JULY 2020

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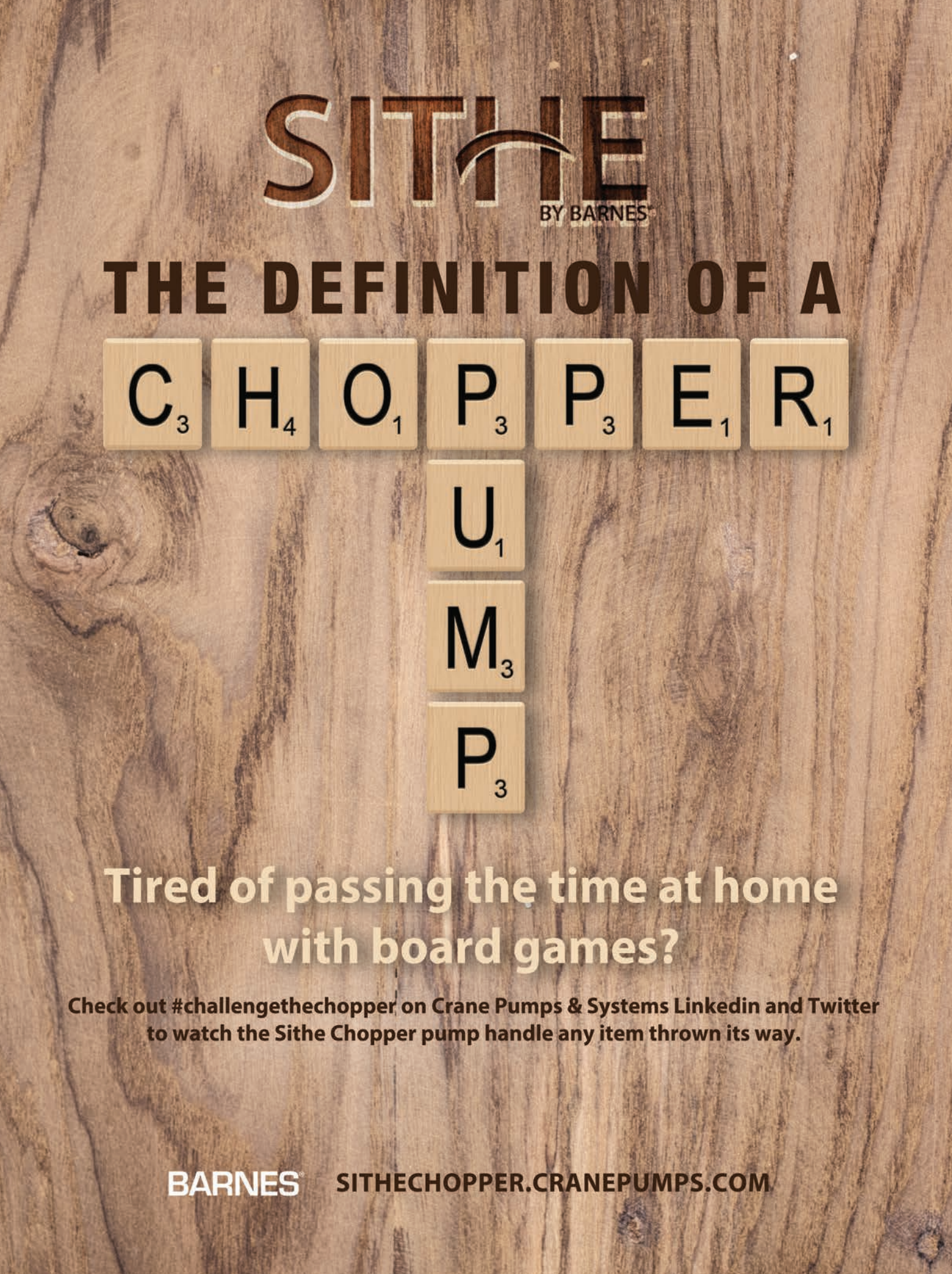
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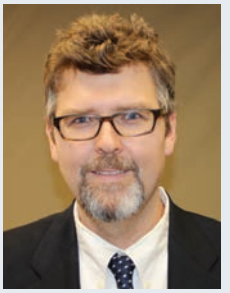

J. Campbell, Editor
Modern Pumping Today

Welcome to the July issue of MPT. An article in our Case Studies section (pg. 18) this month is as informative as it is topical. Clean Works, an innovative startup in food sanitation, recognized its unique position to help fight COVID-19 by using its produce disinfection technology to disinfect up to 1,200 N95 masks per day for hospitals and other healthcare facilities. Joel Jackson of Grundfos shows how this award-winning food sanitation company applied its technology to disinfect PPE.

Every day, industrial workers transfer potentially hazardous chemicals from large drums into smaller containers or into machinery. Traditionally, such potentially flammable or combustible liquids have been tipped and poured. Today such spill-prone, VOC emitting methods are no longer considered acceptable, safe, or compliant. Nancy Westcott, president of GoatThroat Pumps, shares "A Call to Keep Workers Safer When Transferring Flammable and Combustible Liquids" (pg. 30) in this month's Pump Solutions section.

Lastly, on a recent episode of MPT's podcast, The Efficiency Point, Chris Moody from AWWA's government affairs office joined us to discuss the impact of the EPA's new guidelines on PFAS regulations and the organization's current efforts advocating for clean and potable water throughout the country. Read an excerpt of that interview at the end of this issue (pg. 44) and be sure to subscribe to the show on your favorite podcast app. Enjoy!

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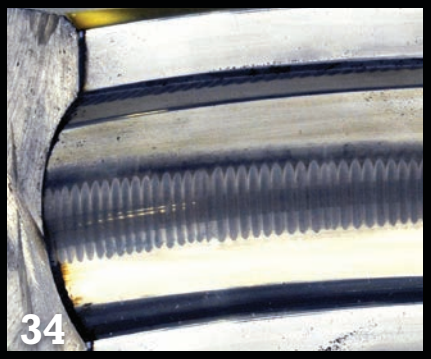

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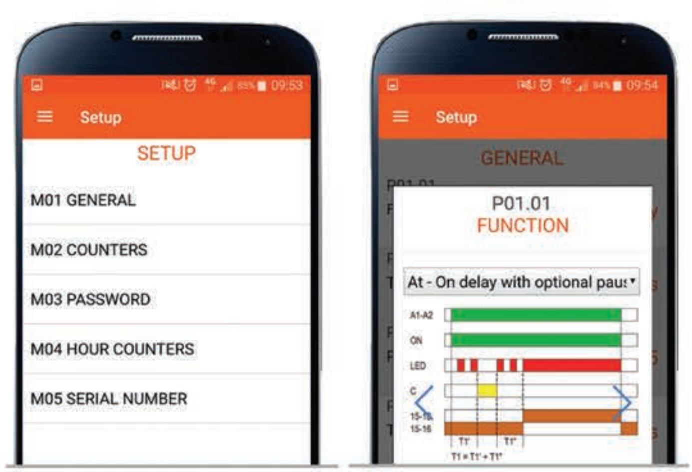

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BULL MOOSE TUBE APPOINTS NEW CHIEF COMMERCIAL OFFICER

Caparo Bull Moose, Inc. (CBM), a Chesterfield, Missouri, based manufacturer, has named Andy Annakin as executive vice president and chief commercial officer of its tubular products subsidiary, Bull Moose Tube Company. CBM is owned by the Caparo diversified global industrial interests of British Indian businessman The Right Honorable Lord Swraj Paul, PC.

Commenting on Annakin's appointment Tom Modrowski, president and CEO of Bull Moose Tube Company states, "We are excited to welcome Andy to our executive team. Andy has the skills to position Bull Moose for long term success by strengthening and building on the talent I have seen in our organization. His ability to forge strong partnerships with customers and suppliers in a dynamic market that is driven by ever-changing needs will be invaluable to Bull Moose and its stakeholders. He is a transformative leader who brings a commitment to commercial excellence with over thirty years of industry experience."

Annakin comments, "Bull Moose Tube has a proud history and reputation of creating value for its customers. I look forward to working with the Bull Moose team in continuing to create an optimal commercial experience that puts the needs of the customer at the center of all we do. Together we will provide our customers with service excellence and the highest quality products."

SUNDYNE NAMES PUMP PRODUCT LINE MANAGER

Sundyne announces that Hélène Balligand has joined Sundyne as pump product line manager. In this new role, Balligand will be responsible for Sundyne's Low Flow High Head product management activities, including pricing, recommending new products based on customer and market needs and insuring the growth and profitability of Sundyne's flagship products. Additionally, she will assist in the expansion of Sundyne's digital promotion and marketing activities.

Balligand comes to Sundyne from Gardner Denver Nash, where she managed channel partners and direct OEM accounts throughout the western United States and Canada. Previously, she garnered sales, engineering, and management experience through a variety of roles with pump companies Sulzer, Enisval Moret, and Wilfley. Prior to that, she gained experience in the power generation markets working at the Woodward Governor Company, where she managed accounts for large industrial companies such as GE and Siemens.

Balligand earned a bachelor's degree in mechanical engineering from Ecole Nationale Supérieure in Strasbourg, France; a PhD in mechanical and aerospace engineering from Syracuse University in New York; and an MBA from Colorado State University. In addition to her doctoral thesis, she has written numerous technical papers for trade publications and scientific journals.

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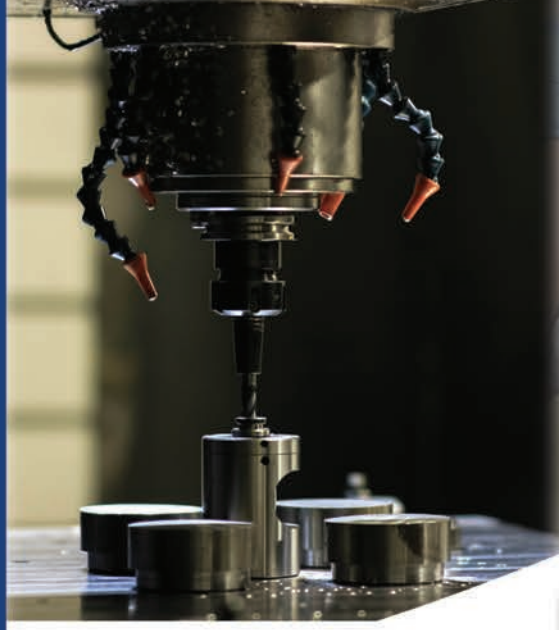

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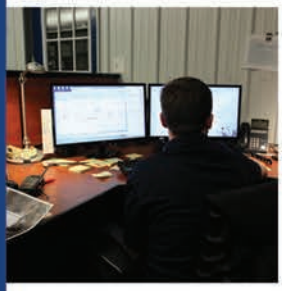

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BLOCKMASTER LAUNCHES NEW WEBSITE WITH PRODUCT SELECTION GUIDE

BlockMaster Electronics, a leading supplier of terminal blocks for electrical and electronic distribution, launches a new website to make it easier for customers to select and order terminal block products. The website features an entirely new Selection Guide for a wide range of terminal blocks and screw terminal hardware.

The new Selection Guide includes a quick visual selection of the primary BlockMaster terminal block and hardware families on the new home page. From there, site visitors are taken to a table for the selected product family that provides a complete listing of terminal block or hardware products, including part numbers, photos, drawings, and data sheets or catalogs. The table also identifies the Voltage, Current, Pitch, and Number of Poles for a quick visual identification of the terminal blocks needed. The Current Rating is provided for the terminal screw hardware line (25A to 150A for PCB and surface mount). Altogether, the Selection Guide covers over 9,500 part numbers.

The new website also includes listings of the company's distributors and sales representatives, and a convenient Cross-Reference Guide of competitor part numbers. To view the new website, visit **www.blockmaster.com**.

AESSEAL ACHIEVES INTERNATIONAL STANDARD FOR INDUSTRIAL CYBERSECURITY

AESSEAL has achieved certification for Information Security Management System (ISMS) ISO 27001, one of the most widely recognized international standards for industrial supply chain security.

The Rotherham-based manufacturer of mechanical seals and support systems completed the ISMS accreditation process despite the challenges presented by the COVID-19 lockdown, which meant all external auditing had to be completed remotely. ISO 27001 will help AESSEAL colleagues to ensure the secure management of the information, business processes, information systems, and facilities that support its products and services.

AESSEAL IT Director Stuart Welsh adds, "As a business which is committed to evidencing best practice, continuous improvement, and outstanding customer service, achieving ISO 27001 certification is an important accomplishment. It sends a clear message to our customers around the globe that we take ensuring the security of their data extremely seriously. We are extremely grateful for the professionalism of our colleagues who helped us to complete the external audit successfully despite the challenges of operating remotely."

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THE ALIAS GROUP PROMOTES MORGNER TO DIRECTOR OF SALESFORCE CRM SERVICES DIVISION

The Alias Group announces that Kate Morgner has been promoted to director of business development, heading up business development and client services for the Salesforce CRM Services division. Morgner's previous role at the Alias Group was director of marketing, a role which she held for six years.

"This is a great opportunity to bring the untapped power of Salesforce to companies looking for a competitive edge in generating leads and managing their sales pipeline," Morgner says. "It's amazing how quickly optimizing Salesforce CRM and sales processes can shorten sales cycles and accelerate lead qualifying, keeping sales funnels full. I'm excited to help our partners use Salesforce to its fullest potential."

The Alias Group recently formalized its Salesforce CRM Services division by expanding service offerings under optimization and implementation categories to serve both new Salesforce users and existing users. The mission at the Alias Group is to raise the performance of clients' Salesforce instances to equal the performance level that the sales teams execute at every day.

MELISSA ELLIOTT OF COLORADO TAKES GAVEL AS AWWA PRESIDENT

Melissa Elliott of Greenwood Village, Colorado, begins her one-year term as president of the American Water Works Association (AWWA) today during a live-streamed gavel passing ceremony hosted at AWWA's Denver headquarters. The Presidential Gavel Passing Ceremony usually takes place at AWWA's Annual Conference and Exposition, but it was conducted virtually this year after the conference was cancelled due to the COVID-19 pandemic.

Elliott is director of strategic communication services at Raftelis, where she consults with utilities across the United States. She has been an AWWA member for over fifteen years, during which time she has served as chair of the Public Affairs Council. She has also served as trustee and chair of AWWA's Rocky Mountain Section.

During her term as president of the largest association of water professionals in the world, Elliott said she will concentrate on three themes: economics, engagement, and equity. She highlighted the financial challenges that water utilities, water sector businesses, and consumers will experience due to the pandemic; the importance of engaging with one another in new ways in a socially distanced world; and advancing an inclusive, diverse water sector that ensures equity. ◆

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Milwaukee, WI

Choosing a Submersible Pump vs. a Dry-pit Pump

By SWPA Executive Director Adam Stolberg and Lisa Riles, Xylem

When deciding on the best pump for an application, it's important to consider not only the initial investment but also the relevant maintenance and efficiency costs over the pump's life-cycle. Critics sometimes point out that, because dry-pit pumps are not in a wet well, they are easier to access for inspection and service. However, in the conversation below, SWPA Executive Director Adam Stolberg and Lisa Riles, product management director for Xylem's Applied Water Systems, discuss how submersible pumps provide long-term benefits and savings that pump users need to factor into their purchasing choice.

What are some of the basic reasons one would choose a submersible pump over a dry-pit pump?

A submersible pump is not visible to the public, essentially the equipment is out of sight and out of mind, which would fall in favor of local authorities trying to integrate infrastructure that does not disturb its residents. Most importantly, submersible pumps are part of a large network on flood-proof pump stations that has drastically increased over the years to keep the equipment in operation while encountering unpredictable weather events.

What are the maintenance advantages of a submersible pump that some users may not be aware of?

Submersible wet-pit pumps are maintained through lifting means whether it's a deep lift or chain system. The maintenance required is very minimal, especially with impeller technology designed to pass modern day rags at the same time maintain efficiency. Dry-pit submersible pumps on the other hand can be maintained in the same methods applied for the above mentioned dry-well pumps with the added benefit of not worrying about misalignment or added work that would be necessary on an extended shaft pump.

Being submersed in a wet environment helps keep a submersible pump cool. How does that advantage translate to its performance and efficiency?

The motor cooling methods are vital in maintaining operating life of the equipment, whether choosing an integral media cooled drive, closed loop cooled, or external cooling. There are cases where a customer would opt to not have a cooling jacket surrounding the stator housing; however, in these cases operations needs to maintain water levels assuring the unit is constantly submerged. This step adds to the operation and maintenance protocol, which is why it's recommended to choose a proper cooling method supplied from the factory. Close-loop cooling methods offer higher efficiency and are often compliant to IE3 standards. Lastly, being submerged also eliminates the need for suction piping and in turn avoiding losses incurred with their installation.

Which impediments in a dry-pit pump's performance don't affect submersibles?

The following impediments do not affect submersible pumps:

- Pump and motor shaft alignment, coupling, and coupling guard.
- Priming conventional pump must be considered (submersible pumps are already submerged/primed).
- Suction piping losses must be accounted for (no suction piping on submersible pumps).
- Mechanical seals typically required a secondary water source for flushing (cooling/lubrication); submersible pump mechanical seals do not require seal flush.
- Proper suction and discharge piping support and alignment are critical for dry-pit pumps. Submersible pumps are typically not "hard-piped" and they automatically connect to their mating discharge elbow by gravity, making pump installation, and removal fast and easy.

Submersible pumps are part of a large network on flood-proof pump stations that has drastically increased over the years to keep the equipment in operation while encountering unpredictable weather events.

- Dry-pit pumps typically have stuffing boxes designed to accommodate mechanical seals from different manufacturers and styles, which requires a longer shaft overhang. Quality submersible pumps are designed with minimal shaft overhang, thus reducing shaft loads and resultant deflection (longer seal and bearing life).

What are some applications where a submersible pump would be exclusively the better option?

Every pump application less than 1,000 horsepower—all kidding aside, wastewater and stormwater are the most common applications where pump stations are constructed below grade as conveyance or routing of pumpage to collection systems and in turn treatment plants. Any location that is prone to flooding, coastal cities for instance. From a civil works standpoint if the pump station is a single wet well it's designed for submersibles or a pre-fabricated lift station which contains valves, float sensors, controls, and additional appurtenances needed for successful operation. On retrofit stations, there are some additional steps needed possibly moving the discharge header to accommodate the dry-pit submersible option but these changes would be very minimal. ◆

The Submersible Wastewater Pump Association (SWPA) is a national trade association representing and serving the manufacturers of submersible pumps for municipal and industrial wastewater applications. Founded in 1976, the association's primary focus is on industry guidelines, education, and promotion.Information on membership as well as technical resources, online training center, and links to SWPA's own industry renowned publications can be found on the organization website. For more information, visit **www.swpa.org**.

Don't Wanna Go Back to My Little Cesspool in Aloha, Aloha

All-Terrain Sewer from E/One strikes the balance between performance and environmental protections

By Joseph Harmes

The Hawaiian Islands encapsulate every conceivable wastewater infrastructure challenge. High water tables requiring expensive dewatering or inviting contamination from septic tanks, which—by design—leak. Excavations of great depth for inclines of large-diameter gravity sewer pipe. The threat of inflow and infiltration from heavy rains. Beds of lava, one of nature's most impenetrable surfaces. Undulating terrains. Preservation of archaeological sites, fragile tropical vegetation, ocean fronts, and sacred anchialine ponds. Notably higher costs for labor, equipment and materials than the mainland.

Then there are the hurdles posed by some of the state's tiniest yet most visited tourist attractions--Hanauma Bay, Sandy Beach and Waimānalo State Park—along a scenic 7.5-mile stretch of the Kalaniana'ole Highway on O'ahu.

ADDRESSING THE PROBLEMS OF GRAVITY SEWERS

In each location, the use of gravity sewers would be environmentally disruptive, prohibitively expensive or physically impossible given their function to transport wastewater downhill, not up steep inclines. Septic already had proven a failure as there was not the space nor soil

conditions for adequate drain fields to prevent nitrogen and phosphorous from threatening marine life and coral reefs. Nor could Hawaii consider the antiquated technology of cesspools (technically, a hole for untreated human waste) as it has passed legislation to eliminate the 88,000 already imperiling its groundwater.

Authorities opted to trial the All-Terrain Sewer® (ATS) developed by Environment One Corporation (E/One) "for the city to be able to understand how these things work and how dependable they were," says Paul Scott of Engineered Systems in Kailua.

The ATS represents a more cost-effective alternative to expensive gravity and is fiscally competitive with the installation and subsequent maintenance costs associated with the current generation of nitrogen-reducing septic tanks. Found on almost every continent, its pressurized, inflow-and-infiltration free small-diameter pipes are conduits to conventional wastewater treatment plants. This go-to wastewater infrastructure has cleansed and protected many other islands including Martha's Vineyard, the Florida Keys, and, notably, Alcatraz.

A DELICATE, PROTECTED, AND CHALLENGING ENVIRONMENT

In 2009, some E/One pumps were installed at Hanauma Bay in the Hawaii Kai neighborhood of East Honolulu. This popular backdrop for TV and movie productions is both a nature preserve and a marine life conservation district with about 400 species of fish known to inhabit the bay. It attracts about 90,000 monthly visitors—and their bathroom needs.

Given its location between a volcanic crater and the Pacific Ocean, the ATS was the magic carpet required to convey wastewater from the restroom facilities up and over to an existing gravity line, then to a wastewater treatment plant. This was made possible by a grinder pump, whose primary component is a 1 horsepower, semi-positive displacement pump. Its robust torque can propel wastewater for a distance of more than two miles—or even vertically 186 feet.

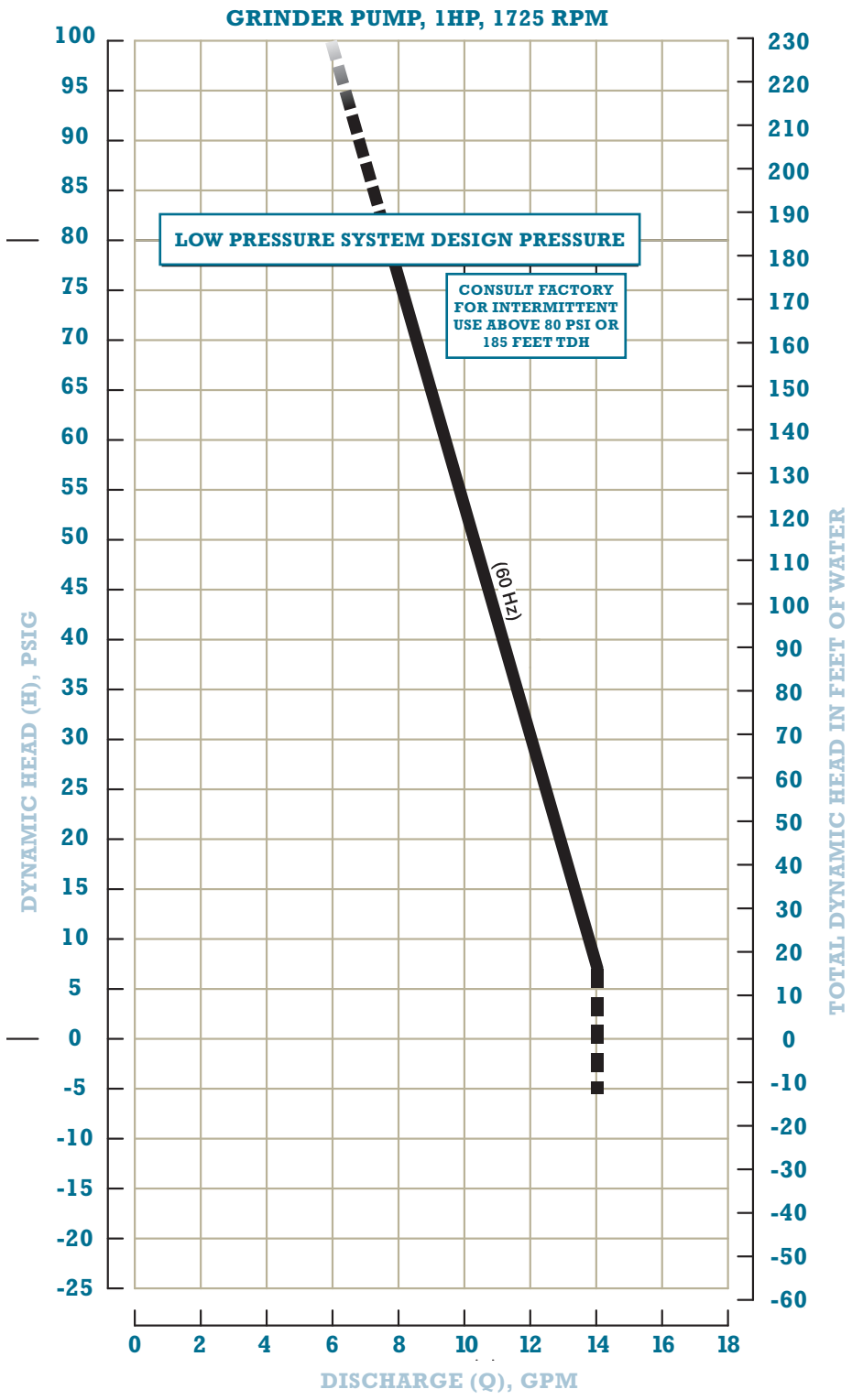
"It was used there because of the low-flow, high-head requirement. The elevation difference is quite steep," says Scott.

GRINDER PUMPS ADDING TO THE PLAN

Subsequently, other grinder pumps were installed to overcome the similar conditions at comfort stations in the beachfront Waimānalo District Park (Waimānalo Beach is regarded as the longest stretch of sandy shoreline on O'ahu. In Hawaiian, Waimānalo means "potable water.").

Grinder pumps also anchor the comfort stations at Sandy Beach, close to Hanauma Bay, which was the childhood body surf break of O'ahu-born President Barack Obama.

E/ONE SPD PUMP PERFORMANCE CURVE



The same high-head advantage of an All-Terrain Sewer dove-tailed nicely with the expansion of a thirty-unit affordable senior housing project in Hilo.

"The Mohouli Street projects are located below the county's gravity system so the only alternative to service the site was to either obtain a variance and install septic systems or

to install pump stations and pump up to the county's existing gravity sewer line," says Nancy Burns in Kailua Kona, principal of Nancy E. Burns PE, LLC, the project engineer.

"The E/One ATS was chosen as it was better from a cost and environmental standpoint. We also felt it would require less maintenance than a septic system and would consume less area on the project site." ◆

With corporate headquarters in New York and regional offices and distribution throughout the industrialized world, Environment One Corporation (E/One) is a manufacturer and provider of products and services for the disposal of residential sanitary waste and utility systems for the protection and performance optimization of electric utility assets. For more information, visit **www.eone.com**.

The food industry uses the Clean Works Clean Flow Mini to kill 99.9 percent of pathogens, providing a more effective and consistent cleaning process while reducing water consumption.

Clean Works Uses Innovation and SMART Digital Dosing to Fight COVID-19

Award-winning food sanitation startup applies its technology to disinfect PPE

By Joel Jackson, Grundfos

The Clean Works Clean Flow Mini sanitizes produce using ultraviolet light, vaporized hydrogen, and ozone.


Sarker, Grundfos district sales manager, tests the Grundfos SMART Digital dosing pump for the Clean Works application.

As an innovative startup in food sanitation, Clean Works quickly recognized the company's unique position to help fight COVID-19 by using its produce disinfection technology to disinfect up to 1,200 N95 masks per day for hospitals and other healthcare facilities.

INSIDE CLEAN WORKS

Clean Works was founded in Ontario, Canada, in 2012, by produce industry veterans who developed a sanitizing system for fruits and vegetables to prevent the outbreak of foodborne illnesses. The Clean Works process uses ultraviolet light, vaporized hydrogen peroxide and ozone to kill 99.99 percent of pathogens. A key component of the Clean Flow Health Care Mini, the system used to disinfect PPE, is a chemical metering pump that provides continuous dosing of their sanitation solution.

"Independently, they're good sanitizers. But when you mix them together, the three of them multiply the effectiveness," Clean Works president and CEO Mark VanderVeen says. "What happens is it creates a hydroxyl radical and that radical is what then finds the pathogen or the virus that's resident."

PRECISION IS THE KEY

Precise control of the dosing levels and constant spray are essential to effective sanitation, whether sanitizing produce or PPE. Early on, Clean Works faced some challenges in this area.

"Pulsation was a big issue with the previous pump manufacturer," says Clean Works general manager Joe Symons. "We needed a fully integrated solution that could deliver the needed accuracy and precision, while communicating with the PLC controls."

To meet the accuracy and precision demands with PLC integration, Grundfos began testing its DDA FCM pumps with the Clean Works nozzle and chemicals. The team was committed to ensuring the pumps worked with the innovative equipment.

"The atomizing was really cool to see," says Grundfos district sales manager Aninda Sarker. "As we tested the solution with our pump variants, I took a video for the Clean Works team, so they could see the pump in action. I also joined them at the plant for on-site testing to ensure our solution consistently delivered the results."

GETTING SMART WITH DOSING

By using stepper motor technology, Grundfos SMART Digital dosing pumps provide a smooth continuous flow profile, even when very small volumes are required. Additionally, an integrated pressure sensor and flow monitoring algorithm controls the flow rate by comparing the actual flow to the set point and automatically making any needed adjustments.

"This pump has completely alleviated our maintenance worries, and it's hands-free," says Clean Works co-owner Paul Moyers. "This has allowed us to a consistent flow of our hydrogen peroxide across the treatment area."

Due to the shortage of N95 masks and other PPE in Canada, Clean Works' newest affiliate, Clean Works Medical, has seen an increased demand from healthcare providers and industries for the Clean Flow Health Care Mini and the chemical dosing pumps that are critical to its functionality.

A GLOBAL PROBLEM DEMANDS A GLOBAL SOLUTION

Grundfos worked with its global operations teams to quickly meet the needs of Clean Works Medical for DDA dosing pumps and ensure the company's innovative solution can be deployed to sanitize equipment that protects the frontline workers who are helping save lives.

Clean Works is now working with the federal and provincial governments, as well as hospitals, nursing homes and other healthcare facilities in Canada, to help supply sanitized equipment during the pandemic.

"The key was to quickly provide a PPE solution to our frontline healthcare providers during this crisis, and Grundfos was an integral part of that," says VanderVeen. ◆

Grundfos, based in Bjerringbro, Denmark, is a global leader in water pump technology. To complement its global presence, Grundfos is committed to the American market with regional headquarters in the Houston, Texas area. The company's purpose—pioneer solutions to the world's water and climate challenges and improve quality of life for people—inspires an operations, sales and service staff of over 1,200 across North America to deliver the world to the next generation in a better state than we inherited. For more information, visit **www.grundfos.us**.

Wastewater Treatment Technology Doesn't Have To Be New To Be Disruptive

By Matt Hale, HRS Heat Exchangers

The term "disruptive technology" can be found everywhere across wastewater treatment, from conferences to whitepapers, and from small industrial and manufacturing sites to large municipal wastewater treatment plants. There is no doubt that disruptive technologies have the power to transform sustainability in the water sector, but it is important to realize that a technology does not need to be new in order to be disruptive. The widespread use of previously niche systems, or the novel use of well-established technologies like heat exchangers, can be equally transformative.

WHAT IS MEANT BY DISRUPTIVE?

A disruptive innovation is typically described as one that creates a new market or value network, leading to the displacement of market-leading businesses and products. High profile examples from everyday life include the Internet, mobile phones, Amazon, and television streaming services. However, it is also evident that while the terms disruptive innovation and disruptive technology may be new, the fundamental idea is not. From the Iron Age overtaking the Bronze Age, to the invention of gunpowder, the steam engine and the internal combustion engine, human history is littered with examples of transformational developments that have changed the course of global civilization.

PART OF A WIDER AGENDA

The current high level of disruptive technological development and implementation is itself part of a wider industrial development, which is often referred to as Industry 4.0. This fourth industrial revolution refers to the increased use of technology, automation, and data across industries as diverse as agriculture and healthcare; and water treatment and the environmental sector are no different. While some people dismiss Industry 4.0 as a marketing buzzword, there is no denying the effects that digitization, data capture and analysis, and automation are having across the economy.

EXAMPLES OF DISRUPTIVE TECHNOLOGY

There have been plenty of disruptive developments in the treatment of wastewater streams through history, from sewer systems and trickling filters, to the use of activated sludge, anaerobic digestion, and nutrient recovery. Some of the current areas that have the most potential for disruption, either because they are new, or because they are becoming increasingly common, include:

- **Decentralized wastewater treatment**: The development of smaller, decentralized treatment technology has the potential to improve levels of sanitation and access to clean water around the world. A number of universities and companies are working on practical solutions for sustainable, small scale wastewater treatment units.
- **Phosphorus recovery**: Economic, political, and environmental factors are already combining to make the recovery of this valuable nutrient from waste streams and sludges routine at commercial wastewater treatment facilities. Consultants are also turning their attention to phosphorus recovery at smaller scale installations, such as septic tanks and agricultural effluent.
- **Wastewater mining**: While the recovery of some key nutrients, such as phosphorus, is now common, an improved understanding of the scarcity of resources and moves towards the development of a true circular economy means that the next generation of wastewater treatment plants is likely to include physical, chemical, and biological systems to recover key materials (including carbon, nutrients, and rare metals) for

HRS Unicus Series scraped-surface evaporators are used to maintain thermal efficiency and remove fouling during evaporation in ZLD installations.

Evaporation and concentration systems based on heat exchangers have a small footprint, making them ideal for decentralized water treatment.

reuse in processes as diverse as farming, food production, and industrial manufacturing.

- **Zero Liquid Discharge**: Commonly abbreviated to ZLD, this technique refers to waste treatment techniques that remove the liquid streams, usually employing a combination of processes such as filtration and crystallization to remove suspended and dissolved materials to leave a number of solid residues—which often contain valuable co-products or components and water. Now categorized as a mature technology, it is an example of a disruptive technology which is rapidly becoming mainstream.

USING EXISTING TECHNOLOGY FOR DISRUPTIVE PURPOSES

There are many drivers for the adoption of all or some of these techniques in wastewater treatment, including environmental, economic, and social factors. However, the good news for companies wanting to evaluate and introduce such technology is that the techniques already exist.

For example, many of the processes described above involve some form of evaporation to concentrate residues for extraction and as part of the purification of wastewater streams. As heat transfer and evaporation specialists, HRS Heat Exchangers already produce a range of heat exchangers and systems that are suitable for any or all the above processes. The patented HRS Unicus series of scraped surface heat exchangers are particularly suitable for use in evaporation systems, such as those used for ZLD and material recovery.

The HRS evaporators used in ZLD systems are run at lower pressures to reduce the boiling point of the liquid, enabling multi-effect evaporation. In multi-effect evaporation, steam from a previous evaporation stage is used as the thermal energy for the next stage, which works at a lower boiling point. In this way, multiple evaporation stages are combined, delivering considerable energy savings. For many components,

crystal precipitation is also favored at lower temperatures; so, lowering the evaporation temperature helps to boost product recovery rates.

The HRS ZLD process consists of an evaporation concentration phase where a concentrated solution is concentrated as much as possible. From that point on there are two possibilities:

1. Concentration to maximum solubility without the formation of suspended solids. This is then followed by a cooling step which causes solids precipitation and separation of the solids which are formed; the liquid fraction is then returned to the evaporator. This method can be applied for a product that has a sharp change of maximum solubility with temperature.
2. Concentration to just above the saturation point, followed by a separation tank where the solids and liquids are separated. The liquid fraction is then returned to the evaporator. This method can be applied for a product which solubility does not change too much with temperature.

Both the evaporation and cooling steps result in a high degree of material fouling on the inside of the equipment. To combat this, HRS Unicus Series scraped-surface evaporators are used, as they maintain thermal efficiency and remove fouling as it occurs in the evaporation process. In addition, HRS R series scraped surface heat exchangers are also used for cooling the crystal-loaded slurry that is obtained in the crystallization tanks.◆

Located in Atlanta, Georgia, HRS Heat Exchangers is part of the HRS Group, which operates at the forefront of thermal technology, offering innovative heat transfer solutions worldwide across a diverse range of industries. With approaching forty years' experience in the wastewater sector, specializing in the design and manufacture of an extensive range of turnkey systems and components, incorporating our corrugated tubular and scraped surface heat exchanger technology, HRS units are compliant with global design and industry standards. For more information, visit **www.hrs-heatexchangers.com**.

I/O for the IIoT

Edge I/O creates a simpler way to meet the needs of today's IIoT applications Part 2 of 2

See Part 1 www.mptmag.com

By Benson Hougland, Opto 22

In last month's installment of this article, we introduced how the new *groov* RIO® family from automation manufacturer Opto 22 offers a simple solution in an increasingly complex era of connectivity and technical capabilities. In this concluding segment, we'll focus on some of the details that best illustrate the product's use in the real world.

EDGE I/O IN ACTION

First, specifying I/O for a particular application becomes much simpler. Because *groov* RIO supports thousands of unique I/O configurations from a single device, you no longer need to identify and procure specific I/O modules. You can order just one part number. Second, mounting the unit and connecting it to a standard Ethernet network are easier.

You place groov RIO near the sensors or equipment with the signals you want. RIO's operating temperature is -4 to 158 degrees Fahrenheit (-20 to 70 degrees Celsius), it is UL Hazardous Locations approved and ATEX compliant, and it can be panel or DIN-rail mounted. An enclosure may not be required, especially in low-voltage applications.

groov RIO attaches to an Ethernet network through one of its two switched Gigabit interfaces. You can use power over Ethernet (PoE) with a PoE switch, or provide 10-32 VDC power. The device automatically receives an IP address from your corporate LAN's DHCP server, just like most other smart devices on an Ethernet network. Note that wireless LAN networking is also supported through optional USB WiFi dongles.

Once the unit is in place, you open a web browser and create a secure user account, configure I/O channels, and set up data communications for your application. The following sections list the steps to complete three of our simple applications.

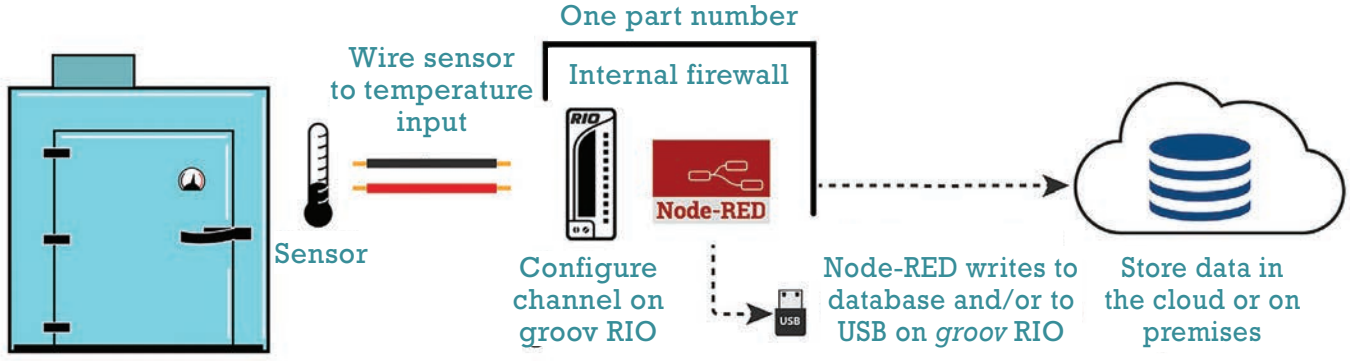
LOG REFRIGERATION UNIT TEMPERATURE TO A DATABASE

1. Wire one of the first eight channels to a low-cost, simple two-wire ICTD (integrated circuit temperature device) temperature sensor and place the sensor in the refrigeration unit.
2. From a computer or mobile device, securely log into groov RIO and use the browser-based groov Manage software to configure the channel as an ICTD input sensor.
3. Still in your web browser, open the embedded Node-RED editor. Use pre-built nodes to create a simple flow that moves the temperature data to an on-premises or cloud-based database, like MariaDB, Microsoft SQL Server, or PostgreSQL.

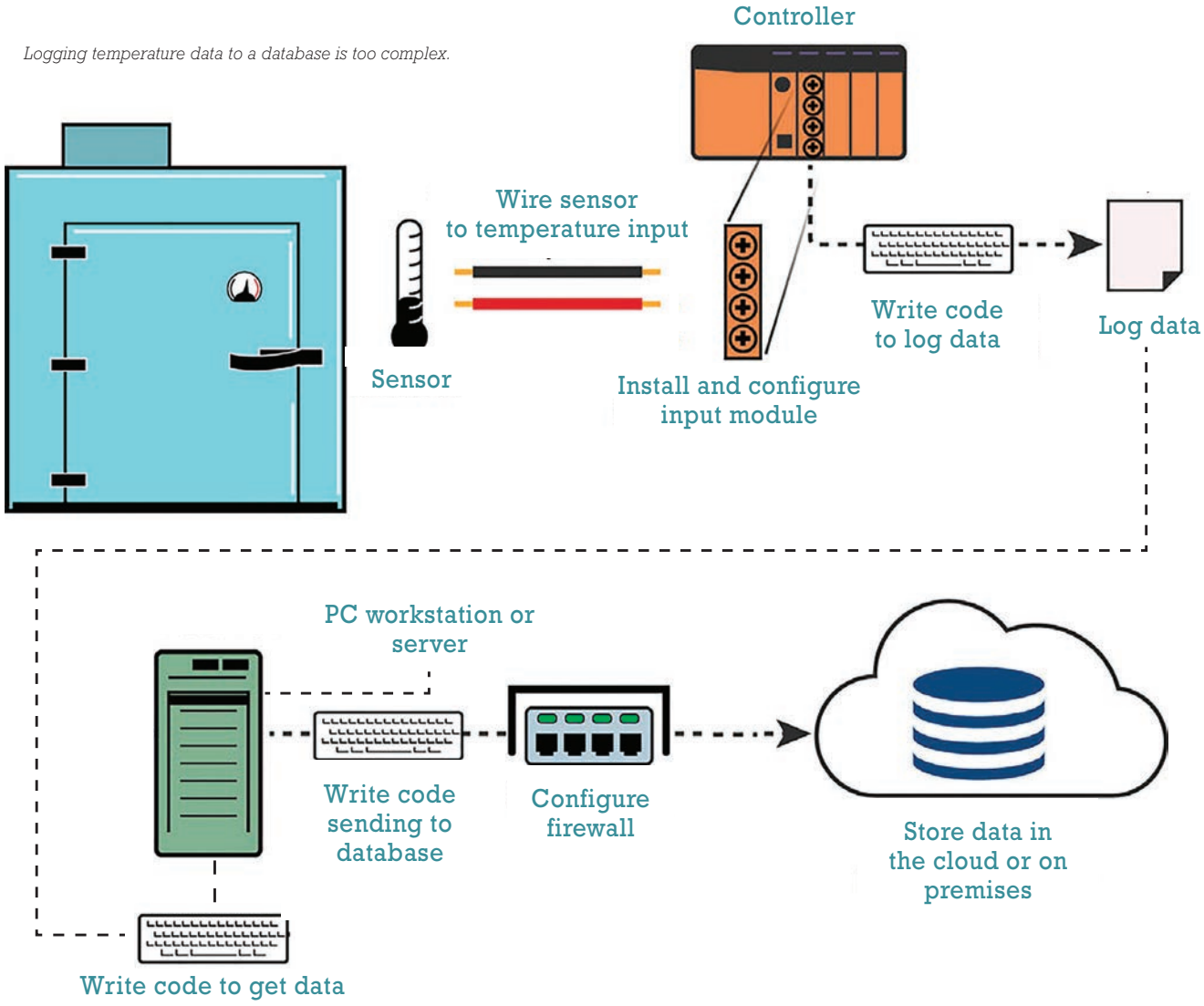
You could also write a flow to log the temperature to local on-board, power-fail-safe flash memory, or to an installed USB memory stick connected directly to groov RIO's USB port—especially handy if the remote location has no internet connection.

SEND COMPRESSOR ON-TIME TO A CLOUD ANALYTICS SYSTEM

1. Wire one of the first two I/O channels to the compressor's run/stop contact. In a web browser, configure the channel as a discrete input with the on-time totalizing feature. groov RIO automatically totals the amount of time the compressor is running.



Logging temperature data to a database is too complex.



2. Open Node-RED and create a simple flow to move totalized data to the analytics system.

PUBLISH DATA TO A SCADA SYSTEM

1. Wire process instrumentation transmitters (like level, flow, or pressure) to the first four I/O channels and configure as analog inputs (voltage or current).

2. In *groov* Manage, configure MQTT communications to publish channel data to an MQTT broker. SCADA systems can then subscribe to data from the broker.

If you have Ignition from Inductive Automation®, you can use the Cirrus Link MQTT Distributor module to publish directly to Ignition, and use the MQTT Engine module to subscribe to MQTT Sparkplug-B payloads, which Ignition understands.

An efficient publish-subscribe method of communication like MQTT reduces security concerns by eliminating open network ports, and provides a high-performance, two-way communications path for both monitoring and control.

WHAT'S YOUR PROJECT?

These three examples point out some key ways in which an edge I/O product can simplify your IIoT projects. Do you have a simple idea you'd like to realize without the complexity and cost of a typical IIoT project? Take a look at newer I/O products like groov RIO and see if they'll do the job for you. ◆

Opto 22 was started in 1974 by a co-inventor of the solid-state relay (SSR), who discovered a way to make SSRs more reliable. Opto 22 has consistently built products on open standards rather than on proprietary technologies. The company's latest product line, *groov* RIO®, provides compact, autonomous remote I/O that is ideal for communicating field data in IIoT applications. All Opto 22 products are manufactured and supported in the USA. Most solid-state SSRs and I/O modules are guaranteed for life. The company is especially trusted for its continuing policy of providing free product support and free pre-sales engineering assistance. For more information, visit **www.opto22.com**.

Going Beyond Efficiency Standards

Part 2 of 2

See Part 1 www.mptmag.com

By Ben Keiser, Applied Flow Technology

As we discussed in the first part of this series, four years ago, the U.S. Department of Energy (DOE) launched the first Energy Conservation Standard for Clean Water Pumps. In part, this is because pumps, fans, and compressors account for about 60 to 70 percent of total electrical energy usage by domestic manufacturers, so these standards are viewed as a starting point for greatly improving pump efficiency and reducing energy costs.

However, though it is good that there are more efforts now for vendors to provide more efficient and energy compliant pumps, as we discussed last month, this is not just about efficiency. With more focus on improving reliability, not only will this minimize repair costs, increase profits, etc., it will naturally improve pump efficiencies as well. Below, we'll look into how to improve reliability as well as efficiency.

HOW DO YOU IMPROVE RELIABILITY?

Many times, a recommended solution is to incorporate a variable speed drive (VSD) or variable frequency drive (VFD). This can help, but it is more of a band-aid solution. When you see operational problems at the pump, rarely is it due to a faulty pump. Plant maintenance usually ends up fixing issue after issue. But they may not always investigate what is causing the problem in the first place. One example could be a plant wearing through pump seals frequently. After a while, operators may suspect the seals from a certain manufacturer are bad. So, the plant starts switching vendors to find different seals. Most likely, this will only lead to more worn-out seals. If the seal manufacturer asks the plant how they are operating the pumps, most likely it would be found that the seals were never faulty or poor quality in the first place. But it was the pump that killed the seal!

However, what caused the pump to operate at flows away from the best efficiency point (BEP) that would lead to seals wearing out faster? This is where flow analysis software is incredibly beneficial. A system approach with flow analysis is a lot more effective at diagnosing the root cause of the problem than only focusing on the symptom of a problematic component itself.

Here are a few of the many advantages and benefits available when using flow analysis software:

Understand Complex System Interactions Easier

- Multiple load cases
- Seasonal considerations
- Different operating configurations and requirements
- Water hammer and cavitation issues
- Pulsation and resonance problems caused by positive displacement pumps

There are several other key benefits that a flow analysis provides including improved system sizing and scale-up, design feasibility analysis, transient analysis, system troubleshooting, quantify pump/system scaling/fouling/degradation, maintain code compliance, etc.

Overall, lots of money is spent fixing and operating poorly designed systems. The investment in a quality flow analysis software tool will lead to a better system understanding which then leads to better designs and operation. Better designed and operated systems that are well-understood to keep pumps operating as close to BEP as possible will have a major effect on reducing long term costs.

BUILDING A HYDRAULIC MODEL FOR A FLOW ANALYSIS

What information do you need in order to build a hydraulic model for a flow analysis? In general, if there is a hydraulic element in the system that makes an impact on system pressure/flow/temperature, then it should be included in the model. The closer to reality that the system is modeled with as-built system configurations, operating data, valve positions, etc., the more accurate the model results will be. The more accurate the results, the better predictions the model can make when it comes to understanding how various system changes will impact performance.

Here are the basic pieces of information that would be needed for an accurate hydraulic flow model.

- **Fluid Properties**: Densities, viscosities, vapor pressure, etc.
- **Pipes**: Inner diameter, friction model (i.e., Darcy-Weisbach, Hazen-Williams, etc.), length, elevation changes

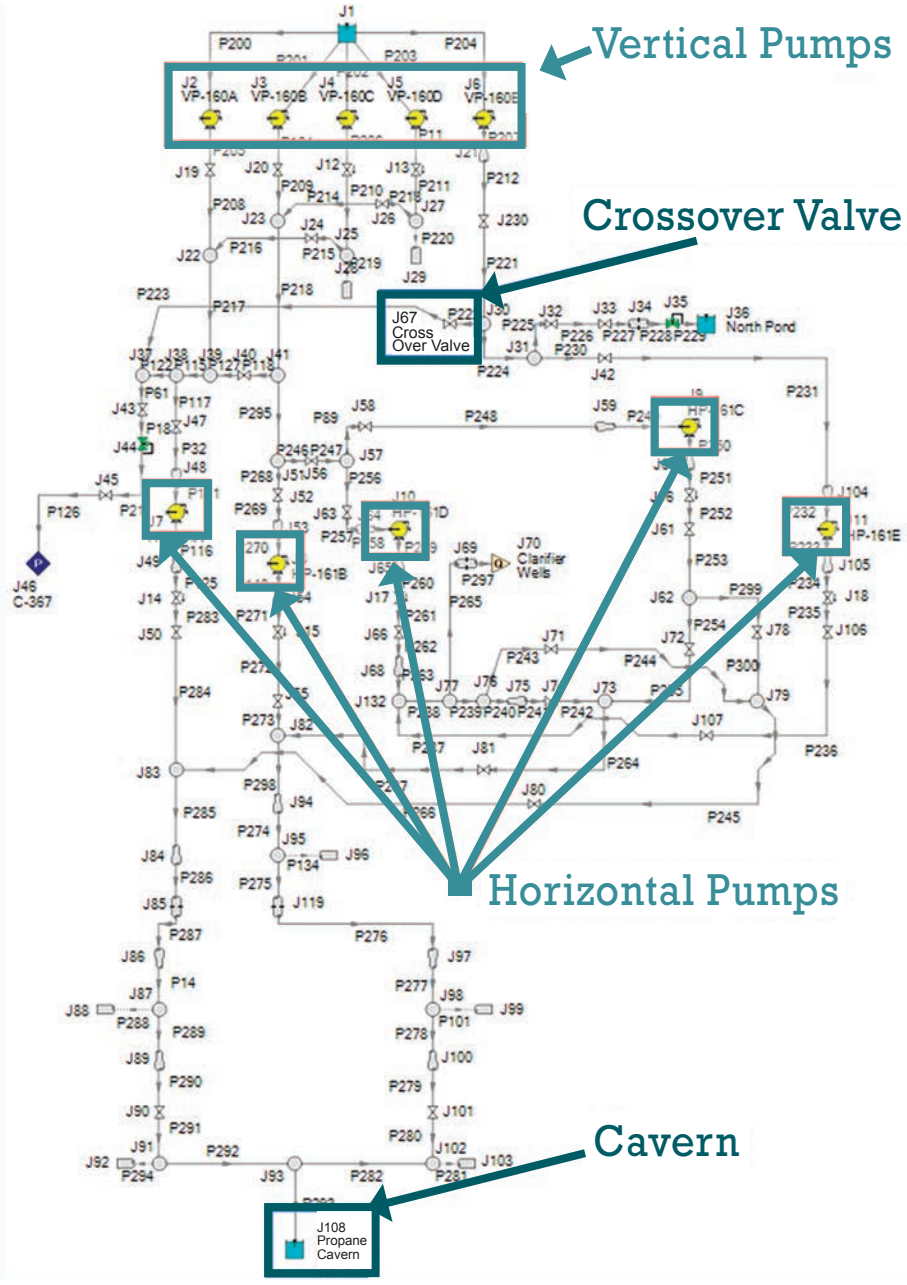


Figure 2: Hydraulic flow model of raw brine injection system. Five vertical pumps operating in parallel competed with each other, causing each of the pumps to operate at 20 to 50 percent of BEP.

- **Tanks**: Liquid level, surface pressure, pipe connection elevation
- **Pumps**: Head curve, efficiency/power curve, NPSH curve
- **Equipment**: Pressure drop versus flow profile
- **Valves**: Cv and open percentage data
- **Fittings**: K factors or equivalent lengths

Let's look at a real-life example of how a system flow analysis had a dramatic impact on improving system reliability and pump efficiency. The hydraulic flow analysis model in figure 2 is for a raw brine injection system that displaced product in a chemical plant's underground cavern storage facility.

In this system, several of the vertical pumps in parallel were completing hydraulically. Ideally, the flow distribution through each of the pumps should be similar, if not, the same. And in best case circumstances, they would each be operating as close to their BEP as possible. However, when

RAW BRINE SYSTEM STUDY VERTICAL PUMP PERFORMANCE				
Test Scenerio	VERTICAL PUMP	FLOW	BEST EFFICIENCY POINT	PERCENT OF BEST EFFICIENCY
	Wireless Field Test Data/Three Pump Performance			
2	VP-160B VP-160C VP-160D	1,964 3,108 1,963	6,800 6,800 6,800	28.88% 45.71% 28.87%
3	VP-160B VP-160C VP-160D	1,585 3,929 1,585	6,800 6,800 6,800	23.31% 57.76% 23.31%
	Wireless Field Test Data/Two Pump Performance			
6	VP-160B VP-160C	3,194 3,578	6,800 6,800	46.97% 52.62%
7	VP-160C VP-160D	3,330 3,098	6,800 6,800	48.97% 45.56%
	Fathom Model Data / J67 Closed / RB Header 300 psi / Two Pump Performance			
6	VP-160B VP-160C	5,150 5,079	6,800 6,800	75.74% 74.69%
7	VP-160C VP-160D	5,056 5,034	6,800 6,800	74.35% 74.03%

Figure 3: Final test results of raw brine injection system. Test 6 and 7 show that operating only two of the five pumps will still provide required flows and the pumps will operate at 75 percent of BEP.

the pumps compete hydraulically, each of the pumps would provide a different flow. Some pumps would dominate and provide more flow than the others. Ultimately, it can cause each of the pumps to operate further away from their BEP.

The pain point for this raw brine injection facility was not high energy costs. They certainly would have had higher energy costs with their pumps operating at low efficiencies. But this was not the problem. This facility dealt with 41 repairs in a five-year period that totaled up to $1.23 million. The MTBF was about fifteen months.

A pump manufacturer was contracted to evaluate pump performance and find ways to improve reliability. After constructing the flow model and calibrating results to measured data, the contractor found that several of the pumps were typically operating between 20 to 50 percent of their BEP. This certainly explains the reliability issues the plant had. Once the model was calibrated, the contractor tested several operating scenarios. This included cases where various combinations of pumps were turned on and off while operating with all valves open, closing off cross-over valves, and maintaining cavern pressures at a certain pressure.

Figure 3 highlights the final results after running over thirty scenarios to determine that only two out of the five vertical pumps needed to operate. This still maintained required system flowrates and dramatically improved reliability where the pumps could operate at 75 percent of the BEP and higher. The simulation discovered better flow paths and pump operation to deliver the same amount of product at required flows and pressures. The simulation improved system reliability and allowed better system recommendations to be made in the future. This is not something that could be accomplished without taking a system approach to a component problem.

CONCLUSION

Ultimately, more attention to pump efficiency is helpful in avoiding wasted energy and reducing energy costs. The new energy conservation standards for clean water pumps will help manufacturers and end users to start purchasing and using more energy-efficient pumps. A deeper focus on reliability and operating pumps as close to the BEP as possible will have a much more dramatic effect on reducing repair and maintenance costs and increasing the MTBF which will decrease downtime and increase profits. And as shown, this effort will naturally improve pump efficiency and reduce energy costs as well. Using a quality flow analysis software tool will streamline the efforts in improving reliability by taking a systems approach to solving operational problems rather than a component by component approach. ◆

Ben Keiser is technical sales consultant at Applied Flow Technology. With a primary focus on developing high quality fluid flow analysis software, AFT has a comprehensive line of products for the analysis and design of piping and ducting systems. For more information, visit **www.aft.com**.

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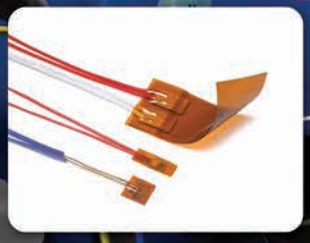

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A Call to Keep Workers Safer When Transferring Flammable and Combustible Liquids

By Nancy Westcott, GoatThroat Pumps

Every day industrial workers transfer potentially hazardous chemicals, such as solvents, acetones, lubricants, cleansers, and acids, from large drums into smaller containers, or into machinery. Traditionally, such potentially flammable or combustible liquids have been tipped and poured. Today such spill-prone, VOC emitting methods are no longer considered acceptable, safe, or compliant—not when a fire or explosion can result.

In particular, younger workers, having seen the resulting physical injuries, chronic respiratory ailments, and even deaths endured by parents, grandparents, and friends want much safer working conditions. Consequently, there is now a call for greater safety and regulatory oversight to protect vulnerable workers and their families as simply and efficiently as possible.

"It can be catastrophic to a company if toxic or highly flammable material is accidentally released at the point of use," says Deborah Grubbe, PE, CEng, founder of Operations and Safety Solutions, a consulting firm specializing in industrial safety.

"When tipping a heavy drum, it is extremely difficult to pour a liquid chemical and maintain control," adds Grubbe. "Companies have to assume that if something can go wrong during chemical transfer, it will, and take appropriate precautions to prevent what could be significant consequences. Because there is no such thing as a small fire in my business."

Although the dangers of transferring flammable and combustible liquids are very real, protecting workers from harm can be relatively straightforward. This includes proper safety training, the use of personal protective equipment (PPE), and the use of engineering controls to prevent dangerous spills.

A LETHAL SITUATION

During a manufacturing process on Nov 20, 2017 at Verla International's cosmetics factory in New Windsor, New York, an employee transferred hexamethyl disiloxane (flash point 21.2 degrees Fahrenheit / -6 degrees Celsius) from a drum into another container and then wiped down the chemical drum. The friction from wiping created static electricity that caused the drum to become engulfed in flames within seconds. The resulting fire and explosions injured more than 125 people and killed one employee.

A video released by the Orange County Executive's Office shows the worker wiping down the chemical tank, "causing static which is an ignition event." "Seconds later, the tank becomes engulfed in flames, with parts of the man's clothing catching on fire as he runs from the explosion," according to the *Poughkeepsie Journal*, a local area newspaper.

Although the man sustained only minor injuries, many at the cosmetics factory were not so lucky. With the potentially lethal consequences from the use of flammable/combustible liquids in so many industrial facilities, it is essential to understand the hazard.

FLAMMABLE AND COMBUSTIBLE LIQUID HAZARDS

In a flammable liquids fire, it is the vapors from the liquid that ignite, not the liquid. Fires and explosions are caused when the perfect combination of fuel and oxygen come in contact with heat or an ignition source. Based on their flash points, that being the lowest temperature at which liquids can form an ignitable mixture in air, flammable liquids are classified as either combustible or flammable.

Flammable liquids (those liquids with a flash point below 100 degrees Fahrenheit, or 37.8 degrees Celsius)

will ignite and burn easily at normal working temperatures where they can easily give off enough vapor to form burnable mixtures with air. As a result, they can be serious sources of a fire hazard. Flammable liquid fires burn very fast and frequently give off a lot of heat and often clouds of thick, black, toxic smoke.

Combustible liquids (those liquids with a flash point above 100 degrees Fahrenheit, or 37.8 degrees Celsius) do not ignite so easily but if raised to temperatures above their flashpoint, they will also release enough vapor to form burnable mixtures with air. Hot combustible liquids can be as serious a fire hazard as flammable liquids.

Both combustible and flammable liquids can easily be ignited by a flame, hot surface, static electricity, or a spark generated by electricity or mechanical work. Highly volatile solvents are even more hazardous because any vapor (VOCs) released can reach ignition sources several feet away. The vapor trail can spread far from the liquid and can settle and collect in low areas like sumps, sewers, pits, trenches, and basements. If ventilation is inadequate and the vapor trail contacts an ignition source, the fire produced can flash back (or travel back) to the liquid. Flashback and fire can happen even if the liquid giving off the vapor and the ignition source are hundreds of feet or even several floors apart.

The most obvious harm would be the danger of a fire or explosion. "If the vapor is ignited, the fire can quickly reach the bulk liquid. A flammable vapor and air mixture with a specific concentration can explode violently," according to information on the topic posted online by the Division of Research Safety by the University of Illinois at Urbana-Champaign.

Consequently, minimizing the dangers of handling flammable and combustible liquid chemicals requires proper training and equipment.

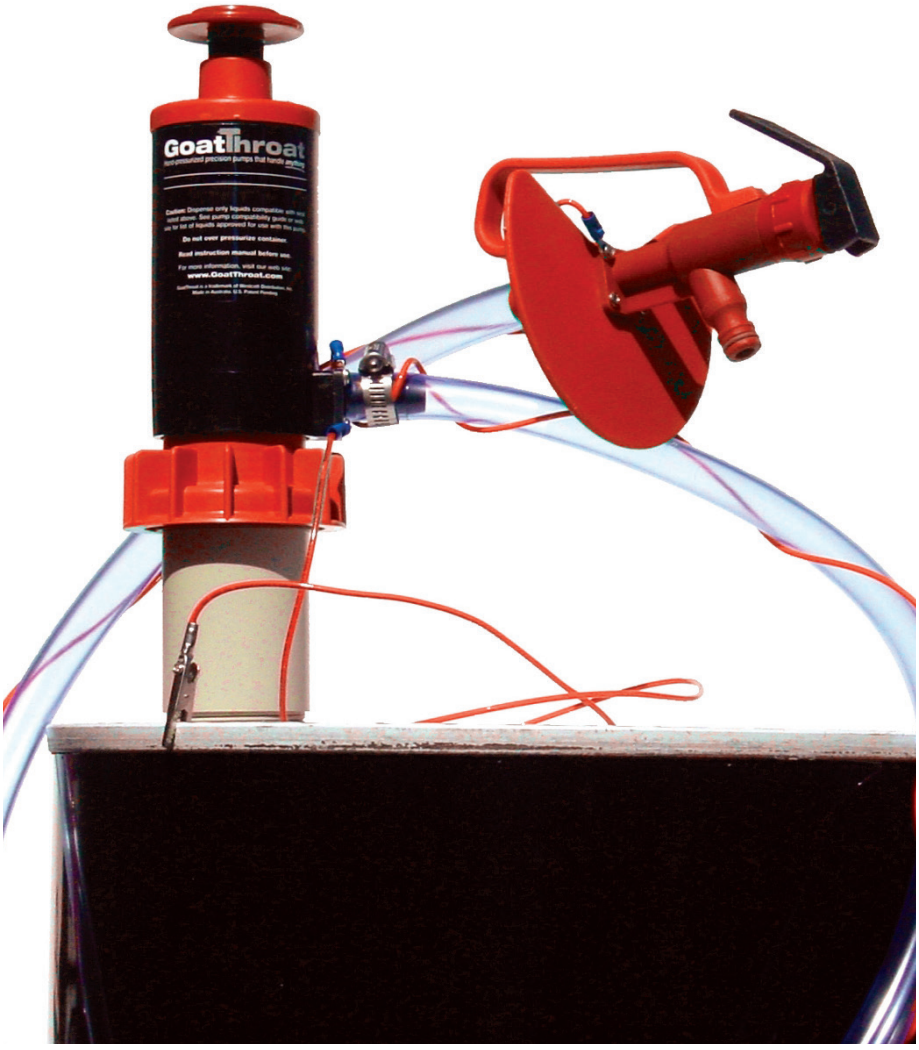
SAFE HANDLING

Without proper ventilation, the handling of flammable substances has a good chance to create an explosive atmosphere. It is essential to work only in well-ventilated areas or have a local ventilation system that can sufficiently remove any flammable vapors to prevent an explosion risk.

Because two of the three primary elements for a fire or explosion usually exist in the atmosphere inside a vessel containing a flammable liquid (fuel and an oxidant, usually oxygen), it is also critical to eliminate external ignition sources when handling such liquids. Sources of ignition can include static discharge, open flames, frictional heat, radiant heat, lightning, smoking, cutting, welding, and electrical/mechanical sparks.

STATIC ELECTRICITY GROUNDING

When transferring flammable liquids from large containers (greater than 4 liters), to a smaller container, the



flow of the liquid can create static electricity which could result in a spark. Static electricity build-up is possible whether using a pump or simply pouring the liquid. If the bulk container and receiving vessel are both metal, it is important to bond the two by firmly attaching a metal bonding strap or wire to both containers as well as to ground, which can help to safely direct the static charge to ground.

When transferring Class 1, 2, or 3 flammable liquids with a flashpoint below 100 degrees Fahrenheit (37.8 degrees Celsius), OSHA mandates that the containers must be grounded or bonded to prevent electrostatic discharge that could act as an ignition source. NFPA 30 Section 18.4.2.2 also requires a means to prevent static electricity during transfer/dispensing operations.

ENGINEERING CONTROLS

Beyond PPE and proper ventilation, it is absolutely critical for workers to use regulatory compliant, engineered controls to safely transfer flammable and combustible liquids at the jobsite. Most states and municipalities across the U.S. have adopted NFPA® 30 Flammable and Combustible Liquids Code and OSHA 29 CFR 1910.106, which address the handling, storage, and use of flammable liquids. With NFPA 30, material is classified as a Class 1 liquid (flammable) and Class 2 and 3 (combustible).

The codes account for safeguards to eliminate spills and leakage of Class 1, 2, and 3 liquids in the workplace. This begins with requirements surrounding the integrity of the container, but also extends to the pumps used to safely dispense flammable and combustible liquids.

POINT OF USE CONTAINMENT

According to Gary Marcus of Justrite Manufacturing in an article posted on EHS Today's web site, "Drums stored vertically are fitted with pumps instead of faucets for dispensing. Use of a pump is generally considered safer and more accurate. Some local codes require pumps for all drums containing flammable liquids.

A fast-growing approach to flammable liquids storage is to keep as much liquid as possible close to the point of use because it is efficient and saves time. Workers can minimize their exposure to potential ignition sources if they replenish their solvent supply from a drum near their workstations, rather than from the solvent room a quarter-mile away. OSHA permits up to 60 gallons of Class I or Class II liquids and up to 120 gallons of Class III liquids to be stored in safety cabinets close to workstations."

In most workplaces, supervisors and facility managers have been recommending rotary and hand suction pumps to transfer flammable liquids for decades. However, they are increasingly turning to sealed pump systems designed for class 1 and 2 flammable liquids, which are a more effective engineering control tool for protecting employees and operations.

Conventional piston and rotary hand pumps have some inherent vulnerabilities. These pumps are open systems that require one of the bungs holes to be open to the outside atmosphere. The pumps dispense liquids from the containers using suction, so it requires that a bung be open to allow air to enter the containers to replace the liquid removed. Without this opening, either the container will collapse or the liquid will stop coming out.

Typically, there is also a small gap between the container opening (bung) and the pump dip tube that allows air to enter. This opening also allows some vapor release into the atmosphere when the pumps are unused and connected to the container. The gaps may allow an explosion to occur at a temperature near the flashpoint. This can cause a high-velocity flame jet to vent near the bung, which could injure personnel near the container.

In addition, using the piston and rotary pumps to remove liquid from containers can allow some spillage since there is no flow control device. If a seal fails, liquid can also be sprayed from the pump and onto the user and the floor.

FINDING THE SOLUTION

As a solution, the industry has developed sealed pump dispensing systems that enhances safety by eliminating spills and enables spill-free, environmentally safe transfer that prevent vapors from escaping the container.

These systems are made of groundable plastic and come complete with bonding and grounding wires. The spring actuation tap handle can be immediately closed to stop liquid flowing preventing any spills. The design of this sealed pump system also prevents liquid vapors from exiting the container when the pump is unused. These characteristics significantly reduce the chance of an ignition event. The combination of all these features ensure the pump meets both NFPA30-2015.18.4.4 standards and NFPA 77.

Now that the hazards of transferring flammable and combustible liquids are clearly recognized, proactive industrial facilities are beginning to protect their workers and their families by implementing safety training, PPE use, and sealed, grounded pumps. This will help their operations stay compliant, mitigate insurance risks while minimizing the risk of fire and explosion due to spills, vapors, and static shock. ◆

Nancy Westcott is the president of GoatThroat Pumps, a Milford, Connecticut, based manufacturer of industrial safety pumps and engineered chemical transfer solutions that keep companies in regulatory compliance. The company has developed a sealed, hand-operated or pneumatic-operated pump system, the SCP Pump Series, that complies with NFPA30.18.4.4. so it can be used to safely dispense flammable and combustible liquids. For more information, visit **www.goatthroat.com**.

Reducing Downtime with Better Grounding

Pumping systems account for 25 percent of the energy consumed by electric motors in the U.S.

By Matt Laufik, Electro Static Technology

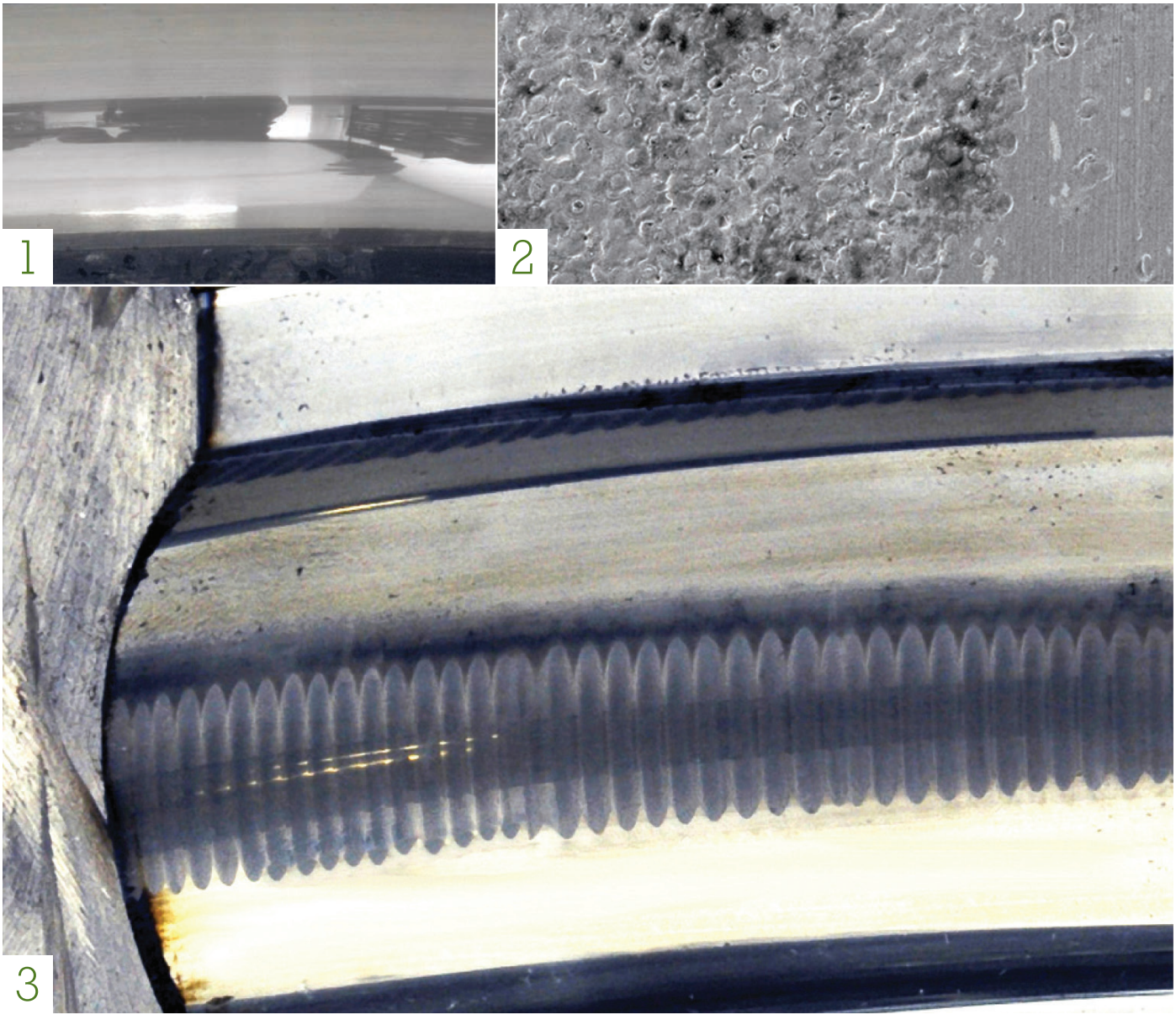


Figure 1: A new bearing race wall has a mirror-smooth surface to minimize friction. Figure 2: Pitting of a bearing race wall (magnified) is the result of electrical arcing as shaft voltage discharges through the bearings, blasting small craters in metal surfaces. Figure 3: In fluting, concentrated pitting at regular intervals creates washboard-like ridges. This causes noise and vibration. By the time this is noticeable, bearing failure is imminent.

Pumps and pumping systems account for 25 percent of the energy consumed by electric motors in the United States. In pumping intensive industries, this number is over 50 percent. In fact, providing clean drinking water to homes and businesses alone accounts for almost 12.5 percent of total U.S. pump energy consumption.

VFDS CAN SAVE 30 PERCENT OR MORE IN ENERGY COSTS

To improve the efficiency of pumping systems and reduce their electricity consumption, a growing number of pump users are turning to variable frequency drives (VFDs), also known as inverters or adjustable speed drives. Most pumping systems are designed for maximum service conditions, but running them at partial load can save a considerable amount of energy. By precisely matching electric motor speed to pumping requirements, VFDs can reduce energy costs by as much as 30 percent.

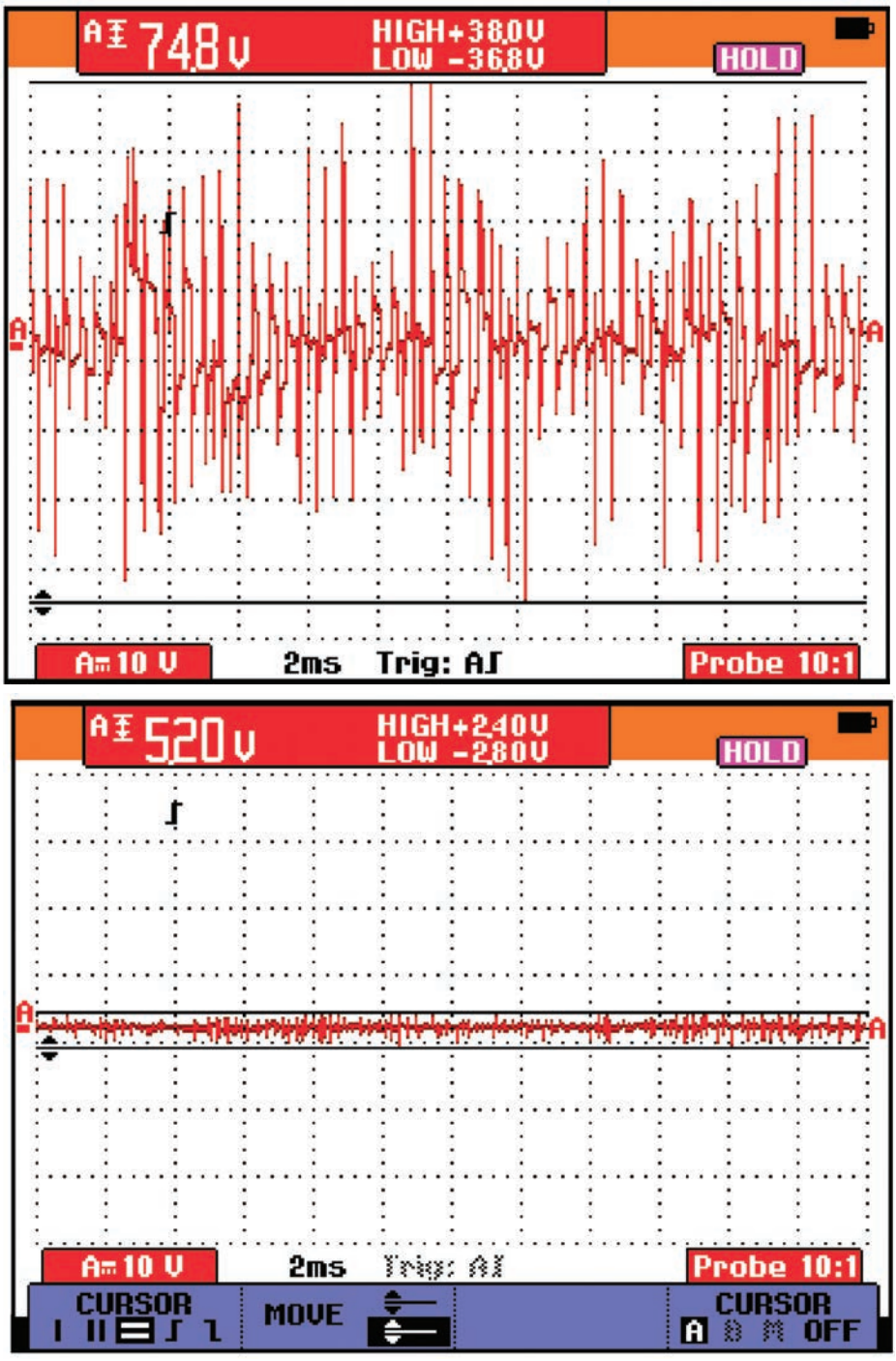
BUT VFDS CAN DAMAGE MOTOR BEARINGS

VFDs work by first rectifying 50/60 Hz AC power to DC, and then inverting the DC back to three phase AC at the desired frequency. But these drives' output is not a smooth sine wave like line voltage. Rather, it is a series of pulses that approximates a sine wave. Because the voltage is pulsed, each phase's voltage is either fully on or fully off. Switching between the on and off states is extremely rapid, so the voltage has a very short rise time.

These voltage pulses can cause problems in the motor. Firstly, the high peak voltages and fast rise times cause cumulative degradation of insulation and bearings, coil varnish, etc. This problem is made worse by the phenomenon of reflected waves in the VFD cable, which can lead to even higher voltages at the motor.

Most new motors are protected against winding damage with Class F or H insulation, so this is less of a problem now than it was twenty years ago. But VFDs can also cause electrical bearing damage.

Figure 4: AEGIS Shaft Grounding Rings are available for any size of motor. They can be factory-installed inside or outside the motor, or retrofitted.



Left: Figure 5: Shaft voltage readings from a VFD-fed motor without shaft grounding (top), and with an AEGIS Shaft Grounding Ring (bottom).

Because each of the three phases of VFD output is always either on or off, the three phase voltages do not sum to zero (as three-phase line voltage does). The total voltage across the three phases, called the common mode voltage, couples to the motor rotor and capacitively induces a shaft voltage.

FOLLOW THE PATH OF LEAST RESISTANCE

This shaft voltage "wants" to discharge to ground. Usually, the lowest-resistance path from the shaft to ground is through the motor bearings, so shaft voltage tends to discharge by arcing through the bearings. This causes pitting (tiny craters in bearing surfaces), frosting (widespread pitting), fluting (washboard-like ridges in the bearing race), and eventual bearing failure. The rate of damage varies, but failure can occur in just a few months.

Electrical damage is believed to be the most common cause of bearing failure in VFD-controlled AC motors. Repair or replacement of failed motor bearings is a costly hassle. But these repair costs pale in comparison to the cost of unplanned downtime, which can easily wipe out any energy savings that VFDs offer.

To prevent unplanned downtime and the losses it entails, it is necessary to protect against electrical bearing damage.

PROTECTING MOTOR BEARINGS FROM ELECTRICAL DAMAGE…

AEGIS® Shaft Grounding Rings provide a very low-resistance path from the motor shaft to ground. By offering a "path of least resistance," a grounding ring channels charge on the shaft away from the bearings and safely to ground, ensuring the reliable, long-term operation of VFD-driven pumping systems. As proven in millions of installations worldwide, AEGIS rings provide unmatched bearing protection for the full L-10 life of the bearings.

AEGIS Shaft Grounding Rings are the only form of electrical bearing protection that comes with a two-year extended warranty against bearing failure from fluting damage.

AS WELL AS ATTACHED EQUIPMENT

One approach to electrical bearing protection is to use insulated motor bearings. But this does not remove the shaft voltage; the charge on the shaft simply seeks another path to ground—typically through a pump, gearbox, tachometer, encoder, etc., which consequently can end up with bearing damage of its own. By bleeding the voltage off the motor shaft, AEGIS

rings protect attached equipment as well as the motor's bearings.

When installed according to AEGIS Best Practices, AEGIS Shaft Grounding Rings protect pump motors and the pumps themselves from VFD-caused bearing damage and costly downtime. These Best Practices are detailed in the AEGIS Bearing Protection Handbook, available at **est-aegis.com/pump**.

EASIEST WAY TO PROTECT A MOTOR

The easiest way to protect a motor against electrical bearing damage is to buy a new motor with an AEGIS ring factory installed. Several motor manufacturers now offer AEGIS Shaft Grounding Rings installed as standard or optional features on certain models. These include:

- ABB Baldor Super-E C-Face Motors with -G suffix (standard).
- NIDEC U.S. Motors CORRO-DUTY® Vertical HOLLOSHAFT® and World® Inverter Duty Motors (standard).
- WEG Electric Close Coupled Pump Motors (standard some lines).
- Regal Beloit Marathon XRI Motors (standard in several lines, including severe duty, IEEE-841, and explosion proof).
- TECO-Westinghouse TEFC Rolled Steel, ODP Rolled Steel and Cast Iron, and MAX-PE™ Motors. ◆

Matt Laufik is global sales manager for AEGIS, a leading brand in bearing protection. Electro Static Technology, the world leader in passive static control solutions, solves industry challenges posed by static charges in many of today's sophisticated machines. For more information, visit **www.est-aegis.com**. .

Reinventing Primer to Prevent Chemical Facility Corrosion

Advanced primer converts rust into a protective layer and can be applied by any method, without the need to sandblast first

By Martin Lawrence, NanoRustX LLC

For chemical plants, chemical tank farms, and refineries, atmospheric corrosion of steel is a continual concern that can require re-priming and re-painting every few years to prevent safety issues and the premature replacement of costly infrastructure.

Industrial primers represent a critical foundation for paints and coatings in harsh environments. However, they have certain limitations and have historically been unable to effectively deal with the eventual formation and future recurrence of rust. Traditional primers only encapsulate rust until the paint/primer is scratched, chipped, or breached and moisture and oxygen migrate under the film, allowing the corrosion to spread.

As a result, facility maintenance personnel or contracted coating applicators must repeatedly utilize costly, time-consuming and environmentally hazardous surface preparation methods such as sandblasting to prepare surfaces to be primed and repainted. However, not all environments can withstand the impact of sandblasting, which can damage critical surfaces and may be impractical for reaching hard-to-access areas such as cracks and crevices. Sandblasting is also expensive and time-consuming, and even poses its own safety risks to applicators and the environment.

Now, however, more advanced primers have been formulated that set a higher performance bar in corrosive environments. These reactive primers go beyond encapsulating rust to instead convert it to a protective material (iron phosphate) to minimize the risk of further corrosion. The chemical bond provides superior adhesion, high corrosion protection, and also eliminates under-film corrosion.

The rust conversion formulation also differs from prior technologies by using a non-toxic, ultra-low VOC water-based acrylic polymer solution that can be applied with minimal surface preparation and without the need for sandblasting of steel substrates.

NanoPrime reacts with iron and iron oxide (rust) to form iron phosphate, creating a Nano bond with both metallic and painted surfaces.

PRIMER PITFALLS ALLOW CORROSION

One of the main reasons that petrochemical facilities are so susceptible to corrosion is that traditional primers have serious deficiencies in this area.

"We have found that the typical primer and topcoat needs to be replaced in a harsh chemical facility environment every couple of years," says Dave Marzano,

The chemical bond provides superior adhesion, high corrosion protection, and also eliminates under-film corrosion.

owner of Maxim Contracting, a Newark, New Jersey-based industrial and commercial contractor. "There are not many products out there that will stop the rust."

A common failure of primers is not sufficiently protecting against under-film corrosion. A primer must first form an effective chemical bond to the metal substrate. Without this, rust promoters like oxygen and humidity will creep underneath the primer causing further corrosion. Most primers on the market go only as far as encapsulating the iron oxide, which is not 100 perfect effective in preventing further rust from occurring.

Another reason that chemical facilities are prone to corrosion when utilizing typical primers is that a high level of surface preparation is required because most rust primers on the market are sensitive to chlorides.

Even a minute amount of chloride on the steel can cause coating system failure. This is why leading coating manufacturers demand extreme levels of surface cleaning (sandblasting) and removal of chlorides to a level of 5 micrograms per meters squared, which is nearly impossible to achieve. Even when sandblasting is used for surface preparation, flash rusting will still occur.

In response, the search for more enduring corrosion protection at petrochemical facilities has involved the development of long-lasting primers that correct the deficiencies of traditional methods.

LASTING CORROSION PROTECTION

NanoRustX (NRX) NanoPrime, for example, works by chemically reacting with iron and iron oxide (rust) to form iron phosphate and creates a Nano bond with both metallic and painted surfaces. The chemically bonded layer is insoluble and extremely corrosion resistant. This "bonding" process also provides superior adhesion and flexibility and stops under-film corrosion that occurs when conventional coatings are damaged.

The non-toxic, ultra-low VOC primer contains nano-polymers for added strength and durability and has been tested to successfully coat surfaces from rust-free to up to 700 microns of rust. The elasticity of the advanced primer makes it very durable in temperature variations from -900 to 400 degrees Fahrenheit (-67 to 200 degrees Celsius).

Because the advanced primer actually chemically reacts with galvanized steel surface, no surface preparation is required other than a water wash. The water-based acrylic polymer is not sensitive to chlorides or rust and can actually neutralize them. Unlike initial generations of rust converting

Tank before coating.

With NRX NanoPrime, less surface preparation is required compared to other primers.

primers, the primer performs equally well on clean, partially corroded, and heavily rusted surfaces. Typically, a power wash (240 bar/3500 psi) is all that is needed before applying to steel (clean or corroded), galvanized steel, or aluminum in order to remove loose paint, dirt, and grease. The primer can be applied to a corroded surface by hand brush, roller, or airless spray gun on the substrate. After the application of the primer, a single coat of a low VOC top coat will complete the job.

APPLYING NRX NANOPRIME

When a chemical plant in the Newark, New Jersey, area had a number of roof exhausts with severe corrosion, Marzano, who had sought a lasting corrosion solution for his customers, applied a coat of NRX NanoPrime with no topcoat to a 50-foot high roof stack as a trial.

"The roof exhausts were so rusty the chemical company was ready to replace them, which would have cost about $7,000 to $9,000," says Marzano. "However, about five

NanoPrime salt spray test panel after 7,775 hours.

years later there still is no visible rust on the roof exhausts. The success of the trial demonstrated the primer's effectiveness against chemical plant corrosion, so we have applied it many times since then on everything from roofs, exhaust fans, and exhaust stacks to tanks for carbon monoxide and sulphuric acid."

In one of Marzano's recent applications, his Maxim Contracting work crew coated four outdoor and three indoor chemical tanks, ranging from 1,500 to 10,000 gallons, including a liquid nitrogen tank and a 2,000-gallon CO_2 tank.

Using a spackle knife and palm sander to remove existing loose flaking paint and rust, and a water wash with nearby hose, the surfaces were readied for applying the primer. The system included two coatings of primer applied by roller, followed by one application of the customer supplied water-based, industrial epoxy topcoat.

"With NRX NanoPrime, less surface preparation is required compared to other primers," says Marzano. "Also, it can dry in thirty minutes to touch and takes about two hours to apply a second coat, depending on temperature, which is much faster than typical primer and paint. So, we finished the job in a few days rather than a week, which helped to reduce potential downtime for the facility."

"But the bottom line is that the primer prevents corrosion and really lasts," concludes Marzano. ◆

Martin Lawrence is managing director of New Jersey-based NanoRustX LLC, a supplier of advanced primer technologies. For more information, call 973.751.2200, email sales@nanorustx.com, or visit **www.nanorustx.com**.

Featured Product

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The SurgeWave Defender™ is simple to set up and easy to use. There are two inputs to capture pressure, flow, level, etc. If a pressure transient occurs, the unit will store the high-speed data that you need to understand what is happening in your system. If nothing of interest is detected, it stores minimal data needed to observe overall trends. Transient thresholds and sensitivity can be adjusted remotely, and the system will generate automatic alerts when events are detected.

Liquid level in your surge vessel or pulsation dampener can be monitored using a differential pressure transducer. You can remotely monitor the performance of the vessel and view overall trends. All data captured is GPS time stamped and stored on a cloud server which can hold years of data, so you never have to worry about storage. The time stamp allows you to precisely compare data to other systems or devices. You can use a backup battery to capture pump trips and events during power outages. The SurgeWave Defender™ also features an external cellular antenna which can be extended for installations below grade.

When considering protection and recording equipment for your system, keep in mind how fast pressure can change and fluctuate. Pipe breaks are most often associated with pressure surges or fatigue. Eliminate expensive damage and repairs with 24/7 constant monitoring. The SurgeWave Defender™ can help detect leaks, ruptures, faulty actuators, insufficient air valves, and more. You do not have to choose between too much data and not enough data, and the easy to use interface takes the stress out of accessing your data anytime from anywhere.

To take advantage of the many benefits the new Blacoh SurgeWave Defender™ has to offer email surgesales@blacoh.com or visit www.blacohsurge.com.

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Oxford YASA Motors, a company created to commercialize the revolutionary YASA motor developed by Oxford University's Energy and Power Group, is finding that a TorqSense non-contact speed and torque sensor from Sensor Technology is an invaluable aid in the refinement of its world-leading motor designs. Used in a test rig to evaluate prototype motors, the sensor provides accurate and dependable real time information in a readily accessible format. The YASA topology is based around a series of magnetically separated segments that form the stator of the machine. For more information, visit www.sensors.co.uk.

PETASENSE

Vibration Mote Model 3

Petasense's Vibration Mote Model 3 (VM3)'s smart sensor enables variable speed equipment monitoring. VM3 is a revolutionary sensor that combines speed detection with triaxial vibration and temperature, enabling continuous monitoring of variable speed assets. Variable speed, intermittently operating, and spared assets have traditionally been difficult to monitor with predictive maintenance programs since the equipment could be operating under different conditions when measurements are taken. With VM3, users can trend readings under consistent operating conditions. For more information, visit www.petasense.com.

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Reed L4N1XP Thru-Bolt™ ratchet wrench keeps the dirt out. New XP model features sealed ratchets for best performance and extra protection for jobsite conditions. The four sockets in a dog bone configuration are designed to stay on the handle, meaning no loose sockets. This wrench replaces the need for multiple wrenches and sockets—carry one wrench for all your jobs. This is the ideal wrench for water, sewer, and gas installations and maintenance. The L4N1XP is made in USA. For more information, visit www.reedmfgco.com.

LEYBOLD

TURBOVAC i/iX Family of Pumps

In June 2020 the vacuum specialist Leybold expanded its TURBOVAC i/iX series—90, 250, 350, and 450—by the sizes 850 i/iX and 950 i/iX to six models. The two new turbomolecular pump variants are characterized by extended, trouble-free operation, longer system life, and lower operating costs. They are used in many applications from research and development and analytics to industrial. In other words, especially where a clean and stable high—and ultra-high vacuum is required—such as in coating, heat treatment, analysis, thin-film research, and helium recovery. For more informaiton, visit www.leybold.com.

What Do the EPA's New PFAS Guidelines Mean for You?

The AWWA lays out four guiding principles for the regulatory future

Chris Moody

The American Water Works Association is the largest organization of water supply professionals in the world and its members represent the full spectrum of the water community, public water and wastewater systems. environmental advocates, scientists and others concerned for effective management of the world's most important resource. On a recent episode of MPT's podcast, The Efficiency Point, Chris Moody from AWWA's government affairs office joined us to discuss the impact of the EPA's new guidelines on PFAS regulations and the organization's current efforts advocating for clean and potable water throughout the country.

MPT: Would you mind providing a brief history of the EPA's approach to PFAS regulation?

Chris Moody: It's helpful to think about where things are starting at with PFAS. It represents a class of thousands of different chemicals. All are perfluorinated alcohol compounds, the chemical makeup of these gives them really unique properties that they first were used for the Manhattan Project and now they're used for everyday things like water repellent for jackets. So they're really ubiquitously used throughout the country, and the world, really.

The EPA's history on regulating PFAS began in the mid 2000s. With both the regulatory and voluntary efforts to reduce use by industry of certain PFAS. … Just last year, they released the PFAS action plan, which is really their way of putting out the detailed plans for multi-barrier approach to PFAS. It involves research, risk communication, contamination—addressing how to clean up a lot of things.

Since that plan was released, the agency has focused on developing different analytical methods and most recently, getting to more than the hot topic of the day, the proposed regulatory determinations for two particular PFAS and drinking water.

MPT: What are the four guiding principles that AWWA has put out with relation to PFAS regulation?

Chris Moody: The four guiding principles really boil down to a commitment to public health protection. That's our main goal as an organization at the end of the day. And then our second one is a fidelity to the scientific process—ensuring that we have any drinking water standards that do get promulgated are actually the most effective they can be, and they're based on science. Next, an investment in research so that we can support that process and ensure that we can have effective protection of source water. That means making sure we're not letting the chemicals just blatantly get put into the environment and then pushed off to the drinking water.

MPT: If I'm someone working on the forefront of facing this issue, where should I turn to get the best information?

Chris Moody: There's lots of different resources! Our organization has people who maintain different fact sheets and we've been tracking different state-to-state activities. … We have a whole webpage dedicated to PFAS. And a lot of those fact sheets are really good, high quality. ◆

To listen to an extended version of this interview, be sure to subscribe to MPT's podcast, The Efficiency Point.

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