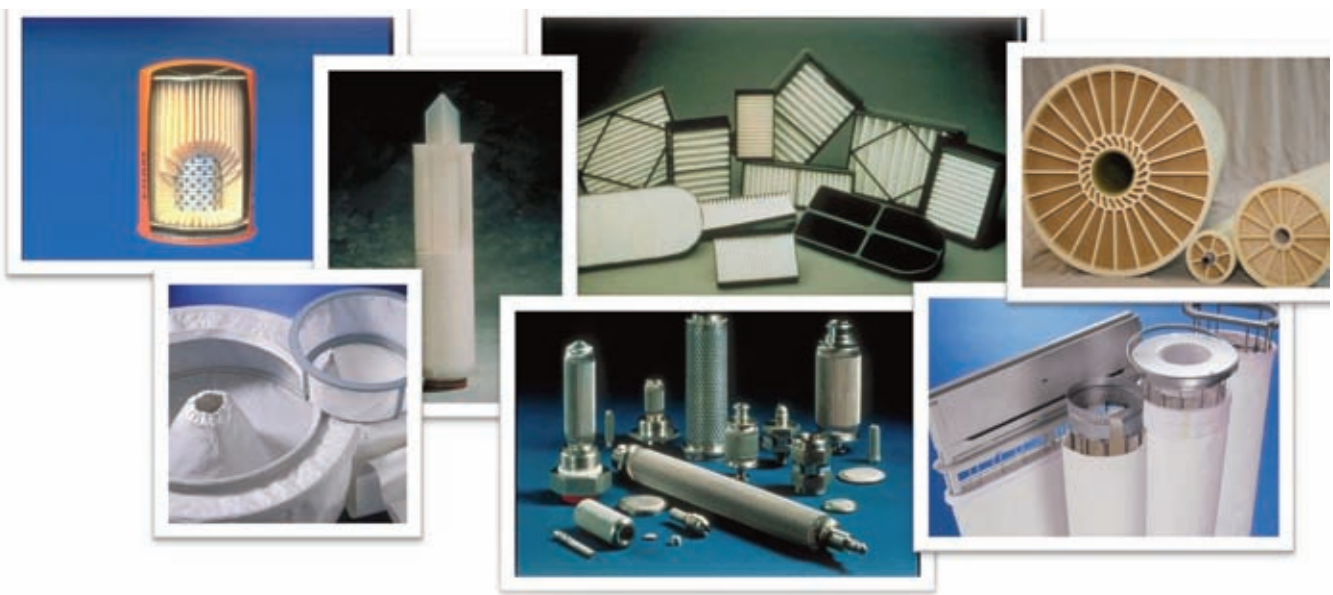

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