WJTA WaterJet Technology Association

Jet News

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Equipment Demonstrations at the WJTA-IMCA Conference and Expo, September 9-11, 2013

On the inside

Refractory Removal by High Pressure Waterjet

D. Wright, StoneAge, Inc., Durango, Colorado, U.S.A.

ABSTRACT

The removal of refractory from lines and vessels in the petrochemical industry is necessary for inspection, repair, maintenance, and replacement. The small spaces and difficulty of access have otherwise limited the methods of removal to manual labor with handheld chipping hammers. This allows only the limited power and force that an individual can support, while exposing these workers to the hazards of silica dust, extreme noise, vibration, and physically exhausting labor in a confined space.

Refractory materials can be safely removed through the proper application of high pressure waterjets and mechanization, from localized repairs to complete vessel cleaning. The use of high pressure water allows the transmission of hundreds of times the power of handheld chippers, with resulting refractory removal rates on the order of days to weeks faster than manual methods. This paper presents the results of multiple tests to define the key operating parameters for the successful removal of several refractory types with high pressure water, the possible rates of removal, and other considerations necessary for the successful execution of field work.

1. INTRODUCTION

Refractory materials are installed in vessels, boilers and process lines to provide insulation and erosion resistance. The primary components are alumina and silica, and the lining may be cast in place, gunned or manually applied. Some refractory also contains steel needles. The refractory is held in place by welded anchors or a steel hex mesh welded to the vessel wall. Dual layer installations consist of a thick layer cast in place, topped by a layer of hex mesh refractory. The analysis and results presented in this paper were obtained by testing a Type 1 cast refractory with needles, RS-17E cast refractory with needles, and AA-22 refractory in hex mesh.

Refractory linings may need to be removed for replacement, inspection or repair. Manual chipping is still commonly practiced, with the only other alternative being replacement of the entire vessel or line. The removal of refractory by high pressure waterjet has been proven to be more than ten times faster than manual chipping, resulting in the elimination of over 500 hours of worker exposure to silica dust, noise, and vibration within a confined space on a typical refractory replacement. The mechanical properties of refractory materials lend themselves to penetration by high pressure waterjets, even more so after being in service, due to fractures and weaknesses that develop in the material. In every case, the sample refractory materials provided for testing were more difficult to remove than the actual in-situ refractory.

The application of water for the suppression of silica is a well known control, dating to the early use of pneumatic rock drills in underground mining. These drilling operations were performed dry, with operators breathing the dust produced. This resulted in an average life expectancy of 4 years for the miners due to silicosis, leading to the “widow maker” name for these first drills. The addition of water through the drill steel to the bit completely eliminated the dust, and saved many lives going forward.

The waterjet equipment employed is relatively lightweight, permitting use in small spaces, yet capable of applying 750 kW (1000 hp) of water power. Confined space entry is often required to install the equipment, but once installed the operation can be controlled from outside of the vessel.

This paper presents the important operating parameters for refractory removal, including effective pressures, flow rates and standoff distances. Based on the results presented, estimated rates of removal can be derived for planning purposes.

2. COMPARISON OF MANUAL CHIPPING TO WATERJET REMOVAL

A demonstration of manual chipping with a 7 kg (15 lb) pneumatic hammer was conducted in Type 1 refractory, 127 mm (5 in) thickness, installed within a 1020 mm (40 in) diameter section. The operator of the hammer worked for 1 hour, within a square of 305 mm (1 ft^2). The result was an estimated removal rate of .003 m^3 (.1 ft^3) per hour, illustrated in Figure 1.

Figure 2 shows the effect of 1 hour with high pressure water, operating at 124 MPa (18,000 psi) and 276 lpm (73 gpm), resulting in a removal rate of .27 m^3 (9.5 ft^3) per hour. The waterjet removal rate was 100 times faster than manual chipping in this application.

3. SELECTION OF OPERATING PRESSURE AND FLOW RATE

The selections of operating pressure and flow rate are dependent on the refractory type, the expected standoff distance from the surface that can be achieved, the refractory thickness, the

(continued on page 4)

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rate of production desired, and the type of equipment to be used.

The power of a waterjet is directly proportional to the pressure and the flow rate. For example, 138 MPa (20,000 psi) at 136 lpm (36 gpm) is the same power as 276 MPa (40,000 psi) at 68 lpm (18 gpm). However, the efficiency of removal is dependent on the material to be removed and the standoff distance of the jet orifice to the surface.

3.1 Optimization of Pressure

The operating pressure must meet the minimum effective pressure to remove the refractory. As with most other materials, the most efficient pressure is around 2 to 3 times the minimum effective pressure. Efficiency then begins to drop as pressure is increased above the optimum pressure. Therefore, to increase the removal rate, it is most effective to operate at the optimum pressure and increase the flow rate to apply more power.

For the pressure efficiency tests, the minimum effective pressure and optimum pressure varied with the refractory type. For the refractory types tested, the optimum pressure occurred between 103 and 138 MPa (15,000 and 20,000 psi). All tests were conducted with a single jet orifice, traversed across the refractory sample at a standoff distance between 76 and 102 mm (3 and 4 in.)

Figure 3 shows the results for pressure versus volume removed in Type 1 refractory, at two different powers. The next curve, for RS-17E refractory in Figure 4 (see page 24), is an average of results at three powers, 19, 38, and 75 kW (25, 50, 100 hp) and plotted as power unit per volume removed versus pressure. This was the lightest weight refractory tested, and the results show that the optimum pressure was accordingly lower. In related work performed with this refractory type present, it has been found that operating at a pressure below 55 MPa (8000 psi) reduced risk of damage to this refractory. Figure 5 (see page 24) presents the curve for AA-22 refractory in hex mesh, tested and expressed in the same fashion as the RS-17E material. Comparing AA-22 to RS-17E, the optimum pressure increased by about 35 MPa (5000 psi), but the power required to remove the same volume of material tripled.

Operating at a higher pressure than the optimum does allow a lower flow rate for the same power if water volume is an issue for work nearby, but removal rate will decrease for the same power, and standoff distances must be more tightly controlled, as the orifice sizes are smaller.

3.2 Standoff Distance

In addition to maintaining effective pressure, the other important parameter is keeping the waterjet orifice within an effective standoff distance range. This can be the most difficult and limiting factor to maintain, due to the complex geometries and access limitations in some vessels. The effective standoff distance is proportional to the orifice size, which determines the flow rate at a given pressure. If the conditions require a larger standoff distance or variations of standoff distance, a larger orifice size, and therefore more flow, is necessary. Even within a range that is effective, the rate of removal decreases rapidly with increasing standoff distance. The thickness of the refractory must also be accounted for within the effective standoff distance to achieve complete removal. To calculate the effective standoff distance with a given orifice size, multiply the orifice diameter by the effective standoff distance ratio.

Figure 1. Results of Manual Chipping in Type 1 Refractory, 1 Hour Duration.

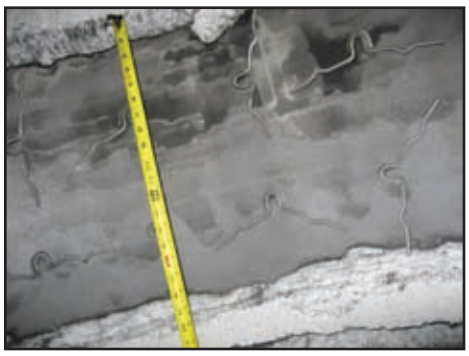

Figure 2. Results of Waterjet Removal in Type 1 Refractory, 1 Hour Duration.

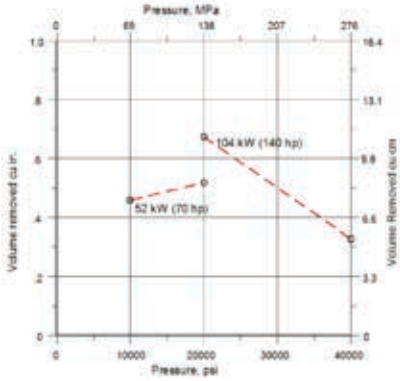

Figure 3. Efficiency of Pressure in Type 1 Refractory Removal.

In Type 1 refractory, the maximum effective standoff distance ratio was found to be 130 times the orifice size, when operating at 124 MPa (18,000 psi). However, when at a closer standoff distance ratio of 84 times the orifice size, the removal rate was more than two times faster. The efficiencies

(continued on page 24)

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Bill Gaff
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Bill McClister
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Gary Noto
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CSM Supply

Kathy Krupp
The Dow Chemical Company

Larry Loper
High Pressure Equipment Co.

Kerry Siggins
StoneAge, Inc.

Forrest Shook
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Jet News is published by the WaterJet Technology Association (WJTA)-Industrial & Municipal Cleaning Association (IMCA) and is a benefit of membership in the Association.

Workshops for Warriors® Congratulates First Class of Certified Flow Waterjet Operators

Flow International Corporation and Workshops for Warriors are congratulating the first class of Flow certified waterjet operators. The two-and-a-half-day training course covered FlowMaster® Software and operator training. Flow believes in continued support of our nation's veterans, providing advanced manufacturing technology to Workshops for Warriors for training and certification.

In January 2013, Flow provided Workshops for Warriors a high-speed, high-precision Mach 2c waterjet system with Dynamic Waterjet® taper control, HyPlex Prime® 55,000 psi pump and FlowMaster Intelligent Control software. With thousands of Flow waterjet system installations across the United States, veterans have the opportunity to learn transferable skills working on advanced, American-made machines. A three-part instructor training program is underway, with the end goal of Workshops for Warriors independently training and certifying operators on the Flow waterjet system.

Workshops for Warriors assist the transition of veterans and wounded warriors into civilian careers. "We are proud to partner with Flow in the training, certification, and placement of wounded warriors and veterans into manufacturing careers," says Hernán Luis y Prado, chairman of Workshops for Warriors. "The waterjet training program gives veterans and wounded warriors the ability to learn from a global leader in waterjet technology, then apply that knowledge and experience into finding a career in the industry." Together, Flow and Workshops for Warriors are working to provide training and career placement for our nation's veterans. Currently, graduates of Workshops for Warriors training programs have a 100% placement rate.

Workshops for Warriors is an accredited educational facility and a 501(c)(3) nonprofit organization that provides compressed training, certification, and placement of wounded warriors and veterans into manufacturing careers, at no cost to them. The company places graduates into careers in CAD/CAM, CNC machining, welding, and fabrication across America ready to work. This proven vocational training program has a 100% placement rate and is scalable, modular, and is being replicated across the United States. Veterans face significant barriers to employment and need high quality training that culminates in portable, stackable, and industry-recognized credentials. With 1,000,000 additional veterans expected to transition out of active duty over the next five years, America owes its returning heroes a chance to earn a living wage and serve once again in the civilian workforce.

For more information, visit www.WorkshopForWarriors.org or www.FlowWaterjet.com.

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Alert: Tax Benefit From Acquiring New Equipment Will Be Drastically Reduced In 2014 - Consider Purchases In 2013

For tax years beginning in calendar year 2014, one major tax break for assets used in business is scheduled to be drastically reduced and another tax break is scheduled to be completely eliminated. Specifically, "expensing" of asset purchases under Code Sec. 179 (a 100% first-year write-off) is scheduled to be drastically reduced from 2013 levels, and additional enhanced first-year depreciation (bonus depreciation) is scheduled to be, for most assets, completely eliminated.

Reduction in Code Sec. 179 expensing. Code Sec. 179 expensing (the deduction of the entire purchase price in the year placed in service) is available, on an elective, asset-by-asset basis, for the following types of property, whether new or used ("Section 179 property"): machinery, equipment, and other tangible personal property; most publicly sold computer software; some non-building land improvements; and some limited types of building improvements and buildings (certain leasehold, retail and restaurant improvements, and restaurant buildings). For 2013 the election is available for up to $500,000 of Section 179 property per year (the dollar limit). The dollar limit is reduced, dollar for dollar, to the extent that the taxpayer's total Section 179 property placed in service during the year is more than $2 million (the phase-out rule). Expensing of the limited types of building improvements and buildings described above is subject to a $250,000 limit (in addition to counting against the $500,000 per year limit).

For tax years beginning in 2014, the above benefits are scheduled to be drastically reduced. Thus, the dollar limit would be $25,000 and the beginning-of-phase-out level would be $200,000. Additionally, the computer software and limited types of building improvements and buildings described above would no longer qualify as section 179 property.

Bonus depreciation. 50% bonus depreciation applies, subject to an election-out on a class-by-class basis, to the following types of new (not used) property ("qualified property"): tangible property with a depreciation period of not more than 20 years (machinery, equipment, other tangible personal property, and non-building land improvements); most computer software; and certain leasehold building improvements. Bonus depreciation results in a deduction of 50% of the cost of an item of qualified property in the year placed in service and depreciation, under the regular depreciation rules, for the remaining cost of the item over the item's assigned depreciation period. However, 50% bonus depreciation is scheduled to end for most property placed in service after December 31, 2013.

The opportunity to claim bonus depreciation should be of most interest to taxpayers who are placing into service Section 179 property in excess of the Section 179 dollar limits (determined after application of the phase-out rule). Note that even if yours is a smaller business, there are certain situations in which you might claim bonus depreciation. For example, certain land improvements (most parking lots, walkways, fencing, etc.) are eligible for bonus depreciation, but not Code Sec. 179 expensing.

If you are currently planning to invest in Section 179 property or bonus depreciation property at levels that do not maximize the pre-2014 tax year benefits discussed above, you might consider accelerating your planned investments. You might anticipate that Section 179 deductions from the investments will offset post-2013 income that might otherwise be taxed at rates higher than the income that would be offset 2013. Or there might be non-tax reasons for not accelerating purchases. Planning for taxes should start now because December may be too late.

Contact your accountant for additional information.

Contributed by Dina Kohout, CPA, Tax Manager, Hochschild, Bloom & Company LLP, St. Louis, MO.


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StoneAge Partners with Industrial Cleaning Contractors in Testing of the Sabertooth Automated Tube Lancing System

Field testing the Sabertooth Automated Tube Lancer allows contractors and end users to fine tune equipment to better suit their needs.

Manual lancing of vertical tubes.

Looking into the dark crawlspace of a 4,600 tube evaporator, Richard Bombard reviews his approach. The plant plans to shut down for 100 hours, during which Richard's team of trained waterblast contractors will polish six heat exchangers on site, each containing 3,000-4,600 2-inch diameter tubes 44 feet in length. It's an operation that used to take twice as long as it does now, but companies like Houston-based PSC have found that delivering the highest level of service for their industrial clients means working smarter. They've made the investment in personnel and equipment to stay ahead of the curve.

As PSC's account manager, Richard is charged with keeping his customers happy. "The industry was looking for a consistent method of cleaning and along with consistency, we were looking for safety." For tube lancing operations, StoneAge's Sabertooth Automated Tube Lancing System promised to deliver the solution he needed: a portable, self-contained system that can be controlled remotely from outside of the immediate danger zone of high pressure hydroblasting. Richard is confident of the tool's capabilities, in part because he helped shape its development.

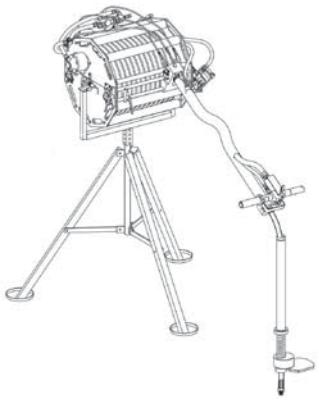
History of the Sabertooth

The need for safer, more productive on site tube cleaning is not a new topic of discussion. The original version of an automated tube lancing system that would eventually become the Sabertooth was developed over a decade ago (2001) to help resolve safety issues related to hose handling in confined spaces such as black liquor evaporators. It consisted of an air powered, single-hose reel that allowed the operator to hand control the forward and reverse hose feed. The system proved successful in reducing operator fatigue and the need for standby crews, thereby increasing productive cleaning time.

"Right then it was a great concept," remarks Terry Walters, owner of Innovative Cleaning Solutions in Houston, TX. "The lance is contained at all times inside a layer of safety. That's what we wanted."

Terry has been working with StoneAge since the 1980's. With over 30 years of experience in waterblasting, his company serves some of the world's largest chemical, petrochemical and refinery clients. Terry was one of the first to test the original hose reel unit, and as he's done with many other StoneAge tools, he was quick to suggest improvements to the on-site engineer. "It had some details that needed to be worked out that most people would have never thought of without intensive field experience," Terry recalls. If a problem arose, such as the need for more flexibility in the air drive system, Innovative Cleaning Solutions compensated with adjustments in the field and StoneAge developed a permanent solution in the next iteration of the tool. "StoneAge's answer was to make it fairly quick to change out the electric motor," said Terry. Changing the speed and torque levels of the air motor provides more versatility. "It gives me a lot of flexibility. I can do things that they haven't thought of and I haven't even thought of yet."

The next advancement in the Sabertooth came when StoneAge introduced the Banshee family of rotary tube cleaning nozzles. Featuring a unique liquid bearing that achieves high rotation speed, Banshee nozzles provided a better solution for clearing plugs and polishing tube lengths than had previously been available. The Sabertooth system was redesigned to make better use of the Banshee with the addition of a second hose to increase productivity and a snout assembly that made it easier to align the hose feed with the tubes. An external gearbox was added to control



Concept drawing of pneumatic hose reel, circa 2001.

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StoneAge Partners with Industrial Cleaning Contractors in Testing of the Sabertooth Automated Tube Lancing System, from page 10

the feed rate and aid the operator to maintain consistent cleaning.

At the time, tube lancing was still done mostly by hand. PSC's Richard Bombard recalls cleaning a 10,000 tube evaporator in a processing plant. "They would stand over it, one person would have a lance and they would run 20k with a foot pedal and a catcher. Every eight hours we had to tear apart a nozzle and replace the bearings in it. It would take three weeks. That was very costly." These days the operation takes them approximately 56 hours, with fewer personnel and more consistent results. "A person who is running the Sabertooth is sitting in a chair outside the hole on top of the tube bundle and he can see what's going on perfectly. That person can sit there for three-four hours and not be anywhere near as fatigued. It's a huge difference."

PSC has a long history of collaborating with StoneAge on tool development. Richard's feedback from the field has been valuable in the design of new equipment from nozzles to fully automated solutions. "When you're hands-on and using it all the time," he states, "you call and ask questions. Can you tweak this? Can you do that? This is what I'm running into, can we get more aggressive? We've done a lot of field testing on the Sabertooth. We'll run it for 100 hours straight around the clock and put it to a good test."

The value to StoneAge comes in the form of feedback from use in the field. One of the challenges of running air-powered machinery in industrial plants is the quality of available air. Especially in humid climates, condensate and particulates in plant air compression systems can compromise the performance of pneumatic tools. In response, a pretreat system was added to the Sabertooth package to filter out water and provide lubrication to air motors to ensure reliability.

With each generation, the Sabertooth became increasingly sophisticated and it was through continued user feedback that StoneAge learned what worked for and against the system. "I've always been able to call StoneAge," affirms Terry Walters, "to get somebody on the phone to second-guess me, to make sure I was doing something right or to listen to what I was seeing in the field - a little give and take." The result is the newest generation Sabertooth, the SRT-100.

Feature Overview

The main benefit of the Sabertooth Automated Tube Lancing System lies in the core of its concept - to provide a safer, hands-free, productive and consistent way to clean on-site tube bundles. Two flex hoses are fully contained on an enclosed, air powered reel that feeds the lances at a constant rate in and out of the tubes. This eliminates the exposure of high pressure hose from personnel as well as abrasive material. The powered drive reel helps increase the life of the hose, as lances are spared the stress of friction drive and can deliver more power to clean heavily contaminated or plugged tubes.

The entire system is remotely operated which allows the operator to move away from the danger zone, preferably to an area of better visibility. The unit is mounted to a rugged cart that is easily positioned with locking castors and it can be disassembled to fit through man ways as small as 24 inches. This modular design and small footprint allows the Sabertooth accessibility to confined areas where only manual cleaning was previously possible.

The nozzle positioning mechanism utilizes a versatile box frame that is attached to the bundle face or tube sheet. Lances are driven in both directions across a frame window that is expandable to 15 feet, offering a great amount of flexibility. The system can even be set up to clean multiple bundles at a time. The positioner works as easily on vertical applications as horizontal and the unit's tilt feature makes it simple to maintain proper height and position of the hoses compared to the tube face. Splash tubes guide the lance tips into tube orifices, minimizing exposure; these are made from standard 1-inch piping that can be modified to fit bundle face or channel head requirements.

Unique to the Sabertooth is its autostroke feature, a "pecking mechanism" that recognizes when a Banshee nozzle has reached a blockage and automatically retracts

Engineering drawing of the Sabertooth SRT-100 Automated Tube Lancing System.

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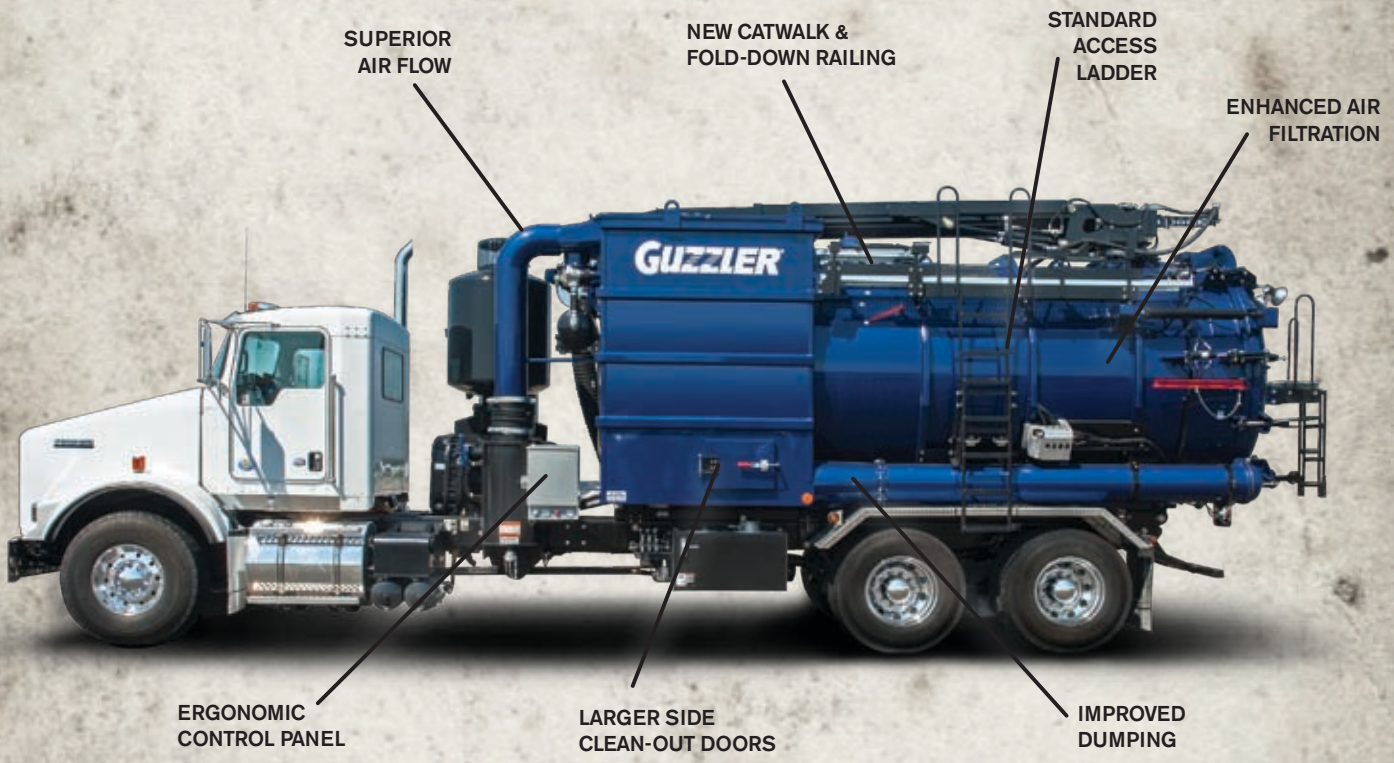

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Prior to 2003 when the job shop portion of the company was sold to focus on building waterjets, WARDJet was the sixth largest capacity job shop in the USA. Trying to cut accurate parts on traditional slats that wobbled around, vibrated, and had serious kick-back was a never-ending challenge. Often the only way to properly secure material to be cut was by clamping directly to the side of the tank. Something needed to be developed to provide the following features:

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SpaceX Uses Waterjets to Cut Parts for Launch Vehicles and Spacecraft

Space Exploration Technologies Corp. (SpaceX) was founded in 2002 to develop and manufacture launch vehicles and spacecraft. SpaceX has successfully launched both the Falcon 1 and the Falcon 9 launch vehicles, and in 2008 was selected by NASA to resupply the International Space Station (ISS).

On May 25, 2012, the Dragon spacecraft became the first privately developed spacecraft to attach to the ISS, delivering water, clothing and food to the astronauts. On October 28, 2012, Dragon completed its first official cargo resupply mission to the ISS, returning with important samples and space station hardware.

Liftoff of Falcon 9 and Dragon to the International Space Station.

Having worked in the many industries that utilize waterjets, SpaceX engineers are familiar with the benefits of waterjets. Waterjets are very flexible and can cut virtually any material. They are often accurate enough to cut net or near net shapes. Burning methods such as lasers or plasma cutters create a heat affected zone that can cause microcracking when the part is shaped. For the aerospace industry, that microcracking can be catastrophic. Accordingly, the part would need to go through extensive secondary processing to grind away that hardened edge. With waterjets, there is no heat affected zone so no additional work needs to be done before the part can be used, saving time and cost.

SpaceX, a high production company, found outsourcing limiting in their control over timing and quality. If a supplier made the part incorrectly, or the part required a design change, the timetable and those involved were negatively impacted. By bringing the work in-house, SpaceX engineers could have better control. "From our experience outsourcing, we knew waterjets and their capabilities. We just wanted more control over the process," says Rick Cortez, manager of Development Operations.

In July 2010, SpaceX purchased a Mach 3 waterjet cutting system with a 60,000 psi intensifier and Dynamic Waterjet®. A few months later, they added more tables. A Mach 2 system with a 60,000 psi pump was purchased for conventional cutting. They also purchased another Mach 3 system, with a HyperJet® pump rated at 94,000 psi and Dynamic XD® for bevel and 3D cutting. Dynamic XD brings to 3D parts the same taper control Flow developed for flat stock cutting.

SpaceX plans to continue its successful development and launch of commercial rockets and spacecraft, resulting in an increasing need for highly accurate, efficiently cut parts. To meet this increasing demand, SpaceX purchased additional systems from Flow, including the latest in Mach 4 technology, to meet their exact requirements. "We decided to purchase Flow's Mach 4 systems to give us even greater flexibility," says Cortez.

The newest addition to Flow's Mach 4 line of waterjets allows the system to be initially sized as a 2 or 3 meters wide by 2 meters long cutting bed; with the ability to later expand to a length of 14 meters (48 feet). Each system is controlled by FlowMaster software, which allows the operator to load a drawing and simply enter the material, thickness and edge quality and then begin cutting parts. It also monitors the pumps, ensuring they are operating at peak performance.

SpaceX engineers enjoyed the waterjet benefits right away because of the time savings, control, and ease of making changes. "Because our waterjets are in-house, and because of waterjet's broad capabilities, parts can be designed and manufactured with a turnaround time of the same day or the next," says Cortez. "Compare that to the two week or more lead time we had when we were outsourcing."

For more information, visit www.FlowWaterjet.com.

Photographs provided courtesy of SpaceX.

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Booth 607

DERC Salotech Introduces the DERC Hose Feeder for Safe Cleaning of Lines and Pipes

DERC Salotech has launched the DERC Hose Feeder, an innovative hose feeding device to feed and retract a live half-inch rubber high pressure hose. The DERC Hose Feeder is made for a safer and more ergonomic way of cleaning pipes (lines) with high pressure water. This innovative hose feeder system replaces the manual handling of a half-inch rubber high pressure hose with a safer mechanical solution. The hose is controlled by the operator from a safe distance by a control panel controlling feed and retraction of the hose at an adjustable speed.

The Hose Feeder ensures maximum ergonomics, safety for the operator and a new way of cleaning pipes (lines).

DERC Hose Feeder

Control panel

The unit is air powered, lightweight and easy to handle. Further, it comes as a complete unit containing the hose feeder, control panel, hose guide with backout preventor and air preparation unit.

DERC Salotech supplies innovative solutions for waterjetting professionals. For more information, visit www.salotech.nl, call +31 (0)186-62 14 84, or e-mail: info@salotech.nl.

Jetstream Named North American Distributor of Aquajet Hydrodemolition Equipment

Jetstream of Houston, LLP, has been named the exclusive North American distributor of Aquajet Systems AB hydrodemolition equipment and related accessories. Aquajet Systems manufactures a complete line of Aqua Cutter hydrodemolition robots and accessories, including the Rotolance and CPH (circular power head). The distribution agreement enhances Jetstream's product offering and gives Jetstream's customers in the United States and Canada who specialize in concrete restoration, rehabilitation and surfacing/resurfacing work access to Aquajet equipment and accessories.

"The collaboration with Aquajet Systems — and the addition of the Aquajet product line — enables Jetstream to better meet our customers' needs in the growing hydrodemolition market, while also delivering unsurpassed parts, training and service support," said Joe Varca, director of global sales at Jetstream. "Aquajet Systems is recognized by contractors around the world for innovation, efficiency and reliability, and we are proud to represent the Aquajet brand in North America."

Hydrodemolition uses high-pressure water to selectively remove damaged or unsound concrete, resulting in clean, straight cuts without any damage to the rebar or the remaining structure. This process is widely used in a variety of industries, including road and bridge construction, building construction, oil and gas and public works.

Aquajet Systems products are equipped with a computer control system that allows the operator to

(continued on page 26)

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StoneAge Partners with Industrial Cleaning Contractors in Testing of the Sabertooth Automated Tube Lancing System, from page 12

the hose slightly so the tool continues to rotate. This allows the operator to clean continuously without binding the tool. The autostroke feature combined with high and low speed functions can serve to more effectively clean tubes that are mostly clear or completely plugged. Forward force can be set on high until the system starts pecking, switched to low to drill through the plug, then back to high to quickly push through a clearer section.

In addition, the unit includes a shotgun tool mounting bracket, allowing for safe cleaning of exterior bundle faces with one setup. As with other features, safety and ease of use were of paramount consideration in the design on the bundle cleaner. The machine and positioner can be set up using only 7/16-inch and 9/16-inch open end wrenches.

The Sabertooth system is designed to clean tubes between .87 to 2 inches in diameter, with 1.32 to 2.32 inch pitch, using 8 mm high pressure hose up to 22k psi. It provides safe and reliable tube lancing with repeatable, consistent cleaning results.

Response from the Field

Having worked with the tool from its earlier stages, Terry Walters knew what to expect when field testing the new Sabertooth SRT-100. He was so certain of the unit's performance that he asked to purchase one for Innovative Cleaning Solutions before the testing began. "I knew what the first one was and all I had to do was open up the covers," he recalls. "I didn't need to see it run. I already knew that my issues had been addressed."

On the ground, it is employees like Harvey Wingate, Innovative's account manager, who oversee operations. "We've done really well with the new Sabertooth," says Harvey. "It's just so much easier to use, easier to keep going shift by shift by shift. We haven't managed to break it just yet."

Automated lancing of vertical tubes with the SRT-100.

An additional benefit of efficiency and ease of use is worker morale. "Everyone's got a better attitude when they can do a job like this versus having to hand-lance it," reports Harvey. Exposure to the dangers of high pressure water as well as backsplash from the products being cleaned is eliminated and the job becomes a lot more comfortable. The requirements for personal protective equipment can be reduced as operators are no longer directly handling pressurized equipment. "Any time that you can take a shotgun out of a man's hand, it's just so much safer. Having a guy in a slicker and rubber boots with a shotgun at 7,000 psi, you're asking for injury… But now I have this wonderful machine and we can go all day without a guy getting dirty."

The automated approach to waterblasting that plants are actively pursuing is a reflection of a greater sensibility within the industry, one which places a high demand on worker safety as well as consistency and productivity. "I'm looking for the safest, most efficient way to do this business and to help my employees make a good living," remarks Terry Walters. "To do that, I have to give my customers the best possible service available in North America. The Sabertooth, hands down, is the best idea out there for a lancing machine."

Important opportunities arise when tool manufacturers align with the practices taking place in the field and listen to what their clients need; opportunities for useful and beneficial innovation. For StoneAge, the approach is not a new one, but a way of working that's evolved for over three decades. "The field testing program is a great opportunity for contractors to put next generation equipment to use," asserts Bill Shires, director of business development at StoneAge. Contractors like Innovative Cleaning Solutions and PSC are given opportunities to increase safety, decrease plant downtime, improve working conditions for their laborers, and get ahead of their competition with these types of new technology. "StoneAge field tests all of its new products, from small tube cleaners to fully automated equipment like the Sabertooth. It's a mutually beneficial relationship that more contractors and plants can take advantage of."

For more information, visit www.stoneagetools.com/sabertooth.■

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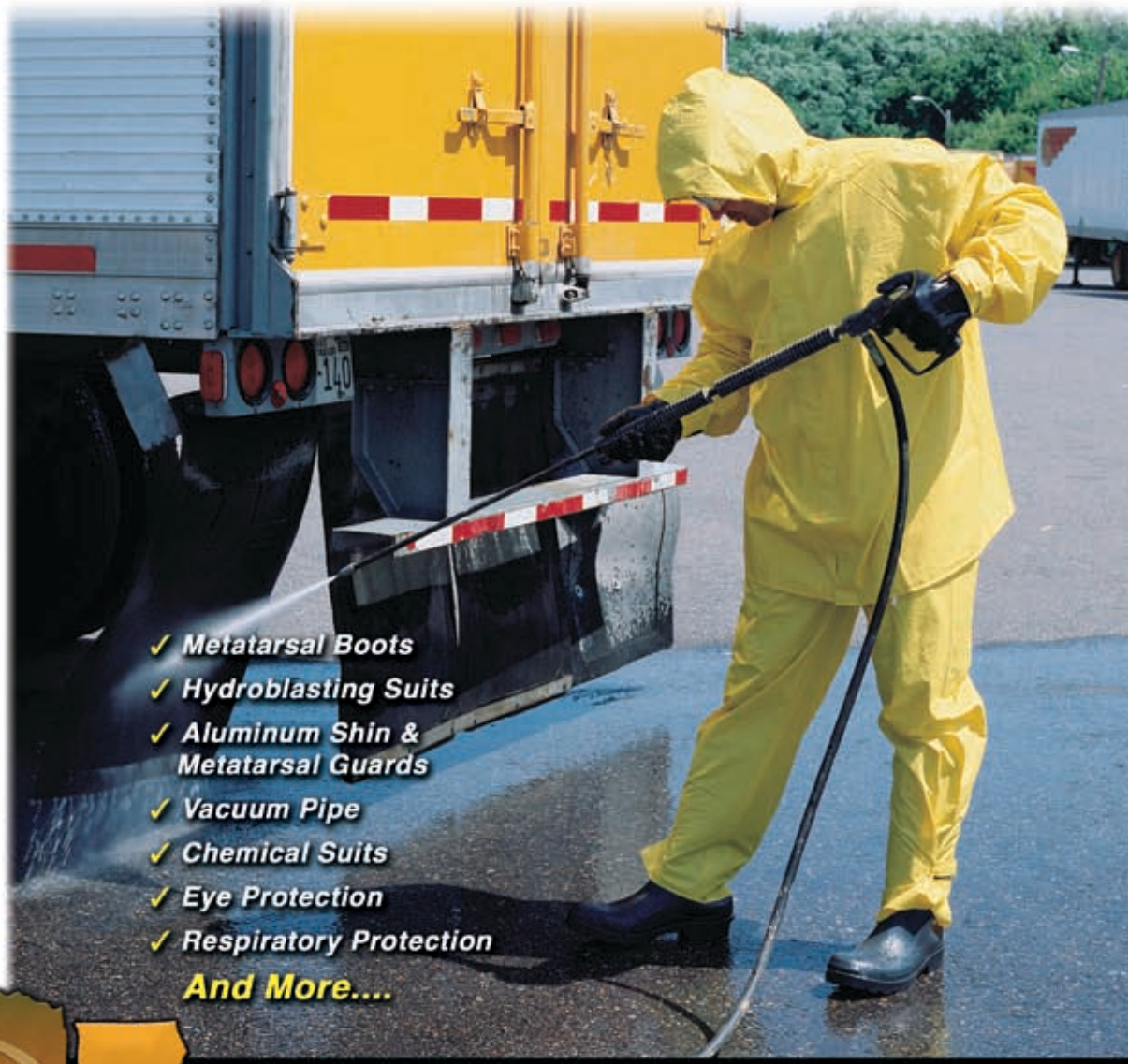

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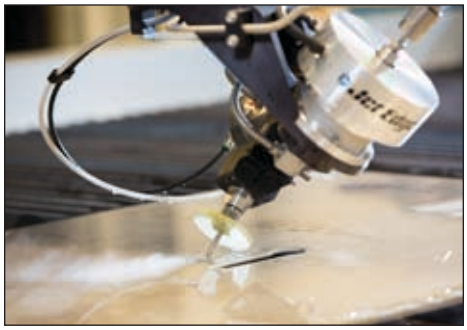
Jet Edge Introduces EDGE X-5 5-Axis Water Jet System

The new Jet Edge EDGE X-5 5-axis Water Jet System cuts complex taper-free and 3D parts from virtually any material. Featuring Jet Edge's Permalign® EDGE technology, the EDGE X-5 is capable of cutting chamfers, weld bevels and sophisticated 3D parts such as impeller blades.

The EDGE X-5 features an industrial PC controller designed specifically for 5-axis waterjet cutting. The AquaVision Di® Controller's open architecture design gives operators the freedom to fine-tune programs from any CAD/CAM/nesting software, utilizing standard G&M code. The system's Intelligent Work Envelope automatically adjusts depending on the angle of the cut to protect the operator, material, and system components.

The EDGE X-5 is designed to provide years of dependable service in harsh industrial environments. Its design separates the motion system



from the catcher tank, eliminating vibration and ensuring maximum part quality. It is ball-screw driven for optimal precision and features direct-couple AC brushless digital servo motors and single or double carriages. Critical bearing components are protected by heavy metal covers with brush seals and positive air pressure.

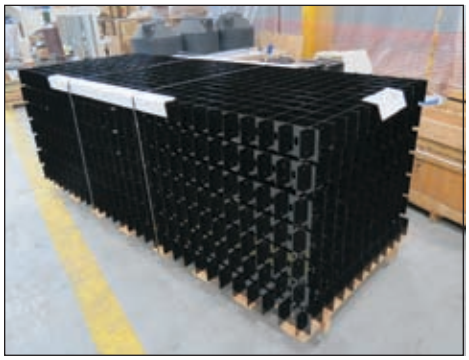
The EDGE X-5 is available in a wide range of sizes, from 5 ft x 5 ft (1525 mm x 1525 mm) to 24 ft x 13 ft (7515 mm x 3365 mm), and is powered by a Jet Edge waterjet pump. Jet Edge offers a wide selection of pumps: 30-200 hp (22-149 kw); 60,000-90,000 psi (4100-6200 bar). Hydraulic intensifier and direct drive pumps are available.

Like all Jet Edge waterjet systems, the EDGE X-5 is made in the U.S.A. For more information, visit www.jetedge.com.

Job Shop Grates© Improve Waterjet Capabilities, from page 14

- Provide a reduced horizontal surface to reduce kick-back as the stream passes over the support
- Employ a modular design to allow for multiple grating options on one waterjet table
- Provide the ideal surface to cut a wide variety of materials

Once these characteristics were defined, the next challenge WARDJet faced was employing thinner gauge material while still providing a rigid, level surface for cutting. WARDJet's solution was the Job Shop Grates using 5-inch tall 16-gauge material fashioned into a grid. After years of



research, the extremely durable Job Shop Grate was developed. The final obstacle was developing an efficient way of manufacturing Job Shop Grates. Each joint has eight welds, which equates to at least 3,000 welds per grate with three to four grates per table. Originally these welds were all done by hand, which was time consuming, expensive to produce and drove up the final cost of the product to customers. WARDJet realized that they had the solution at their fingertips. By utilizing their existing CNC control technology they were able to develop a welding robot to automate the grate building process.

"By designing and building a robotic gantry welder (now named the WELDBOT) we can achieve consistency of weld length and position. We can also program the

(continued on page 30)

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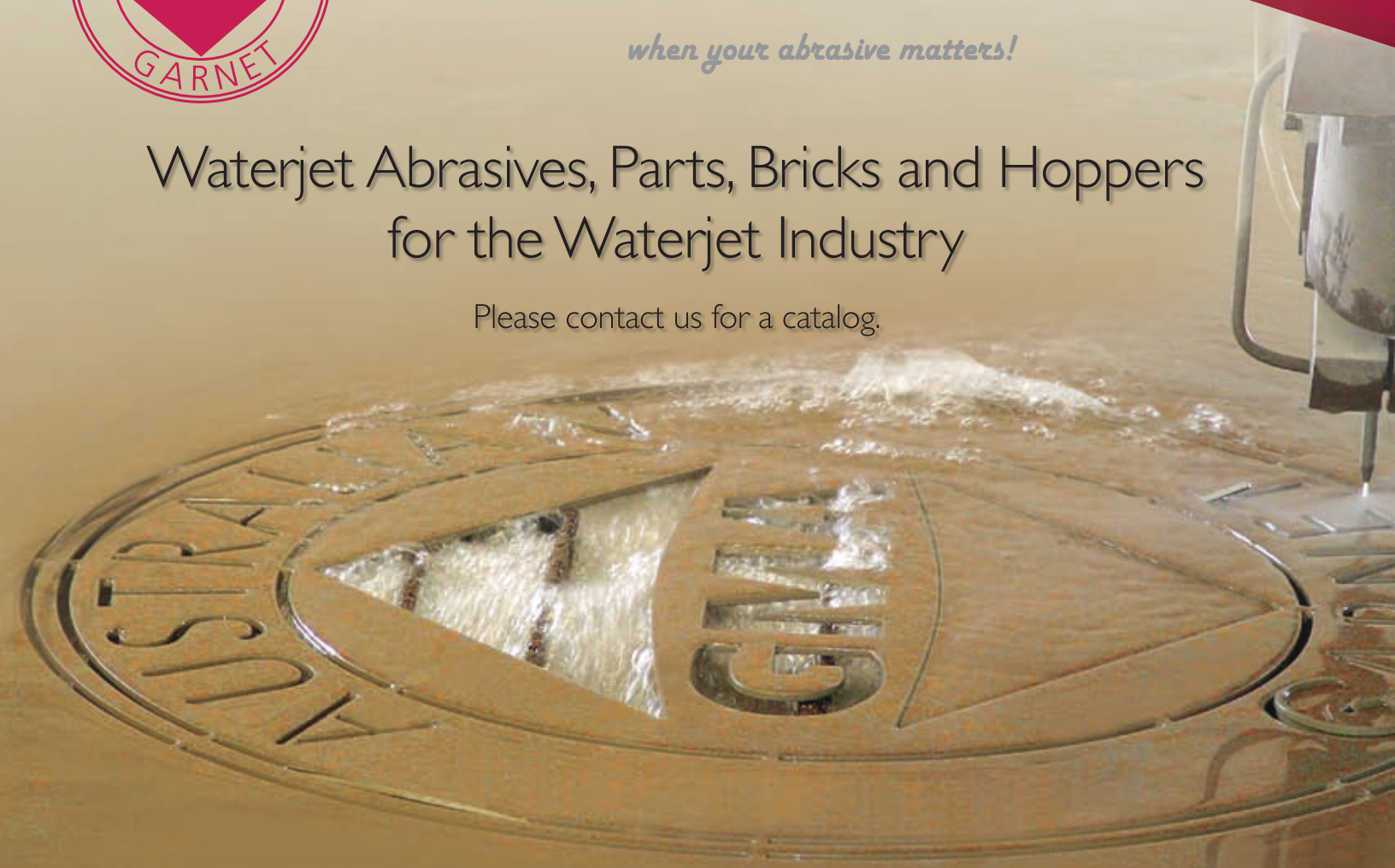

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Refractory Removal by High Pressure Waterjet,

from page 4

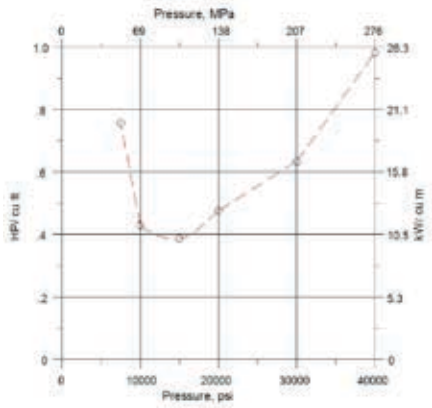

Figure 4. Efficiency of Pressure in RS-17E Refractory Removal.

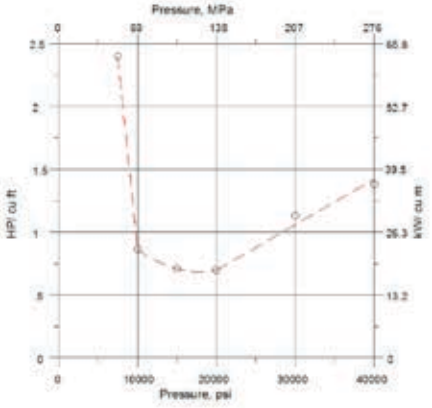

Figure 5. Efficiency of Pressure in AA-22 Refractory Removal.

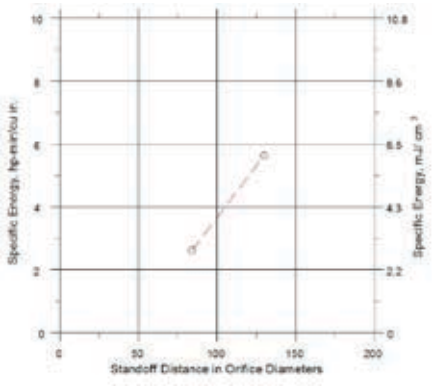

Figure 6. Efficiency Versus Standoff Distance in Type 1 Refractory.

versus standoff distance are shown in Figure 6.

The maximum effective standoff distance ratio for AA-22 refractory was found to be 120 times the orifice size, operating at 124 MPa (18,000 psi). When the standoff distance was reduced to 90 times the orifice size, the efficiency of removal doubled.

Another test conducted in AA-22 refractory was the comparison of a 2-D rotating head to a 3-D rotating head, both operating at the same pressure and flow. The 2-D head maintained the jets perpendicular to the surface and at a constant standoff distance, while the 3-D head pattern spent only

(continued on page 26)

Hughes Pumps Helps Maintain Vietnamese Oil and Gas Facilities

A Hughes Pumps HPS1000 high pressure triplex pump unit has been supplied to the Vietnam National Oil and Gas Group (Petrovietnam) for maintenance work at one of the country's oil and gas facilities, including loose paint and rust removal and cleaning inside tanks, pipes and vessels.

The HPS1000 has a heavy duty capability designed to deal with challenging requirements, producing a maximum flow rate of 185 lpm at 220 bar (40.6 igpm/49 usgpm at 3,190 psi), maximum pressure 1400 bar at 30 lpm (20,300 psi at 6.5 igpm/7.8 usgpm) and maximum power of 75 kW (100 hp).

The unit, supplied through Comnet Industries Company Vietnam, is driven by a diesel engine, and mounted inside a fully enclosed crashframe. This was specified to give 31 lpm at 1000 bar discharge pressure and supplied with a full set of accessories for surface preparation (waterjetting using a gun with a rotary nozzle), and also for tube cleaning (cleaning inside small diameter tubes/pipes in heat exchangers).

Vietnam Oil and Gas Group has developed rapidly since it was established in 1977, being responsible for all oil and gas resources in the country. It has become its country's largest oil producer and second-largest power producer.

Hughes Pumps is a leading UK specialist manufacturer of waterjetting pumps and equipment operating at pressures up to 2750 bar (40,000 psi) for sensitive cleaning applications, as well as delivering critical subsea cleaning solutions to hundreds of metres depth for some of the world's leading contractors.

With more than 40 years of experience, Hughes manufactures a complete range of high pressure pumps in house, giving it complete control of lead times, quality, development, spare parts stock holding and vital after sales support.

For more information, visit www.hughes-pumps.co.uk.

Jetstream Named North American Distributor of Aquajet Hydrodemolition Equipment, from page 18

use the equipment while tracking operating hours and production rates. The company's Aqua Cutter robots feature patented EDS (equal distance system) technology that increases productivity and provides higher quality and energy savings. These machines efficiently remove concrete layers of constant or variable thickness from both flat and curved surfaces. The robots can perform vertically, horizontally and overhead as standard, while attachments allow concrete removal beneath bridge decks or underwater.

For more information about Aquajet Systems AB hydrodemolition equipment available from Jetstream, or for a product demonstration, call (800)231-8192 or visit www.waterblast.com.■

Refractory Removal by High Pressure Waterjet, from page 24

30% of the time within the effective standoff distance range. The angle of impingement of the jets to the surface resulted in shadowing by the hex mesh, preventing complete removal of the refractory. In repair work, this 3-D shadowing results in partial removal in many cells as compared to a clean line of removal with a 2-D pattern, as illustrated in Figures 7 and 8. The 2-D tool was six times more efficient than the 3-D in refractory removal.

4. ESTIMATIONS OF REMOVAL RATE

The tests performed allow a calculation of specific energy required to remove a refractory, and this value can be used to estimate the time it will take to remove a given volume or surface area of material. These values assume operating near the optimum pressure and standoff distance; as was shown in Figure 6, the specific energy more than doubled with an increase in standoff distance.

Table 1 (see page 28) lists the values of specific energy by refractory type. The dual layer type was composed of AA-22 in hex mesh on top of Stellit FS70, shown in Figure 9. The steel hex mesh interferes with the jet, increasing the specific energy to remove the Stellit beneath.

To calculate the time it would take to remove a known volume of refractory, a flow rate must be selected. Using this flow rate and the operating pressure, the power of the system can be calculated. To calculate the estimated time for removal, multiply the known volume of refractory by the specific energy of the refractory type and divide by the power to be used. This shows that removal rate is directly proportional to power applied; it is possible to double the removal rate by doubling the power applied.

Figure 7. Partial Removal by 3-D Due to Mesh Shadow in AA-22 Refractory.

Figure 8. Complete Removal by 2-D in AA-22 Refractory.

Figure 9. Dual Layer Refractory.

An important practical consideration is minimizing pressure losses through the high pressure system with increasing flow rates.

5. PLANNING AND EXECUTION CONSIDERATIONS

There are other important considerations when planning refractory

(continued on page 28)

NLB Launches New StarJet Website

NLB Corp. has introduced a new website, www.nlbstarjet.com, devoted to its closed loop StarJet® system and related equipment for waterjet removal of pavement markings and runway rubber.

The new website is designed to help highway and runway contractors quickly find information about the waterjetting process and typical applications, and about the NLB equipment designed for such applications. It features StarJet trucks for long-line projects, the compact StripeJet™ for smaller jobs, the semi-automated Vortex™, and manual accessories, such as hand lances.

Visitors can also find details of NLB's unique pump guarantee, which protects customers against pump parts failure for one year when they buy a StarJet system. The company also offers for purchase an optional five-year guarantee that provides a full set of replacement pump parts to use while NLB's factory refurbishes the original parts.

The easy-to-navigate site goes beyond basic product and application information, offering video demonstrations; access to training, parts and service; a troubleshooting guide; a dedicated customer support section; and NLB news. Visitors who need more information about waterjetting or NLB can link to the company's main website, www.nlbcorp.com.

Important Information for Companies Whose Employees Handle Hazardous Chemicals

The Occupational Safety and Health Administration (OSHA) revised its Hazard Communication Standard (HCS) in 2012 to align with the United Nations' Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

Two significant changes contained in the revised standard require the use of new labeling elements and a standardized format for Safety Data Sheets (SDSs), formerly known as Material Safety Data Sheets (MSDSs). The new label elements and SDS requirements will improve worker understanding of the hazards associated with the chemicals in their workplace. To help companies comply with the revised standard, OSHA is phasing in the specific requirements over several years (December 1, 2013, to June 1, 2016).

The first compliance date of the revised HCS is December 1, 2013. By that time, employers must have trained their workers on the new label elements and the SDS format. This training is needed early in the transition process since workers are already beginning to see the new labels and SDSs on the chemicals in their workplace.

For additional information, visit https://www.osha.gov/dsg/hazcom.

Major Changes to the Hazard Communication Standard

Hazard Classification: Provides specific criteria for classification of health and physical hazards, as well as classification of mixtures.

Labels: Chemical manufacturers and importers will be required to provide a label that includes a harmonized signal word, pictogram, and hazards statement for each hazard class and category. Precautionary statements must also be provided.

Safety Data Sheets: Will now have a specified 16-section format.

Information and Training: Employers are required to train workers by December 1, 2013, on the new labels elements and safety data sheets format to facilitate recognition and understanding.

Refractory Removal by High Pressure Waterjet, from page 26

removal in field applications. The complex geometry of some internal structures may require a support system for the waterjet tooling to maintain effective standoff distances. Access locations and size of openings for tool installation, along with a means to hold the tooling in place, are necessary information. A plan of high pressure water pump location and hose rigging is needed to manage pressure loss, particularly with higher flow rates over long hose run distances.

The execution planning should allow for the time to obtain access and install the equipment; it is typical for the total time to take over twice the actual time the pumps are operating and refractory is being removed. If the hex mesh is sufficiently welded to the vessel wall, the waterjet will not damage it and it can be repacked. However, V-anchors typically get flattened against the wall by the impact of the jets. A plan should be in place for capturing and managing the spent water and refractory material as it is removed.

6. CONCLUSIONS

High pressure waterjetting, when properly applied, has proven to be an effective method of removing refractory. The use of high pressure water allows the transmission of hundreds of times the power of handheld chippers, with resulting refractory removal rates on the order of days to weeks faster, while removing workers from exposure to the hazards of silica dust, extreme noise, vibration, and physically exhausting labor in a confined space.

The key considerations for the effective removal of refractory as presented in this paper include operating at the optimum pressure for a given refractory type, maintaining the standoff distance within an effective range relative to the orifice size, and the estimation of removal rate based on power applied through the high pressure waterjet system.■

Type 1	RS-17E	AA-22	Stellit FS70	Dual Layer
2.5 hp-min/in^3	1.8 hp-min/in^3	6.2 hp-min/in^3	1.2 hp-min/in^3	3.7 hp-min/in^3
114 W-min/cm^3	82 W-min/cm^3	282 W-min/cm^3	55 W-min/cm^3	168 W-min/cm^3

Table 1. Specific Energy by Refractory Type.

Vacuum Truck Rentals Opens Ohio Location

Vacuum Truck Rentals has opened a new rental location at 212 Pike Street in Marietta, Ohio. Chuck Cisler, with over 30 years of experience in the rental, environmental and construction industries, will manage the Marietta location.

The new location is Vacuum Truck Rentals' eighth facility. Other locations are in Deer Park, Texas; Geismar, Louisiana; Richland, Mississippi; Gaston, South Carolina; Worcester, Massachusetts; and Oakland, New Jersey.

Dedicated truck and trailer jetters have been added to the company's rental offering, which includes industrial vacuum loaders, combination sewer cleaners with hydro excavation kits, DOT-coded liquid vacuum tankers in mild and stainless steel, roll-off trucks, 130-barrel vacuum tank trailers, liquid ring vacuum loaders, hydro excavation units and road tractors with wet kits.

Daily, weekly and monthly rentals are available, as well as a "rent to own" option on all rental units, which allows customers to apply a percentage of their rent to purchase the rental equipment. Vacuum Truck Rentals continually updates their late model fleet to ensure that well maintained, quality used units are available for sale for the cost conscious buyer.

For more information, visit www.vactruckrental.com.

Job Shop Grates© Improve Waterjet Capabilities, from page 22

location of each weld to keep the fixture cool, eliminating bowing and distortion, all while not taking a breath or lunch break…or sleeping at night!" notes Kulick.

Not only has the 'WELDBOT' allowed WARDJet to increase quality and production capacity, but the WARDJet automation and software team developed a program that with the click of a few buttons, will automatically generate the tool path to process and produce Job Shop Grates of any size for any machine. This means any waterjet operator can benefit from Job Shop Grates regardless of the machine being used.

The real proof of success of the Job Shop Grates are the users who keep coming back for more. "Running a waterjet on slats is like driving a car with no air in the tires," says Tim Ghrist, an experienced waterjet operator. "Using the Job Shop Grate system, I can set up as many different jobs as I can fit on the table. By preparing multiple jobs on the same table to cut all at once, I am constantly beating the production schedule - sometimes by as much as 50% with almost no loss in time to load and unload."

For more information, email: sales@wardjet.com or call: (330)677-9100.■

IMPORTANT NOTICE REGARDING SPAM

Email addresses and other member contact information published in the WJTA-IMCA Membership Directory are meant to encourage helpful, informative communication between members. The information is not provided to circulate spam or junk mail.

The WJTA-IMCA leadership requests that members respect the contact information of fellow members and not use that information for the dissemination of spam or junk email. Membership information is not meant to be circulated beyond the WJTA-IMCA membership.

Charissa Putnam and Linda Williams Join Blasters

Charissa Putnam and Linda Williams have joined Blasters, Inc. Ms. Putnam has been appointed chief financial officer. She is a Certified Public Accountant with over 25 years of experience as an accounting and finance executive and over 17 years of experience in the construction industry. Prior to joining the Blasters, Inc. team, Ms. Putnam worked for 12 years in residential construction, leading companies through periods of tremendous growth. For the past five years, Ms. Putnam worked as the chief financial officer for a steel fabrication company, where she lead the company through growth and positive change.

Charissa Putnam

Linda Williams is the newly appointed purchasing and inventory manager. Ms. Williams is a seasoned specialist in purchasing and inventory of industrial construction parts. Prior to joining the Blasters, Inc. team, Ms. Williams worked 16 years in the concrete pumping industry and as a parts manager for Napa Auto Parts.

Linda Williams

Comments Solicited on Improvements to Recommended Practices

Comments are solicited regarding improvements to the WJTA-IMCA publications, *Recommended Practices for the Use of High Pressure Waterjetting Equipment* and *Recommended Practices for the Use of Industrial Vacuum Equipment*. While both publications are reviewed periodically at the WJTA-IMCA conferences and throughout the year, your comments and suggestions for improving the publications are invited and welcome anytime.

Please address your comments and suggestions to: WJTA-IMCA, 906 Olive Street, Suite 1200, St. Louis, MO 63101-1448, phone: (314)241-1445, fax: (314) 241-1449, email: wjta-imca@wjta.org. Please specify which publication you are commenting on.

See you in New Orleans in 2014

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PowerFlow ME Celebrates 5th Anniversary

PowerFlow ME commenced its Middle East operation on June 26, 2008. The office is located in Sharjah, United Arab Emirates (UAE), and the workshop is located in Ras al-Khaimah (RAK), UAE, at the Al Ghayl Industrial Park. Highly experienced people from similar industries in the Middle East joined PowerFlow ME to form a core team for its professional functioning and specialized waterjet and industrial vacuuming services.

The company is an authorized distributor and service provider for WOMA Germany, StoneAge USA, Vac-Con USA, IDROJET Italy, and the 40K Safety Suit by Warwick Mills USA.

PowerFlow ME's rental division includes a large fleet of UHP and HP

jetting machines, combination trucks for jetting and vacuuming for sewer line industries, and truck mounted Super Suckers for industrial dry and wet operations.

The company also specializes in the training and certification of hydroblasters, which is recognized by major companies in the Middle East.

PowerFlow ME celebrated its 5th Anniversary on June 26, 2013, with in-house functions for employees and visitors at the Sharjah Office and RAK Workshop.

Visit www.pflowme.com for more information about PowerFlow ME.

WJTA-IMCA Welcomes New Members

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Innovative Cleaning Solutions Inc.
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Koryeo General Technology Co., Ltd.
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Phone: (780)455-9160

Corporate Individuals

Bruce Allen
Matrix Service
P.O. Box 468
284 Airport Road
Reserve, Louisiana 70084-0468
Phone: (985)535-3000

Chris Boase
Clean Harbors
9856 Steelman Street
Houston, Texas 77017
Phone: (713)534-8656
Fax: (713)534-8618
Email: Boase.Chris@cleanharbors.com

Charles Cisler
Vacuum Truck Rentals, LLC
212 Pike Street
Marietta, Ohio 45750
Phone: (740)374-5700
Email: ccisler@vactruckrental.com

Mike Johnson
Matrix Service
PO Box 468
284 Airport Road
Reserve, Louisiana 70084
Phone: (985)535-3000

Randy Parker
StoneAge, Inc.
466 S Skylane Drive
Durango, Colorado 81303
Phone: (970)259-1084
Email: randy.parker@stoneagetools.com

Domonic Polman
Matrix Service
P.O. Box 468
284 Airport Road
Reserve, Louisiana 70084-0468
Phone: (985)535-3000
Fax: (985)479-3287

Peter J. van Gestel
Xervon Co., Ltd.
No. 1150, Xin Lin Dong Road
Feng Xian
Shanghai 201416
China
Email: peter.vangestel@xervon.com.cn

Ronnie Zenon
Matrix Service
P.O. Box 468
284 Airport Road
Reserve, Louisiana 70084-0468
Phone: (985)535-3000
Fax: (985)479-3287

Individuals

Don Bieberich
Fort Wayne Wire Die, Inc.
2424 American Way
Fort Wayne, Indiana 46809
Phone: (260)747-1681
Email: debieberich@fwwd.com

Jorgen Borgtoft
HIGH-JET
Artekilen 6
Vissenbjerg
Danmark-Dansk 5492
Phone: [45]22113121
Email: jb@high-jet.com

Justin L. Butts
Bodine Services of the Midwest
5350 E. Firehouse Rd.
Decatur, Illinois 62521
Phone: (217)428-4381
Fax: (217)864-2086
Email: jbutts@bodineservices.com

James R. Directo Sr.
Bering Sea Environmental, LLC
91-343 Kaiholo Street
Kapolei, Hawaii 96707
Phone: (808)682-1422
Fax: (808)682-1422
Email: jamesdirecto@bseak.com

Ivelin Esmerov
Mostremont 97, Ltd.
257 Tzar Boris III Boulevard
Sofia 1619 Bulgaria
Phone: [359](2)9534078
Fax: [359](2)8517223
Email: esmerov@mostremont.com

Charles L. Hawes Jr.
C&K Industrial Services, Inc.
5617 Schaaf Road
Cleveland, Ohio 44131
Phone: (216)642-0055
Fax: (216)642-0059
Email: chuck@ckindustrial.com

Chris Lovisek
TRC Limited
1020 Toy Ave
Pickering, Ontario L1W 3P1
Canada
Phone: (905) 428-9209
Fax: (905) 428-7341
Email: Chrisl@trcltd.com

Peter Mantha
Canadian Liquid Blasting Systems Inc.
114 Kendall Street, Unit 5
Point Edward, Ontario N7V 4G6
Canada
Phone: (519)383-1650
Fax: (519)383-8508
Email: peter-clbs@cogeco.net

Michael S. Pardoen
Veolia ES Jamaica Ltd
7 Rutland Drive
P.O.Box 721
Kingston 6, Jamaica
Fax: [876]9867711
Email: michael.pardoen@veolia.com.jm

Nick Wojtowski
Mid Valley Industrial Services, Inc.
718 Industrial Park Avenue
Hortonville, Wisconsin 54944
Phone: (920)779-9950
Email: nick@midvalleyindustrial.com

Student

Nicholas Vollmar
Rice University
1605 Rice Boulevard
Houston, Texas 77005
Email: nhv1@rice.edu

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SPIR STAR Announces Newest Members

SPIR STAR Ltd. has announced two new team members, Sales Representatives Carolina Sanchez and Keith Tierney. Ms. Sanchez has experience in sales and customer service, and she is fluent in Spanish. Mr. Tierney has over ten years of sales experience.

Carolina Sanchez

Ms. Sanchez and Mr. Tierney will assist in the development of SPIR STAR's sales strategies and help maximize customer satisfaction and performance. Their commitment to customer service makes them a perfect fit to the SPIR STAR sales team.

For more information, visit www.spirstar.com.

Keith Tierney

Booth 112

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