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#### **A NOTE ON THIS ISSUE:**

Welcome to the February issue of MPT! We start out with a success story revealing how the Weir Minerals team provided a Multiflo mega barge comprising of six floating pontoon modules for a massive dewatering application (pg. 12). Weir's Raymond Buchanan explains how his company achieved the goal of 2.3 million gallons per hour in our Case Studies section.

With any waterworks device that will be buried in the ground—sometimes for decades proper maintenance is essential to ensure it

performs as needed and fulfills its expected life. But unlike many of these devices, a fire hydrant that does not work when required can have grave consequences. Patrick Nein and Alexander Bailey of Mueller Water Products emphasize that, when it comes to safety, there are no shortcuts, in "Best Practices for Hydrant Maintenance" (pg. 20).

Though the previous year presented challenges for several industries, many manufacturers navigated these troubled waters to bring new products to market. For example, Tsurumi America brought its new line of explosion-proof pumps, the Avant series, to North America for the first time. Glenn Wieczorek, managing director at Tsurumi, fills in the details in this issue (pg. 36)—enjoy!

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#### INDUSTRY NEWS



## ANUE WATER NAMES CHANNEL PARTNER FOR PENNSYLVANIA AND NEW JERSEY

Anue Water Technologies has named Kershner Environmental Technologies as the exclusive new channel partner for the sales and distribution of Anue's ecofriendly product line in Eastern and Central Pennsylvania, as well as Central and Southern New Jersey.

According to Anue Water's Greg Bock, "We are happy and excited to have Kershner Environmental Technologies as our exclusive channel partner throughout this large and important region. Kershner Environmental has an excellent history of leadership in the wastewater treatment industry, a truly great team of process technology experts and a high-level of energy and enthusiasm for solving customer problems."

Rob Kershner, president of Kershner Environmental, adds, "Taking on Anue Water's clean-tech product line is an important milestone in our history of providing solutions to the municipal, industrial, and process water industry. Partnering with Anue Water Technologies enables us to offer clean oxygen/ozone injection systems that pay for themselves. ... Anue's FOG busting Enviroprep wellwashers and odor eliminating Geomembrane Covers with embedded carbon-filters will also be very popular."

#### LUFKIN APPOINTS SAEID RAHIMIAN AS CEO

Lufkin announces the appointment of Saeid Rahimian as its new chief executive officer. According to a company spokesperson, Rahimian possesses a demonstrated track record of success in over thirty years in the oil and gas industry. In his most recent role as the CEO of Aereon, a global provider of vapor recovery systems, custom flares, and low emission, engineered combustors, Rahimian led a successful merger of Aereon with Cimarron Energy.

Prior to Aereon, Rahimian spent nearly four years as the CEO of Gardner Denver Energy Group, where he led four divisions with 1,800 employees and manufacturing and service facilities on four continents. Under Rahimian's leadership, the business achieved exceptional growth and profitability and completed two highlyaccretive strategic acquisitions.

Rahimian began his career with Robbins and Myers, where he spent thirty years with increasing responsibilities, leading various segments including the largest group, Robbins and Myers Energy Systems. During

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The Pump People.

his tenure at Robbins and Myers, Rahimian led several key acquisitions and guided their successful integration. Rahimian was instrumental in the \$2.5 billion merger of Robbins and Myers with National Oilwell Varco in 2013.

#### BCCK HOLDING COMPANY CONTRACTS FOR HIGH BTU LANDFILL GAS TO ENERGY PLANT

BCCK Holding Company has signed an agreement with Archaea Energy to provide a 13,700 SCFM Style IV NiTech Nitrogen Rejection Unit (NRU) to the world's largest high BTU landfill gas to energy plant in Pennsylvania.

BCCK's patented NiTech technology performs a key role in transforming landfill gas into nearly 100 percent pure renewable natural gas. BCCK's NRUs, which are engineered in-house and fabricated at BCCK's fabrication facility, deliver less footprint, less compression requirements in terms of horsepower, at reduced CAPEX to alternative solutions on the market.

There have been four major revisions to the NiTech process design over the past three decades. Style IV features a new, modular skidded design that allows greater flexibility with respect to compositional changes or flow capacity changes than ever before. With lower required horsepower compression and higher recovery, NiTech is a simple, flexible, and efficient NRU.

John Peterson, senior vice president of business development, BCCK, adds, "BCCK is continuing to further

expand our presence in the renewable gas industry and our patented technology is contributing to the reduction of greenhouse gas emissions."

#### GTI APPOINTS ERIC HUSTON TO KEY LEADERSHIP ROLES

GTI Spindle Technology announces the appointment of Eric Huston to its leadership team as a vice president. Huston also serves as chief operating officer of the GTI Predictive Technology subsidiary.

"We are fortunate to have Eric join us to help both GTI Spindle and Predictive brands evolve. Eric's track record of developing leading-edge solutions while remaining passionate about customer success is paramount to helping us achieve our strategic goals," says Tom Hoenig, president.

At GTI Spindle, Huston will drive the development and launch of subscription-based business solutions for machine tool spindle repair enabled through digital transformation. At GTI Predictive, Huston provides leadership and focus encompassing the whole value chain with emphasis on customer excellence, sales, marketing, business, and product development.

"I am excited to join the leadership team of GTI Spindle Technology as we embark on the development of new go-tomarket approaches for machine tool spindle repair business through implementation of servitization, digitalization, and outcome-based business models," states Huston.

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Earlier in his career, Huston gained extensive experience in industrial aftermarket services and digital transformation in both domestic and international markets.

#### APPLIED FLOW TECHNOLOGY NAMES NEW CHANNEL PARTNER IN CANADA

On December 14, 2020, CodeCAD was acquired by Hexagon. Consequently, as of January 13, 2021, Patrick Tremblay and Flumen have taken over CodeCAD's role as the AFT representative for Canada. Tremblay is a familiar face at Applied Flow Technology. He previously worked at CodeCAD where he sold and supported customers on AFT software for the past seven years.

Trey Walters, AFT founder and president, says, "This was a natural step for both AFT and Flumen and we are extremely happy to know that AFT customers in Canada will receive continuity and the same excellent service from Patrick, just under a new name."

In total, Tremblay brings more than fourteen years of experience in engineering acquired in the fields of R&D, consulting, construction, and sales that has helped him grow as a skilled engineer with a broad knowledge of multiple engineering disciplines and industries.

Flumen dedicates itself to supplying Canadian customers with state-of-the-art engineering software. As the AFT channel partner for Canada, Flumen offers a broad range of fluid dynamic simulation products.



#### WATEREUSE ASSOCIATION APPLAUDS NEW LEADER OF EPA'S OFFICE OF WATER

The WateReuse Association applauds the appointment of Radhika Fox as principal deputy assistant administrator for the U.S. Environmental Protection Agency's Office of Water.

Radhika brings more than twenty years of experience in developing policies, programs and issue-based advocacy campaigns on the most salient water issues facing the nation.

Prior to her appointment at EPA, Radhika Fox was the Chief Executive Officer of the U.S. Water Alliance, a national nonprofit organization advancing policies and programs that build a sustainable water future for all.

"Under Radhika's leadership, the U.S. Water Alliance was an important stakeholder and partner for WateReuse. I'm excited for Radhika personally, and wish her all the best in this new post," adds WateReuse Association President Gilbert Trejo, who is also chief technical officer for El Paso Water.

Fox previously served as director of policy and government affairs for the San Francisco Public Utilities Commission and as the federal policy director at PolicyLink.





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# Mega Barge Answers the Call

Even on the go, Multiflo pumps move millions of gallons of water per hour

MULTIFLO

By Raymond Buchanan, Weir

The CBMM, or Companhia Brasileira de Metalurgia e Mineração, is the global leader in the production and commercialization of Niobium products. CBMM has more than 400 customers, in more than forty countries. Headquartered in Brazil, with offices and subsidiaries in China, the Netherlands, Singapore, Switzerland, and the United States, the company supplies cutting-edge products and technology to the infrastructure, mobility, aerospace, and energy sectors.

Founded in 1955, in Araxá, Minas Gerais, Brazil, CBMM has a technology program that expands Niobium applications and contributes to the growth and diversification of this market. The reserves of the Araxá mines are measured and quantified for more than 100 years of operation, along the lines of current consumption.

#### THE CHALLENGE

As part of CBMM's production expansion plan they needed to install a new tailings dam on site, which was located inside a canyon. As a trusted partner, Weir Minerals was invited to design a water solution collection and transfer system capable of extracting 2.3 million gallons of water per hour. The complete solution needed to include 656-foot-long walkaways, discharge pipelines, electrical control system, mooring and anchoring system, and all safety requirements.

This pumping solution was essential to the customer in order to ensure the water level in the dam was kept to a minimum, thus increasing the dam's wear-life, and avoiding risks as liquefaction, collapses, or earth contamination. The recovered water is used in the process and minimize the need for "fresh" make-up from other water source.

In addition to the large scale of the project, the water level in the dam was going to rise on a frequent basis.

This required the pump operating conditions be automated to accommodate

the changing discharge head requirements. Subsequently Weir Minerals Brazil designed and supplied an electrical control system that would a utomating adjust for the changing discharge head conditions.

Another critical component was to develop a longterm flexible, custom mooring and anchoring system to accommodate the floating pumping system.

#### THE SOLUTION

The Weir Minerals team provided a Weir Multiflo® mega barge water reclaim solution that included two barge clusters comprising of six floating pontoon modules each. Each of the pontoon modules were fitted with a single Hero HG 250G dewatering pump installed on an angle to allow for self-priming.

To achieve the goal of 2.3 million gallons per hour, the final pump solution was based on a parallel pumping pontoon system configuration that allows for ten operating units and two units on standby.

To ensure that the proposed solution was the best possible for the application, the Weir Minerals team

#### CASE STUDIES



evaluated the solution taking into consideration multiple factors such as: energy consumption, water level variation, TDH reduction, flow rate control, vibration, bearing house temperature variances, mooring analysis, hydraulic transient analysis, naval engineering as stability, fluctuation level, and complete structural analysis. Additional effort was made to ensure the pump system operated at the optimal NPSH point: optimal power consumption and optimal variable frequency drive (VFD). The team also considered future design changes, such as when the operating level of the tailings pond rises and the discharge head on the pump system reduces. Therefore,





to allow the pumping system to continue to operate at an optimal it was determined that it would be advisable to exchange the original impeller with a different design. Returning the pump system back into original high efficiency operating point.

In the future, when the water level of the dam rises, the installed



equipment can be easily modified, saving energy and improving the flowrate.

#### THE RESULTS

Weir Minerals Brazil was directly involved with the entire scope of this project. From the initial conceptual detailed design; equipment fabrication, supply, onsite assembly, and commissioning process. In conjunction with the customer Weir Minerals Brazil determined the most effective solution was to assemble the equipment during the construction phase of the new B8 Tailings dam.

Multiflo mega barge water reclaim solution system has been operational since December 2018 and operating within the design parameters determined for this project. With this solution the CBMM Araxá plant can increase the operational capacity, recovering the water from the B8 Tailings Dam in a safety and sustainable way to keep our customers operations running. •

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# Tier 3 Nozzles Optimize Sewer Crew Efficiency and Profitability

Water conserving Tier 3 nozzles clean better and faster, enabling work crews to accomplish more between refills

By Del Williams

In sewer, storm, and sanitary line cleaning, hose nozzles are an essential tool that directs pressurized water to clear out obstructions such as silt, sludge, grease, mineral buildup, and tree roots as part of required maintenance or to prepare pipes for re-lining. In this way, the nozzle is like a gun and water like bullets that must be precisely directed with force to the target.

While there are many nozzle options available in a variety of configurations, the standard Tier 2 nozzles that typically are supplied with the purchase of a sewer truck are only rated 50 to 60 percent efficient. Although these nozzles can handle some blockages, some sewer crews are opting for the highest performance nozzles to make short work of even the most challenging jobs.



Utilizing such high-performance nozzles has benefits that go far beyond conserving water to protect the environment. Reducing water use also minimizes trips to refill the sewer truck water tank and keeps crews effectively cleaning to expedite work completion. By decreasing unnecessary travel, the approach also reduces the cost of vehicle fuel and maintenance, which further boosts profitability.

#### OPTIMIZING EFFICIENCY

As is known throughout the industry, there are tiers of nozzles, rated for water efficiency from Tier 1 (about 30 percent efficient), Tier 2 (50 to 60 percent efficient), to Tier 3 (75 to 98 percent efficient). Although they cost less, low efficiency Tier 1 nozzles tend to utilize only 30 percent of the available energy, wasting 70 percent due to excessive turbulence or otherwise lack necessary precision to clear obstructions. Tier 2 nozzles are more efficient, but are still not adequate to tackle tougher jobs or perform with anywhere near the efficiency offered by more sophisticated units.

In contrast, the most effective Tier 3 nozzles have tight water patterns that efficiently clean the pipe wall and create a powerful water stream to move debris long distances and propel the nozzle. Crucially, these nozzles provide efficient fluid mechanics to prevent the wasteful use of water (GPM) and operating pressure (PSI).

However, even within the Tier 3 category there are significant differences in levels of efficiency. Opting for the lower end Tier 3 nozzle with 75 percent efficiency could still lead to additional trips to refill. Additionally, such units may not remove restrictive sewer buildup or blockage in a timely manner.

#### PROACTIVE PRODUCTIVITY

Consequently, to proactively improve operations sewer truck/accessory dealers and contractors are turning to the most efficient Tier 3 nozzles. This is enabling sewer maintenance work crews to clean better and faster while conserving water and achieving dramatically more between each water tank refill. This approach also substantially reduces labor and machine hours to clean lines, along with equipment wear and tear, and can save approximately 9 to 17 percent in vehicle fuel costs, including travel to refill water tanks and run equipment.

"Today, operators want to conserve water use to be more productive with their trucks and work crews. Water is an important natural resource, and usually drinking water is used," says Matthew Woods, vice president of sales and marketing at Haaker Equipment, a dealer of sewer cleaners, pipe inspection equipment, and parking lot sweepers for the contractor, municipal, and industrial sectors in California, Nevada, and Arizona.

In the case of Haaker Equipment, Woods says that Tier 3 nozzles from KEG Technologies are frequently recommended, although the dealer also carries nozzles of various tiers from other manufacturers as well.

#### MEASURING THE DIFFERENCE

KEG Technologies, a manufacturer of sewer and storm lines products including Tier 1 to Tier 3 nozzles, chain cutters, floor cleaners, and camera nozzle systems, is a member of NASSCO, the National Association of Sewer Service Companies. The Spartanburg, South Carolina-based company's Tier 3 nozzles, such as the Aqua Power 700 and OMG, provide up to 98 percent efficiency.

According to Woods, refilling the sewer truck tank with water can take thirty minutes to an hour, depending on the hydrant location. "Typically, the highest operating cost over the life of the vehicle isn't the truck or the nozzle: it's the operator's labor, and that is saved tremendously by using an ultra-efficient Tier 3 nozzle. If an operator can avoid two water tank fill cycles a day by using the most efficient nozzles, they can save an hour a day, twenty hours a month, and 140 hours annually, which is a great boost to productivity," says Woods.

According to Woods, the difference between using a Tier 2 nozzle and a top Tier 3 nozzle can be cleaning from 30 percent to virtually 50 percent more sewer line with the



#### WATER & WASTEWATER FOCUS



same amount of water. Also, efficient water use also reduces vehicle fuel as well as wear and tear by requiring fewer trips to the hydrant.

#### BENEFITS IN FLUID MECHANICS

In addition, while municipal water is usually free locally, the ability to conserve water can minimize potential water use charges for contractors who use water from a county line. What sets the most efficient Tier 3 nozzles apart from others in the category is fluid mechanics engineering on a par with the aerodynamics of race cars or jet fighters.

In the case of KEG's Tier 3 nozzles, the high-performance fluid mechanics design leaves little room for power losses and excessive turbulence. After exiting the jetter hose, water travels into the body of the nozzle before moving through smooth, curved channels. This design enables the water to maintain its power and speed before entering the nozzle's replaceable titanium ceramic inserts. Next, the water is funneled from a short conical shape to a larger, longer cylindrical shape, allowing a tight water pattern to emerge.

The internal workings of the nozzle, including the way the water gets turned, redirects the energy of the high-pressure water entering the nozzle as efficiently as possible. This results in what is needed for the task: more thrust and power using less water.

"There is tremendous force and pressure created in a Tier 3 KEG nozzle. It is often what is needed to get the most out of the Vactor sewer trucks we represent, which are considered the 'Ferrari' of the industry. To extend the analogy, you cannot go 200 miles per hour in a Ferrari with the cheapest tires available," says Woods.

While Woods does not insist that such a Tier 3 nozzle is necessary for every job, he does recommend it as an essential tool for the sewer crew's toolbox.

#### CHOOSING THE BEST TOOL FOR THE JOB

Troy Whitton is a parts and service sales specialist at Vimar Equipment, a British Columbia, Canada-based dealer of sewer and street vehicles and equipment for the contractor and municipal markets. Whitton, who has been a dealer for twenty years and is the startup demonstration trainer for the equipment that Vimar sells, also recommends utilizing highly efficient Tier 3 nozzles.

"With the KEG design, operators get the greatest efficiency out of their water, which provides the most power to clean the pipe and pull the hose. Because it is so efficient, operators typically achieve more than they ever could before with a lot less water," says Whitton.

According to Whitton, as a dealer it is important to educate contractors and municipal mangers to help them understand how they can achieve the greatest value with their equipment.

As a Vactor sewer truck dealer, he wants Vimar Equipment's customers to understand the importance of using the highest quality nozzle on the hose to get the cleaning job done safely, quickly, and efficiently.

Additionally, he suggests that choosing the best tool for the job can resolve the most difficult cleaning challenges, when a less powerful or precise nozzle may not be sufficient to do the job in a timely way.

"Selling the best nozzle for the job goes hand-in-hand with selling Vactors because the nozzles do the work. The nozzles are essentially the 'tip of the spear' so you need the right nozzle for the job," says Whitton.

#### SAVINGS OVER TIME

While he acknowledges that lesser nozzles may cost less at first, he says that such units ultimately end up costing considerably more in less efficient work performance on the job.

"Compared to a Tier 2 nozzle, a high efficiency Tier 3 nozzle will cost a little more initially, but can pay off rather quickly because you can get the job done in much less time," concludes Whitton.

While dealers, contractors, and municipal supervisors have long accepted the status quo in sewer, storm and sanitary line cleaning, better approaches now exist in the form of ultra-efficient Tier 3 water conserving nozzles that can enable work crews to perform significantly more in less time. Ultimately, this helps to cost effectively boost both service ratings and profitability.  $\blacklozenge$ 



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# **Best Practices for Hydrant Maintenance**

## When it comes to safety, there are no shortcuts

By Patrick Nein and Alexander Bailey, Mueller Water Products

When required can have grave consequences.

The most effective way to keep a fire hydrant in working order is to have a biannual or annual testing and maintenance program. The frequency of the testing and maintenance will depend on the type of fire hydrants in the system (dry or wet barrel) and the climate in which they are installed. Fire hydrants in cold or harsh climates may need more frequent inspections and maintenance. Here are some best practices for your maintenance program:

#### EXERCISING THE FIRE HYDRANT

This will ensure the fire hydrant operates as expected. It is important that when a fire hydrant is operated, the auxiliary valve tied to the hydrant is also exercised.

#### PROPER LUBRICATION OF THE FIRE HYDRANT

Fire hydrants are typically grease or oil-filled. Follow the manufacturer's instructions on lubrication. Without proper lubrication, corrosion can occur making the hydrant difficult or, in some cases, impossible to operate.



#### FIRE HYDRANT FLUSHING

It is important to remove any foreign material that may be inside the fire hydrant or lead line. During flushing, we have seen many obscure things appear like soda cans, tire innertubes, bathroom rugs, and chunks of wood. These items can block the fire hydrant main valve hindering the ability to open or close the hydrant.

#### CHECKING FIRE HYDRANT FOR STANDING WATER

This is especially important in cold climates. The presence of a high-water table or clogged drains holes can cause water to accumulate in the fire hydrant. This accumulated water can freeze causing damage to the hydrant. This inspection can be done after flushing by holding your hand over the exposed nozzle to feel for small amounts of suction. This signals that the fire hydrant is draining properly. Some fire hydrants in areas with a higher water table may have plugged drains, these need to be pumped after use.

#### **INSPECT TRAFFIC FEATURES**

During the inspection, double-check that the breakaway devices are not damaged. Depending on the age and type of the fire hydrant, this feature could be breakaway flanges or breakaway bolts. Some fire hydrant models do not have a breakaway design. It is also important to inspect the fire hydrant surroundings. Make sure there are no obstructions hiding the fire hydrant, like bushes or debris, from firefighters. Homeowners sometimes landscape around the hydrants to hide it from their view or with the best intentions of beautifying, but with no maintenance, it can easily become difficult to find.

#### PROPER FIRE HYDRANT HEIGHT

A fire hydrant that has the incorrect height above the groundline can have serious implications if hit by a vehicle. A hydrant that is buried too low can cause a hydrant to not break as expected during a collision and make removal of the nozzle caps difficult. A hydrant that is buried to high may allow for a vehicle to impact the lower barrel. Improper fire hydrant height can cause not only more damage to the vehicle during a collision but also damage water piping systems.

#### INSPECT FIRE HYDRANT FOR LEAKS

The hydrant can be pressurized to inspect for leaks. This is achieved by removing a hydrant cap and operating the hydrant a few turns. Allow the hydrant barrel to fill until a small amount is coming out of the nozzle, this allows for as much air to escape as possible. Replace the cap and fully open the hydrant. With the hydrant pressurized, all visible joints can be inspected for leaks. A leaking hydrant can cause many issues including erosion of the soil in areas with poor drainage, accelerated corrosion, and groundwater contamination.



#### CHECK HYDRANT OUTLET NOZZLE CAPS

Over time, corrosion can make nozzle caps difficult to remove. Remove caps during each inspection and clean them. Adding food-grade lubrication or anti-seize to the nozzle and cap threads can assist with easier operation in the future.

#### RECORD KEEPING OF HYDRANT MAINTENANCE

This is very important for a municipality to know which hydrants have been repaired/inspected or need to be repaired/inspected. This is an important part of any maintenance and inspection program and benefits from more detail than less. It is also very important that any issue discovered during an inspection is repaired in a timely fashion. Any fire hydrant that is deemed inoperable should be black bagged or tagged to prevent accidental use and replaced or repaired as soon as possible.

#### SAFETY MEANS NO SHORTCUTS

Cities and municipalities also need to make sure that when buying new hydrants that they have the same threads and operating nut size as other hydrants in the area. Firefighters need to be able to quickly access fire hydrants and



if their wrenches and hoses won't fit, this can cause a dangerous delay. Hydrants with stainless steel components will last longer and are better protected against corrosive soil or hot soil. Proper thrust blocking and installation of a drain field will also help with the performance and longevity of the hydrant.

There are no shortcuts taken when it comes to manufacturing fire hydrants because they have a critical function and need to perform at a moment's notice. Still, the most common cause of failure is the lack of a proactive preventative maintenance program. Municipal crews that have solid maintenance programs will have fewer repairs and more reliable performing hydrants.

Most manufacturers have a step-bystep document that walks operators through fire hydrant maintenance and inspection for their particular model. Also, the AWWA M17: Installation, Field Testing, and Maintenance of Fire Hydrants is an excellent resource that can be found on their website **www.awwa.org**. Generally speaking, the mechanics of fire hydrants have not changed that much, so once you have a good grasp of the basics you will be set for a long time. ◆

Patrick Nein is project manager and **Alexander Bailey** is application engineer for Mueller Water Products. Mueller Water Products is a leading manufacturer and marketer of products and services used in the transmission, distribution, and measurement of water in North America. The company's broad product and service portfolio includes engineered valves, fire hydrants, metering products and systems, leak detection, and pipe condition assessment. It helps municipalities increase operational efficiencies, improve customer service, and prioritize capital spending, demonstrating why Mueller Water Products is "Where Intelligence Meets Infrastructure." For more information, visit www.muellerwaterproducts.com.

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# Solar Pump Market Goes Mainstream

# Expect an infusion of funds in photovoltaic pump technology

By Sagar Randhe, GMI, Inc.

S olar powered pumps are making a massive difference and are going an extra mile by providing farmers ecofriendly solar irrigation systems and harvesting pivotal data to streamline local water sources. With unpredictable weather patterns leading to desertification and climate change, stakeholders are likely to infuse funds in solar pumps.

In the present landscape, advent of novel technologies will potentially boost solar market revenue as new value chains continue to be created. Technological innovations are at peak with several solar-powered water pumps being integrated with the internet of things (IoT) or remote monitoring. IoT has been enabling a network of communication between a slew of internet-enabled devices and the solar pumps.

#### IOT MAKES INROADS IN SOLAR PUMPS

Use of IoT is likely to set the trend in the industry landscape as it has been become a catalyst for farmers to keep track of the pump's signs and fuel savings. Technological developments in solar photovoltaic (PV) devices will boost operating strategies such as improved scheduling of power plants, sophisticated renewables, advanced renewable energy forecasting and improved scheduling of power plants. Growth in PV technology is likely to further the business outlook as stakeholders, including farmers and governments agencies vie to reduce operating costs.

Considerable uptake of the PV technology has been instrumental in reducing the cost of solar pumps, with easy-to-install and eco-friendly systems profoundly being tested in the market.

Advanced technologies will become prevalent with monitoring of irrigation fields with drones and the use of thermal imaging cameras. For instance, thermal and satellite imagery are being used to calculate irrigation water demand and assess actual water supply.

#### A GROWING MARKET

In the latest research report compiled by Global Market Insights, Inc., solar pump market size has been projected to grow substantially by 2026. At the time when farmers in developing countries are deprived of proper irrigation facility and don't have access to electricity grid, trend for solar pumps has turned out become pivotal to keep up with the irrigation demands. Off-grid measures have helped governments in underpinning the global adoption of solar pumps.

With stakeholders in agriculture sector eying to enhance income generating opportunities; reduce postharvest cost; boost productivity; and increase efficiency, economic growth with shorter payback period within the solar pump market has been projected in the next five years.

#### BIRD'S EYE VIEW: GOVERNMENT FUNDING AND THRIVING AGRICULTURE SECTOR

Use of solar pumps in agriculture sector will propel potentiality of augmenting agriculture productivity in the light of diversification of cropping patterns and efficient use of water. APAC has come up as a happy hunting ground for stakeholders as the region looks to reduce dependence on electricity and unreliable and expensive fuel supplies.

Developing countries such as India envisage solar pumps to improve water quality through fertigation and filtration systems and mobilize groundwater resources when rainfall patterns are erratic.

Global Market Insights, Inc. is a global market research and management consulting company catering to leading corporations, non-profit organizations, universities, and government institutions. Our main goal is to assist and partner organizations to make lasting strategic improvements and realize growth targets. Our industry research reports are designed to provide granular quantitative information, combined with key industry insights, aimed at assisting sustainable organizational development. For more information on this report, visit **www.gminsights.com/industry-analysis/solar-pump-market**.

# Innovative Vibration Learning System

## Part l of 2

By Dr. Budhaditya Hazra, Liang Xu, and Dr. Suri Ganeriwala, SpectraQuest

ith an increase in highspeed manufacturing and automation, it has become more important to use the theory of vibration for design and maintenance of machinery. This vibration theory is even more important in the monitoring and diagnosis of machinery malfunctions. Hence an effective manner of handson teaching of vibration principles is the need of the decade. However, most academic institutions include only theoretical lectures without laboratory exercises due a lack

of an apparatus combined with an instrumentation setup. Keeping this chasm between industrial needs and academic output in mind, SpectraQuest has introduced a new innovative and modular bench scale experimental set-up called vibration fundamentals training system.

The Vibration Fundamentals Training system (alias VFT) is a turnkey integrated educational package for teaching/learning the fundamental principles of mechanical vibration as well as engineering mechanics. It provides both a comprehensive



Figure 1: SpectraQuest's Vibration Fundamentals Training system (VFT).

hands-on experimental device and an instrumentation package including wireless sensors for performing laboratory exercises to enhance student understanding of vibration theory. The VFT clearly brings classical theory to life by providing a convenient means to validate predictions and to demonstrate the influence of parameter changes on system response visually. Students can perform virtual experiments using the vibration simulation software and then verify the results with actual experiments thereby reinforcing the learning of difficult principles. The VFT provides an ideal tool for damping free vibration experiments using the wireless sensors without affected by the damping associated with the sensor cables. It is a perfect tool for teaching mechanical vibration courses both at under graduate and graduate levels.

In this technote, we present some of the very basic set of experiments that can be easily performed as a part of the vibration teaching curriculum. More advanced applications will be dealt later in subsequent tech notes.

Figure 1 shows the VFT system with the basic modules, such as torsional vibration module, beam vibration module, spring-mass-damper system module, and vibration control module. Wireless accelerometers are used to collect data in the framework of a wireless data acquisition system. The data thus obtained is processed through SpectraQuest's custom built software.

#### MOTOR SOLUTIONS

We now demonstrate the usage of the VFT system with the aid of a few simple experiments. The experiments are created in such a way that it can be used by any enduser to incorporate in a vibration teaching curriculum.

#### EXPERIMENT 1: DETERMINATION OF SPRING STIFFNESS

The basic step towards performing laboratory experiments to verify the fundamental concepts of vibration theory is to determine the spring stiffness or the stiffness constant. The most common practical problem is getting a massless spring. Mass springs merely facilitates theoretical development of single degree of freedom vibration equations. In reality, all springs have masses and the mass of the spring that participates in the SDOF vibration idealized as a lumped system is called the effective mass. The expression of effective mass is given in any standard textbooks and the readers are referred to some common works in this area. In the first experiment, the stiffness constant of the spring is determined using both the static and the dynamic methods and verified with the theoretical expression obtained from the strength of materials background on close coiled helical springs.

#### **OBJECTIVES**

To determine the stiffness of a helical spring using two methods:

- Deflection curve and Hooke's Law (static method).
- 2. Natural frequency measurements of the SDOF mass-spring system (dynamic method).

Compare their results with the analytical value.



Figure 2: General layout of the experiment set-up.

#### SYSTEM DESCRIPTION

The spring-mass system in figure 2 shows an extension linear helical spring with an initial free length  $L_{i}$ , effective mass  $m_s$  ( = 0.006 kg), supported vertically from one of its ends; while the other end is free to elongate and attached to a load carrier of ( $m_c = 0.028$  kg) mass. The free length of the spring loaded with the load carrier alone is  $L_{o}$ .

Disks each of (m = 0.350Kg, 0.572Kg, 0.784Kg, and 0.920Kg) mass are added to the carrier gradually, and each loading state causes the spring to elongate by the distance from its unloaded length L<sub>o</sub> to get a total length of L.

#### **GOVERNING EQUATIONS**

For the spring-mass system shown in figure 2, in the case of free vibration in the vertical direction Y, the equation of motion of the system is given by

$$M\dot{y} + Ky = 0$$

(where M is the total mass of the system, and equals to  $M = m + m_c + m_s$ ). From the equation of motion, we can find that:

Natural frequency =

$$\omega_{\eta} = \sqrt{\frac{K}{M}}$$

Period of oscillation =

$$\tau = \frac{2\pi}{\omega_e} = 2\pi \sqrt{\frac{M}{K}} = 2\pi \sqrt{\frac{m + m_c + m_s}{K}}$$

For the linear spring following Hooke's law, then:

$$F_{s} = K\delta$$

But for the present system, the spring force  $F_s$  is also given by:

$$F_s = mg$$

Combine these two equations to get:

$$\Rightarrow m = \frac{K}{g}\delta$$

For a helical spring, the stiffness is expressed analytically as:

$$K = \frac{Gd^4}{8ND^3}$$

Using the dimensions of the spring as d = 0.062 inches, D = 0.938inches, number of coils (N) = 17 and, torsional modulus G as 77.2 GPa, the theoretical value of stiffness comes out as 254.0836 N/m. To verify the stiffness dynamically, the vertical mass spring system is set to vibrate using initial velocity (impulse) and the natural frequency of vibration is recorded using the spectra quest's software. The stiffness calculated from the recorded value of natural frequency can be written down as:

$$\omega^2 = \frac{K}{M}$$
$$K = 4\pi^2 f^2 M$$

(where f is the natural frequency in hertz).

TRIAL	m (kg)	ð (cm)	w <sub>n</sub> (Hz)	K (est) using 8 (N/m)	K (est) using 6 (N/m)
1	0.35	1.3	4.02	245	264.3
2	0.57	2.1	3.26	253	266.54
3	0.784	2.9	2.75	244.2	265.47
4	0.920	3.4	2.55	245	265

Table 1: Data collected from the free vibration of spring mass system.

#### EXPERIMENTAL PROCEDURES

- 1. Hang the spring vertically with the load carrier attached to its end, and then measure the total length of the spring  $L_0$  (this length is not the initial free length of the spring  $L_i$ ).
- 2. Add one disk to the carrier  $(m = m_d)$ , and measure the total length of the spring after elongation L.
- 3. Calculate the extension.
- 4. With this loading, stretch the spring downward, then leave it to oscillate freely and record the natural frequency.
- Keep changing the disc mass to higher values (0.350Kg, 0.572Kg, 0.784Kg, and 0.920Kg) and repeat steps 1 to 4.



Figure 3: Absolute error in stiffness estimation using static and dynamic methods.

#### DATA PROCESSING

Figure 3 clearly shows that the errors in estimating stiffness is more using the static method compared to the dynamic method. However, for both the cases, the errors are less than 5 percent, which are within the acceptable limits for engineering applications.

## ADDITIONAL EXPERIMENTS BASED ON THE SAME WORKING PRINCIPLE

A few more experiments can also be performed based on the sample working principle. They are summarized briefly in Table 2.

Square eqn-3, to get: $\tau^{2} = \frac{4\pi^{2}}{K} (m + m_{e} + m_{s})$	Draw $\tau^2$ versus <i>m</i> as graph; Slope $S_4 = \frac{4\pi^2}{K}$	1) Intercept with the vertical axis $Y_{har} = \frac{4\pi^2}{K}(m_c + m_a)$ $\Rightarrow m_x \text{ can be estimated}$
From eqn-6: $m = \frac{K}{g}\delta$	Draw <i>m</i> versus $\delta$ graph	Slope $S_3 = \frac{K}{g}$ $\Rightarrow K$ can be obtained.
Multiply the slopes of the previous two steps.	You get the value: $S_1 S_2 = \frac{4\pi^2}{g}$	$\Rightarrow$ g is estimated; compare it with textbook value
Use eqn-7: $K = \frac{Gd^4}{8ND^3}$	Find K directly.	Compare the two experimental values of K obtained before, with this theoretical value.
Square eqn-3, and eliminate K using eqn-7, then: $\tau^{2} = \left(\frac{32\pi^{2}D^{1}N}{Gd^{*}}\right)(m + m_{c} + m_{b})$	Draw r <sup>2</sup> versus <i>m</i> as graph	Slope = $\frac{32\pi^2 D^1 N}{Gd^*}$ , $\Rightarrow$ Determine G, and compare it with the standard value for steel

Table 2: Summary of the experiments that can be performed with Experiment 1.

#### A LOOK AHEAD

Generally speaking, vibratory systems consist basically of potential energy storing element (stiffness), kinetic energy storing element (mass or inertia), and energy dissipation element (damping). Damping effect in vibratory systems may be caused by friction between moving parts (dry friction), or material deformation and internal friction between layers of a part (structural action), or the use of mechanical viscous dampers. The first two may never be completely eliminated but can be, generally, ignored under certain conditions. However, the third can be used to achieve a required damping effect. In the experiments presented in next month's conclusion to this series, we show that the damping contribution from dry friction and structural action is indeed negligible.

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# Safe Handling of Toxic Fluid Mixtures with No Environmental Impact

# Plasticizer production requires hermetically tight process diaphragm pumps

By Rainer Sonnenfroh, Lewa

he sales market for plasticizers is enormous. In 2018, their global volume was 7.6 million metric tons according to the Ceresena Research market research institute—and the trend is steadily rising. For 2026, researchers anticipate a total volume of 10.5 million metric tons. However, special care is required in the production of these colorless, odorless fluids that are used to make plastic products more flexible and stretchy and in other applications. Some plasticizers are considered highly toxic and can have a severely negative impact on health and the environment if mixed with other media such as water or grease. Since this has to be taken into account as early as the chemical manufacturing stage, rugged process diaphragm pumps are usually used. These pumps are designed without dynamic seals, thereby guaranteeing absolutely safe handling of

carcinogenic and toxic fluids. A comprehensive approach, which includes the design of hermetically tight pumps, planning, sales, commissioning, and services, ensures that the project is handled efficiently and successfully.

In total, 87 percent of all plasticizers were used for plastic products, according to data from the market research institute Ceresena Research. At 2.33 million metric tons, various film products based on the commodity plastic polyvinyl chloride (PVC), such as many floor coverings, cables, and hoses, accounted for most of the demand. They all get their special performance characteristics from the addition of colorless and largely odorless plasticizers. The additive allows naturally hard, brittle materials to become flexible and stretchy without losing their dimensional stability, and sometimes make them useful in the first place. Plasticizers used for this purpose are also called softeners. Most of them are phthalates, an ester that can exist in many variations.

#### ROBUST, LOW-WEAR TECHNOLOGY REQUIRED

Therefore, particularly high safety measures must be taken in the production of plasticizers when non-toxic, long-chain plasticizers are being manufactured from the gasoline-like preliminary product naphtha using a multi-stage process. This especially applies to the use of pumps, since they are responsible for conveying the often toxic fluid mixtures without problems and are used during the production process as reactor filling units or pressure boosting units. They also have to function properly in extreme operating states using installed safety mechanisms, or prevent operating damage after operating errors. For safety reasons it is preferable to use hermetically tight process diaphragm pumps. Thanks to their safe and robust technology, such pumps guarantee that the naphtha mixture is conveyed without leaks, thereby preventing hazardous liquids from leaking into the environment.

> Comprehensive planning approach needed from consultation to installation

This is primarily because the pump technology functions without dynamic seals. The PTFE diaphragm is the transporting component and simultaneously, the static seal of the pump's working area: a basic requirement for safely pumping hazardous fluids. Thanks to this principle, it is possible to achieve low life cycle costs and low maintenance costs at the same time. This cost reduction is based on the patented Lewa DPS diaphragm protection system. A spring supports the diaphragm's suction movement and reliably ensures that the diaphragm is always in the correct position. The monitoring system immediately indicates any damage to the diaphragm. The pump remains hermetically tight and can be shut down in a controlled manner if the diaphragm needs to be changed. In addition to the DPS, each process diaphragm pump has an internal overpressure safeguard. These protection systems ensure that the machine can be reliably controlled even in critical operating states, and that leaks can be avoided.

## INTEGRATION OF THE PUMP UNIT INTO THE OVERALL CONCEPT IS CRUCIAL

However, production process efficiency depends on more than just selecting and commissioning suitable pump technology. For this reason, a comprehensive approach that includes development, production, and service offers clear advantages. Pump/system manufacturers are only able to offer users a complete, individually tailored solution for the respective project when all factors come Replace your bearings less often with Thordon's long wear life, abrasive resistant pump bearings.





from a single source. The pumps should be integrated into an overall concept covering the complete service spectrum from planning support to active system and from tool consultation to a warehousing strategy. This kind of "everything from a single source" approach ensures more efficient communication and focuses the required expertise at the interfaces of individual task areas.

This is why experienced system manufacturers like Lewa create piping design studies and feasibility analyses ahead of time, before the design plans of the responsible engineers go into production. This approach enables customer-specific requirements to be integrated into the planning stage and design components to be adapted to whatever situation is at hand. Thanks to their space-saving mono-block design, Lewa process pumps are suitable even for the smallest installation spaces.

After the system is commissioned by a service engineer, a service expert is also assigned to the customer for the entire life-cycle of the requested pumps. The expert provides advice in case of application difficulties and carries out any maintenance work that arises. Solutions with a comprehensive approach like this enable faster handling without problems, since challenges and difficulties can be simplified and communicated more easily within a company. An "all-in-one" solution guarantees the necessary process quality in risky applications such as plasticizer production.

#### CONCLUSION

Global production volumes of plasticizers for use in plastic products are constantly increasing. Leak-proof

metering is critical here, since plasticizers are produced from a fluid mixture based on naphtha, which is toxic to humans and the environment. That is why the process diaphragm pumps that are used must satisfy highest safety requirements to ensure that the fluid is pumped without any problems. Integrating the pure production and delivery of the pump into an overall concept that also includes planning, consultation, commissioning, and maintenance service is helpful here.

Thanks to its hermetically tight diaphragm pump technology, Lewa can provide a safe solution in this area and is able to offer a comprehensive concept consisting of planning, commissioning support, and warehousing strategies. At the same time, efficient communication and concentrated expertise accelerate the overall solution being implemented.  $\blacklozenge$ 

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# A Tough Pump for Tough Times

Tsurumi's Glenn Wieczorek on introducing the Avant series to North America

In hough the last twelve months presented challenges for several industries, many manufacturers navigated these troubled waters to bring new products to market. For example, Tsurumi America brought its new line of explosion-proof pumps, the Avant series, to North America for the first time. These submersibles, fitted with options for a wide range of wastewater applications, fill a definite need for users looking for reliable dewatering in harsh conditions. Glenn Wieczorek, managing director at Tsurumi, recently appeared on our podcast to fill in the details. An excerpt of that conversation appears below.

#### MPT: Even in the midst of COVID-19 restrictions, Tsurumi was able to successfully launch the Avant series in Asia early in 2020 and then bring it to the North American market. How has that process been?

**Glenn Wieczorek:** As you know, 2020 was an unprecedented year. And we've been affected by that, like so many other people in so many other industries around the world. Yet, we were successful in launching it first of all earlier this year in some of the Asian markets and here in North America. Initially, the plan was to present at the WEFTEC show—make it really big, you know.

However, last year, of course, WEFTEC was a virtual show, so once we found that out, we weren't really sure what exposure to expect from that show. But really, surprisingly, we've had a lot of interest and a lot of traction already, just through WEFTEC and through the launch to our distributors, because they are taking it out to the market themselves and they're beating that drum for us.

#### MPT: Any time there's a new product launch, it's built on the learning experiences from other industries. What are some of the needs Tsurumi is looking to fill with the Avant series?

**Glenn Wieczorek:** You're absolutely correct, and since we have the longevity of both here in the North American market and the worldwide market, a lot of those experiences have gone into this. Our experience is especially safe for the dewatering side. And when you look at applications in the mining industry, we're very, very active. And we've been very active in that for a long time, as our pumps have been designed to handle those really tough applications. Frankly, you're not going to find any applications that are more difficult than mining.

From mining and tunneling and construction, we have a lot of experience with what it takes to have a robust pump and a robust design. So that was all put into there. We took that experience and a lot of those same features, as well as some of the other features that are well known on Tsurumi, and placed them in this product range as well. We feel very confident that we're going to be able to bring to the market a very robust product, as robust as any that Tsurumi has ever built.

## MPT: How does the Avant series conform to the current efficiency requirements?

**Glenn Wieczorek:** They are all standard with the IE3 premium efficiency motors. As you're aware, new standards have been put into place for many applications, requiring those premium efficiency motors. If customers didn't necessarily always have that available on some previous models, we're now going to be able to go with a pump that offers that across the whole product line. So that no longer should be a concern for anybody. Plus, the biggest advantage is that it lowers the cost of operating these pumps.

In addition to that, all of these are explosion proof, and our horsepower range goes from 4 to 275, which means we're going to be able to reach a very broad range of different applications. All told, that translates to our being able to offer more to our customers.  $\blacklozenge$ 

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