

CHEMICAL PROCESSING

LEADERSHIP | EXPERTISE | INNOVATION

SUSTAINABILITY GETS THE SPOTLIGHT

Chemical makers are striving for improvements along many fronts

MAKE YOUR **PROCESS
ANALYZER SMARTER**

GET UP TO SPEED ON
AXIAL COMPRESSORS

TAILOR YOUR **WIRE CLOTH**

Ryan Simmons
Marketing Manager Level

Endress+Hauser, Inc.
2350 Endress Place
Greenwood, IN 46143

Phone 888-ENDRESS
Fax 317-535-8498
info@us.endress.com
www.us.endress.com

Endress + Hauser 
People for Process Automation

The Proof (test) is in the measurement.

Is safety important to you? Solution for in-situ proof testing

When you utilize a safety system such as SIL, SIS or API2350, you are familiar with mandatory level instrument proof tests. Most require you to take your vessel off line and manipulate the level in the vessel or remove the instrument completely for testing.

These methods typically:

- Require hours to complete the test
- Increase risk to personnel by placing maintenance staff on tall vessels
- Cost money due to extended down time and lost production

At Endress+Hauser, we can help you migrate to in-situ proof testing using free space radar, guided wave radar or vibrating tuning fork instruments installed in your safety system.

This solution provides the ability to:

- Verify the health of the instrument and the associated wiring
- Significantly reduce downtime and the risk to your staff
- Improve your maintenance cycle, productivity and bottom line
- Provide up to SIL3 rating in overfill prevention with one device

www.us.endress.com/process-safety-SIL



Micropilot FMR5x
Free space radar

Levelflex FMP51
Guided wave radar

Liquiphant FTL80
Point level switch



Endress+Hauser, Inc
2350 Endress Place
Greenwood, IN 46143
info@us.endress.com
www.us.endress.com

Sales: 888-ENDRESS
Service: 800-642-8737
Fax: 317-535-8498

Endress + Hauser 
People for Process Automation

ANNOUNCING AN AMAZING SCIENTIFIC DISCOVERY. IOWA.



Hypothesis: Iowa is a great location for bioscience companies. Proof: look at the numbers. Bioscience R&D in Iowa was 12% higher than the national average. Iowa State University and University of Iowa invested 70.8% of R&D funding in life sciences and biotech. Bioscientists make another big discovery outside the lab: it's called having a life. We're the 7th best state to raise a child, 5th highest for high school graduation rates, 6th for safest neighborhoods. Discover more at iowaeconomicdevelopment.com. If you follow the logic, it'll lead you to Iowa.

iowaeconomicdevelopment.com



 [iowaeconomicdevelopment](https://www.facebook.com/iowaeconomicdevelopment)

 [businessiowa](https://twitter.com/businessiowa)



**NO OTHER
LOCATION
IN THE COUNTRY
HAS SUCH A
COMPLETE
SUITE
OF CAPABILITIES FOR
BIOSCIENCE
DEVELOPMENT.**

—BATTELLE

MORE THAN EQUIPMENT

There's something different

that you're looking for in a material handling system. Sure, you want superior performance. That's a given. Let's talk about what you don't want:

- Boilerplate design
- Major customization markups
- Difficult parts replacement
- Sleepless nights

We get it.

Meet Hapman. Whether custom-made or custom-matched, all of our systems come with real people who care about your success.



And here's what Hapman will get you:

- ✓ Your ideal design
- ✓ Free material testing
- ✓ Guaranteed performance
- ✓ Round-the-clock support

The right system starts with the right people.
(And that makes all the difference.)



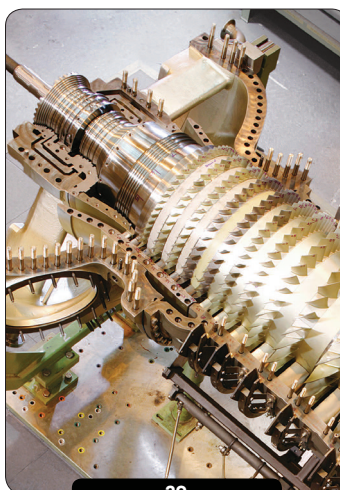
HAPMAN.

Ideas that move.

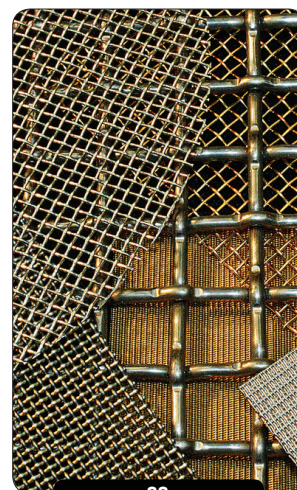
a global company



18



29



33

COVER STORY

18 Sustainability Gets the Spotlight

More chemical manufacturers are placing greater emphasis on improving the sustainability of their operations. This impacts a host of factors, including feedstock selection and even choice of supply-chain partners.

FEATURES

MAINTENANCE AND OPERATIONS

29 Get Up to Speed on Axial Compressors

An axial compressor offers higher efficiency, speed capability and capacity for a given size than a centrifugal compressor, but pose some concerns such as fragile components.

SOLIDS AND FLUIDS HANDLING

33 Tailor Your Wire Cloth

Process uses for the material abound. Proper selection of wire cloth can make a big difference in the cost and efficiency of a fluid handling system, and depends upon a variety of factors.

INSTRUMENTATION AND CONTROL

37 Make Your Process Analyzer Smarter

Sample conditioning systems can suffer from a host of issues that compromise analyzer measurements. A new standard may lead to better ways to address these challenges.

MAKING IT WORK

40 Know the Limits of Duplex Stainless Steels

Duplex stainless steels aren't immune to corrosion, as stress corrosion cracking found on a distillation column at one chemical plant points up.

COLUMNS

7 From the Editor: New Safety Center Moves Ahead

9 Field Notes: Check "Standard Conditions"

15 Energy Saver: Control Steam System Energy Costs, Part II

17 Compliance Advisor: California Calls for Changes to Prop 65

49 Plant InSites: Fight Flow Recirculation

58 End Point: U.K. Invests in Advanced Chemical Products

DEPARTMENTS

11 In Process: Catalyst Promises Cleaner Methanol Production | Biogasoline Beckons

43 Process Puzzler: Preclude Pump Problems

51 Equipment & Services

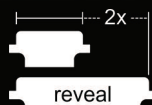
55 Product Spotlight/Classifieds

57 Ad Index

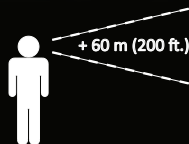
a better way to view

LEVEL

Featuring
reveal™
wide view indicator



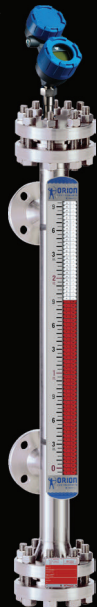
1.5 in wide
metal construction



visit our **new** website www.orioninstruments.com

Aurora®

Advanced MLI with
integrated Guided Wave
Radar level transmitter.



Atlas™

Basic, high-performance
MLI suitable for a variety
of applications.



Jupiter®

Magnetostrictive Level
Transmitter



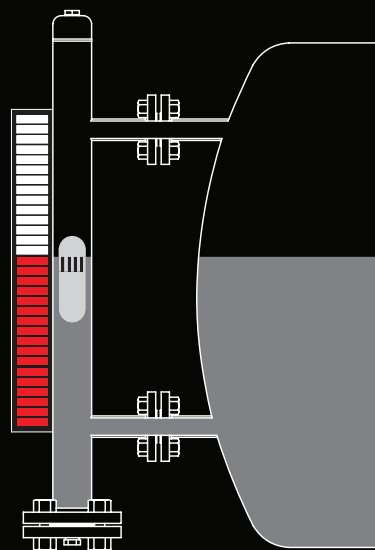
HIGH VISIBILITY MATTERS. Orion Magnetic Level Indicators are equipped with the widest visual indicator available: REVEAL™. You can also upgrade an existing level gauge with Reveal to enhance reliability, visibility, & performance.

With thousands of installations across the globe in some of the world's toughest conditions and applications, Orion Instruments® proves daily that we are the leading supplier of magnetic level indication.



#1 MAGNETIC LEVEL INDICATOR

#1 MAGNETOSTRICTIVE LEVEL TRANSMITTER



In Memory of Julie Cappelletti-Lange,
Vice President 1984-2012

1501 E. Woodfield Road, Suite 400N
Woodfield, IL 60173
Phone: (630) 467-1300
Fax: (630) 467-1109
www.chemicalprocessing.com

E-mail: chemicalprocessing@putman.net
Subscriptions/Customer Service:
(888) 644-1803 or (847) 559-7360

EDITORIAL STAFF

Mark Rosenzweig,
Editor in Chief, x478
mrosenzweig@putman.net

Amanda Joshi,
Managing Editor, x442
ajoshi@putman.net

Traci Purdum,
Senior Digital Editor, x428
tpurdum@putman.net

Seán Ottewell,
Editor at Large
Ireland
sottewell@putman.net

CONTRIBUTING EDITORS

Andrew Sioley,
Troubleshooting Columnist
Lynn L. Bergeson,
Regulatory Columnist
Ven Venkatesan,
Energy Columnist
Dirk Willard, Columnist

DESIGN & PRODUCTION

Stephen C. Herner,
Vice President of Creative Services, x312
sherner@putman.net

Angela Labate,
Associate Art Director, x461
alabate@putman.net

Rita Fitzgerald,
Production Manager, x468
rfitzgerald@putman.net

EDITORIAL BOARD

Vic Edwards, Consultant
Tim Frank, Dow Chemical
Ben Paterson, Eli Lilly
Roy Sanders, Consultant
Ellen Turner, Eastman Chemical
Jon Worstell, Consultant
Sheila Yang, Genentech

PUBLISHER

Brian Marz, Publisher, x411
bmarz@putman.net

EXECUTIVE STAFF

John M. Cappelletti, President/CEO
Rick Kasper, CFO
Jerry Clark, Vice President of Circulation
Jack Jones, Circulation Director

REPRINTS

Rhonda Brown,
Reprint Marketing Manager
rhondab@fosterprinting.com
866-879-9144 x 194 • Fax 219-561-2019
4295 S. Ohio Street, Michigan City, IN 46360



Folio Editorial Excellence Award Winner

New Safety Center Moves Ahead

Australian engineer is selected as first director of IChemE group

THE INSTITUTION of Chemical Engineers (ICChemE), Rugby, U.K., has appointed Trish Kerin as director of the new IChemE Safety Centre (ICS).

CP contacted Kerin, who earned a mechanical engineering degree from the Royal Melbourne Institute of Technology and has held safety-related roles at oil, plastics and gas companies in Australia, and asked about her plans for the ISC:

What will you be doing in the near-term (say, the next twelve months)?

“The ISC work streams are selected by the member companies... The initial streams selected are focused on building foundations and establishing common understanding. This is in the form of a common-language working group to review current terms across industry and agree to the common adoption of them. We are also conducting a survey to form a baseline for where companies are at on their safety journey. This will be used to prioritize future work streams as well as measure improvement over a period of time. Other initial work streams are likely to include developing sharing tools, expanding the implementation of leading indicators and exploring human factors.”

What are your goals for ISC over the next three-to-five years?

“ISC aspires to offer leadership in fundamental research, knowledge and competence in process safety, which underpins inherently safer process design and robustly engineered safety systems, and supports the upholding and continued evolution of systems and procedures for maintaining safer process operations... taking full account of the contribution of human factors, behaviors and external influences and recognizing that the ISC, in partnership with other experts, must communicate and engage all key stakeholders... to shape the prevailing culture in the workplace and in society at large... to build a common understanding of risk issues and to develop and utilize new ways for

cost-effective and sustainable risk reduction in the process industries.

“One focus area... in the medium- to long-term is to explore how education and training can be improved across all levels of an organization, from shop floor, to managers, to the board. IChemE currently offers a range of programs in these areas, and we are looking to enhance these programs. We are also exploring ways to improve how process safety is taught in university, not only to chemical engineers, but other disciplines of engineering and OHS [occupational health and safety] graduates. This activity has a long-term delivery plan, and is about investing in the future. Other goals will be developed as the member companies identify their priorities. We will also be looking to establish some research projects to take safety management to the next level.”

How will ISC differ from existing professional society efforts, such as AIChE's Center for Chemical Process Safety?

“The ISC will build on the fantastic work of the CCPS and other organizations, such as the European Process Safety Centre and the Mary Kay O'Connor Process Safety Center. A key to the ISC platform is to enable sharing of learning and experience across a multitude of industry sectors, taking process safety from the traditional world of petrochemical industries to... other industries where high-consequence, low-frequency events occur... The fundamentals of maintaining control are similar, no matter which industry you work in.”

ISC initially will operate from Melbourne. It can be contacted via safetycentre@icheme.org. ●



Trish Kerin shared her thoughts about what the ISC aims to do.



MARK ROSENZWEIG, Editor in Chief
mrosenzweig@putman.net



We create
chemistry
that lets
individual needs
love global
innovation.

As the global leader in catalysis, BASF draws on the talent and expertise of more than 1,100 researchers working in close partnership with our customers. This collaboration results in innovations that drive new levels of performance and achievement, today and over the long term. When global catalyst innovations help our customers become more successful, it's because at BASF, we create chemistry.

www.catalysts.basf.com

 **BASF**

The Chemical Company

Check “Standard Conditions”

Otherwise you risk using the wrong value for density in calculations

“**THE PUMP** discharge pressure will change depending on the liquid,” said the client’s maintenance engineer. For the sake of decorum, I remained quiet and kept a poker face despite knowing he was wrong. For years, I had specified pumps in psi *not* head to avoid such confrontations. This and other misconceptions seem to run amok in engineering.

First, let’s consider the pump head. In my opinion, head, where used, should be in feet of water at 68°F. Those are the conditions the Hydraulic Institute, an association of pump makers and users, chooses when it talks about pumps. The trouble with many pump curves is that they imply water is at 68°F but never state that. This leaves room for mischief.

When you have discharge head (DH) and suction head (SH) in pressure, e.g., psi, the total dynamic head (TDH) is a fixed quantity (TDH = DH – SH). The pressure depends upon the specific gravity (SG) of the liquid versus that of water at 68°F. You might argue that using the density of water at 60°F would be more appropriate if the operating company uses that basis — but, remember, we’re ordering a pump! If the head is in ft-liquid, as it is during energy balance calculations, then the pressure, unless converted, isn’t known yet. If stated as a result in pressure, the value remains constant.

Water density introduces another potential snag. Water at 68°F has a specific gravity of 0.9983, *not* 1.0000, so let’s discuss that misconception. “Cameron Hydraulic Data,” 19th ed., takes considerable pains at the beginning of Section 4 to define the specific gravity of water. The oil industry, including the American Petroleum Institute, uses 60°F as the reference temperature for specific gravity; simulation results for “standard conditions” reference 60°F. Water’s specific gravity at 60°F is 0.9991; its density is 62.367 lb/ft³, according to the U.S. National Institute of Standards and Technology (NIST). In the International System of Units, the reference temperature is 25°C (77°F); water has a specific gravity of 0.9971 and a density of 62.25 lb/ft³ at that temperature. Other groups use 4°C (39.2°F), the temperature at which the specific gravity actually is 1.000, the maximum value; density is 62.425 lb/ft³. As “Cameron Hydraulic Data” and other engineering books point out, the

variety of so-called standard conditions can cause confusion. So, it’s best to define the reference conditions at every use, regardless of how pedantic that may seem.

While we’re on the topic of the misuse of specific gravity, let’s discuss density calculations with vapors. Gas specific gravity often is defined in terms of the gas density divided by the density of air at a standard condition (SC): $SG = \rho_{\text{gas}} / \rho_{\text{air-SC}}$. Numerous online references use cute shortcut methods, e.g., $SG = \text{molecular weight of the gas} / \text{molecular weight of air}$. This definition is at best sloppy engineering and at worst completely erroneous. If the temperature increases, the density should decrease but won’t based on this unsound over-simplification, especially when the compressibility factor, Z , is not 1. The “Standard Handbook of Petroleum and Natural Gas Engineering,” 2nd ed., p. 2-19, describes gas specific gravity as the density of the gas at a specified temperature and pressure divided by the density of air at a standard condition. Again, there’s quite a variety of SCs.

The NIST and the International Union of Pure and Applied Chemistry take 1 bar (0.987 atm, 14.504 psia) at 0°C (32°F) as standard pressure and temperature (STP) while acknowledging informal standards for ambient temperature and pressure (SATP). NIST uses 20°C (68°F) at 1 atm for SATP. The gas industry relies on so-called International Standard Metric Conditions, 1 atm (14.696 psia) and 15°C (59°F), for natural gas and other refinery gases. For a listing of SCs of some organizations and government entities, including the U.S. Environmental Protection Agency, see: http://en.wikipedia.org/wiki/Standard_conditions_for_temperature_and_pressure. Another useful source is: www.thefreelibrary.com/A+twenty-first+century+molar+mass+for+dry+air.-a0186399836.

Don’t confuse STP and SATP with standard state used in thermodynamics. Enthalpy, heat capacity and entropy all require a reference state. Most tabular data for these thermodynamic functions are at 25°C (77°F), although 0°C also has been used as reference. The gas pressure at thermodynamic reference state usually is such that the gas behaves as perfect gas. ●

DIRK WILLARD, Contributing Editor
dwillard@putman.net



It’s best to define the reference conditions at every use.

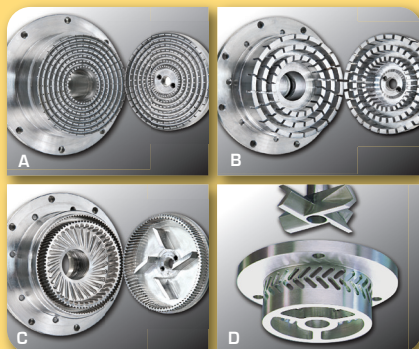
"Join the ultra-high shear revolution."

When Ross introduced the first **Ultra-High Shear Mixer**, we revolutionized high speed, high shear mixing. Operating with tip speeds up to six times higher than conventional rotor/stator mixers, these mixers can produce sub-micron emulsions and dispersions faster than any conventional rotor/stator design.

Today, in applications from foods to pharmaceuticals, coatings and adhesives, the results include smaller particle sizes, tighter particle size distributions, greater throughput – and superior end-products.

Patent No. 5,632,596: X-Series
Patent No. 6,241,472: MegaShear
Patent No. 6,000,840: PreMax

Christine Banaszek
Applications Engineer
Employee Owner



Ross Ultra-High Shear Mixers produce ultra-fine emulsions and dispersions in inline (A-C) and batch (D) applications. Many models also allow you to fine-tune shear to mix shear-sensitive materials safely.



See the newest generation of rotor/stator mixing technology.

Visit highshearmixers.com/ultra
Or call 1-800-243-ROSS



Scan to learn more.
Free Tag Reader: <http://gettag.mobi>



Catalyst Promises Cleaner Methanol Production

Method could lead to lower cost fuel and chemical feedstock

A NEW nickel-gallium catalyst can create methanol from hydrogen and carbon dioxide with less byproduct than conventional copper-zinc-aluminum catalysts, say a team of international researchers.

The scientists, hailing from Stanford University, Stanford, Calif.; SLAC National Accelerator Laboratory, Menlo Park, Calif.; and the Technical University of Denmark, Kongens Lyngby, Denmark, note their ultimate goal is to develop a large-scale, low-cost, non-polluting, carbon-neutral manufacturing process using clean hydrogen to produce methanol for use as a potential fuel and chemical feedstock.

“Eventually we would also like to make higher alcohols, such as ethanol and propanol, which, unlike methanol, can be directly added to gasoline today,” says Jens Nørskov, a professor of chemical engineering at Stanford who worked on the project.

“Methanol is processed in huge factories at very high pressures using hydrogen, CO₂ and CO from natural gas,” adds Felix Studt, a staff scientist at SLAC. “We are looking for materials that can make methanol from clean sources, such as sunshine, under low-pressure conditions, while generating low amounts of CO.”

The group spent three years studying methanol synthesis at the molecular level to identify the active sites on the copper-zinc-aluminum catalyst that synthesize methanol. Next, the team searched for a new catalyst that would react at low pressures using only hydrogen and CO₂. A massive computerized database at SLAC compared the copper-zinc-aluminum catalyst with thousands of other materials and found nickel-gallium to be a potential candidate.

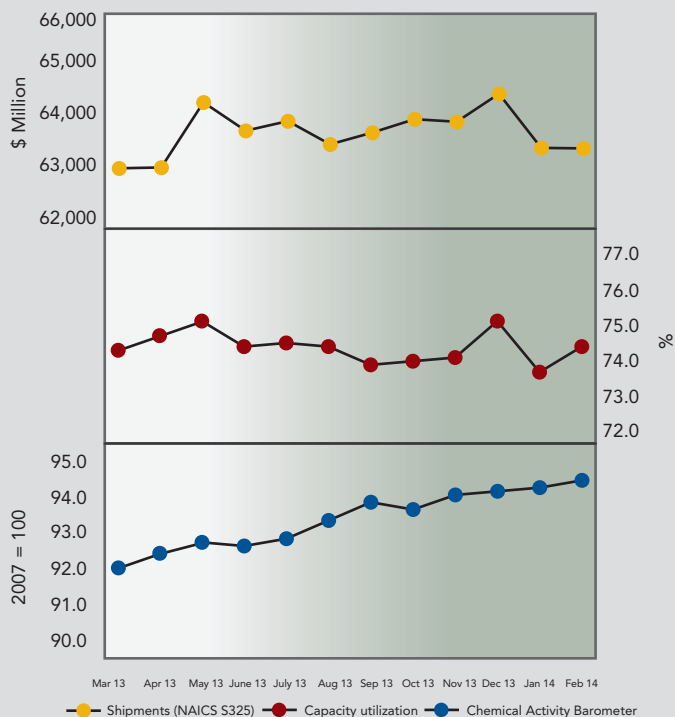
The group then turned to a team at the Technical University of Denmark led by Ib Chorkendorff, to test the compound. Nickel and gallium were synthesized into a solid catalyst, which then was tested at ambient pressure. It produced more methanol at high temperatures than the conventional catalyst and significantly less CO byproduct.

“You want to make methanol, not carbon monoxide,” Chorkendorff notes. “You also want a catalyst that’s stable and doesn’t decompose. The lab tests showed that nickel-gallium is, in fact, a very stable solid.”

More details appear in a recent article in *Nature Chemistry*.

While these results show promise, a great deal of work lies ahead, the researchers say. Currently, the group is focused on optimizing both the reaction conditions as well as the catalyst. “There hasn’t really been a lot of

ECONOMIC SNAPSHOT



Shipments slipped slightly while capacity utilization and the CAB edged up. Source: American Chemistry Council.

catalyst optimization done so far and we’d like to make the catalyst more phase pure (and with less pure nickel). We are also looking at promoters as we try to find ways of suppressing the formation of CO further. We think that this could be achieved by selectively poisoning the sites that are active for CO formation while we keep the sites that make methanol,” notes Studt.

In addition, because the reaction mechanisms for CO₂ hydrogenation to methanol and the reverse water gas shift to make CO are quite different, Studt believes optimizing the catalyst in a way that is only active for methanol formation could result in high selectivity, but adds it’s very hard to make any predictions in numbers.

NEW CATALYST

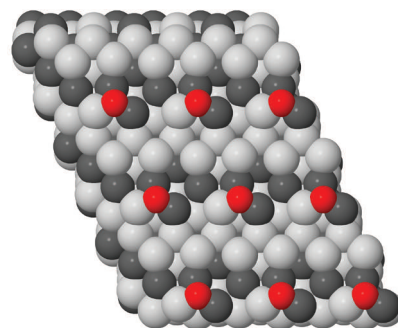
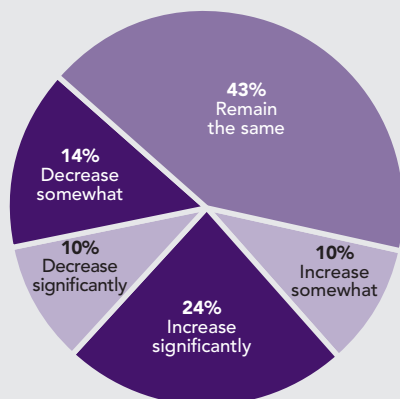


Figure 1. The nickel-gallium active site synthesizes hydrogen and carbon dioxide into methanol. In this artist’s rendering, the nickel atoms are light grey, gallium atoms are dark grey, and oxygen atoms are red. Source: Jens Hummelshøj/SLAC.

HOW DO YOU EXPECT STAFFING LEVELS AT YOUR SITE TO CHANGE OVER THE NEXT 12 MONTHS?



Responses (%)

TO PARTICIPATE IN THIS MONTH'S POLL, GO TO CHEMICALPROCESSING.COM.

Only about one third of respondents expect a rise in staffing levels.

Further challenges include taking CO₂ from air or power plant operations and hydrogenating that using H₂ made from renewable resources. "I think there are quite some challenges ahead for all of the different processes. It has to be shown that CO₂ can be captured efficiently (that might be the biggest challenge here). But we would also need efficient production of H₂, and

there is actually a lot of research being done right now on the topic of both electrochemical and photo-electrochemical H₂ production (this is actually done both by our group at Stanford and by Ib Chorkendorff's group at the Technical University in Denmark)," says Studt.

Once the catalyst is optimized, the group plans to find an external partner to run tests on a pilot-plant scale.

Biogasoline Beckons

BIOMASS CAN provide a drop-in replacement for gasoline, report researchers at the University of California, Davis. The team has developed a three-step catalytic process using levulinic acid as feedstock. "It's a cheap and practical starting point that can be produced from raw biomass with high yield," says Mark Mascal, a professor of chemistry at the school.

"What's exciting is that there are lots of processes to make linear hydrocarbons, but until now nobody has been able to make branched hydrocarbons with volatility in the gasoline range," he adds.

In the process, first the levulinic acid is dehydrated to angelica lactone using a heterogeneous acid catalyst,

Spraying Systems Co.
Experts in Spray Technology

FREE
TANK CLEANING
EVALUATION

TankJet® 360 High-Impact Tank Cleaner

SUPERIOR SPRAY. SERIOUS RESULTS.

Shown left to right: TankJet AA190 Motorized Tank Cleaner; TankJet 6353 Tank Cleaning Nozzle; TankJet 80 Tank Cleaner and TankJet 180 Directional Tank Cleaner.

CLEANER TANKS IN LESS TIME. LET US SHOW YOU HOW.

One of our local tank cleaning experts will visit your plant to:

- Evaluate your current cleaning methods
- Suggest ways to clean tanks more thoroughly, reduce water and chemical use and return tanks to service more quickly
- Recommend which of our wide range of tank cleaners will deliver the performance you need
- Provide a payback analysis

If you're cleaning tanks up to 100' in dia., we have the expertise and tank cleaner you need. Plus, we're in your area – a local sales engineer from one of our 90 sales offices is nearby.

Call 1.800.95.SPRAY or visit TankJet.com to request your FREE tank cleaning evaluation.

montmorillonite clay (K10). This then is treated with catalytic K_2CO_3 to produce angelica lactone dimer. Finally, the dimer undergoes hydrodeoxygenation at relatively mild conditions using robust platinum- or iridium-based catalysts to give branched C_7 – C_{10} hydrocarbons. Overall yield for the three steps reaches up to 76%, note the researchers. More details appear in a recent article in *Angewandte Chemie*.

Considering that biomass conversion to levulinic acid can exceed 80%, the “field-to-tank” yield for drop-in gasoline potentially could surpass 60%, they believe.

At this point, the researchers want others to take over development. “We do not have the equipment to adapt the process to a flow reactor, or to go to the demonstration scale (kilograms) or beyond,” notes Mascal. “The challenge that remains is effective scaling and process development. In the hands of expert engineers, we feel that a highly competitive biomass-to-gasoline technology can be developed.”

Availability of the catalysts isn’t an issue, says Mascal. “K10 and K_2CO_3 are cheap, readily available, and are both probably recyclable. The metal catalysts are sold on large scales to industry, so no problem there.”

Output of biomass-based levulinic acid seems



Figure 2. Saikat Dutta, who is part of team working on biomass-to-gasoline process, stands next to reactor used in study. Source: University of California, Davis.

poised to take off. A number of companies already are planning to commercialize processes to make levulinic acid from agricultural wastes and other biomass. For instance, Biofine, Framingham, Mass., has been operating a demonstration plant in Gorham, Maine, since 2007 (see: “Cellulosics Conversion Gets a Boost,” www.ChemicalProcessing.com/articles/2010/016/), and Segetis, Golden Valley, Minn., successfully started up a pilot plant last October. ●

The Smart Way to Unload, Convey, Weigh & Mix

Less degradation

Move your dry granular materials gently, reliably and with significant reductions in product degradation and/or system wear.

Proven capability

Dynamic Air dense phase pneumatic conveying systems have been proven in over 15,000 installations worldwide.

Sixteen concepts

Each Dynamic Air system is custom designed from one of our sixteen different conveying concepts. So you get a conveying solution that fits your process perfectly, without compromises.

Cost effective

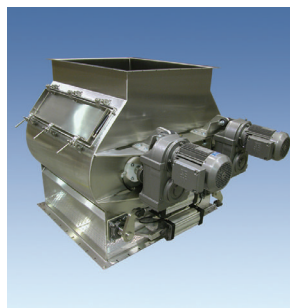
Our high material-to-air ratios reduce energy and compressed air requirements. Our low conveying velocities provide significant process savings in both operation and maintenance.



Dense Phase Transporter, J-Series



BulkBuster™ Bulk Bag Unloader



Bella® Twin Shaft Fluidized Zone Mixer



GYRO EX™ Bin Activating Feeder

DYNAMIC AIR®
Conveying Systems

+1 651 484-2900 • Fax +1 651 484-7015

www.dynamicair.com

Retractable
Spray Lance

BETE... your one-stop resource from spray lances to tank washing nozzles.

MaxiPass®
provides a full cone spray pattern
with even distribution

Performance Through Engineering

BETE is your complete single-source supplier of solutions from custom spray lances and chemical injectors to tank cleaning nozzles. Our in-house operation includes all aspects of design, fabrication, and performance testing, ensuring a seamless process from RFQ to delivery.

BETE's integrated engineering, quality, and manufacturing departments combine to meet a wide variety of code, testing, and inspection requirements.

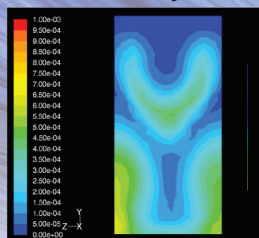
Request a quote...

BETE's Application Engineers are ready to take your sketch/inquiry and produce a recommendation and drawing of our proposed solution. We'll use our experience to work with you to improve your process with the right spray nozzle coupled with custom fabrications designed for your application.

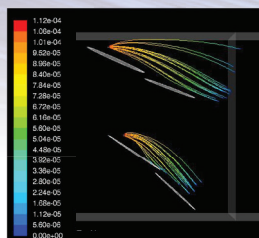
BETE. Your strategic partner for engineered spraying solutions.

Made in the USA

CFD Analysis



Distribution



Evaporation

MaxiPass® Nozzles
The ultimate in clog-resistance with the largest free passage available in a full cone nozzle.



HydroWhirl® Orbitor
is a versatile Clean-In-Place (CIP) rotating tank cleaning machine that combines high-impact cleaning efficiency with extended operating life, reduced life cycle costs, and simple on-site service. ATEX approved for Zone 0.



TF Spiral Nozzles
produce sprays composed of droplets significantly smaller for quenching and cooling applications.



BETE®

BETE Fog Nozzle, Inc.
T(413)772-0846
F(413)772-6729
www.bete.com

Control Steam System Energy Costs, Part II

Don't accept steam and condensate leaks as low-priority housekeeping issues

IN PART I of this column (www.ChemicalProcessing.com/articles/2014/control-steam-system-energy-costs-part-i/), I addressed steam cost optimization opportunities, mostly regarding steam generation, as well as the need for maintaining a reliable condensate return system. More opportunities exist in other parts of the system, in particular, the large network of pipelines, valves and other fittings that are possible sources of heat energy loss. In addition, the steam distribution system requires devices to collect condensate, keep steam dry and control its flow and required pressure level. If these devices aren't designed and maintained properly, the energy loss could be substantial.

A steam distribution system collects steam from boilers, waste heat boilers and steam turbine exhausts. In multiple-pressure-header steam systems, the lower-pressure-level headers automatically collect steam from the higher-pressure headers through letdown valves. As steam travels through various pressure-level pipelines to the point of use, it loses some of its heat and energy content, resulting in condensate formation.

For plants with sections of steam distribution piping outdoors, energy and process engineers can monitor steam demand change when it rains to quickly assess losses due to poor pipe insulation. One chemical processing complex in West Virginia with widely distributed steam distribution piping reported a 5,000-lb/hr steam surge whenever it rained. Losses likely occur even when it doesn't rain and go up during the winter months. Hence, it's worth conducting an insulation survey at least once every three years and fixing any damaged or exposed hot surfaces. Providing insulation blankets is preferable for pipe sections and fittings, especially those located outdoors, that require periodic removal for maintenance.

Steam's thermodynamic properties offer some design challenges in transporting heat to multiple locations. Because heat loss can quickly transform steam into a bi-phase fluid, it's important to take extra care when designing the steam distribution piping. To ensure dry steam supply and steam flow free from water hammer, the condensate formed in steam lines should be removed at appropriate sections of the steam distribution piping. Piping should slope downward in the flow direction and include drip legs at sufficient distances and before each rising section of pipe. Each drip leg should include a steam trap to drain out the collected condensate, ensuring dry steam delivery. Typically, these requirements should be addressed

during the design stage. However, I find missing drip legs, inadequately sized drip legs and drip legs without steam traps in more than 90% of the plants I visit. Both wet steam supply and water hammer — resulting from an absence of steam traps or cold-plugged steam traps — lead to condensate accumulation that can slow down the heating of the process and cause plant stoppages. Hence, plant engineers shouldn't think only leaking steam traps cause energy losses. An annual steam trap survey and fixing failed steam traps is an essential requirement that shouldn't be compromised when management trims budgets.

Steam leaks and condensate drains are visible profit drainers in a steam distribution system. Instead of accepting them as low-priority housekeeping issues, fix them as soon as they are noticed. High-pressure superheated steam leaks generally aren't visible and pose a safety risk to personnel. They might be worth fixing, even if "on-line" leak repair is the only option. If plant engineers have the option to review the design of new or extended steam distribution systems, they should consider providing enough isolation valves, by identifying and classifying critical maintenance-prone sections.

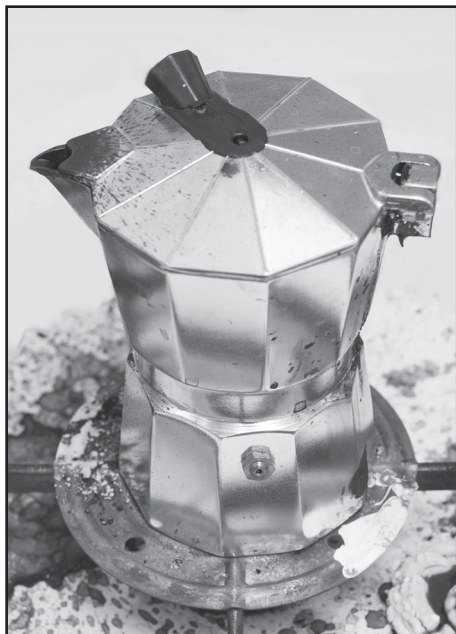
Periodic steam system audits should be a routine part of the plant engineer's cost optimization plan. Audits typically focus on finding any steam, condensate or heat losses and verifying the correct operation of the steam-heated equipment. Because of the higher temperature of steam and condensate, steam distribution systems are ideal subjects for inspection with infrared (IR) test instruments. Thermal imaging IR cameras are now available at affordable prices and provide temperature information across a wide field of view. Even if a steam leak occurs inside an enclosed object, such as a steam trap, it can be detected easily by an IR camera. Thermal imagers also can be used to identify hot spots on steam handling equipment with broken or damaged insulation. (For more on thermal imagers, see: "Use Thermal Imagery for Process Problems," www.ChemicalProcessing.com/articles/2009/202/.)

According to a U.S. Department of Energy survey, steam accounts for one-third of all the energy used in process plants. Monitoring and optimizing the cost of your steam system can yield big rewards. Ignoring inefficient operation easily could drain profits. ●



Plant engineers shouldn't think only steam traps that leak cause energy losses.

VEN V. VENKATESAN, Energy Columnist
vvenkatesan@putman.net



Unidentified condensate in steam systems can result in a range of issues from process inefficiencies to equipment failure and safety issues. If only I had more visibility into the health of my steam traps.

YOU CAN DO THAT

ROSEMOUNT® Accurately detect potential safety issues and process inefficiencies with **real-time automated steam trap monitoring.** Knowing the status of your steam traps could enable you to prevent serious safety incidents and minimize production losses. With the Rosemount 708 Wireless Acoustic Transmitter, you'll have instant visibility to all your critical steam traps through a non-intrusive, *WirelessHART®* monitoring system. Backed by Emerson's proven experience in Smart Wireless field instrumentation, the Rosemount 708 will enable you to prevent serious safety incidents and minimize production losses without running all over the plant. **Talk to Emerson. We're the experts in wireless so you don't have to be.**



rosemount.com/stopsteamloss

The Emerson logo is a trademark and a service mark of Emerson Electric Co. © 2014 Emerson Electric Co.



EMERSON. CONSIDER IT SOLVED.™

California Calls for Changes to Prop 65

Proposal seeks to include more detailed information on warning labels

ON MARCH 7, 2014, the California Office of Environmental Health Hazard Assessment (OEHHA) released a proposal for a draft regulation amending Proposition 65 regulations. The proposal seeks changes to the warning requirements to include more detailed information, including the names of the chemicals covered by individual warnings, the ways individuals are exposed to these chemicals, and how individuals can avoid or reduce their exposure to these chemicals. This column explains this proposal and its significance.

The proposal “is to improve the quality of Proposition 65 warnings while providing both flexibility and certainty for businesses.” The following are the proposed changes to the warning requirements:

Pictogram: Proposed Section 25607.2(a)(1) would require the inclusion of the following standard (Globally Harmonized System) pictogram:



This pictogram would have to appear on all Proposition 65 consumer product warnings, with limited exceptions for food products, drugs and medical devices; occupational warnings; and environmental warnings.

Warning Signal Word: Proposed Section 25607.2(a)(2) would require the signal word “WARNING” appear in all capital letters and bold print.

“Expose”: The current warning label, “WARNING: This area contains a chemical known to the State of California to cause [cancer or birth defects or other reproductive harm],” would be modified to “WARNING: This product will expose you to a chemical [or chemicals] known to the State of California to cause [cancer or birth defects or other reproductive harm].”

Chemical Name Disclosure: Proposal would require disclosure of the following 12 chemicals in the text of the warning: acrylamide; arsenic; benzene; cadmium; chlorinated tris; 1,4-dioxane; formaldehyde; lead; mercury; phthalates; tobacco smoke; and toluene.

New Website: Proposed Section 25604 would require on the label a link to a new OEHHA-hosted website (www.P65Warnings.ca.gov) to allow the public to access more information relating to the warning, including additional chemicals, routes of exposure, and if applicable, any actions that individuals could take to reduce or avoid the exposure.

Opportunity to Cure: To avoid frivolous litigation, proposed Section 25607 includes a new “Opportunity to Cure” provision that would provide small retailers (establishments with 25 or fewer employees)

an opportunity to address certain minor warning violations (e.g., a short-term absence of a sign or inadvertent obstruction of a warning label or sign) if the retailer was previously in compliance; the violation is not due to intentional neglect or disregard of the regulations, not avoidable using customary quality control or maintenance; and the violation is corrected within 24 hours of discovery or notification, or within 14 days where software equipment must be repaired or replaced.

The proposed changes provide additional guidance regarding Proposition 65 warnings (e.g., recognizing warnings covered by existing court-approved settlements) that may help some in industry and expand provisions to prevent frivolous lawsuits. However, the proposal also includes game-changing requirements that are sure to inspire controversy for companies that manufacture, distribute or sell consumer products with Proposition 65 warnings.

OEHHA states its proposal is intended to provide more meaningful information for individuals in Proposition 65 warnings, facilitate the public’s understanding and make the warnings more consistent. However, it’s possible these changes could have the opposite effect. Because the proposed changes would significantly increase the mandatory elements of a warning, create different warning requirements for a multitude of specific circumstances and require companies to compile and report burdensome exposure information, the regulations could create more compliance and consistency issues while also causing confusion for the general public.

OEHHA encouraged parties to submit written comments via e-mail by May 14. OEHHA intends to propose formal regulations in early summer and adopt final regulations in early summer 2015. There also are plans to develop a website concurrent with the regulatory process.

Companies should review carefully the proposal and how it will affect their cost and compliance capabilities. To review the draft regulation and Initial Statement of Reasons visit <http://oehha.ca.gov/prop65/warnings/030714warningworkshop.html>. ●

LYNN BERGESON, Regulatory Editor
lbergeson@putman.net

Lynn is managing director of Bergeson & Campbell, P.C., a Washington, D.C.-based law firm that concentrates on chemical industry issues. The views expressed herein are solely those of the author.



Significant changes to the warning requirements could affect your cost and compliance capabilities.

SUSTAINABILITY GETS THE SPOTLIGHT

Chemical makers are striving for improvements along many fronts

By Seán Ottewell, Editor at Large



SUSTAINABILITY HAS many dimensions for chemical manufacturers. Reflecting this, a number of major companies, including AkzoNobel, Eastman and Dow, have broad-based initiatives, while other firms are focusing particularly on using renewable resources and sustainable processes.

AkzoNobel, Amsterdam, relies on a program called Operational Eco-efficiency to disseminate sustainability experiences from different plants company-wide.

“While each site has its own team dedicated to improving eco-efficiency, Operational Eco-efficiency involves an outside team coming in with experience from other sites. Details about best practices also are available on the company intranet, and regular webinars are also used to pass on important information on subjects such as sustainable solutions in packaging and using waste as a byproduct,” explains Johan Widheden, Gothenburg, Sweden-based senior sustainability specialist.

This sharing of ideas is coming together in a major way at a project in Ashington, U.K., where a £100-million (\$166-million) paint manufacturing plant currently is under construction. Designed to be one of the most sustainable plants in the world when it opens next year, Ashington will produce 100 million L/yr of paint yet aims to achieve 100% re-use of water and 90% reuse of solvents. On top of that, the plant will consume 60% less energy to produce each liter of paint, reduce VOC emissions by 75% and cut waste by 50%. A minimum of 10% of site energy will come from on-site low-carbon sources such as biomass, photovoltaic panels and solar thermal water heating.

“This sharing of ideas has also been important at our specialty chemicals plant in Stenungsund, Sweden, which manufactures ethylene amine (Figure 1). Here they have cut energy consumption by 20% over the last two years. Lots of information about the processes and projects undertaken to achieve this have come via the Operational Eco-efficiency program,” adds Widheden.

Alongside this program, AkzoNobel’s CEO last year launched Planet Possible. “The drive here is to create greater value from fewer resources,” notes Widheden.

The initiative has three targets. First is to reduce by 25% by 2020 the impact on climate that AkzoNobel’s products have over their lifecycle. “Here we are working with our customers to see how we can help them use our paints or coatings more efficiently,” he explains. Successful solutions include a new paint for ships that reduces drag and, therefore, fuel consumption, and an additive that allows asphalt to be laid at a lower temperature, cutting energy costs and fume emissions.

The second target is to ensure that by 2020 20% of the company’s revenue comes from products with a sustainability advantage over their main competitors in the market. To this end, the company annually assesses all products for sustainability over their whole lifecycle — with a third party reviewing the process and results.

Finally, AkzoNobel is using a new index to measure whole business sustainability. “Called the Resource Efficiency Index, this is an expression of efficiency in terms of cradle-to-grave carbon footprint, divided by group profit. It measures how we create more value from fewer resources,” he concludes.



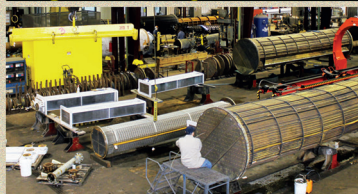
DUNN HEAT EXCHANGERS, INC.

Dunn's specialized facility offers complete services for shell and tube type heat exchangers and related process equipment.

**24 hours a day
7 days a week**



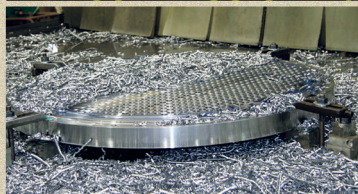
► CLEANING



► REPAIR/RETUBING



► DECOMMISSIONING



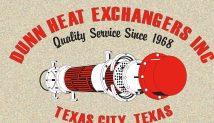
► FABRICATION



► BAKE-OUT



► SAFE TRANSPORT



Contact: rfq@dunnheat.com
409-948-1704 • 281-337-1222

www.dunnheat.com • Texas City, TX 77590

ENERGY EMPHASIS

At Eastman Chemical, Kingsport, Tenn., the drive is on to reduce energy intensity by 20% by 2020 (Figure 2). To this end, the firm raised its corporate energy budget, which is focused on improving operational efficiency and reducing environmental footprint, to \$11 million last year and maintained that level for 2014.

A corporate energy management team spearheads these efforts. "In 2013, Eastman expanded the sites in the energy program to include some of the acquired Solutia sites. Sixteen of the company's manufacturing sites are now included, with plans to continue adding sites to the program. The team is led by a designated certified energy manager who regularly coordinates with Eastman's executive team, including the sustainability council," says Sharon Nolen, manager, corporate energy program.

Nolen leads monthly teleconferences that include input from Eastman sites around the world. Representatives from the technology and energy procurement departments also take part. Typical agenda items cover available

resources (both internal and external) and a review of capital plans. In addition, all team members give a brief highlight from their sites.

"There are also special meetings dedicated to a specific topic. For example, we recently had a meeting devoted to more-energy-efficient steam traps. Two sites which were considered to have best practices (identified through an internal survey) and the company's expert on steam traps discussed the best practices, the latest technology, and addressed questions," she notes.

Data for energy intensity are pulled monthly from an online SAP system; significant changes are analyzed and addressed.

Nolen can okay energy efficiency projects costing less than \$1 million that meet a specified threshold of return. More expensive projects go to the vice president and general manager of worldwide manufacturing support for approval.

Eastman has set aside a capital budget in excess of \$8 million specifically for energy projects in 2014. It has allocated an additional \$3 million to its two largest sites for maintenance programs that reduce energy use.

IMPROVED ENERGY EFFICIENCY



Figure 1. Specialty chemicals plant at Stenungsund, Sweden, has pared energy consumption by 20% in the past two years. Source: AkzoNobel.



Spraying Systems Co.®
Experts in Spray Technology

ACHIEVE BETTER COOLING REDUCE CLOGGING



MFP FullJet nozzles

SUPERIOR SPRAY. SERIOUS RESULTS.

If you're cooling gas, cleaning tanks, spraying ceramics, humidifying paint tanks or have other applications, turn to the leader in spray technology. Our products deliver results – better performance, longer wear life, easy maintenance and more.

Minimize Clogging – Maximum Free Passage (MFP) FullJet® nozzles feature the largest free passage available in a full cone nozzle. Clogging is reduced – even when using debris-filled liquid. Use in operations plagued by clogging.

Maximize Production Time – Extend the time between maintenance with nozzles made from wear-resistant materials. Examples include SprayDry® nozzles made from specially-formulated tungsten carbide and FloMax® air atomizing nozzles in materials like reaction-bonded silicon carbide, ceramic and more.

More Effective Scrubbing – Uniform Distribution (UD) FullJet nozzles provide the best spray distribution available in high-capacity full cone nozzles. Superior distribution results in better fume and gas scrubbing.

Learn more at spray.com/results or call 1.800.95.SPRAY

LOCAL, FAST SERVICE
With more than 90 sales offices, one of our sales engineers is nearby and ready to help.



IMPROVE COOLING
FloMax air atomizing nozzles and UD FullJet nozzles provide superior gas cooling and scrubbing.



OPTIMIZE PERFORMANCE AT INJECTION POINTS
Built-to-order spray injectors ensure effective mixing and/or cooling.



UNMATCHED GLOBAL ENGINEERING, MANUFACTURING & TECHNICAL SUPPORT
NOZZLES | CONTROL SYSTEMS | HEADERS & INJECTORS | RESEARCH & TESTING

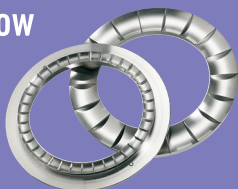
BROOKFIELD

See us at
PTXI Powder & Bulk Solids
Booth #2745

SMALL SAMPLES NO PROBLEM!

PFT™

**Powder Flow
Tester**
with Small
Volume
Shear Cell



Requires only 43cc of powder
perfect for testing expensive
or messy powders

Quick and Easy Analysis
of flow behavior using proven scientific
method ASTM D6128

University Discount Program
Special Offer - 30% OFF



TEL 800-628-8139 or 508-946-6200 www.brookfieldengineering.com

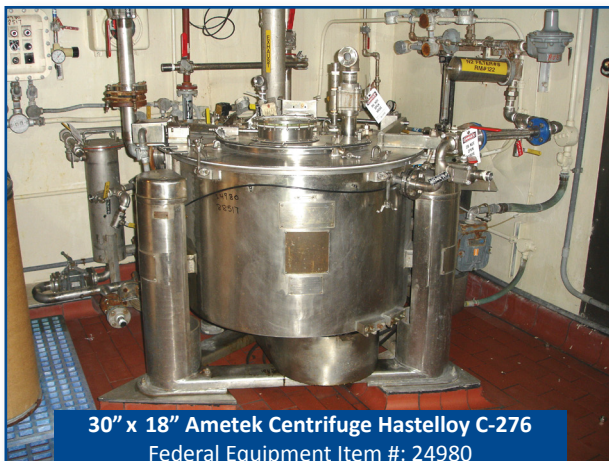
High-Quality Used Chemical Processing Equipment!

877.503.9745 or chemical@fedequip.com

**Federal
Equipment**
Company

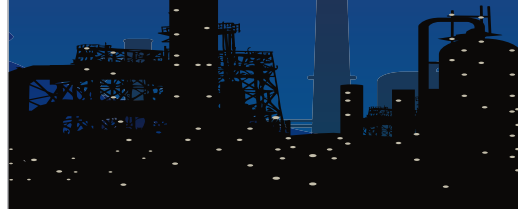
Chemical Processing Equipment

- Agitated Nutsche Filters
- Basket Centrifuges
- Double Cone Dryers
- Glass Reactors
- Hastelloy Reactors
- Heat Exchangers
- Inverting Filter Centrifuge
- Kilo Lab Reactors
- Stainless Reactors
- Vacuum Shelf Dryers



30" x 18" Ametek Centrifuge Hastelloy C-276
Federal Equipment Item #: 24980

8200 Bessemer Ave. • Cleveland, Ohio 44127 • T (800) 652-2466
www.fedequip.com • chemical@fedequip.com



The approach is bearing fruit. For example, last year the company invested \$500,000 in ultrasonic flow meters to monitor utility process liquid flow to various users as well as condensate return to the powerhouses on one site. Historically, the site primarily has relied on steam flow meters to quantify steam demand.

"The benefits of improved metering include increased billing accuracy and improving our knowledge of where major energy consumers exist in the plant to help target/prioritize energy assessment efforts," says Lisa Lambert, Tennessee site energy coordinator. "It also allows us to perform tests on major energy-consuming equipment such as steam turbines and energy pumps, while correlating area utility meter data with daily production helps forecast utility demand throughout the plant," she adds.

Other initiatives include annual energy fairs where vendors and internal groups are on hand to offer energy efficiency advice for both work and the home, and the addition of an Energy Wise site to Eastman's intranet. That site contains resources from Energy Star (a program established by the U.S. Environmental Protection Agency) for employees to help improve energy efficiency both at work and at home.

To reinforce the message, new employees must take an online energy-training course — those who work in manufacturing must retake it every three years. New engineers must take a course on energy efficient design and pinch technology. In addition, 100 company managers so far have completed green sustainability training.

Without these changes, Eastman estimates it would have spent \$25 million more in 2013 on energy when compared to the 2008 energy intensity baseline.



Complete Solids Level Measurement

Guided Wave, Pulse Radar, and Switching Solutions For Continuous and Point Level Measurement



Discover Your Benefits:

- Highly sensitive electronics allow for precise, reliable level measurements through dust and product buildup
- Robust non-mechanical sensor designs and non-contact measurement technology reduce maintenance costs
- Combination of speed, excellent support, and reliable performance ensures VEGA is the right partner for your level measurement needs



@vega_americas

www.vega-americas.com

1-800-FOR-LEVEL

Looking Forward

VEGA

TENNESSEE COMPLEX



Figure 2. Company is focusing on energy efficiency at its large complex in Kingsport as well as at other sites worldwide. Source: Eastman Chemical.

LEVERAGING NATURE

For Dow, Midland, Mich., novel use of nature is becoming an increasingly important part of meeting its sustainability goals.

One of the company's first experiences of this came three years ago when dioxane was found in some groundwater at its Terneuzen site in The Netherlands. Following an extensive study by a Dow remediation team, the site decided against the traditional pump-and-treat strategy and opted instead for "tree mediation" technology. It planted 240 trees, each in a large waterproof bag. A small diameter pipe acts as a "straw" for contaminated groundwater to travel to the roots. Acting like a solar pump, the tree takes the dioxane into its leaves where it is degraded through photo-oxidation.

"We are using similar technology at others plants in Ontario, here in Midland and Pittsburgh. It's a great technology because it's less invasive and able to treat a lot of remediation issues while they are in place rather than having to dig up soil and remove it for treatment. Effectively you are replacing the pumps and treatment systems such as scrubbers and distillation columns that have traditionally done this sort of job," explains Mark Weick, director of sustainability.

"Although the target at Terneuzen was dioxane, we are continuously working to find the best possible species to conduct phytoremediation. Our efforts to utilize existing species like poplar and willow trees have been successful. The suite of contaminants often varies from site to site and [we] will look to other indigenous species when we have unique issues that need to be addressed," he adds.

Dow is relying on phytoremediation at a former manufacturing site in Sarnia, Ontario. "We didn't

The *Right* Solution!

IBS is the leading manufacturer of industrial blinds for the petroleum and chemical processing industries and is the leading provider for renting and purchasing blinds. IBS blinds are available in sizes up to 96" at flange ratings to meet the customer's specific requirements. IBS provides 24/7 service and hotshot deliveries for emergencies.

Count on IBS to be the
'Right Solution' for
your Blind needs.



• IBS' Blind Racks are professionally manufactured and are designed for easy movement by forklift or crane



INDUSTRIAL BLIND SOLUTIONS



Call today 24/7, We're here for you! - 800.255.3349
Get more info online - IndustrialBlindSolutions.com



want to have to run lots of infrastructure once we had left, so we have almost 1,000 trees — poplars and willows — doing a wonderful job. We continue to review data in terms of cost benefit analysis. We have set operations and maintenance procedures — the trees are evaluated on a regular basis (normally at least once per year) and replaced as needed.”

The company’s latest initiative is in Houston. Here, Dow is collaborating with The Nature Conservancy, Austin, Texas, on the use of trees to replace gray infrastructure such as scrubbers.

“No one considered reforestation an economically viable option to gray infrastructure before. Right now we are publishing the work in an academic journal and discussing the technology — benefits and questions — with the appropriate regulatory officials.”

The challenge now for Dow is proving that the tree technology works in a structured way. “After all, we as site owners are accountable to the regulators to ensure that remediation is taking place to the appropriate standard. But such green infrastructure solutions are less proven than the traditional pipes and pumps,” Weick notes.

PRODUCTION INITIATIVE

Using renewable resources and advanced sustainable manufacturing processes is drawing more attention, too. For instance, Elevance Renewable Sciences Inc., Woodridge, Ill., is doing both to create new products and ingredients that deliver enhanced performance.

Called Renewicals, the products are created via an olefin methathesis catalytic process that breaks complex molecules into simple fragments and recombines them in novel ways, for example to create polymers or to exchange functional groups.

got mussels?



GET ZEQUANOX®.

Highly effective, bio-based aquatic molluscicide for controlling invasive zebra and quagga mussels.

- Safe for workers
- Short application times
- No detox needed upon discharge
- Nonvolatile/Noncorrosive
- No equipment to procure or maintain
- Environmentally friendly

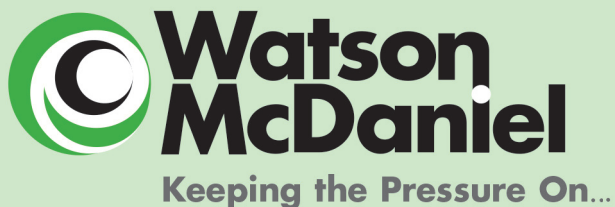
Approved by the U.S. EPA and the Health Canada PMRA

Chlorine and other chemical treatments, and the risks that go along with them, can now be a thing of the past. With Zequanox you benefit from powerful mussel control without risking downtime, employee injury, equipment damage, or regulatory penalty.

Contact us today and let us design a Zequanox treatment program to meet your specific mussel control needs.

ZEQUANOX®
Invasive Mussel Control

gotmussels@marronebio.com
1-877-664-4476
www.gotmussels.com



Watson McDaniel Offers the Most Diverse Selection of Steam Specialty Products in the Industry

Steam Traps

Condensate Pumps

Pressure Regulators

Temperature Regulators

Specialty Products



Please contact us with your next steam system requirements. Visit our Website at:

www.watsonmcdaniel.com

US Corporate Headquarters

428 Jones Boulevard • Pottstown PA • 19464 • USA

tel. 610.495.5131 fax. 610.495.5134



Figure 3. Project aims to replace toxic solvent used in making Li-ion batteries and improve their performance and life. Source: Solvay.

“Combined with patented processing technology, natural oil compounds from soy, canola and palm are synthesized with greater efficiency, offering superior performance at a lower cost and using less energy to produce than fossil-based products,” says Andy Shafer, executive vice president, sales and market development. Any renewable oil is a potential feedstock; emerging ones such as from jatropha and algae already are being evaluated.

Product options so far include waxes, renewable alpha olefins, unsaturated acids and esters, as well as derivatives of the unsaturated acids and esters, such as diacids, epoxides, novel lubricant base stocks, surfactants and alcohols.

Elevance has a joint development agreement with Stepan Co., Northfield, Ill., which in late March launched the first product resulting from the cooperation — Steposol MET-10U, a novel surfactant derived from natural oils that is targeted to displace solvents.

Elevance itself in February announced expanded availability of Aria WTP (wide temperature performance) 40 base stock, which is made via proprietary technology from renewable feedstocks. “We expect to see Aria WTP 40 in gear and hydraulic fluid lubricant formulations within the year,” notes Shafer.

Also in February, Elevance revealed that it is partnering with Versalis, the chemical subsidiary of Eni, Milan, Italy, to jointly develop and scale new metathesis technology to produce chemicals from vegetable oils.

“Today we use a metathetic catalyst based on ruthenium. Being able to use molybdenum and tungsten would allow us to deploy our technology at,

for example, ethylene plants. There are plenty of these that need repurposing in Europe, for example," he explains.

MORE BENIGN BATTERY MAKING

Meanwhile, Solvay Specialty Polymers, Bollate, Italy, has launched the Life+ Glee project, a highly focused sustainability program that aims to use water instead of organic solvents in manufacturing rechargeable lithium ion (Li-ion) batteries (Figure 3).

At the moment, the Li-ion slurry production process uses the solvent N-methyl-2-pyrrolidone (NMP), which is classified as a "substance of high concern" by the European Chemicals Agency; REACH regulations call for its progressive substitution by more sustainable chemicals. Unfortunately, replacing the toxic solvent with water would expose cathode active materials (CAMs) to corrosion.

So the project is seeking to develop waterproof yet Li-ion-permeable barrier technologies for the CAMs. "The novelty is not so much in the material we are using — a thin layer of metal/metal oxide — but the technology used to apply it. The protective layer has to be thick enough to protect from water yet thin enough to let the lithium ions work," says Francesco Triulzi, alternative energy open innovation manager. "In addition, the existing solvent recovery and re-purification phase is very costly and difficult because of the associated health and safety risks."

Solvay is nearing the end of the design phase for a pilot plant to produce the new materials at its research and innovation center in Bollate. The company is targeting March 30, 2015 as the

date for the first materials to be sent for testing by battery makers, research organizations and electric car manufacturers.

The Life+ Glee project should result in a chemicals plant capable of producing several hundred kilograms of active battery cathode material per year under real industrial conditions.

"These are very small volumes in comparison to a commercial

plant which would produce one hundred or one thousand times this amount. However, one key goal of the Life+ Glee project is the evaluation of the large-scale industrialization and commercialization potential of the technology," adds Triulzi.

Solvay is providing €1.7 million (\$2.3 million) in funding, and the European Union is kicking in €593,000 (\$818,000). ●

RELATED CONTENT ON CHEMICALPROCESSING.COM

"Eco-friendly Developments Blossom," www.ChemicalProcessing.com/articles/2012/eco-friendly-developments-blossom/

"Water Turns Green," www.ChemicalProcessing.com/articles/2011/water-turns-green-for-sustainability/

"Long March Toward Sustainability Begins," www.ChemicalProcessing.com/articles/2010/215/

"Sustainability Proves Its Worth," www.ChemicalProcessing.com/articles/2010/059/

"Sustainability Sustains Its Appeal," www.ChemicalProcessing.com/articles/2009/214/

"Biofeedstocks Still Grow," www.ChemicalProcessing.com/articles/2009/094/

Emission control systems at chemical processing plants require high destruction efficiency, low operating cost and minimal carbon output.

Anguil vapor combustion and oxidation technologies have been successfully applied on numerous chemical processes, from PTA plants to API separators.

• Thermal & Catalytic Oxidizers • Vapor Combustors • Acid Gas Scrubbers



Committed To Cleaner Air.



(800) 488-0230

ANGUIL™

www.anguil.com

Saving You Money Every Step of the Way



PowerDyne®

Pure Performance Thermodynamic Disc Traps

TLV CORPORATION

13901 South Lakes Drive, Charlotte, NC 28273-6790

Phone: 704-597-9070 Fax: 704-583-1610

E-mail: TLV@TLVengineering.com

For Technical Service 1-800-TLV-TRAP

<http://www.tlv.com>



Manufacturer

TLV® CO., LTD.

Kakogawa, Japan

is approved by LRDA Ltd. to ISO 9001/14001

ISO 9001/ISO 14001





AXIAL COMPRESSOR

Figure 1. Units such as this can handle large flows with relatively small head. Source: Siemens.

Get Up to Speed on AXIAL COMPRESSORS

These complex machines provide benefits but also pose concerns

By Amin Almasi, rotating equipment consultant

AN AXIAL compressor is a compact turbo-compressor that suits applications with a very large flow and a relatively small pressure difference (head). It probably is one of the most crucial and complex turbo-machines at many process plants. Achieving and maintaining desired performance depends upon properly addressing some complicated design and operational issues. These include fragile blades, manufacturing problems, surge, stall, noise-related concerns and many more.

An axial compressor (Figure 1) offers higher efficiency, speed capability and capacity for a given size than a centrifugal compressor. However, it has a narrower recommended application range (Figure 2) and delicate components. Some compressors contain both axial and centrifugal stages (Figure 3).

Some operating companies will use whenever

possible rugged, versatile and reliable centrifugal compressors instead of dedicated, efficient but fragile axial machines. Large horizontally split centrifugal compressors now are available in capacities up to $\approx 450,000 \text{ m}^3/\text{h}$ or even more. However, for very large capacities (say, $>1,000,000 \text{ m}^3/\text{h}$), an axial compressor may be the only option.

It's difficult to give a general rule for selecting between a very large, sturdy centrifugal compressor and a compact, relatively more efficient, properly optimized more-economical axial machine.

DESIGN ISSUES

Many chemical plants require axial compressors to operate within a relatively wide operating envelope (capacity/pressure range), and sometimes relatively far from nominal conditions. Considering the steep

RELATED CONTENT ON CHEMICALPROCESSING.COM

"Carefully Consider Nozzle Loads," www.ChemicalProcessing.com/articles/2014/piping-design-carefully-consider-nozzle-loads/

"How Much Will Your Compressor Installation Cost?," www.ChemicalProcessing.com/articles/2014/how-much-will-your-compressor-installation-cost/

"Apply Wet Screw Compressors Wisely," www.ChemicalProcessing.com/articles/2013/apply-wet-screw-compressors-wisely/

"Choose the Right Air Compressor," www.ChemicalProcessing.com/articles/2013/choose-the-right-air-compressor/

"Make the Most of Reciprocating Compressors," www.ChemicalProcessing.com/articles/2013/make-the-most-of-reciprocating-compressors/

"Correctly Commission Rotating Equipment," www.ChemicalProcessing.com/articles/2013/correctly-commission-rotating-equipment/

"Rethink Options for Large Drivers," www.ChemicalProcessing.com/articles/2013/rethink-options-for-large-drivers/

"Avoid Bad Turns with Rotating Equipment," www.ChemicalProcessing.com/articles/2012/avoid-bad-turns-with-rotating-equipment/

nature of an axial compressor's curve, this is a great challenge. Variable-speed and the variable inlet-guide-vanes (IGV) systems can provide additional flexibility in operation. A number of issues, including structural, vibration, weight, cost, manufacturability, accessibility and reliability, need evaluation for any axial compressor.

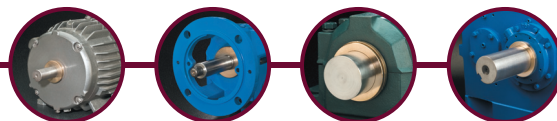
The operating Mach number usually is less than 0.8 for a subsonic cascade but can go up to 2 or more at the tip of a transonic blade assembly. Some subsonic axial stages can develop pressure ratios on the order of 1.5–1.8. The transonic stages operate with pressure ratios of ≈ 2 and greater while maintaining an acceptable efficiency and aerodynamic design. A well-designed subsonic axial stage can achieve a polytropic efficiency of ≈ 0.9 . The polytropic efficiency for transonic blades is a bit lower, say, ≈ 0.82 – 0.89 . High peripheral-mean-stage rotor velocities can reach ≈ 300 – 340 m/s for subsonic rotors and up to ≈ 580 m/s for transonic ones. Designers set the annulus radius (or hub-to-tip) ratio, $R_{\text{hub}}/R_{\text{tip}}$, after a careful optimization that considers aerodynamic, technical, mechanical and economic constraints. For inlet stages, assigned $R_{\text{hub}}/R_{\text{tip}}$ values usually range between 0.45 and 0.65 while outlet stages often get a higher value, typically from 0.75 to 0.9, to achieve a relatively high Mach number.

A proper axial compressor design should avoid a flow separation inside the machine. Analysis of axial Mach number distribution along the different

Expert Engineering. Proven Results.

Improve MTBR With Permanent Bearing Protection

At Inpro/Seal®, our forward thinking team is committed to providing proven application solutions through engineering excellence, superior technology and unmatched customer support.



Inpro/Seal's bearing isolator technology improves reliability and increases MTBR by permanently protecting the bearings on your rotating equipment from contamination ingress and lubrication loss. We understand your high cost of downtime, that's why we offer same day shipments on most products, even new designs.



INPRO/SEAL®
A Waukesha Bearings Business

Learn more:
888.633.8518 | www.inpro-seal.com/CP03

blade stages is essential. This distribution should follow an acceptable pattern; variation shouldn't exceed a specified level.

The ultimate goal of an axial compressor design is to create an axial blade arrangement with the maximum pressure rise and the minimum total pressure loss, i.e., a relatively high efficiency, along with an acceptable operating range.

The different blade and component profiles play an important role because these can affect the nature of the boundary layers and, therefore, the amount of losses (and the operating margins). The stage arrangement is critical; the stage stacking procedure intrinsically is iterative.

Maximizing the adiabatic efficiency can significantly impact the choice of stage geometrical and functional variables. In addition, it's important to optimize the surge/stall margins.

An optimum axial compressor design combines minimum weight with compactness. This calls for decreasing the number of stages and increasing individual stage loading, which can affect the choice of blade shape and cascade parameters.

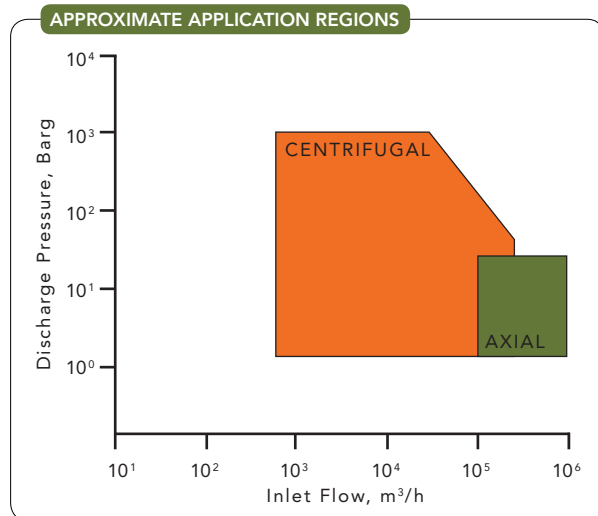
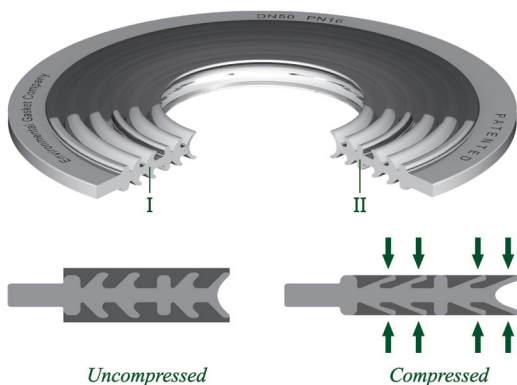


Figure 2. Axial compressors have a narrower operating range than centrifugal machines.

The availability of advanced materials for blade/component construction and high-quality production methods makes it possible to reach levels of aerodynamic loading never before possible in axial compressors while preserving high levels of efficiency for normal and alternative operation cases. This is true both for high-speed subsonic as well as ultra-high-speed transonic blades.

THE FUTURE OF HIGH PERFORMANCE SEALING



PATENTED FISHBONE™ GASKET

- I. Patented Concentric Crescent-shaped Ribs, creates individual self-energized sealing chambers.
- II. Unique Stop-Step Design, prevents overcompression of sealing element.

- **1,000,000** times lower leakage than TA-LUFT Test limit
- **25** times lower leakage than CFET Test limit
- **Pass** API 6FB Fire Test

Replace **ALL** Spiral Wound Gaskets & Camprofile Gaskets !



ENVIRONMENTAL GASKET

www.environmentalgasket.com

email us at : info@environmentalgasket.com



SURGE CONTROL

A surge event can damage or even separate the fragile blades of an axial compressor. However, the machine's surge line maps are complex. The surge line

could change with a slightly different gas condition or composition. So, an axial compressor requires a dedicated anti-surge system. This usually includes five protection arrangements:

- an anti-surge valve;
- a hot-gas-bypass valve;
- an inter-stage bleed valve (IBV);
- an IGV system; and
- speed variation.

The speed reduction and IGV characterization should be used to map the "surge area" in a two-dimensional plot. In addition to an anti-surge valve, an axial compressor most often is protected by a hot-gas-bypass (HGBP) recycle loop, usually with a hot-gas-bypass valve. This is mandatory if the anti-surge valve isn't installed immediately after the compressor discharge. The IBV also should be opened to provide sufficient flow to the compressor suction to avoid surge at initial stage(s).

Dynamic simulation is crucial. The model requires accurate, actual dynamic performance data such as the IGV stroke speed, the control and actuator delay, and the valve stroke time. These data play important roles in dynamic simulation results, anti-surge system design, reliability and overall safety. Proper validation of the model is essential, considering the criticality of avoiding surge and the disastrous consequences of a surge event.

The IGV stroke time usually is in the range of 2–6 s. Conceptually, fast response of the IGV system might seem desirable as it could help unload the compressor quickly. However, the IGV stroke could affect the performance curve — for example, the distance between the operating point and surge. Results from some dynamic simulations indicate that fast closing of the IGV mechanism sometimes (depending upon the compressor's operating map) could drive the machine toward surge. This suggests that a moderate IGV stroke time, say, 3–5 s, rather than the fastest time, might be better for surge prevention. The stroke time of an IBV possibly could be as short as 1.5–2 s. However, for a machine in which surge could initiate at the final stages, fast IBV opening could pose problems because it can significantly reduce the gas flow at the final stages. So, it's important to determine an optimum window for the opening time to avoid surge in either section of axial stages. Accurate dynamic simulations are essential for identifying all these optimum values. ●

AMIN ALMASI is a rotating equipment consultant based in Brisbane, Australia. E-mail him at amin.almasi@gmail.com.

DIFFERENT TYPES OF STAGES

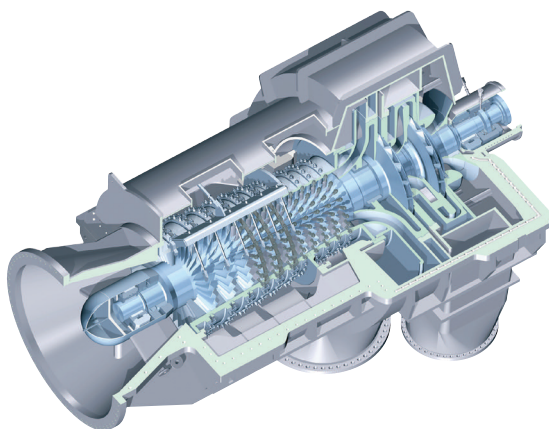
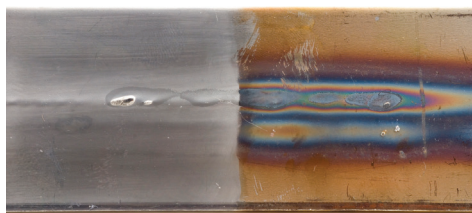


Figure 3. The initial (high flow) stages of this compressor are axial while the final two stages (low flow) are centrifugal. Source: Siemens.

BRADFORD DERUSTIT CORP.

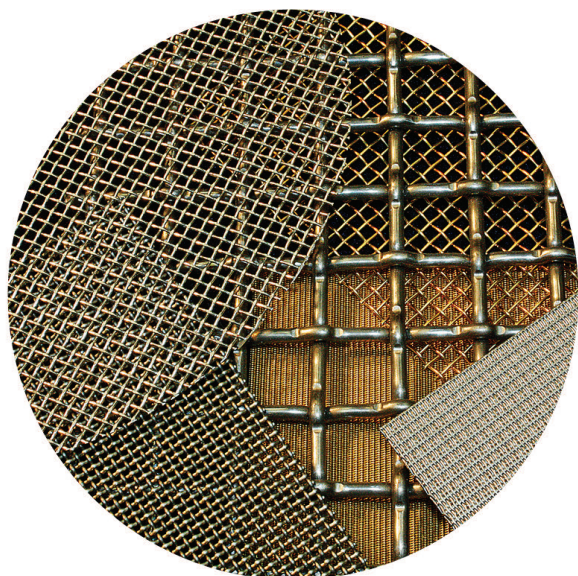


Achieve maximum corrosion resistance to stainless steel. Surface contamination may drastically reduce the life of stainless steel. Wonder Gel removes (**pickles**) stubborn impurities, cleans the toughest slag, scale and heat discoloration and restores (**passivates**) the protective oxide layer.



BRADFORD DERUSTIT CORP.
PO Box 1194
Yorba Linda, CA 92885-1194
International ph: 714.695.0899
International fax: 714.965.0840
e-mail sales@derustit.com

www.derustit.com



Tailor Your WIRE CLOTH

Versatile material can handle myriad duties but requires careful selection

By E. Marvin Greenstein, Newark Wire Cloth

IT IS difficult to imagine a fluid handling system that doesn't employ wire cloth, mesh or screen in one capacity or another. Wire cloth long has been used for its ability to separate the desirable from the undesirable. It can filter particulates ranging in size from inches and above to a few microns and below. Moreover, the material provides strength, rigidity and consistent sizing performance, retains impurities or treatment material and, by virtue of its design, doesn't tend to impede flow.

For instance, its capability for separating liquid from solid has made wire cloth virtually indispensable in water pollution control — e.g., for screening raw water intake and removing particulate matter from plant effluent. Likewise, the material handles a variety of duties in air pollution control: meshes woven of silver, platinum or other precious metals are used in catalytic combustion processes while more-conventional wire cloths serve as baghouse filters and backing cloths for services requiring extra strength and corrosion resistance, and as arresters on stacks to prevent escape of sparks, cinders and other coarse particulates. Wire cloth screens also are finding increasing application as a contact medium for cooling towers to control thermal pollution. In addition, the material can act as a sound barrier to abate noise.

Process uses also abound. For instance, ion-exchange-resin and activated-carbon treatment systems for process water often rely on wire cloth for collectors, under-drains and distributors. The material also serves for centrifuge cloths and backing cloths of all kinds. In addition, it frequently is used to remove scale and construction debris to protect pumps and other equipment.

CHOOSING THE CORRECT CLOTH

Proper selection of wire cloth can make a big difference in the cost and efficiency of a system. Making the right choice requires consideration of a variety of important factors. For instance, use in a liquid waste system involves coordinating pressure drop requirements with liquid temperature, viscosity and specific gravity as well as factoring in the size of particulate matter, flow rates and the nature of the contaminants or the corrosive environment to be encountered.

Once the parameters are set, there almost certainly will be a suitable wire cloth for the job. Hundreds of standard cloths are available in the common metals, stainless steels, high-nickel alloys, titanium, etc. In most cases, the engineer won't need to custom design a cloth; manufacturers are helpful with application and metallurgical assistance for specific problems.

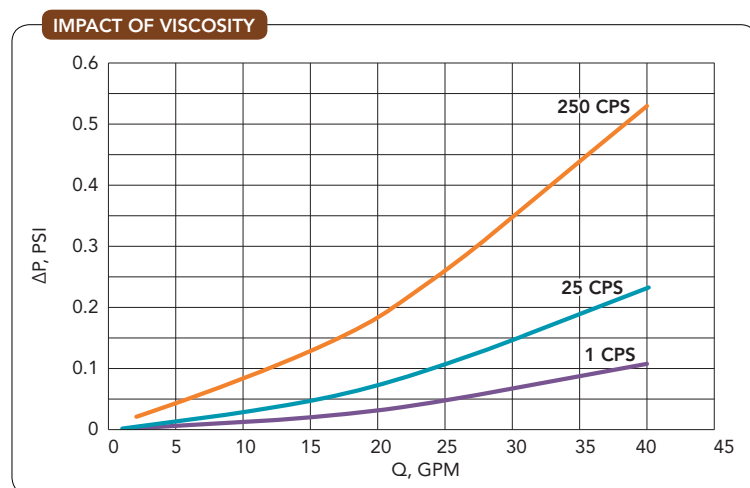


Figure 1. Pressure drop at higher flow rate can increase dramatically for more viscous fluids.

CORROSIVE	METAL							
	Brass	Copper	Inconel	Monel	Nickel	Nichrome	Stainless Steel	Steel
Alcohol	E	E	E	F	G	G	G	G
Alkalis	F	X	E	E	E	G	E	E
Ammonia	X	X	E	G	F	E	G	G
Ammonium salts	X	X	E	F	F	E	F	F
Brine	G	G	E	E	F	G	G	X
Cyanide	X	X	G	X	F	E	E	G
Hydrochloric acid	F	X	F	G	F	E	F	X
Hydrofluoric acid	X	F	G	E	F	F	X	X
Nitric acid	X	X	G	X	X	E	E	X
Sulfuric acid	F	F	F	F	F	E	F	X

KEY: E = Excellent, G = Good, F = Fair, X = Not Recommended

Table 1. These are only rough guidelines because suitability also depends upon other factors such as concentration, temperature, environment, etc.

Let's now look a bit more closely at some of the key parameters to assess.

RETENTION SIZE

You first must determine the retention size, often given in microns, needed to separate the particulate matter (which either may be a waste or the desired product) from the influent stream. Vendors provide charts that relate micron size to wire diameter and mesh count per inch. So-called market-grade cloths are most common but many other weaves and engineered configurations also are available. When a particular retention is critical for the filtration process, select a value slightly smaller than that actually needed, to accommodate standard tolerances and ensure the correct result.

Various wire mesh alternatives can attain equal retentions — but with different flow-rate/pressure-drop profiles. For example, a standard market-grade 40 mesh with wire diameter of 0.010 in. and an open area of 36.0%, and a “mill screen” 48 mesh with a wire diameter of 0.0055 in. and an open area of 54.2% both have a retention of 389 μ . The mill screen alternative offers a higher flow rate (or lower pressure drop) because of its greater open area but lacks the strength of its standard market-grade counterpart.

There are situations in which a standard square-weave mesh count, while adequate for retention, isn't the correct choice — e.g., in the design of filter leaves. This application calls for a more-rugged configuration such as that provided by twilled-Dutch-weave wire cloth. Twilled Dutch weaves and similar filter cloths offer a more-rugged construction suitable for the cleaning, scraping and power washing that is common to many filter operations. They also provide a smoother

surface that aids in the release of filter aid and retained particles.

Where exacting retention and throughput are more crucial than strength, as in many pharmaceutical applications, the choice commonly is a mesh that conforms to a very high tolerance U.S. standard sieve grade. In these instances, the screen is manufactured taut in a frame that is shaken to aid in separation. These screens offer consistency and repeatable results.

If the flow rate is critical and regular wire cloths don't offer suitable open area, alternative engineered designs or configurations often will provide the solution. For instance, corrugated wire mesh can furnish larger effective open area in a restricted space. Economics then would become an increasingly important component to the decision-making process.

Accurate influent characteristics are critical for flow-rate/pressure-differential calculations and, thus, to proper design. For instance, as Figure 1 shows, viscosity can have a major impact. Too often, though, fluids are characterized as “similar to water” or “just like ...” This lack of significant data often leads to improper mesh choice.

In every application that involves throughput of liquid or gas, the selected wire cloth's pressure differential is a critical consideration. Cloths that appear quite similar actually can differ significantly in the pressure differential they produce. Direct orifice calculations, charts and graphs are available to determine pressure differential.

Many of the finer cloths, such as the Dutch weaves, don't have an easily measurable opening. So, getting pressure differential values may require testing or tapping the manufacturer's experience and data.

The shape and style of filter — conical, fluted, corrugated, multitier or multistage — enable tailoring to achieve the desired result while passing the necessary flow.

KIND OF WEAVE

Like ordinary fabrics, wire cloth comes in a wide variety of weaves. It is made out of practically every gauge of wire and in innumerable combinations of wire diameter and mesh size (i.e., the number of openings per linear inch — for example, 10 × 10 mesh has 10 openings/linear in. or 100 holes/in.²).

Every type of weave has a use. Wire cloth most typically has a square configuration, with the same count vertically and horizontally. Rectangular or off-count mesh also is available, offering greater throughput but less structural strength for the same sizing ability.

Most separation services and coarse filtrations usually use a simple double-cripp weave. Cloth made of extra-fine wire (up to 400 × 400 mesh or 160,000 holes/in.²) is either double-cripp or twill. The Dutch and standard weaves don't produce square openings but rather wedge-shaped ones that aren't parallel to the surface of the cloth. These cloths serve in centrifugal and pre-coat filters, and comprise the majority of the ultra-fine wire cloths.

Wire cloth customarily is woven 100-ft long (the industry's "standard bolt") and 36- or 48-in. wide, although cloths as wide as 96 in. sometimes are made. Finer versions usually are a standard 36-in. width. Cloths of any desired width or length are attainable by welding sections together.

4 ways to clean tube bundles faster



Saflex™ 2001



Saflex™ 3000



ATL-5000



Shellside systems

- 1. Saflex™ 2001** cleans 2 tubes at once at up to 20,000 psi. Optional lance positioning and wireless controls.
- 2. Saflex™ 3000** cleans 3 tubes at once at up to 40,000 psi, indexing the flexible lances via wireless controls.
- 3. ATL-5000** cleans 5 tubes at once with rigid lances, while an operator monitors the 20,000 psi action from overhead.
- 4. Shellside systems** clean tube exteriors at up to 10,000 psi, rotating a bundle as robotic water jets move from end to end.

No tube bundle cleaning method is more productive than water jetting, and no one offers more water jet solutions than NLB. Get our free white paper at www.nlbcorp.com, or give us a call.



(248) 624-5555

**The Leader in
Water Jet Productivity**

nlbmktg@nlbusa.com

RELATED CONTENT ON CHEMICALPROCESSING.COM

"CP Online Ask the Experts Forum: Environmental Protection,"
www.ChemicalProcessing.com/experts/environmental-protection/
"CP Online Ask the Experts Forum: Liquid Filtration," www.ChemicalProcessing.com/experts/liquid-filtration/

WIRE MATERIAL

Cloth may be woven of any malleable metal or alloy. The choice depends upon corrosion, environmental and other issues posed by a particular application.

Cloths most commonly are made of steel, copper, brass and high-nickel alloys; aluminum, bronze, phosphor-bronze, nickel, nickel-chromium, galvanized- or tinned-steel, and stainless-steel cloths are readily available. Noble, rare and refractory metals, e.g., gold and gold-plated metal, platinum, silver, tungsten, molybdenum, columbium, tantalum and titanium, also are used.

Water applications most commonly rely on stainless steels because they have the greatest range of corrosion resistance at a practical cost. Certain concentrations of contaminants in liquids may require use of a more-exotic material. Table 1 indicates normal resistance of common wire-cloth materials to various contaminants.

In air-pollution-control baghouse applications,

MAXIMUM OPERATING TEMPERATURE

METAL	TEMPERATURE, °F
Stainless steel, type 304	1,500
Incoloy	1,600
Stainless steel, type 330	1,650
Nichrome	1,700
Hastelloy C	1,800
Inconel	1,800
Nichrome V	2,000
Nickel	2,700
Columbium	3,000
Molybdenum	4,700
Tungsten	5,000

Table 2. Metals commonly used in high-temperature services vary significantly in their temperature limits.

a wire cloth's strength and corrosion resistance frequently are crucial. For example, where free sulfides are a particular problem, titanium and other exotic alloys find use, either as a strengthening backing cloth or as the actual filter medium.

Always keep in mind that wire cloth by nature is susceptible to corrosion. Instead of attacking one surface, corrosive action will take place all around the wire. So, a corrosion rate that might be considered negligible for metal plate might be excessive for wire cloth. For this reason, it's usually wise to choose a material with the highest corrosion resistance consistent with the economics of the application.

In some applications, particularly in filtering or screening seawater or brackish water, the risk of galvanic or electrolytic corrosion due to other components in the system can impact the selection of wire cloth material. Metals close to each other in the electrolytic galvanic series are less severely affected; materials usually are chosen so that the more-active one forms the major component.

A major value of wire cloth comes from its combination of excellent physical strength with relatively light weight. Actual weight, of course, depends upon the specific metal, the diameter of the wire and the mesh of the cloth. Used as a structural member, wire cloth provides support without impeding flow and without excessive weight. Used as a screen, it resists abrasion, can be cleaned with high-velocity water or chemical cleaners, mechanically scraped or rapped, and even, in some cases, have ice pounded off with a hammer, with little chance of damage. Equally important for applications such as spark arresters, petrochemical pressure filtration, etc., is wire cloth's high-temperature strength (Table 2). ●

E. MARVIN GREENSTEIN is director of engineering of Newark Wire Cloth, Clifton, N.J. E-mail him at emgreenstein@newarkwire.com.

MAR Systems Sorbster™ Media FOR METALS REMOVAL

SORBSTER™ MEDIA IS THE ADSORBENT
TREATMENT TECHNOLOGY OF CHOICE FOR:

Mercury*	Arsenic	Selenite*
Copper*	Fluoride*	Selenate*
Cadmium	Thallium	Silica*
Tin	Barium	Vanadium
Antimony	Cobalt	Hexavalent Chromium
Lead	Zinc	UP TO 99% REMOVAL TO ACHIEVE
Boron	Molybdenum	Mercury < 1.0ppb
Nickel	Cyanide	Selenium < 1.0ppb

* Optimization for these specific
contaminants available

With low capital cost, MAR Systems
Sorbster Media can be deployed
in industry standard vessels with
no ancillary waste stream.

MEDIA DEPLOYMENT IN:

- Tank clean out
- Temporary applications
- Dewatering
- Mining ponds
- Post FGD
- Refinery effluent
- Refinery stripped sour
- Storm water runoff
- Chemical plant wastewater
- Contaminated ground water
- Ponds
- Remediation



MAR SYSTEMS
TECHNOLOGY FOR CLEAN WATER

www.marsystemsinc.com

Corporate Headquarters: 30625 Solon Road, Unit G, Cleveland, OH 44139
Tel: (440)505-0962 | Fax: (440)505-0964 | Email: info@marsystemsinc.com

MAKE YOUR PROCESS ANALYZER SMARTER

Adding communication capabilities to its sample conditioning system can provide important advantages

By Michael Hoffman, Siemens Industry

PROCESS ANALYZER performance can benefit from access to information on the state of the sample conditioning system. Such systems can suffer from incorrect temperature, restricted flow, improper phase control, etc. These failings can result in delivery of an inadequate or inconsistent sample to the analyzer and, thus, can undermine the accuracy of a measurement.

Fortunately, development of a standard related to NeSSI (the New Sampling/Sensor Initiative) to foster adoption of miniature modular sampling systems now extends to communication between components of the sample system and an analyzer or controller. The second sub-standard of ANSI/ISA76.00.02, "NeSSI Generation II — Smart Systems and Communications Bus," defines a communication structure that enables the sample conditioning system to evolve from a mechanical component in the field requiring physical monitoring

to a control element providing feedback for the benefit of the process.

The implementation of the ISA standard should spur the availability of more hardware to measure the sample system's pressure, temperature and flow as well as to control flow, etc., in the size and ranges needed for NeSSI systems. Importantly, the sub-standard is independent of the form factor specified by ANSI/ISA 76.00.02 and, thus, can be applied to components mounted in a traditional tube-and-fitting sampling system.

THE IMPLICATIONS

A sample conditioning system that can communicate to the process analyzer the temperature, pressure, flow, valve position, etc., will allow the analyzer to determine if the current analysis has value or should be aborted. In turn, the analyzer can immediately notify the system controller of suspect analytical information. This notification clearly has value. In addition, it provides wider benefits with significant value by helping users achieve:

- greater confidence in analyzer values,
- better reliability for process measurements, and
- lower total cost of ownership, and deal with:
- increased staff workloads due to attrition, and
- decreased availability of skilled labor.

The confidence operators have in the values being reported by process analyzers directly impacts their operational decisions. A system that can advise whether or not the analytical values could be

RELATED CONTENT ON CHEMICALPROCESSING.COM

"GC Stands for Greater Control," www.ChemicalProcessing.com/articles/2013/gc-stands-for-greater-control/

"Rethink Sample System Automation," www.ChemicalProcessing.com/articles/2009/096/

"Streamline Your Sampling System," www.ChemicalProcessing.com/articles/2009/076/

"Intrinsically Safe NeSSI Nears," www.ChemicalProcessing.com/articles/2008/185/

BINMASTER

Bin Level Sensor



RL for Reliable Levels

New! BinMaster RL for Reliable Level Measurement in Dusty Environments

- Dust-penetrating, non-contact technology performs reliably and consistently over time
- Acoustics-based, continuous level indicator for tough environments where other sensors fail
- Works in powdered and solid materials of all types, including low dielectric materials
- Self-cleaning, minimal-maintenance sensor doesn't require air purge for cleaning

BINMASTER LEVEL CONTROLS
800-278-4241 or info@binmaster.com

©2014 BinMaster, 7201 N 98th St., Lincoln, Nebraska 68507 USA

PROCESSING PRESSURE RELIEF & PRESSURE ACTIVATION **EXPERTS**



RUPTURE DISCS & HOLDERS
CUSTOMIZED PRESSURE RELIEF PRODUCTS



Continental Disc Corporation

(816) 792-1500
sales@contdisc.com
www.contdisc.com

Engineered Safety Products Which Protect Equipment, Lives & The Environment



PERFORMANCE UNDER PRESSURE®

suspect should substantially affect the acceptance of the values being reported.

Information available from the process analyzer's sample conditioning system could improve staff utilization efficiency. It could allow a plant to perform maintenance as required instead of the more-traditional maintenance by schedule.

The notification that a filter element requires replacing can enable staff to take action before plugging occurs, improving reliability and also reducing the cost of ownership. A sample conditioning system that can advise when maintenance is necessary or, better yet, provide information for predicting maintenance demands may eliminate the need to schedule rounds.

Staffing a location with analyzer technicians or mechanics isn't a simple task. These positions require a broad mix of skills. Suitable people are relatively scarce and the loss of experienced personnel is making matters worse. This is taking a toll on the efficiency of maintenance efforts. Up-skilled analytical systems in the field that can help diagnose themselves will ease maintaining the systems.

SPECIALIZED SUPPORT

While up-skilling the sample conditioning systems offers benefits, it doesn't eliminate the need for personnel with suitable skills. The solution often is to employ specialized outside support, as needed, to evaluate the performance or provide periodic inspections of a process analyzer. Such specialists can add a new dimension to a group's ability to manage its workload.

SMART SAMPLE SYSTEM



Figure 1. This sampling system includes sensors for pressure, temperature and flow.

These experts can tap into information provided from the sample-conditioning-system components and periodic validations of measurement performance — either locally or via a secure remote connection — to assess measurement-system accuracy and reliability.

Examples of this type of support include:

- periodically evaluating the performance of a sensor using statistically derived data to establish the expected accuracy and precision of the process measurement,
- using a measured parameter to determine the need for a maintenance activity such as changing a gas cylinder, and
- determining how long a filter may be left in service before it impairs measurement performance.

Transitioning to the ANSI/SP 76.00.02 standard provides an impetus to look beyond what has been considered good enough; however, the evolution might require a cultural change. Up-skilling a sample conditioning system incurs costs but, as already noted, can lead to very significant benefits.

Adding components to a sample conditioning system that communicate back to the analyzer turns the system from basically a dumb field element to a control element. The feedback provides the information needed to implement logic-based schema that can validate the analytical information significant to the process.

However, not every system can justify the additional components. Cost, system complexity and environmental limitations — as well as the creation of another potential point of failure — can rule out an upgrade. Each system must be evaluated on its own merits.

Up-skilling the sample conditioning system can support planned maintenance, provide information for predictive maintenance, improve the reliability of analytical data, and even enable the analyzer to serve as a primary safety device. Minor improvements in each of these categories will have net positive impact on the overall cost of ownership.

ANSI/ISA76.00.02, “NeSSI Generation II – Smart Systems and Communications Bus,” provided the catalyst to develop the technology to make sample conditioning systems intelligent and, thus, allow use of advanced maintenance concepts. Adding another dimension to the sample conditioning system will permit a broader view into the performance of the analytical measurement. It’s up to each of us to explore and decide what works best for our processes. ●

MICHAEL HOFFMAN is business development manager, solutions process analytics, for Siemens Industry, Houston. E-mail him at Hoffman.Michael@Siemens.com.

PROTECT PUMPS

DRY RUNNING • CAVITATION • BEARING FAILURE • OVERLOAD

MONITOR PUMP POWER

- Best Sensitivity
- Digital Display

TWO ADJUSTABLE SET POINTS

- Relay Outputs
- Adjustable Delay Timers

4-20 MILLIAMPER ANALOG OUTPUT

COMPACT EASY MOUNTING

Only 3.25" x 6.25" x 2"

- Starter Door
- Panel
- Raceway
- Wall

UNIQUE RANGE FINDER SENSOR

- Works on Wide-range of Motors
- Simplifies Installation



ALL PRODUCTS
MADE IN USA

**LOAD CONTROLS
INCORPORATED**
WWW.LOADCONTROLS.COM



**CALL NOW FOR YOUR FREE
30-DAY TRIAL 888-600-3247**

CHEMICAL PROCESSING CUSTOM REPRINTS

Use reprints to maximize your marketing initiatives and strengthen your brand's value.

REPRINTS ARE IDEAL FOR:

- New Product Announcements
- Sales Aid For Your Field Force
- PR Materials & Media Kits
- Direct Mail Enclosures
- Customer & Prospect Communications/Presentations
- Trade Shows/Promotional Events
- Conferences & Speaking Engagements
- Recruitment & Training Packages

For additional information, please contact Foster Printing Service, the official reprint provider for Chemical Processing.

Call 866.879.9144 or
sales@fosterprinting.com

F O S T E R
PRINTING SERVICE



REBUILT COLUMN

Figure 1. After corrosion problems, column was rebuilt using duplex stainless steel but stress corrosion cracking occurred after a few years.

Know the Limits of Duplex Stainless Steels

A distillation column shows that stress corrosion cracking can occur

By Helga Leonhard and Gernot Grötsch, TÜV SÜD Chemie Service

IN THE chemical industry, pressure vessels such as distillation columns must satisfy special requirements regarding safety and availability. Given this, they are made from high-strength materials such as duplex stainless steels. Such steels include both austenitic and ferritic phases and, therefore, have long been considered resistant to stress corrosion cracking.

However, under certain conditions — mostly involving chloride-containing fluids and elevated temperatures — even duplex stainless steels are vulnerable to this type of corrosion. This makes thorough failure analysis and corrosion testing imperative. The current condition of the materials

used is not only important for safety and availability but also crucial for the profitability and the service life of existing plants.

DISTILLATION COLUMN CORROSION

At a chemical plant, a failure occurred in a distillation column that had been in continuous operation for ten years. The column was made from robust austenitic steel (1.4571, titanium stabilized). Stress corrosion cracking in various areas of the wall caused the failure. The bottom of the column suffered the most severe cracking, but stress corrosion also was found in upper parts of the unit at a height of up to 15 meters. Corrosion was attributed to an

acidic oxygen-free aqueous chloride solution with highly oxidizing admixtures that had a temperature of 125°C in the bottom and around 90°C in the upper part of the column.

The experts sought an alternative material that is completely immune to stress corrosion cracking. After laboratory analyses, they selected a duplex stainless steel (1.4462) and reconstructed the column in this material (Figure 1). To improve the column's resistance to stress corrosion cracking even further, its internal surface was treated by applying strong pickling agents to remove a specific amount of material (normally 3–5 μm) from the surface together with all superficial residual stresses.

The column was placed into service and examined for signs of corrosive attacks during each maintenance shutdown. Five years later, the bottom of the column — which had been in direct contact with the fluid — showed the first signs of corrosive attacks. The inspectors found pronounced pits on the inner surface of the metal wall and corrosion grooves along the weld seam (Figures 2 and 3). Electrochemical tests performed using the chloride solution from the bottom part of the distillation column as test fluid revealed the probability of pitting corrosion to be high at temperatures as low as 90°C. Given this, the experts assumed pitting corrosion to be the problem in the case at hand.

Over the following years, they monitored and documented the progress of corrosion. They marked selected surface areas and produced surface replicas on film to see whether the area affected by corrosion was growing. In addition, they measured the depth of the most-pronounced defects. A comparison of pit depths with the surface replicas produced at various times revealed that no new pits had developed and existing pits had not become either deeper or bigger. The case at hand obviously was caused by one-time corrosion that did not progress. Pitting corrosion can be tolerated up to a certain degree. However, in combination with tensile stress, it may cause stress corrosion cracking that could significantly reduce component integrity.

PITS TURN INTO CRACKS

After another four years of operation, the distillation column had to undergo a gas pressure test. For this reason, to be on the safe side, the experts decided to re-examine some of the corrosion grooves at the circular bottom weld and the longitudinal weld of the bottom part. Dye penetration

RELATED CONTENT ON CHEMICALPROCESSING.COM

"CP Online Ask the Experts Forum — Corrosion," www.ChemicalProcessing.com/experts/corrosion/

"Avoid Costly Material Mistakes," www.ChemicalProcessing.com/articles/2008/003/

"Conquer Corrosion," www.ChemicalProcessing.com/articles/2004/316/



Figure 2. The inside surface of the column's duplex-stainless-steel bottom exhibited pits after five years in service.

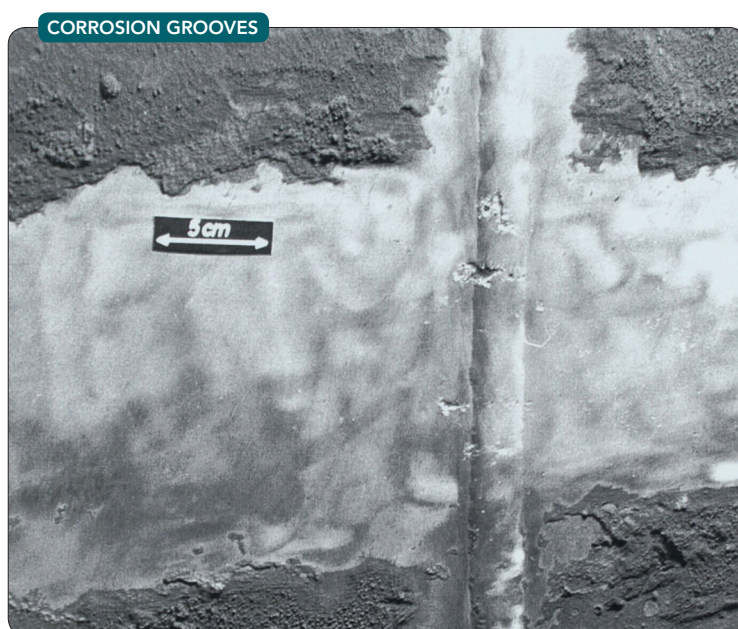


Figure 3. The weld seam at the bottom of the column also showed significant signs of attack.

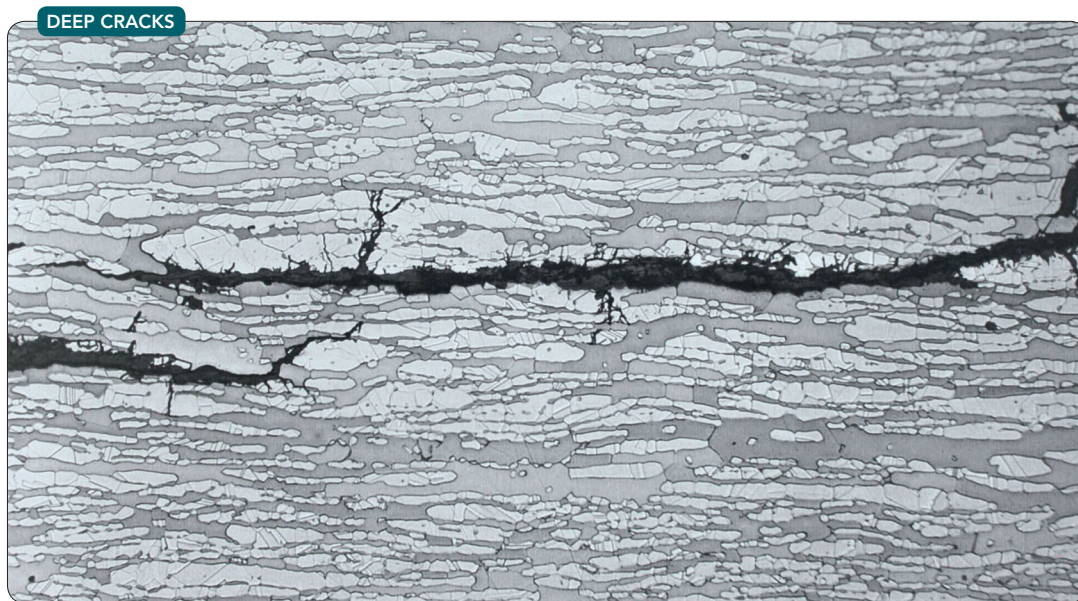


Figure 4. Some fissures in the austenitic phase (bright; ferritic phase, dark) extended right through the column wall.

testing did not produce a clear result. Therefore, the experts carefully sanded and polished the weld surface. To exclude cracking, they repeated the dye penetration test, which now revealed cracks that had been invisible previously (Figure 4). Further measurements of crack depth showed that some cracks had penetrated the entire wall.

The experts separated isolated sections from the affected areas and performed metallographic analysis. It became evident that the problem was due to stress corrosion cracking, which was limited almost exclusively to the austenitic grain. This explained the difference in appearance between the defects on the inner surface of the metal wall and those along the weld seam. In the metal wall, the austenitic and ferritic phases run in lines parallel to the surface, therefore the corrosive attacks were flat and pit-like. The cracks were unable to penetrate deeply and were “stopped” at the ferritic lines. In the weld seam, by contrast, austenitic and ferritic phases run almost perpendicular to the surface. Residual tensile stresses from welding act in parallel to the surface where they are strongest. This causes incipient cracking, which then progresses. The cracks generally grow vertically to the tensile stresses acting upon them, which means the cracks in the austenitic phase penetrate relatively deeply into the weld seam and branch out. Some of these cracks were filled with corrosion products. Using coarsely ground samples, the experts succeeded in reproducing these results in the corrosion test. The bottom part of the column was replaced with one made of titanium, which

is even more corrosion-resistant — making the column fully functional again.

EVALUATE THE SUITABILITY

The case study shows not only that stress corrosion cracking can develop in duplex stainless steels but also how it does — depending upon the fluid involved and the temperature. The tensile stresses acting on the material cause different forms of corrosion on the weld seam (cracks) and the metal wall (pits). Because cracking in the weld seam is not always visible, it is important to examine the seam carefully when pitting corrosion is suspected in the metal wall. Corrosion products might cover the cracks in the seams to such an extent that dye penetration testing without prior sanding and polishing of suspicious spots might not deliver valid results.

The analysis of corrosion processes like the one discussed here requires careful monitoring, coupled with extensive experience and expertise in materials technology. Most operating companies lack such capabilities. Specialist consultants, such as TÜV SÜD Chemie Service, have experts that can advise about material selection and corrosion protection, carry out monitoring and damage analysis, and create expert reports. A few, e.g., TÜV SÜD Chemie Service, also operate an accredited corrosion laboratory. ●

HELGA LEONHARD and **GERNOT GRÖTSCH** are materials experts at Materials Engineering & Testing, TÜV SÜD Chemie Service, Frankfurt am Main, Germany. E-mail them at leonhard@tuev-sued.de and gernot.groetsch@tuev-sued.de.

Preclude Pump Problems

Achieving adequate performance requires multiple measures

CAREFULLY CONSIDER TANK LEVEL

I have the following observations and comments. Regarding the first pump, assuming it is a metal magnetic-coupled pump: the flow rate may be too large, causing the pump to run beyond its operating range. This may be caused by the bypass if the orifice pressure drop is too small, or the flow rate to the consumer is too large. It might be advisable to check the flow rates, for example, using a clamp-on ultrasonic flow meter. At a high flow rate, a magnetic-coupled pump may encounter too high radial forces and a loss of lubrication in its sleeve bearings, causing the failure, before motor protection can cut in.

Now, consider the water pump. This pump also may be running at too high a flow rate, not yet triggering motor protection, since flow seems not to be restricted by a control valve, etc. This flow rate may also be checked using a clamp-on flow meter.

I assume that suction-side strainers have been checked for both pumps and they are not (partially) blocked. I also assume that PSLs for these pumps are set to pressures higher than the geodetic height, i.e., the full level of the tank over pump.

These failures may be aggravated by a high liquid level in the tanks, which reduces the pressure drop the pump has to overcome. At high level, the pumps may seem to be oversized. Using power consumption measurements to check operating points is another way to determine the pumps' flow rates, but this lacks precision. My advice is to use flow controls to restrict the pumps' operating ranges.

*Dr. Walter Schicketanz, consultant
Ing. Pumpenfachingenieur GmbH,
Rosenheim, Germany*

LOOK AT THE SUCTION STRAINERS

If you read many installation manuals you will find that a medium strainer (40–60 U.S. mesh) often is used to catch debris during startup from suction lines. A tank farm application might consider a 100-mesh self-cleaning suction strainer; above 30 mesh the strainer basket must be reinforced. So, let's consider the details.

It sounds like you need to replace the elements in the strainer with coarser ones. Usually, this is a U.S. mesh 3–8 (with holes: 7.42 mm and 2.54 mm, respectively) but to be more exact you should refer to the pump cut sheet; I've seen 500 mesh used in pump suctions. In these cases, opt for a coarse strainer upstream and have your controls watch for flow restriction or pressure drop, say, by an increase in control valve position.

The pressure drop can be estimated by the following equation:

$$\Delta P = (Q/C_v)^2 \times SG \times C_1 \times C_2$$

where Q is flow rate in gal/min, C_v is a vendor-supplied flow value for the filter, SG is specific gravity, C_1 is the mesh correction factor ($C_1 = 1$ for 8 mesh and below) and C_2 accounts for the % of area clogged. Vendors usually use $C_2 = 2$ for 50% clogged. A rule-of-thumb, if you don't have any other data, is to take strainer pressure drop as 1 psi at the (maximum) design flow.

For the mesh, look for the maximum solids (assumed diameter) that the manufacturer allows. In Europe, suction strainers are specified as requiring a hole diameter of 67% of the pump manufacturer's maximum solids size and a surface area 3–5 times the pipe cross-sectional area. Don't run a pump without a strainer because this violates your warranty

THIS MONTH'S PUZZLER

Catastrophic pump failures at the tank farm are plaguing the commissioning of our new plant. The tank farm has an ordinary centrifugal pump (CP) as well as magnetic-drive CPs and a gear pump (see Figure 1 on page 45). The mag-drive pump started failing after the first few days. We got some warning from a pressure switch low (PSL) that flashed for a couple of minutes. We switched to a spare and it did the same thing after a day. The gear pump seemed to be operating fine, even after a few days — but a reading on an infrared gun indicated the casing was hot; the downstream flow meter showed a dropping flow rate. An operator loosened the packing on the pump while I was away at lunch and it now runs fine. The water pump is showing the same symptoms as the mag-drive pump but hasn't failed yet during the first week of commissioning. Are we out of the woods?

and could put you out of business; I've seen zebra mussels and even a big chunk of a pallet go through suctions and demolish impellers.

As for the operator, he pulled a fast one. The gear pump is operating without a basket. Discourage this practice by locking down the strainers as you would lock-open a valve. Gear pumps have even tighter constraints than centrifugal pumps: a gear pump won't survive a pallet. Consult the manufacturer for specific details with equipment like gear pumps and wet gas compressors; one compressor manufacturer listed 11 mm as the minimum impeller clearance but this assumes there is a working mesh pad in the upstream knockout drum — always consult the manufacturer. I guessed 67% of 11 mm for the compressor and later was proved correct.

Some pumps are even more delicate. An air diaphragm pump usually requires a 40–60 mesh strainer because of the piston check valve.

Now, let's consider some of the other reliability problems. First, you don't need double seals for a water pump. Single seals, packing or both in tandem will suffice. Because gear pumps are not pressure-variable, you should use a flow alarm to catch problems such as missing teeth and a blocked valve. Magnetic-drive and seal-less pumps pose a particular problem because of tight clearances. As a general rule, a PSL is not an effective tool even with double-seal centrifugal pumps used as the baseline in

the refinery and chemical industry. Use a flow meter or switch, not a pressure switch, to detect a problem with a centrifugal pump.

You may want to look at your net positive suction head available (NPSH_A) calculations. Strainers often are treated as pipe fittings even though they're not.

*Dirk Willard, senior process engineer
Ambitech Engineering, Joliet, Ill.*

OKLAHOMA STATE STUDENTS OFFER IDEAS

This puzzler was used by the Chemical Engineering Graduate Student Association at Oklahoma State University, Stillwater, Okla., with *CP's* approval, for a process troubleshooting contest, which also was partly sponsored by the Graduate and Professional Student Government Association.

Graduate and undergraduate students participated in the contest as teams. Dr. Russ Rhinehart, Dr. A. J. Johannes and Dr. Rob Whiteley judged the entries. Below are the joint first-place winners as well as the third and fourth place entries. (The fifth place winner appears online at www.ChemicalProcessing.com/articles/2014/preclude-pump-problems/.)

JOINT FIRST PLACE #1

General assumptions on which proposed solution is based:

1. Power supply is not fluctuating.

JULY'S PUZZLER



We manufacture product in a 4,000-gal reactor operated at 150 psig that has a conventional steam-heated jacket. We're considering a project to cool a batch after a reaction using an external plate heat exchanger: the project involves doubling the size of the product pump and adding a plate-and-frame exchanger. Presently, a shell-and-tube exchanger handles cooling: product flows through the shell side of a 1,2 exchanger (2 shell passes); 85–115°F cooling-tower water provides cooling. The area is about 2,500 ft². Currently, the contents of the reactor take four hours to heat up with 35-psig steam, and fifteen hours to cool down with cooling tower water, before being pumped to storage as product. The reactor's jacket provides heat for initiating the reaction and heating the ingredients in the early steps of the batch. A waxy material added in the beginning would form a second phase and precipitate without heating; this problem disappears when the material reacts with the aqueous phase. A multi-speed agitator, running at 120 rpm early in the

batch, often is turned off altogether because of foaming in the middle of the process cycle. The only circulation then is by a 100-gal/min pump circulating fluid through the product heat exchanger with water off. We want to cool the product from 250°F to 125°F, near the product gel point. Can you suggest a better way to speed up cycle time and reduce heating and cooling time?

Send us your comments, suggestions or solutions for this question by June 13, 2014. We'll include as many of them as possible in the July 2014 issue and all on ChemicalProcessing.com. Send visuals — a sketch is fine. E-mail us at ProcessPuzzler@putman.net or mail to Process Puzzler, *Chemical Processing*, 1501 E. Woodfield Road, Suite 400N, Schaumburg, IL 60173. Fax: (630) 467-1120. Please include your name, title, location and company affiliation in the response.

And, of course, if you have a process problem you'd like to pose to our readers, send it along and we'll be pleased to consider it for publication.

2. Pumps have been sized and rated for selected duties.
3. Material of construction is compatible with service fluids.

Magnetic-drive pump servicing organic solvent with high vapor pressure. Magnetic-drive pumps are used when we want to prevent direct contact of the fluid and drive coupling and also to eliminate any possibility of leak. A PSL is activated when the pressure on the suction side of the pump falls below a minimum pressure. Commonly, the pressure drops below the minimum pressure if there is no feed at the suction side of the pump. For the suction side of the pump not to have any feed, the following events might have occurred:

- The organic solvent tank was completely drained off.
- The strainer was partially or completely choked, preventing any liquid from flowing into the pump.

We are assuming that the level transmitter (LT) in the organic solvent tank was calibrated and installed appropriately, and the low level and low-low level alarms in the distributed control system (DCS) were set right. Check the calibration documentation. The low level alarm ought to have displayed when the level dropped below the set limits. So, it will be worthwhile checking the level alarms on the DCS and correcting them if they were off. If the alarm settings are right on the DCS, then the likely cause is strainer blockage. In many cases, the reason for pump failure during commissioning activities is a blocked strainer due to debris from installation. Therefore, check the strainer and clear any debris.

A third but less probable event that could have occurred is generation of vapor bubbles when throttling the solvent back in the suction line through the restriction orifice. When a high-vapor-pressure solvent from the discharge side of the pump flows through a restriction orifice, there is a possibility of some of the liquid getting flashed. When this vapor mixes with the suction side of the pump, the possibility of some vapor going through the pump exists. Vapor will cause the pump to cavitate. Also, temperature will build up on continuous operation and as more organic solvent is recycled, due to churning of fluid in the pump casing. You may consider installing an inter-cooler before the restriction orifice to avoid flashing. We cannot rule out the combined effect of a blocked strainer, low level in the tank and cavitation — leading to the PSL alarm and failure of main pump. It also is possible that some solvent vapor existed in the suction line and, once the pump was switched over, led to cavitation in the spare pump as well. For smooth

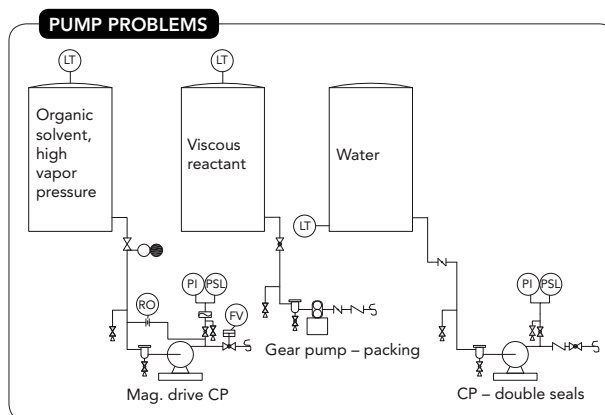


Figure 1. All three types of pumps in the tank farm are experiencing problems.

operation and maintenance, we recommend having two strainers in parallel in the common suction line, upstream of both the main and spare magnetic-drive pumps. We also recommend that you install pressure transmitters in the suction line with set points such that the minimum suction pressure always is maintained above the vapor pressure of solvent, i.e., to maintain net $NPSH_A$ above net positive suction head required ($NPSH_R$). This will avoid any vapor from going through the pump.

Gear pump with packing serving viscous reactant.

The dropping flow rate in the gear pump servicing the viscous reactant likely was because of excessive back slip. For a gear pump to deliver a constant flow rate, the viscosity, differential pressure and rotations per minute should remain constant. There is bound to be a small amount of back slip in all gear pumps because of the clearances meant for the pumping parts to move. However, to keep a constant delivered flow rate, this back slip should remain a constant. If the differential pressure between the inlet and outlet side increases, the amount of slip would have increased, thereby leading to a drop in flow rate. We suggest you check the differential pressure data during the time of commissioning to determine if differential pressure caused a drop in flow rate. If it did, the next question will be to identify what caused the change in differential pressure in the first place. To have a constant flow rate, we recommend installing a tachometer to measure motor speed and then tying [the reading] into a control loop that will increase or decrease the motor speed to keep the delivered flow rate constant. Alternatively, you can consider using a control valve to bypass excess flow rate back to the inlet side to keep the delivered flow rate a constant.

Centrifugal pump with double seal servicing water.

As mentioned in the magnetic-drive-pump troubleshooting, a PSL is activated if the pressure in the discharge line of the centrifugal pump goes below a

minimum pressure set point. The reasons that a PSL will activate on the water pump are similar to those for the magnetic drive pump — a blocked strainer or no feed on the suction side. The first step here would be to check and clean the strainer of any entrained debris. If there was no debris, then the tank might have been drained off, activating the PSL. However, when a tank drains off completely, the level alarms would have displayed on the DCS before the PSL. We are assuming that the level alarms in the DCS were programmed right. The order of the alarms should have been a series of low level alarms followed by the PSL. Taking the process and instrumentation drawing at face value, the LT is shown installed at the bottom of the tank and the high-pressure leg of the LT is below the suction line of the pump. This arrangement will cause the low level alarms to display only when the water level falls below the suction line of the pump. Consequently, the PSL will display before the low level alarms, thereby confounding you. Therefore, check and correct the installation of the LT. In general, an LT is installed at the top of the tank if it is a radar type LT. Again, for smooth operation and maintenance, we recommend two strainers in parallel in the common suction line, upstream of both the main and spare pumps.

Anand Govindarajan, PhD candidate
Roshan Patel, PhD student

JOINT FIRST PLACE #2

Tank 1 — Organic solvent with magnetic-drive centrifugal pump. The organic solvent present in the first tank is highly volatile, which would cause cavitation in the centrifugal pump. Cavitation occurs when fluid pressure is lower than the vapor pressure; this causes vapor bubbles to form and implode in the pump. Therefore, the fluid pressure must exceed the vapor pressure at all points in the pump. If cavitation exists, the pump will be less effective, yielding a lower-than-expected pressure downstream. Initially, the tank would have been filled with the organic solvent, which means there is large pressure head located at the bottom of the tank. As the level in the tank decreases below the initial height, the pressure head decreases, which in turn might cause the fluid pressure in the pump to decrease below the vapor pressure. When the pump is replaced with the spare and the tank is refilled to its original height, the pressure head is recovered to its original value. As soon as the spare pump is activated, the tank level starts to decrease again, resulting in a lower pressure head. Hence, given the current situation, it is highly likely that there is cavitation at the pump inlet due

to insufficient pressure head. The level of the tank should be checked whenever the PSL flashes. The solution to this problem is to maintain the level in the tank to keep the pressure head sufficiently above the vapor pressure to prevent cavitation. This can be done by increasing the pressure in the tank with an inert gas blanket on top of the organic solvent. If the structure of the tank cannot handle this increase in pressure, a heat exchanger can be added before the pump to ensure the fluid does not vaporize. Another option is to place the pump at a lower elevation, which would cause the NPSH to increase. If the organic solvent or the operating temperature near the pump were known, one could determine if cavitation is truly the problem by comparing the pressure of the fluid to the vapor pressure of the solvent.

Tank 2 — Viscous reactant with gear pump packing. Packing failure in gear pumps typically occurs from over-tightening the packing material. The packing on the gear pump is loosened to allow minor leakage, which lubricates and cools the sealing surface, ensuring the seal has a longer life. The infrared gun detected overheating in the casing, which was caused by the packing being too tight. This did not allow sufficient fluid leakage for lubrication and cooling of the pump. Another reason for the casing to overheat may be due to the friction caused between the seal and the shaft as a result of over-tightening. Based on the present scenario, the pump is overheating due to insufficient lubrication as a result of over-tightening of the packing material. The solution is to ensure the packing is adjusted proportionally to the leak rate. As the pump heats up, the fluid becomes less viscous, which in turn causes slippage of the fluid in the gear pump. An increased amount of slip causes a decrease in flow rate downstream.

Tank 3 — Water with double-seals centrifugal pump. Double seals are utilized in a centrifugal pump for a fluid that operates at a high temperature or is toxic, abrasive or volatile. The primary reason to use a double seal is if water is used at a high temperature. This particular scenario would make sense if the tank farm were commissioned in the summer months. As the fluid temperature rises, the vapor pressure increases, which escalates the risk of cavitation. If cavitation occurred, there would be a lower pressure downstream of the pump. Another reason for cavitation would be if the original height in the tank dropped. This results in a corresponding decrease in the pressure head, which in turn would lower the fluid pressure below the vapor pressure of water. Compared to the organic solvents in Case 1, water has a lower vapor pressure, which yields a lower risk for

cavitation. There is a high chance the pump is failing to perform due to cavitation as a result of insufficient pressure head and higher water temperature. To check for the cause, the performance of the pump must be observed with respect to the water level in the tank and water temperature. The solution is to maintain the level in the tank so that the fluid pressure remains above the vapor pressure. Another possible solution would be to pressurize the tank with an inert gas blanket such as in Case 1 if the tank can withstand this increase in pressure. Another option is to install a cooler upstream of the pump.

*Leigh Krause, MS student
Kaston Murrell, MS student
Jagdeep T. Podichetty, PhD*

THIRD PLACE

The tank farm is not out of problems. Low suction-side pressure of the pumps connected to the tank is causing the problem.

Magnetic-drive pump issues. The choice of the magnetically driven centrifugal pump is logical considering a volatile organic solvent. This would avoid leakages and thus enhance safety over a motor-driven centrifugal pump. The important point to note here is that generally magnetically driven pumps have lower efficiency than motor-driven pumps.

The flashing of the PSL suggests cavitation taking place inside the magnetic-driven centrifugal pump. Cavitation usually occurs when the $NPSH_A$ is less than the $NPSH_R$. The $NPSH_A$ for centrifugal pump is computed as the difference between the sum of static head and absolute pressure at the liquid's free surface and sum of suction line losses and vapor pressure of the liquid. In this case of the organic solvent tank with the magnetic-drive

centrifugal pump, there exists a suction head and not a suction lift because the source of supply of the liquid is above the centerline of the pump. The suction head is represented as the vertical height between the free level of the fluid to be pumped and the centerline of the pump. The liquid's vapor head is high because of the high vapor pressure of the liquid in the tank. This is because the liquid's vapor head is directly related to its vapor pressure. This difference in the $NPSH_A$ and $NPSH_R$ can occur in various cases. One of the causes can be insufficient pressure head on the suction side because of insufficient height difference between the liquid level and centerline of the pump impeller.

Centrifugal pump issues. The water tank with the centrifugal pump also might have the same problem as the organic solvent tank with the magnetic centrifugal pump. In order to avoid this problem, the available $NPSH$ can be increased. The tanks with the magnetic and ordinary centrifugal pumps might not have issues if the $NPSH_A$ is increased such that it exceeds the $NPSH_R$.

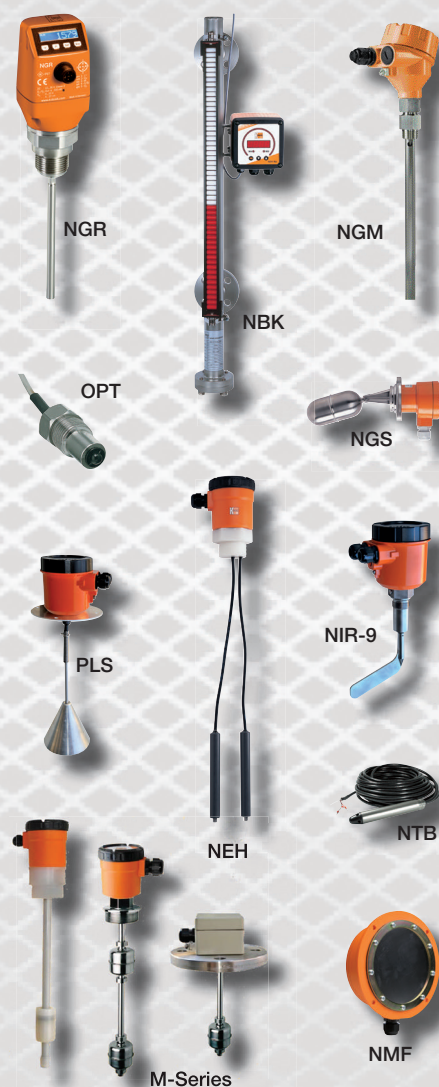
Gear pump issues. Gear pumps generally are used to pump high-viscosity fluids. Cavitation in a gear pump usually is not as intensive as that in a centrifugal pump. Though there is drop in flow rate, the pump did not fail, but the pump casing became hot. The equivalent term for $NPSH$ for any positive displacement pump is net inlet pressure requirement (NIPR). Similar to other pump cases, the low inlet pressure led to less NIPR than required. This increases the pressure drop across the gear pump. This pressure drop couldn't produce work because of the dropping flow rate. All the input energy started transforming into heat and, hence, the casing

KOBOLD

Level Solutions: Rugged, Reliable, Proven

Our Expanding Level Line Includes:

- Float Level Switches/Transmitters
- Ultrasonic Level Switches/Transmitters
- Magnetostrictive Level Transmitters
- Capacitance Level Transmitters
- Optical Level Switches
- Conductive Level Switches
- Bypass Level Gauges
- Liquid Level and Dry Bulk Applications



Flow Level Pressure Temperature



www.koboldusa.com
1-800-998-1020

started to become hot. Loosening the packing reduced the pressure drop across the gear pump, making it work better.

Investigation results/suggestions. Thus, we narrow down to increasing the available NPSH and NIPR for the pumps. There are several strategies to achieve this:

1. Lower the pumps a few meters into the ground (data and calculations would give the actual distance the pumps need to be lowered.)

2. Frictional head losses in the pipe can become significant if the pump is located far away from the tank farm. This problem can be overcome by placing the pump as near to the tank as possible (considering safety issues).

3. If the first two steps do not suffice, then the following options can be considered:

- Increasing the height of the liquids in the tanks (increased solvent inventory);
- Pressurizing the solvent tank with an inert gas to generate additional head (additional equipment and inert gas supply); or
- Reducing the operating temperature (additional utility requirement).

*Upsasana Manimegalai Sridhar, PhD candidate
Amey Thorat, MS student*

FOURTH PLACE

The warnings and indications, analysis and solution to the pump failure problems are provided below.

1. Cavitation of the magnetic-drive centrifugal pump for organic solvents with high vapor pressure:

Warnings/indications. Two warnings of cavitation in the magnetic-drive centrifugal pump for organic solvents are seen in the troubleshooting memo, while the third can be checked on.

- Flashing of the PSL light indicating low pressure at the pump;
- High-vapor-pressure fluid being pumped.
- Cavitation will be confirmed if intermittent discharge flow rate and pipe vibrations are seen.

Solution. Apply energy balance/Bernoulli's Equation between point one at the exit of the tank and point two at the inlet of the pump (noting that the pump is at ground level and assuming a negligible velocity change from point one to two). If Bernoulli's Equation is not satisfied, the solution to the problem is to raise the tank height, which will provide necessary head to avoid the cavitation.

2. Cavitation of the magnetic-drive centrifugal water pump:

Warnings/indications. The following warning sign of cavitation is seen in the memo, while the second indication can be checked for.

• Again, the PSL indicator flashed for this pump. The pumped fluid in this case is not a high-vapor-pressure fluid but we suspect that water flowing with high velocity through the pipe creates a vacuum at the eye of the impeller (assuming there is no vent to the pumping system).

• If intermittent/irregular water flow rate and pipe vibrations are observed, cavitation of this pump will be confirmed.

Solution. The same solution applied to the cavitation problem in the magnetic-drive centrifugal pump for organic solvents can be applied here.

3. Choking of the gear pump:

Warnings/indications. The warnings, indicating choking of the gear pump, are as follows:

- An infrared gun indicated the casing was hot.
- The downstream flow meter showed a dropping flow rate.
- The packing on the pump was loosened, which made the pump run fine.

Analysis. First, fluid begins to block the gaps between the teeth of the gears, dropping the flow rate downstream. Thus, the inlet fluid and discharged fluid flow rates are not equal. The fluid starts accumulating inside the casing, particularly by deposition on the casing walls. If the pump is run at this condition, less energy is used for pumping due to the lower flow rate. Part of the energy supplied is used for pumping while the remaining energy is dissipated as heat by means of high shear stress induced by high viscosity fluid. This makes the casing hot. The choked viscous fluid also creates an obstruction to the smooth rotation of gears. Loosening the packing solves the problem — and supports the previous statement. It may show some fluid leak through loosened packing, which will confirm choking of the pump.

Solution. Implementation of the following, based on their practicability, would help to eliminate choking of the gear pump:

- The pump casing should be opened and internals cleaned periodically to help avoid this problem.
- A viscosity-reducing agent should be added to the liquid if permissible and possible.
- The pump suction line should be heated using steam tracing and the fluid tank using a heating jacket.
- The gear pump should be replaced with a screw pump if the fluid viscosity cannot be reduced and the problem persists after the above changes.

*Nikhil Japtiwale, MS
Carrie German, MS*

Fight Flow Recirculation

But first understand why the phenomenon occurs in centrifugal pumps

SUCTION RECIRCULATION can undermine operation of a centrifugal pump at low flows. The pump's suction specific speed and suction energy can provide insights about potential difficulties (see: "Cut Pump Speed to Cut Problems," www.ChemicalProcessing.com/articles/2009/167/). Variable frequency drives (VFDs) frequently can provide a solution ("Consider VFDs for Centrifugal Pumps," www.ChemicalProcessing.com/articles/2014/consider-vfds-for-centrifugal-pumps/).

Fixing suction recirculation problems often costs money. Typically, getting the funding requires convincing the holder of the purse strings of what's the real cause of a problem.

Many people have trouble grasping the idea that flow can go backward within a centrifugal pump. Over the years, I've often struggled to find a fundamentally correct but simple explanation.

First, we must realize that what's simple to a mechanical engineer may appear complicated to a chemical engineer. So, let's explain the phenomenon in ways both groups can understand.

For mechanical engineers, a centrifugal pump increases the pressure of a liquid stream. The natural direction of fluid flow is from high pressure to low pressure. Fluid flow through the pump occurs because the rotating impeller provides velocity to generate pressure. The velocity gradient creates the discharge pressure.

In a centrifugal pump, liquid enters the suction eye at the center of the impeller disc. The liquid changes velocity before exiting the pump at the impeller periphery. To deal with the geometry of flow from the center to the edge of the impeller and changes in velocity, the flow passage shape changes. Figure 1 shows an end-on view of an impeller that's rotating counter-clockwise and Figure 2 shows a side view.

Inlet flow contacts the impeller's leading edge at a specific incidence angle (Figure 1). Vector analysis of liquid flow directions shows the incidence angle affects eddy formation. As flow rates drop, the eddies formed become larger. Eventually, eddies can create partial flow from the pump discharge to the pump suction. The local flow pattern follows the outline shown in Figure 1.

For chemical engineers, it's better to consider how pump flow patterns interact with material balance boundaries. A series of material balance boundaries through the pump always will have the

same net flow as the pump suction flow. If pump suction flow drops, the net flow through any cross section of the pump drops. Because typical fluids are incompressible at most conditions, this creates an absolute requirement that average velocity in any cross section varies linearly with flow rate.

However, close to the pressure edge (the leading surface) of the impeller, impeller speed sets liquid velocity. If average liquid velocity must drop but velocity in that area of the flow passage is close to constant, velocity in other areas must fall even more than the average. At some point, when average velocity decreases enough, the flow direction in areas far from the impeller's leading edge must reverse to meet the average velocity requirement. Figure 2 shows a schematic of net flow in a pump at its best efficiency point (BEP) and at a low flow condition (0.25 of the BEP). At low rates, the flow passages in the pump are simply too big. Nevertheless, they must be filled with liquid. Flow recirculation results.

Flow recirculation can damage the impeller due to cavitation caused by vaporization in the low-pressure regions that recirculation creates. Flow recirculation also stresses pump components with unbalanced forces and vibration.

Both mechanical and process changes can reduce the consequences of flow recirculation.

Mechanical solutions focus on the pump. For instance, impeller-volute-geometry matching and vane-angle, leading-edge and inlet-eye modifications,



Many people have trouble grasping the idea of backward flow in a centrifugal pump.

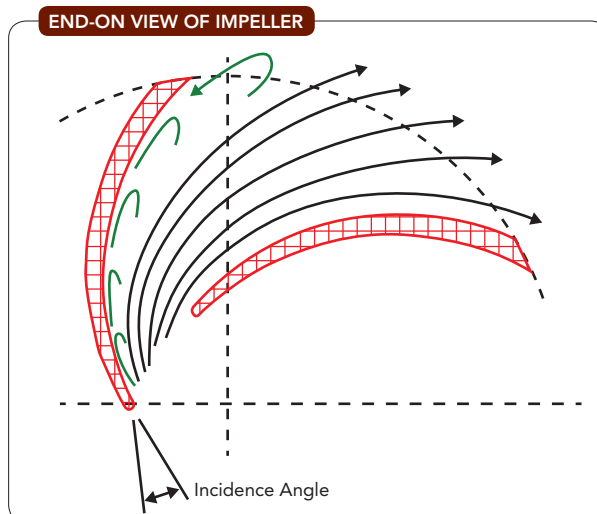


Figure 1. The incidence angle at which inlet flow contacts the impeller's leading edge affects eddy flow formation.

New QUICK MOUNT AGITATOR FOR IBC POLY TANKS



The new Quick Mount agitator is sealed system ideal for mixing low and medium viscosity materials. Quick Mount slips over any 4", 6" and 8" poly tank openings with any existing thread design. Quick Mount requires no tools.

FEATURES / BENEFITS

- Easy Quick Mount slip-on design
- Mounts in seconds – No tools required
- Lightweight / portable - ease of handling
- Standard Air drive, available Electric
- Stainless Steel agitator components
- Heavy Duty, quality construction
- Long service life
- Folding impeller blades
- Shafts & blades available in multiple sizes
- Made in America

**For further information contact us
(877) 629-0091 TOLL FREE**



AMERICAN MACHINING INC.

2232 Wiggins Road, Fenton, MI 48430

P : (810) 629-0091 | F: (810) 629-0046

Toll Free: (877) 629-0091

www.ibcresource.com

IMPELLER SIDE VIEW

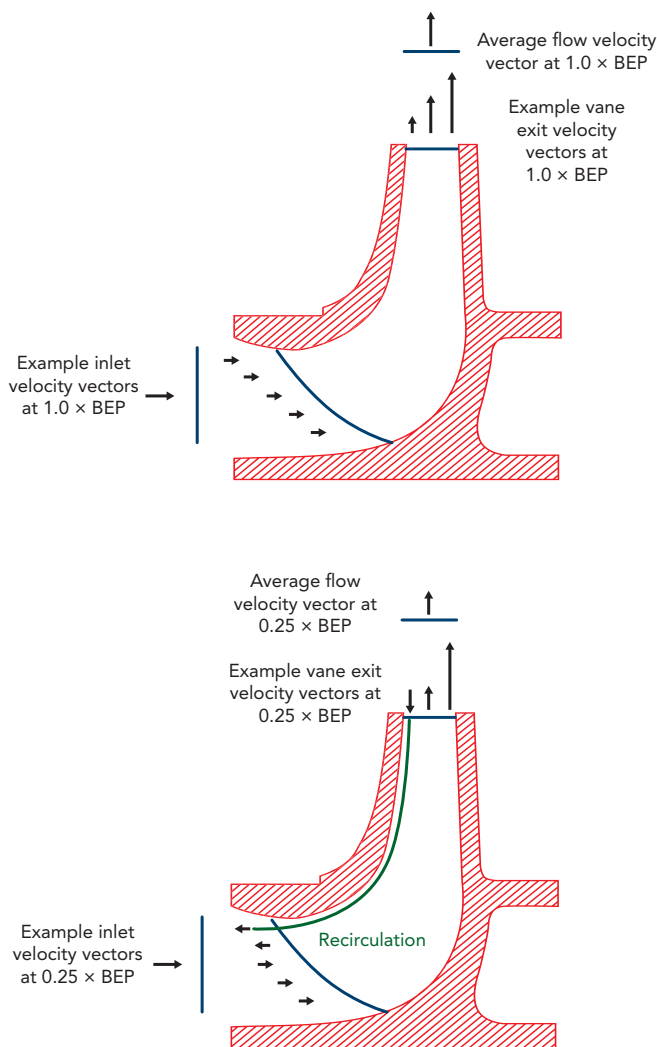


Figure 2. Proper flow takes place at the BEP (top) but at 0.25 BEP (bottom), to satisfy the average velocity requirement, recirculation occurs.

as well as pump speed changes all can improve pump flexibility. However, each affects efficiency, discharge head and capacity differently.

One process modification adds a recirculation loop to keep the pump out of the low flow region. Recirculation systems require extra equipment (piping, restriction orifices, control valves, etc.). In my experience, many flow control loops are abandoned due to maintenance costs or ignorance of their importance.

Another process modification provides excess suction head to the pump. This helps prevent cavitation-like damage. Even the low-pressure regions in the pump have sufficient head to keep the fluid above its bubble point. However, extra suction head

doesn't solve stress and vibration problems. At some point, pump vibration may exceed good practice values. Extra stress and vibration decrease mean time between repair and mean time between failure. Maintenance costs rise with high vibration and stress. Reduced operating speed lowers vibration and pump loads.

While it may not be a perfect solution, switching to a VFD can benefit nearly every centrifugal pump service suffering from inler recirculation.

Picking the right option requires a thorough analysis of both mechanical and process constraints and costs. ●

ANDREW SLOLEY, Contributing Editor
ASloley@putman.net

Liquid Expansion Trap Protects Against Freezing

The compact Byd-rain liquid expansion trap reportedly protects against pipe freezing, preventing production losses, high repair costs and potential safety hazards. It can be installed on the equipment or downstream of the equipment to be drained, ensuring easy access for inspection and maintenance. The stainless steel fixed-temperature discharge trap continuously monitors the temperature in the pipes; the trap is firmly closed at 45°F, but as the liquid cools to 36°F the trap opens, discharging any liquid in the pipe. Typical applications include float and thermostatic steam traps, coils, tanks, tracing condensate manifolds, condensate return lines, pressure powered pumps, electric pumps and flash tanks.

Spirax Sarco, Inc.

800-883-4411

www.spiraxsarco.com/us



calibrators also measure 4–20-mA signals with 0.001-mA resolution while simultaneously sourcing a temperature signal — with both readings displayed for easy transmitter calibration. They can scale the measured mA to the programmed temperature settings to verify the values scaled in a temperature transmitter.

Fluke Corporation

800-443-5853

www.fluke.com



Water Jet Lances Ease Use

The NCG-286A high-pressure water jet lances increase operator comfort while making hose or fitting failures less likely. The models reduce stress on the inlet hose connection and feature a redesigned, padded shoulder stock that helps center the thrust of the high-pressure water. The lances have an inlet tube with a 90° bend, supported by a bracket that eliminates the bend radius in the hose behind the inlet connection. Because the hose no longer passes through a loop on the shoulder stock, there's no hose friction. The bracket also strengthens the overall assembly. Lances are rated for operating pressures from 10,000 to 40,000 psi.

NLB Corp.

248-624-5555

www.nlbcorp.com

Probe Speeds Equipment Maintenance

The hand-held Leica B-Probe is designed for the inspection, alignment and assembly of large-scale



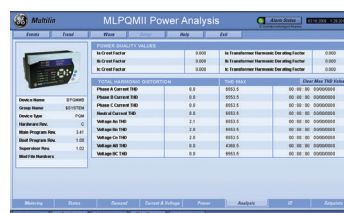
machinery and fabrications.

This wireless probing device extends the capability of the Leica Absolute Tracker AT402, a portable measurement system for measuring and inspecting in a radial volume up to 1,050 ft. Machine setup, as well as downtime, is reduced with the laser-tracker-based probing system. The probe's small footprint and wireless functionality enable a smooth construction or repair process while other tasks are conducted simultaneously on the plant floor.

Hexagon Metrology

855-443-9638

www.hexagonmetrology.us



Software Improves Asset Energy Efficiency

The Power Management Control System version 7 (PMCS v7.0) delivers data faster to help operators make quicker, more-informed decisions for problem determination and improved predictive maintenance, as well as to improve energy efficiency. By proactively monitoring energy assets and trends, users can make system changes to optimize energy use, reduce downtime and deliver higher productivity. PMCS v7.0 delivers visualization capability and support for larger device counts and newer versions of devices. Users also can remotely optimize device performance to help manage costs and maximize asset efficiency.

GE

905-927-5426

www.ge.com

Temperature Calibrators Test Process Instruments

The 712B RTD and 714B thermocouple temperature calibrators allow process and plant engineers to quickly and easily test process temperature instrumentation. The 712B measures and simulates 13 different resistance temperature detectors types and resistance, and the 714B measures and simulates 17 different thermocouple types as well as millivolts, to verify process sensors by direct comparison of measured-versus-reported temperatures. The





Distributed Control System Enhances Security

Version 6 of System 800xA distributed control system delivers productivity through consolidating process, electrical, safety and telecoms in one system and provides a high performance operator control room environment featuring the Extended Operator Workplace. 800xA v6 is not only for new projects but has been developed to support upgrades of older DCS systems running on unsupported platforms such as Microsoft XP. 800xA v6 adds more security features such as advanced access control, white listing, and means to monitor and manage the control system's security integrity through the use of the latest operating system Windows MS 8.1 /Server 2012 R2.

ABB

800-435-7365
www.abb.com

Analyzer Detects Gas Percent Level

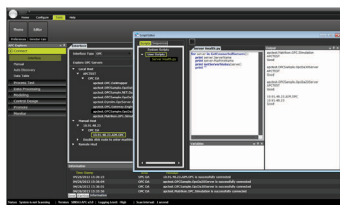


The XTC601 binary gas analyzer uses thermal conductivity technology to detect percent levels of a target gas mixed with a background gas. The measured gases include carbon dioxide, methane, argon, helium, nitrogen, hydrogen and air. Typical applications include H_2 generator cooling systems; H_2 in heat treatment furnaces, blast furnace top gas, hydrocarbons, or in NH_3 , methanol or chlorine; CO_2 in fermentation process or biogas; He recovery; or

N_2 in CO_2 . Non-depleting thermal conductivity sensors reportedly minimize maintenance costs, and provide long-term reliable operation. The sensor is capable of measuring gases from 0–5% up to 0–100% (calibrated to suit application).

Michell Instruments

978-484-0005
www.michell.com/us



Software Shrinks Testing and Commissioning Time

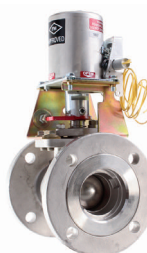
SimSci APC 2014 enables users to shorten plant testing and commissioning schedules, and improve plant operations and personnel performance, the company says. It modernizes the graphical user interface while retaining the calculation engine from the company's Connoisseur APC offering. The software is structured around an enhanced, natural workflow that includes full support for model case file development and a connection wizard for faster integration to any distributed control system and programmable logic controller, including the company's Foxboro I/A Series DCS and Foxboro Evo process automation system.

Invensys

888-869-0059
www.invensys.com

Valves Protect Against Fire Hazards

The FM Fire-Safe Shutoff assemblies are API 607 and Factory Mutual-approved for flammable liquids,



and used to activate sprinkler systems to control fire and shut down hazardous lines when fire occurs. These valve and fusible link assemblies include manually operated ball or butterfly valves. If a fire occurs, the thermal link automatically stops the flow of flammable liquids (in a normally open configuration), opens flow to release a fire retardant, or diverts the flammable material (a normally closed configuration). Rather than bearing 100% of the spring tension, the UL-listed fusible links are installed with a lever design that requires little to no maintenance.

Assured Automation

800-899-0553
www.assuredautomation.com

Controller Monitors Dust Collection Equipment

This touch screen controller provides full monitoring and control of all functions of an industrial dust collector and associated equipment. It's designed for use with Farr Gold Series dust collectors, or other types of collectors if integrated with a motor starter or variable frequency drive package. A built-in differential pressure sensor monitors the primary filter pressure drop. Four analog inputs can be used to monitor the secondary filter as well as other devices such as leak detectors, flow meters and compressed air pressure monitors. Six digital inputs also are included to monitor hopper level, smoke detection, remote cleaning and other functions.



Camfil APC

800-479-6801
www.camfilapc.com

Diaphragm Valve Improves Flow Performance



Type 514–519 high-flow diaphragm valve series feature an optimized, turbulence-free flow geometry that reportedly offers increased

flow rate performance and lower energy consumption. The new design suits applications previously not considered due to flow restriction. The flow geometry provides C_v values that on average are more than double those of a diaphragm valve with a traditional design, the company claims. The modified geometry provides linear flow and control characteristics that improve processing stability, resulting in reduced operating costs and more-cost-effective media transport. A self-draining feature minimizes dead space and achieves improved hygiene and better resistance to crystallizing fluids.

GF Piping Systems

800-854-4090

www.gfps.com

Heat Exchanger Minimizes Lifecycle Costs



A range of tantalum-coated heat exchangers offer high corrosion resistance, but at a much lower investment cost, reports

the company. A thin layer of tantalum is metallurgically bonded to all surfaces of the stainless steel heat exchangers that would be exposed to corrosive media. The result is maximum corrosion resistance and mechanical stability for a range of applications. It has been developed for use with hot, highly corrosive liquids at temperatures

up to 437°F, and can be used with mixed media and at variable concentrations. The only required maintenance is a cleaning-in-place procedure if the heat exchanger is operating in a fouling duty.

Alfa Laval

804-236-1318

www.alfalaval.com/tantalum



Screw Compressors Boast Improved Efficiency

The SFC 30S and SFC 30 variable-speed-drive rotary screw compressors deliver reliability, simple maintenance and sustainable energy savings, the company says. The 30S has a flow range of 37–171 cfm at 125 psig and is available with pressures up to 190 psig. The SFC 30 has a flow range of 47–202 cfm at 125 psig, with pressures up to 217 psig. Both models feature Siemens drive technology. Power reportedly has been improved by up to 6% through a combination of true direct drive design, premium efficiency motors, lower internal pressure differential and optimized airdrains.

Kaeser

877-586-2691

us.kaeser.com



Sensor Monitors Corrosion

The portable Ultracorr 2 corrosion and erosion monitoring system

provides high resolution and cost-effective, direct wall thickness and temperature measurement on a pipe or vessel, using fixed ultrasonic transducers mounted at various locations throughout a site. The ultrasonic reader and data logger is intrinsically safe and is said to be ideal for applications where direct corrosion or erosion of complex pipe geometry is desired or where monitoring locations are in areas with limited access. Readings can be downloaded using an IS Bluetooth handheld unit and subsequently transferred to a PC running Corrddata II software for storage and trend analysis.

Rohrbach Cosasco

562-949-0123 ext 213

www.cosasco.com

Filter Centrifuge Reduces Drying Times

The centrifuge with a filter cloth that's axially moveable allows the cloth to be inverted while under rotation. This completely discharges the solids, leaving the filter cloth free of residual heel while maintaining a totally enclosed gastight system. The HF and F model centrifuges incorporate inverting filter technology, thin cake filtering, and PAC direct-contact drying of the material all in one machine for separation and filtration. With these technologies, it's possible to dry product inside of the gastight centrifuge, reducing overall drying cycle time or eliminating downstream drying equipment. The models handle difficult filtering materials and offer flexible process recipe management with repeatable batch quality.



Heinkel USA

856-467-3399

www.heinkelusa.com

Continuous Mixer Minimizes Clean Up

The OS10DD and OS12DD continuous mixers achieve even dispersion and total wet-up with the most difficult of materials, most notably troublesome light-weight fillers, the company says. These continuous mixers are equally efficient with slurry-like formula and paste-like viscosities. Throughput rates can range from 5 lb/min. to 500 lb/min. Because of the self-purging mixhead design, flushing and clean-up requires minimal time and labor. Energy (HP) savings over batch processing reportedly are substantial. These mixers were recently introduced to the explosives market because the residual quantity of sensitized materials is minimal compared to other processors, the company adds.

Autocon Systems

800-225-6192

www.autoconsystems.com

Wireless Transmitter Simplifies Installation



The Rosemount 3051S MultiVariable wireless pressure transmitter measures two process variables in one installation so users can gain greater insight into their process. Because the transmitter measures differential and static pressure, users can reduce pipe penetrations and impulse piping along with their associated costs. The static pressure sensor is available as either true gage or absolute, reducing maintenance and calibration costs.



Users have instant visibility to their measurements through a non-intrusive, WirelessHART monitoring system. With the wireless transmitters, users can monitor more assets throughout their facilities with greater than 99% reliability and at 40 to 60% cost savings over wired installations, the company says.

Emerson Process Management

800-999-9307

www.rosemount.com



Control Interfaces Speed Data Entry

Mixers now include human-machine interfaces (HMI) and supervisory control and data acquisition (SCADA) packages for data entry and recipe selection from a color touchscreen. The PLC control panel supplied for full mixing, heating and vacuum control maximizes a machine's overall productivity by improving batch-to-batch consistency and reducing operator errors while accelerating product changeovers, the company claims. It also enables automatic data logging into a CSV or Excel file format with time and date stamp.

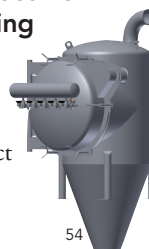
Ross SysCon

800-243-7677

www.mixers.com

Sanitary Filter Receiver Simplifies Cleaning

The sanitary filter receiver (SFR) provides automatic separation of product



material from the convey air for vacuum and pressure conveying sanitary applications in batch and continuous processes. The SFR is designed for quick clean-out and to reduce contaminants or cross contamination. The unit is easily cleanable thanks to its round corners, no ledges and no hidden areas. The tool-less side-entry access door allows for safe and easy cleaning of the unit and simple access to the filter media for fast changeover. The access door and tube sheet are integrated on a single hinge with removable tube filter assemblies.

Coperion K-Tron

856-589-0500

www.coperionktron.com

Vacuum Receiver Facilitates Rapid Filter Changes

Constructed of stainless steel, this vacuum receiver with a pneumatically actuated dump valve for dilute-phase conveying systems features a rugged, clamp-together design that facilitates rapid, tool-free disassembly for filter cleaning and maintenance. The modular design permits the addition of cylinder segments for increased holding volume. The flap-type dump valve is actuated by a pneumatic cylinder via manual contact closure or programmable controls based on weight gain, elapsed time or other user-defined parameters. It employs a single, large-diameter filter cartridge that enables rapid filter changes, and automatic reverse-pulse jet cleaning of the filter element to maintain conveying efficiency during operation.

Flexicon Corporation

610-814-2400

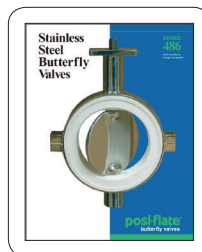
www.flexicon.com



STAINLESS STEEL BUTTERFLY VALVE

Posi-flate has introduced an inflatable seated butterfly valve with a highly polished 316 stainless steel housing and disc. It is suitable for many applications, such as food, chemical and pharmaceutical, and is available in sizes from 2 in. (50mm) to 20 in. (500mm). The inflatable seat design of the Posi-flate butterfly valve provides a better seal by utilizing air pressure to expand the seat against the disc, providing more sealing area and an even pressure distribution against the disc every time. www.posiflate.com/products/486.html

Posi-flate, (651) 484-5800, www.posiflate.com

**PUMP LOAD CONTROL**

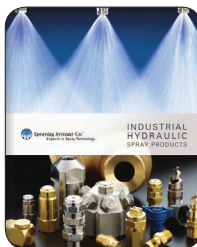
The PMP-25 pump load control guards against dry running, cavitation and overload. It monitors true pump power for maximum sensitivity. The display shows pump load, trip points and delays. Its NEMA 4X enclosure is small enough to fit on Size 1 starters and can be door-, panel- or wall-mounted.

Load Controls Inc., (800) 600-3247, www.loadcontrols.com

**NEW COMPREHENSIVE SPRAY TECHNOLOGY CATALOG**

Spraying Systems Co. has released Industrial Hydraulic Spray Products Catalog 75 for those involved in specifying or maintaining spray systems. Catalog includes a checklist of key factors to consider when selecting spray nozzles, optimization tips to maximize performance, maintenance guidelines and detailed information on the largest line of hydraulic nozzles in the industry.

Spraying Systems Co., (800) 957-7729, www.spray.com

**ELIMINATE
Valve Cavitation**

- Eliminate valve cavitation by placing one or more diffusers downstream of the valve.
- Noise and pipe vibration will also be eliminated or reduced.
- Valve's first costs and maintenance burden will also be reduced.

**CU Services LLC**

725 Parkview Cir,
Elk Grove Vlg, IL 60007
Phone 847-439-2303

rcronfel@comcast.net www.cuservices.net

NLB Solutions**Water jets blast
shellsides clean**

NLB makes shellside cleaning fast and easy. High-pressure water jets (10,000 psi) move robotically along a rotating bundle, removing hardened deposits while personnel keep clear.

Call NLB today, or download our SSC brochure at www.nlbcorp.com.



**The Leader in
Water Jet Productivity**

(248) 624-5555 nlbmktg@nlbusa.com

**Looking
to advertise?**

Contact:
Peggy Harrington-Marz

Phone: 708-334-9348
pharringtonmarz@putman.net

Sales Offices

PUBLISHING HEADQUARTERS



1501 E. Woodfield Road, Suite 400N
Schaumburg, IL 60173
Phone: 630-467-1300 • Fax: 630-467-1109
Web site: www.chemicalprocessing.com

Brian Marz, Publisher
E-mail: bmarz@putman.net
Phone: 630-467-1300, x411

Carmela Kappel, Assistant to the Publisher
Phone: 630-467-1300, x314
Fax: 630-467-0197

SALES

FAITH DALTON, District Manager
Digital Sales Manager
Email: fdalton@putman.net
Phone: 630-467-1300, x485

PRODUCT SPOTLIGHT/CLASSIFIEDS/AD-LITS

PEGGY HARRINGTON-MARZ, Inside Sales Manager
E-mail: pharringtonmarz@putman.net
Phone: 708-334-9348

REPRINTS

Foster Reprints
866-879-9144
www.fostereprints.com

ADVERTISER INDEX

ADVERTISER	PG #
American Machining	50
Anguil	27
Baldor	60
BASF	8
Bete Fog Nozzle	14
Binmaster	38
Bradford Derustit	32
Brookfield Engineering	22
Continental Disc	38
Dunn Heat Exchangers	20
Dynamic Air	13
Emerson Process Mgmt./Rosemount	16
Endress + Hauser	2
Environmental Gasket	31
Federal Equipment	22
Hapman	4
IEDA	3
Industrial Blind Solutions	24
Inpro/Seal	30
Kobold	47
Load Controls	39
Magnetrol	6
MAR Systems	36
Marrone Bio	25
NLB	35
PNC	59
Ross, Charles & Sons	10
Spraying Systems	12, 21
TLV	28
Vega	23
Watson McDaniel	26

BFM® FITTING SNAP-IN FLEXIBLE SLEEVE



BEFORE



AFTER

- ✓ Tool-free, snap-in flexible sleeve
- ✓ Easy installation & changeover
- ✓ Dust tight & explosion resistant design
- ✓ USDA accepted & meets 3A sanitary standards

Get a free quote!



1-877-236-3539
www.powder-solutions.com

STATIC MIXERS

For turbulent or laminar flow.
LPD/LLPD/ISG for ultra-low ΔP &
unlimited viscosity. Most in stock!



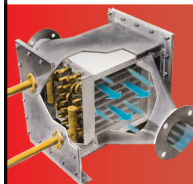
Scan to learn more
& get a free quote.

Free Tag Reader:
<http://gettag.mobi>

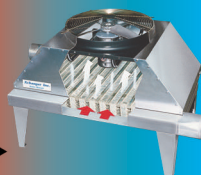
1-800-243-ROSS
www.StaticMixers.com



HEAT EXCHANGERS



◀ Liquid Cooled



Air Cooled ▶

FOR GASES & LIQUIDS!

Talk Directly with Design Engineers!
Blower Cooling Vent Condensing

INDUSTRIAL HEAT EXCHANGERS
XCHANGER
(952) 933-2559 info@xchanger.com

BOILERS

SELL • RENT • LEASE

- 24 / 7 -
EMERGENCY SERVICE



IMMEDIATE DELIVERY
CALL: 800-704-2002

10HP TO 250,000#/hr

250,000#/hr	Nebraska	750 psig	750°TTF
150,000#/hr	Nebraska	1025 psig	900°TTF
150,000#/hr	Nebraska	750 psig	750°TTF
150,000#/hr	Nebraska	350 psig	
115,000#/hr	Nebraska	350 psig	
80,000#/hr	Nebraska	750 psig	
75,000#/hr	Nebraska	350 psig	
60,000#/hr	Nebraska	350 psig	
40,000#/hr	Nebraska	350 psig	
20,000#/hr	Erie City	200 psig	
10-1000HP	Firetube	15-600 psig	

ALL PRESSURE AND TEMPERATURE COMBINATIONS
SUPERHEATED AND SATURATED

RENTAL FLEET OF MOBILE TRAILER-MOUNTED BOILERS

75,000#/hr	Optimus	750 psig	750°TTF
75,000#/hr	Nebraska	350 psig	
60,000#/hr	Nebraska	350 psig	
50,000#/hr	Nebraska	500 psig	
40,000#/hr	Nebraska	350 psig	
30,000#/hr	Nebraska	350 psig	
75-300HP	Firetube	15-600 psig	

ALL BOILERS ARE COMBINATION GAS/OIL
ENGINEERING • START-UP • FULL LINE OF BOILER
AUXILIARY SUPPORT EQUIPMENT.
Electric Generators: 50KW-30,000KW

WEB SITE: www.wabashpower.com
847-541-5600 • FAX: 847-541-1279
E-mail: info@wabashpower.com

wabash POWER EQUIPMENT CO.
444 Carpenter Avenue, Wheeling, IL 60090

CENTRIFUGES & DRYERS

- Nutsche Filter-Dryers
- Conical Vacuum Dryers
- Horizontal Peeler Centrifuges
- Basket & Inverting Filter Centrifuges

856-467-3399
www.heinkelusa.com



BOILERS

Available Immediately



Lease • Rental • Sale

(2) New 250,000 PPH 800 PSI / 750 Deg. S.H. with Low NOx Burners

250,000-850 PSI / 750 Deg. F.	Trailer Mounted
250,000-750 PSI / 750 Deg. F.	80K-395 PSI
180,000-750 PSI / 750 Deg. F.	72K-350 PSI
165,000-1025 PSI / 850 Deg. F.	70K-350 PSI
165,000-350 PSI	60K-750 PSI
150,000-750 PSI / 750 Deg. F.	45K-750 PSI
135,000-750 PSI / 750 Deg. F.	40K-350 PSI
120,000-350 PSI	36K-300 PSI
120,000-725 PSI / 750 Deg. F.	30K-300 PSI
110,000-350 PSI	24K-300 PSI
90,000-395 PSI	
75,000-395 PSI	
70,000-350 PSI	
60,000-750 PSI / 750 Deg. F.	
50,000-350 PSI	
40,000-750 PSI	
40,000-350 PSI	
30,000-350 PSI	
20,000-1600 PSI	
10-1,000 HP - 15-250 PSI	

Emergency Service
24HR
Emergency Service

INDECK

Indeck Power Equipment Company
tel 847.541.8300 / 800.446.3325
fax 847.541.9984
info@indeck-power.com
www.indeck.com

ICP Inc.
Quality Contract Manufacturer

PAST CONTRACTS INCLUDE:

- Titanium Dioxide Slurrying
- Boric Acid/Borax Solution
- Resist Salt Dissolving
- Sodium Sulfate Bagging
- Bulk Sack to Bag/ Bag to Bulk Sack

Warehousing & Distribution
INTERNATIONAL CHEMICAL PROCESSORS
8800 E. Kelso Dr. Baltimore, MD 21221
410.960.7068 410.686.5156 (fax)
internationalchemical@verizon.net

CHEMICAL PROCESSING

LEADERSHIP | EXPERTISE | INNOVATION

CUSTOM REPRINTS

REPRINTS ARE IDEAL FOR:

- New Product Announcements
- Sales Aid For Your Field Force
- PR Materials & Media Kits
- Direct Mail Enclosures
- Customer & Prospect Communications/Presentations
- Trade Shows/Promotional Events
- Conferences & Speaking Engagements
- Recruitment & Training Packages

For additional information, please contact
Foster Printing Service, the official reprint
provider for Chemical Processing.

Call 866.879.9144 or
sales@fosterprinting.com

F O S T E R
PRINTING SERVICE

CHECK IT OUT!

WWW.CHEMICALPROCESSING.COM



Q Are your mixers driving your maintenance crew crazy with seal problems?

A www.autoconsystems.com
www.theosten.com

EXPERIENCED
● **CUSTOM SPRAY DRYING**
Pilot or Production Runs
wheel atomization; Lab Dryer
● **CRUSHING, GRINDING & BLENDING**
Modern Facilities — Eastern, Cincinnati, OH
CinChemPro, Inc.
dba
CINCINNATI CHEMICAL PROCESSING
458 W. Main St., Batavia, OH 45103
513-732-2464

U.K. Invests in Advanced Chemical Products

A new research center aims to bridge innovation with industrial manufacturing



"The CDT model has proved highly popular with universities and industry," says professor David Delpy.

U.K. RESEARCH into developing advanced chemical products has received a boost following chancellor George Osborne's March 28 announcement that he is adding 22 more Centers for Doctoral Training (CDTs) around the country.

CDTs are designed to inspire the next generation of engineers and scientists in high-tech research and manufacturing. As part of the government's £500-million (\$837-million) investment, 91 CDTs already have been established. The advanced chemical products CDT, which won a £7-million (\$12-million) slice of this money, will be based at University of Leeds, and be known as the CDT in complex particulate products and processes. The money will fund 50 new research students.

"Advanced formulated chemical products are worth more than £200 billion (\$335 billion) a year to the U.K. economy and are used in a wide range of sectors, from advanced drugs and protecting crops through to the toiletries we use," says professor Simon Biggs, of the university's Faculty of Engineering, who led the bid. "Our center will be working across the whole supply chain, whether that's discovering new materials, getting these things on the manufacturing line or delivering them to consumers."

The government money, allocated by the Engineering and Physical Science Research Council (EPSRC), will provide more than half of the center's funding, with the remainder coming from the university and industrial partners.

Companies backing the CDT include the multinational consumer goods company Procter & Gamble, agrochemical developer Syngenta, petroleum additives manufacturer Infineum and major drug companies GlaxoSmithKline, Pfizer and AstraZeneca.

"This is not just about researchers sitting in their labs formulating clever materials. One of the problems in research is that a molecule might be ideal in theory but it may be impossible to manufacture it at scale and at a cost that can be supported by the market. We are going to be training researchers who can see the whole picture. An engineer looking at manufacturing problems will need to understand the limitations and restrictions of the chemist. The chemist will need to engage with the production line and the market. They will work in cross-disciplinary teams. The focus is on developing people who can go out there and continue the U.K.'s leadership in this field," Biggs notes.

One key area of work is micro-encapsulation,

which allows active ingredients in products such as drugs, agrochemicals, foods, cleaning products and toiletries to be better targeted.

"Think about chemotherapy. It kills cancer cells but it also kills off a lot of good tissue. If we can encapsulate those active ingredients on the micro-scale, so that they are only released on the cancer cells, we could give you a lot less drug and be better at targeting the cancer. We might also be reducing the cost of the drug because we need a lot less active ingredient," Biggs explains.

Other applications include micro-capsules that slowly leak active ingredients in pesticides, protecting a plant over an extended period, or micro-packages that preserve active ingredients in cleaning products so they remain effective after months in the supply chain.

The CDT will involve academics from the university's School of Process, Environmental and Materials Engineering; Mechanical Engineering; Chemistry; Design; Food Science and Nutrition; and Business School.

Research students will be recruited from backgrounds including chemical engineering, chemistry, physics, material engineering, product engineering and product design.

The course includes four modules covering creativity, innovation and teamwork; chemical product design; particle product manufacturing; and a particle product design project. Participants will be expected to develop their skills in core technologies including particle design and synthesis, colloidal dispersions, particle characterization, process flowsheets, product formulation, unit operations, process design and scale up. The first cohort of 10 PhD students will start work in October.

The other 21 CDTs will be based at universities around the U.K. and will focus on subjects such as the advanced characterization of materials, integrating sensing and measurement, sensor technology applications and formulation engineering.

"We have been working hard with universities and partners to ensure that as many centers as possible can be supported. The CDT model has proved highly popular with universities and industry and these new centers will mean that the U.K. is even better placed to maintain the vital supply of trained scientists and engineers," says professor David Delpy, chief executive of the EPSRC. ●

SEÁN OTTEWELL, Editor at Large
sottewell@putman.net

THE ENHANCED CASH FLOW INSIGHTSM



the different parts of your cash flow.



Now do even more with Cash Flow Insight powered by PNC CFO – an innovative online financial management experience.

- > Visualize your current and projected cash position
- > Forecast and scenario plan for future equipment purchases
- > Manage and automate your invoicing and bill payments, all in one place
- > Sync your receivables and payables data with accounting software

Try it at no cost today*. Stop by any PNC branch, call a Cash Flow Insight Consultant at 855-762-2361 or go to pnc.com/cashflowinsight

for the achiever in you[®] **PNC|CFOSM**
Cash Flow Optimized



*Cash Flow Insight requires a PNC business checking account and enrollment in PNC Online Banking. Free trial offer valid for Cash Flow Insight and for additional tools (Receivables, Payables and Accounting Software Sync) for your current statement cycle period and two additional statement cycles. One free trial period per customer. For information on post-trial fees, how to un-enroll, a list of supported accounting software and other details, visit pnc.com/cashflowinsight. Monthly charges will apply unless you un-enroll. CFO: Cash Flow Optimized and Cash Flow Insight are service marks of The PNC Financial Services Group, Inc. ©2014 The PNC Financial Services Group, Inc. All rights reserved. PNC Bank, National Association. Member FDIC

Make the Right Connection



Engineered exclusively for the oil and gas industry, Baldor • Dodge® Disc Couplings meet API 610 specifications for use in critical pumping applications. Utilizing dual scalloped disc geometry, Baldor • Dodge Disc Couplings produce the highest torque and misalignment capability of any disc coupling in the industry, greatly improving reliability and overall product life. And, customers can lower their total costs by utilizing the extended bore capacity of Baldor • Dodge's large hubs to downsize coupling selections.

High speed capabilities and high torque ratings. Unsurpassed reliability and improved uptime. Make the right connection with Baldor • Dodge Disc Couplings.

baldor.com 479-646-4711

- Meets API 610 Specifications
- Increase Uptime
- Unmatched Quality
- Superior Reliability
- American Made Since 1880

BALDOR®
A MEMBER OF THE ABB GROUP