WJTA Jet News

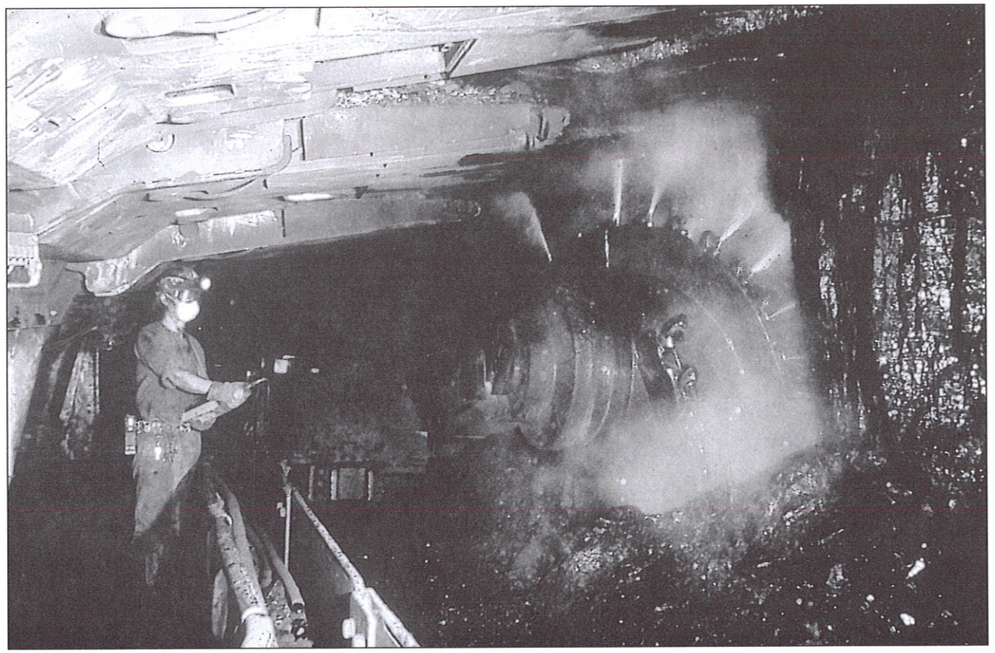
WaterJet Technology Association

NOVEMBER 2002

Published by the WaterJet Technology Association for the benefit of its members

917 Locust Street, Suite 1100 • St. Louis, MO 63101-1419, USA • Telephone: (314)241-1445, Fax: (314)241-1449

Waterjets On A Coal Mining Machine



Longwall coal shearer in operation underground in a coal mine. The coal is fragmented by mechanical picks mounted on a circular drum which moves along the coal face. Waterjets are used to control the dust generated in the fragmentation process. The roof above the miner controlling the shearer is supported by moveable cantilevered hydraulic supports. See article on page 12. *Photograph contributed by George A. Savanick, Ph.D.*

On the inside

Robert Ulrich, President And Founder Of LAI, Dies

Robert Ulrich

Robert Ulrich, founder and president of the LAI Companies, died unexpectedly October 4, 2002. He was 53.

Ulrich was a pioneer in developing non-conventional precision machining methods for contract manufacturing and was a passionate innovator of new laser and waterjet machining technologies. He founded Laser Applications, Inc. in Maryland in 1979 with a contract for laser heat-treating cardboard corrugating rolls. He continued to build the business by gaining new manufacturing contracts and by adding new laser manufacturing capabilities, including high-speed laser cutting, localized welding, small-hole drilling and permanent marking. In 1987, he became one of the first to bring an abrasive waterjet cutting machine into a U.S. job shop.

Ulrich was instrumental in developing split-beam laser workstations, high-speed automated laser-cutting machines, precision waterjet drilling stations, advanced waterjet equipment and many other technological innovations, including several patented technologies. He also led developments in applications ranging from precision laser-welded medical components to titanium screen panels used in the assembly of Lockheed Martin's F-22 Raptor fighter jet. His latest project was developing advanced waterjet equipment and cutting techniques in his newly formed LAI Advanced Waterjet Technologies, Inc.

"Our company is mourning the loss of a man who was greatly admired, respected and liked by his employees," Stewart Cramer, VP of Business Development, says. "We want to reassure our customers that they can expect the same excellent service and value from LAI Companies as they have always received. We appreciate your patience as we deal with this difficult time, and hope to continue to be your choice for precision waterjet and laser machining services."

WaterJet Technology Association's Order Form for Publications/Products

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		WJTA Member Price	Non Member Price	Shipping & Handling	
____	**Proceedings Book & CD-ROM of The 2001 WJTA American Waterjet Conference** (2001)	@ $ 130.00	$ 155.00	$ 8.00	= $_____
____	**Proceedings Book & CD-ROM of The 10th American Waterjet Conference** (1999)	@ $ 65.00	$ 80.00	$ 8.00	= $_____
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____	**An Overview of Waterjet Fundamentals And Applications,** Fifth Edition (2001)	@ $ 55.00	$ 70.00	$ 8.00	= $_____

A limited supply of the 7th Conference Proceedings are available for the cost of shipping (varies depending on destination). Contact WJTA for details.

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*Contact the WJTA office for the shipping and handling charge of more than one Safety Video.

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WJTA
WaterJet Technology Association

2003 WJTA American Waterjet Conference

August 17*-19, 2003 • Adams Mark Hotel • Houston, Texas

Abstract Submission Form

For each paper to be submitted for consideration, please complete this form, **attach a copy of the abstract**, and mail or fax to WJTA by **December 31, 2002**. Authors will be advised by **February 28, 2003**, regarding the decision of the Abstract Review Committee. Please mail or fax this form even if you email your abstract.

Paper Information

Paper Title _____

Authors _____
(First Name) (Surname/Family Name)

Contact Person

(Please print or type)

Name _____
(First Name) (Surname/Family Name)

Position/Title _____

Company/Organization _____

Street Address _____

City, Province _____ State _____

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Please check the category that best describes the topic of your paper. ❑ Applications ❑ Research ❑ Contractor

Key words (Check the boxes under the different categories that apply to your paper):

Type of Study
- ❑ Modeling (theoretical)
- ❑ Experimental study
- ❑ Hardware development
- ❑ Contractor case study
- ❑ Manufacturing case study
- ❑ Software development
- ❑ Economic analysis
- ❑ Legal
- ❑ Other_____

Process
- ❑ Cutting
- ❑ Drilling
- ❑ Surface preparation
- ❑ Cleaning
- ❑ Stripping
- ❑ Safety
- ❑ Milling
- ❑ Jet-assisted
- ❑ Other_____

Related Industry
- ❑ Generic
- ❑ Shipyard
- ❑ Mining
- ❑ Construction
- ❑ Aerospace/Aircraft
- ❑ Automotive
- ❑ Oil/Gas/Refinery
- ❑ Quarrying
- ❑ Other_____

Jets
- ❑ Waterjet
- ❑ Abrasive-waterjet
- ❑ Abrasive suspension jet
- ❑ Pulsed
- ❑ Cavitation
- ❑ Polymer Jets
- ❑ Other_____

Material
- ❑ Metal
- ❑ Rock
- ❑ Glass
- ❑ Ceramic
- ❑ Composite
- ❑ Concrete
- ❑ Other_____

Environment
- ❑ Field work
- ❑ Factory work
- ❑ Submerged
- ❑ Nuclear
- ❑ Demilitarization
- ❑ Offshore
- ❑ Other_____

*August 17 is reserved for the Waterjet Short Courses on Field and Factory Applications and the Surface Preparation Course.

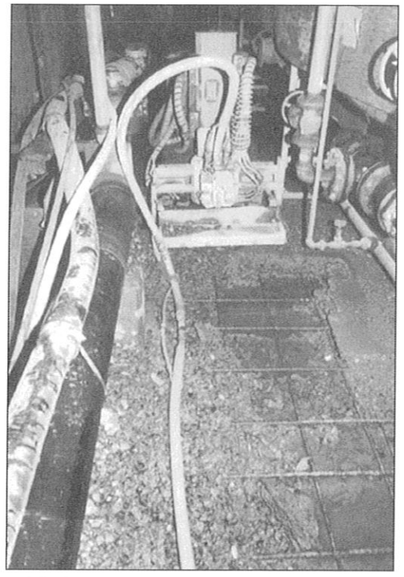
Mail completed form and abstract, **NO LATER THAN DECEMBER 31, 2002**, to: **Conference Coordinator, 2003 WJTA American Waterjet Conference, WaterJet Technology Association, 917 Locust Street, Suite 1100, St. Louis, MO 63101-1419, USA, telephone: (314)241-1445, fax: (314)241-1449, email: wjta@wjta.org, web site: www.wjta.org**

Hydrodemolition In A Dry Dock Utility Tunnel

A compact Conjet Robot 322 concrete hydrodemolition machine, owned and operated by the US specialist concrete repair contractor A&B Concrete Coring Company, has been adapted for the company's approximate US$300,000 sub-contract to assist in the repair and renovation of a utility tunnel serving a major dry-dock in North America. The concrete had to be removed from the tunnel floor to expose the reinforcement, which had weakened and corroded with age. The Robot 322, purchased specifically for the dry-dock tunnel repair, also cleaned the reinforcement of rust prior to the main contractor fixing additional rebar and pouring in fresh concrete to complete the floor repair.

The flat bottom of the 8 ft (2.44 m) wide, rectangular section approximately 1,000 ft (305 m) long tunnel, which is believed to be over 50 years old, had suffered from carbonization corrosion. Carbon dioxide in the air is thought to have caused a chemical reaction in the naturally basic concrete material, which destroyed the ability of the cement to protect the steel reinforcement from corrosion. The pH in the concrete normally protects the steel from corroding, but carbonization lowers the pH value and when this drops below a level of pH9 the corrosion of the reinforcement accelerates, leading to a breakdown in the protection. The corrosion causes the rebar to expand, which cracks and delaminates the surrounding concrete.

A&B Concrete Coring Company, based in Zachary, Louisiana, was able to quickly and easily adapt its new high pressure waterjetting Conjet Robot 322 to suit concrete removal from the tunnel floor. But the company first had to modify the single oscillating nozzle's 5 ft (1.53 m) long feed beam and protective shroud to account for obstructions in the congested tunnel. "There were a lot of obstacles on the tunnel walls and floor, such pipe stands and pipe and cable racks, which could not be moved," says A&B Concrete Coring Company President Richard Jones. "So we had to modify the 322's feed beam and its protective shroud so that we could get around and under these fixed obstructions and still remove the concrete from the floor. The access to the tunnel was also extremely restricted and very tight. To get the 322 into the working area we had to take off the modified feed beam and shroud so we could drive the crawler based 322 down two flights of stairs and through a 90 degree turn."



A&B Concrete Coring Company modified its Conjet Robot 322 to negotiate obstacles and remove concrete from the tunnel floor.
Photo provided courtesy of Conjet AB.

Once in position the Conjet Robot 322 had to remove between 4 inches and 6 inches (100 mm to 150 mm) of concrete to expose and clean the reinforcement. "We had to remove and clean about 8,000 ft² (740m²) of concrete from the tunnel floor, which we were able to do at the rate of between 60-80 ft²/high pressure hour. That's equivalent to about an average volume of around 29 ft³/h (0.82 m³/h), which is exceptionally good under the restricted working conditions. The 322 also cleaned the rebar extremely well and any reinforcement, which had been too badly corroded, was replaced with new, prior to a new overlay of fresh concrete," adds Jones.

The high pressure water for the Robot 322 was provided by a complementary diesel driven power pack housed in a silenced 20 ft (6.1 m) long ISO container. Water at a pressure of 21,750 psi (1480 bar) and flow of 30 US gals/min (113 litres/min) was fed through a flexible hose to the Conjet Robot's nozzle from a Hammelmann HDP 353 high pressure pump driven by a 442 hp (33 KW) Caterpillar 3406B diesel engine.

"For national security reasons we cannot reveal the location of the dry-dock. But the main contractor we are working for believes our Conjet hydrodemolition technique is at least three times cheaper and considerably faster and less damaging to the concrete left in place than conventional chipping out with breakers, a system the company had used on a previous and similar tunnel repair contracts," adds Jones. "Our client read an article about us using our larger Conjet Robot 363 on a submarine dry dock in Connecticut. They contacted us and from that inquiry we won the job to repair this dry-dock service tunnel."

For more information, contact: Conjet AB, PO Box 507, S-136 25 Haninge, Sweden, phone: 46-8-5565-2240, fax: 46-8-5565-2260, email: conjet@conjet.se, or visit www.conjet.com or contact National Hydro Inc., 5643 Warner Road, Fowlerville, MI 48836, phone: 1-517-223-0915, fax: 1-517-223-9525, email: toms@ismi.net.

2003 WJTA American Waterjet Conference

August 17-19, 2003
Adams Mark Hotel • Houston, Texas, USA

Announcement and Call for Papers

Impressive progress and a fast-growing understanding of the diversified applications of waterjet technology are generating a growing excitement in the industry. New techniques and applications are being developed and current ones are being improved. Waterjet technology, now being used in nearly all types of industry — manufacturing, mining, construction, concrete, stone, aerospace, engineering, process, and medical industries — continues to expand at a rapid pace.

The **2003 WJTA American Waterjet Conference** will focus, from a practical and scientific viewpoint, on the most up-to-date industry advances in waterjetting equipment, techniques, and applications. The areas to be addressed include, but are not limited to:

- **Abrasives, Water, and the Environment**
- **Advanced Industrial Applications**
- **Advances In High Pressure Technology**
- **Automotive and Aerospace Applications**
- **Cleaning and Coating Removal**
- **Components and Systems**
- **Construction and Non-Manufacturing Applications**
- **Contractor Applications and Processes**
- **Demilitarization, including Removal of Land Mines (demining)**
- **Drilling Applications**
- **Excavation, Tunneling, and Mining Applications**
- **High Pressure Equipment and Systems**
- **Jet Mechanics**
- **Jet-Material Interaction**
- **Manufacturing Processes**
- **Market and Future Needs**
- **Novel Jets and Applications**
- **Process Modeling and Control Studies**
- **Rock Cutting**
- **Safety, Training, and Environmental Protection**

Commercial and academic authors are encouraged to submit titles and abstracts for consideration. To submit an abstract(s), please complete the abstract submission form on the back of this sheet, attach a copy of your abstract(s), and forward to the attention of the Conference Coordinator at the WaterJet Technology Association. **The deadline date for submission of abstracts is December 31, 2002.**

An Abstract Review Committee consisting of six referees will review the abstracts. Authors will be advised by **February 28, 2003**, regarding the decision of the Abstract Review Committee.

The 2003 WJTA American Waterjet Conference is organized by the **WaterJet Technology Association** and is endorsed by the **International Society of Water Jet Technology**. The WaterJet Technology Association looks forward to providing this forum and to your involvement and participation.

Authors - Please Note

- Papers must be original. Papers must not have been published elsewhere or be pending publication.
- A nonrefundable publication fee of $460 is required. **This publication fee will be waived if at least one author registers (Full or Combo) for the WJTA Conference.** Also, one registration is good for multiple papers. The deadline date for receipt of your final paper will be **April 18, 2003**. The publication fee or payment for a Full or Combo registration is due no later than **June 2, 2003**. Your paper will not be included in the Proceedings if the publication fee or registration fee is not paid by this date.
- Papers and presentations must be in English. Papers should be no longer than 15 printed pages. A "Paper Guide" containing directions for submitting papers will be forwarded to you after your abstract is accepted. Papers that do not follow the "Guide" will be returned to the author(s) for correction(s) or charged a fee for revisions made by the WaterJet Technology Association office.
- Papers should be free of commercialism.
- Papers should be submitted as a Word file and a PDF file. If an author cannot produce a PDF file, a fee may be charged to convert a Word file to a PDF file if the Word file requires significant reworking (e.g., page breaks, pictures moving).

2003 WJTA Conference Committee

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Nominations Open For WJTA Board Of Directors

"Nominations for the WaterJet Technology Association (WJTA) Board of Directors are now open," says Dr. Andrew Conn, secretary of the WaterJet Technology Association.

"The WaterJet Technology Association needs dedicated directors to lead the members as the WJTA grows," says Dr. Conn, who is also chairman of the Committee on Nomination. "The duties of the directors are truly challenging and rewarding."

The terms of office of Craig Anderson, Pat DeBusk, Lydia Frenzel, Larry Loper, Forrest Shook and John Wolgamott will expire in August 2003. Therefore, nominations are sought for six (6) board members, each to serve a four-year term of office beginning August 16, 2003.

The WJTA bylaws provide that no more than one of the elected board members may be from the same company or organization. Therefore, board members may not be nominated from the same company or organization that are already represented on the board by individuals whose terms expire in 2005. These companies or organizations include: George A. Savanick, Ph.D., Andrew F. Conn, Ph.D., Onyx Industrial Services (Randy Kruger), JETECH, Inc. (G.J. DeSantis), University of Missouri-Rolla (David Summers, Ph.D.), and Flow International Corporation (Mohamed Hashish, Ph.D.).

According to the WJTA bylaws, any WJTA member in good standing (2003 membership dues paid) may submit a nomination(s). Nominees must also be WJTA members in good standing. The deadline for making nominations is **March 18, 2003**. Your nomination(s) should reach the WJTA office no later than **March 18, 2003**. To submit a nomination(s), complete the Nomination Form and return to:

Chairman, Committee On Nomination
WaterJet Technology Association
917 Locust Street, Suite 1100
St. Louis, MO 63101-1419
Phone (314)241-1445
Fax (314)241-1449

Remember, nominations must be received no later than March 18, 2003.

Nominations/Elections Procedures

In accordance with the bylaws of the WaterJet Technology Association, revised in 2002, nominations and elections to the Board of Directors include the following procedures:

- At least two calls for nominations to the board of directors will be published in the *Jet News*. The first call for nominations appears in this issue. **Nominations will be accepted through March 18, 2003.**
- An official ballot listing the eligible nominees and a brief biographical sketch for each individual will then be forwarded by mail to all eligible voting members of the Association on May 18, 2003. **Signed and executed, ballots must be mailed to the Association's office for tallying by July 3, 2003.**
- The names of newly elected board members will be announced in the *Jet News* and on the WJTA web site.

Only eligible members of the WaterJet Technology Association may submit a nomination and nominees must be eligible members of the WaterJet Technology Association.

WJTA WaterJet Technology Association Nomination Form

Name Of Nominee _____ Title _____

Address _____

City _____ State _____

Country _____ Postal Code _____

Telephone

In US/Can (____)_____ (area code) Outside US/Can [____] (____)_____ [country code] (city code)

Fax

In US/Can (____)_____ (area code) Outside US/Can [____] (____)_____ [country code] (city code)

Attach biographical information with a brief statement of your nominee's mission and vision for WJTA.

Name Of Nominator _____ Title _____

Address _____

City _____ State _____

Country _____ Postal Code _____

Telephone

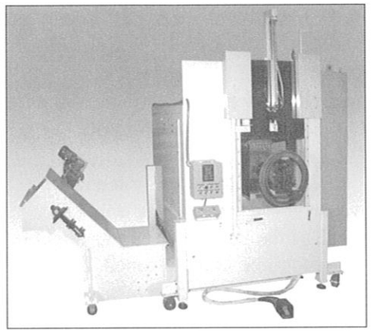
In US/Can (____)_____ (area code) Outside US/Can [____] (____)_____ [country code] (city code)

Fax

In US/Can (____)_____ (area code) Outside US/Can [____] (____)_____ [country code] (city code)

Precision Cleaning® Technology

Triplex Systems, Inc., specializes in manufacturing high and ultra-high pressure waterjet cleaning centers for industrial cleaning applications. The cleaning centers contain the waterjets within the cleaning cabinets, allowing the use of high and ultra-high pressure water on the factory floor. Applications for waterjet cleaning are very diversified from removing adhesives and coatings from metal substrates to removing ceramic material from investment cast parts. Triplex Systems, uses water only in its cleaning processes with high or ultra-high pressure water providing the cleaning energy. The cabinet style cleaning centers are available as manually operated cleaning cabinets, where operator views the parts to be cleaned through a viewing portal, while directing the waterjet remotely, by a gimbal mounted lance. The company also manufactures automatic cabinet style cleaning centers, where parts are cleaned automatically using a carousel or batch processing with fixtures to a programmed cleaning sequence. Triplex Systems has a total system approach, providing its customers with an engineered cleaning center, specialized conveyors for removing debris from the cleaning process and reclaiming the process water for reuse. Triplex Systems, has been awarded several patents for rotary clamping mechanisms, used for remote manipulation of parts during the waterjetting process. The use of these clamping mechanisms in the cleaning centers in conjunction with waterjetting lance movements is comparable to precision machining methods. The clamp or turntable rotates the parts and the lance tracks the parts at the optimum distance for cleaning. Triplex Systems has the registered trademark Precision Cleaning®, which best describes the results of cleaning techniques achieved using waterjetting technology. Triplex Systems, has standard cabinet designs and offers custom design services to meet the customers cleaning applications requirements.



Statoblast Precision Cleaning® high pressure waterjet cleaning center, designed for cleaning stators and rotors used in the aerospace industry.

For more information contact: Joe Tebbe, President, Triplex Systems, Inc., 2859 84th Lane NE, Minneapolis, MN 55449 USA, phone (763) 786-8027, fax (763) 786-6286, e-mail Jtebbe@triplexsystems.com

Four Keys To Quality Cleaning Jets

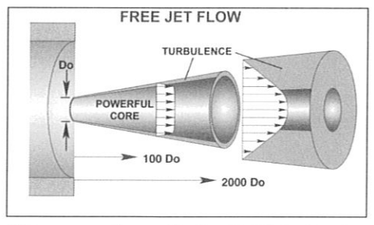
When water jetting, it's important to use a tool well designed for the job — but that by itself is not enough. Factors outside the realm of tool design are also important.

In the simplest terms, the goal of a water jetting system is to deliver as much of the pump's power as possible to the surface being cleaned. Use of the wrong tools or mismatched equipment can forfeit as much as 80 percent of the jetting pump's power.

Four factors are critical to productive, profitable water jetting.

1. Preserve jet quality

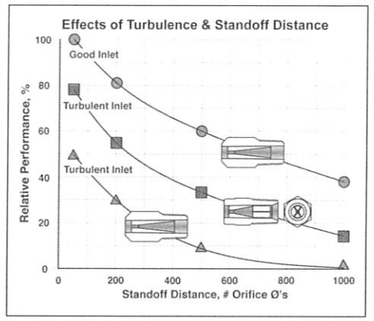
The first prerequisite for a successful job is excellent quality jets. The jet is nothing more than a shaped restriction in the flow channel that forces the water to accelerate, converting potential energy (pressure) into kinetic energy (velocity).



The power of even the best jet deteriorates with distance.

The jet shape, materials, and upstream flow turbulence are all important to delivering maximum energy to the work. The powerful, cohesive, high-velocity jet is established in the first 8 to 25 orifice diameters downstream from the orifice. Farther away, the outside surface of the jet is slowed by drag through the air.

Droplets of water appear in the air surrounding the jet, and bubbles of air are entrained into the jet's outer surface. This turbulent zone grows at the expense of the powerful, cohesive core of the jet until there is no power left at all. Only the cohesive core of the water stream cleans effectively, not the turbulent zone.



Greater turbulence and greater distance from the work surface reduces jet performance.

Even the best jet deteriorates with air drag. It is possible, though, to lose as much as half the jet's power at the start due to excessively turbulent flow upstream of the jet. Turbulence can be increased by abrupt diameter changes in the flow channel, or by direction changes.

Of course, we can't avoid turbulence completely, so we need ways to repair its effects. Fortunately, that can be done with a straight section of pipe, or with a flow straightener inlet to the orifice.

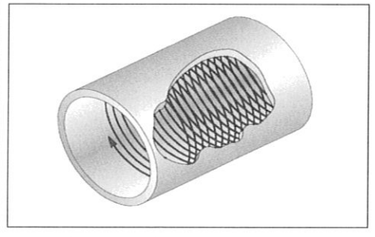
Eventually every nozzle wears out from erosion caused by microscopic cavitation from the high-velocity water. Seen through a microscope, the eroded surface looks like a rough canyon. That rough flow channel causes rapid growth in the turbulent zone, which can be seen as a fanned-out shape to the water jet.

In severe cases, the orifice diameter grows to the point that pump discharge pressure falls. Even before it's worn so badly that pressure falls, the jet's impact power is severely reduced. When cleaning performance deteriorates, with no obvious reason, then it's time to replace nozzles.

Erosion-resistant materials are important in jet design. Ceramics are probably the most erosion-resistant materials. Tungsten carbide nozzles are also popular, and hardened, plated, polished stainless steel nozzles can last even longer. Whatever the material, the important point is to select nozzles that start with a visible tight, cohesive jet shape, and retain it for a long time.

2. Manage the numbers

The second important principle is to use the fewest and most powerful jets possible. If one good jet doesn't cut the surface of the deposits to be cleaned, then more of them will not do better.



A rotating water jet cleans the pipe surface in a helical pattern.

Consider the conventional assortment of jetting nozzles used — non- rotating sleds, bullets, torpedoes — needing 6 to 12 jets to clean without leaving dirty streaks. These are good designs because they have no moving parts and are inexpensive. The drawback is that they divide the

(continued on page 8)

Questions From The Internet, from page 18

sandblasting tools. We are doing a study for the government (Canada). We would be very interested if you could provide us with any information on the subject or if you could refer us to a specialist, an organization or a company that might know something about the subject.

Q

The information that I am looking for is where I can find the published standard or the published length on waterblasting gun. What is the name of the organization or institute that has set these standards and where can we obtain a copy of the standards?

Q

I'm looking for the outfit that performed the hydrodemolition recently at Davis Bessie Nuclear Site. In this case a hole was cut into the reactor building to permit a new reactor head egress. Any help is greatly appreciated.

Q

On board we have one of your units a 160A3W-UHDT serial #63160-001-101. I am looking to purchase a spare set of high pressure hoses that connect the unit to tumblebox and tumblebox to TAPT style B gun. The unit is rated with 47,500 psi rupture discs.

Can you please provide me with all information as regards various hose lengths, adaptor couplings for joining different lengths of hose, all complete with prices and part order numbers?

Q

Could somebody tell me what is "Hydraulic Braking Coefficient of Solids" connected with waterjet technology?

Q

We have some 3-4 million square feet of concrete to prepare and coat over the next few years. One concern I have is ASR. I do not know much about it. What can you tell me about Alkali-Silica Reaction (ADR) as it relates to high pressure waterjetting concrete and its eventual effect on subsequent applied coatings? I understand there are some chip manufacturing facilities that have serious coating failures associated with waterjetting activating the ASR. Do you know anyone I can contact on the subject? I understand it is a real problem and waterjetting enhances the problem much more than abrasive blasting.

Q

I'm a consultant. One of my clients, in Italy, is looking for a waterjet machine to cut out slices of wall in a tunnel. Mainly the wall is in concrete. Can you suggest a producer for such a machine in the US or Europe?

Forward your input to the WJTA office by fax: 314-241-1449, email: wjta@wjta.org or by mail to: WJTA, 917 Locust Street, Suite 1100, St. Louis, MO 63101-1419.

Are you signed up for the **WJTA***ListServ*? The *ListServ* is an email broadcast system developed by WJTA to help you communicate and network with other WJTA members. The system is still new and growing and we are working out the kinks as we go. An enrollment form for the *ListServ* appears below.

WJTA*ListServ* Now Available To Members

Take advantage of prompt e-mail interaction with your colleagues!

How does **WJTA***ListServ* work?

Forward your question, comment or request via e-mail to **WJTA***ListServ*. Your e-mail will be forwarded to other **WJTA***ListServ* participants who then have an opportunity to respond. Everyone on the **WJTA***ListServ* receives the questions, comments and/or requests made by other participants.

You are not required to submit questions and/or comments in order to participate in the **WJTA***ListServ*. **WJTA***ListServ* is a benefit of WJTA membership and is **FREE** to members in good standing.

To participate in **WJTA***ListServ*, simply fill in the information requested below and return to the WJTA office.

PLEASE PRINT

Name _____ WJTA Member # _____

E-mail _____

Phone (___) _____ Fax (___) _____

Fax the completed form to WJTA: (314)241-1449, or mail to: WJTA, 917 Locust Street, Suite 1100, St. Louis, MO 63101-1419.

Abrasive Jet Cutting At 87,000 PSI

In response to market demand for lean parts production capabilities, Flow International Corporation has introduced the HyperJet™ abrasive waterjet cutting machine.

The HyperJet will revolutionize waterjet cutting for the sheet metal industry through the world's first commercially viable application of 87,000 psi (pounds per square inch) hyper pressure waterjet pump. Harnessing the power of 87,000 psi, the HyperJet can cut 30 percent to 40 percent faster than lower pressure machines and uses 40 percent less abrasive to help reduce operating costs.

For years, manufacturers have searched for economical methods to produce a variety of parts quickly to help maximize profits. Traditional cutting processes such as laser and punch press require lengthy and expensive set-up times in order to cut different parts. However, the HyperJet like all waterjets, can easily switch shapes, material, and thickness without the time consuming set up, tooling, or fixturing changes required by other machine tool processes. As a result, manufacturers are able to produce a variety of parts quickly and efficiently, as they are needed, without pausing operations to change presses, gases, or cutting heads.

To optimize specific applications of sheet metal cutting, the HyperJet features a unique machine design that moves material from left to right under a cutting head that moves from front to back By splitting the cutting motion between the work piece and cutting head, the dynamics of motion are improved, cuts are faster and more precise.

Users of the HyperJet machine will also realize:

- Greater flexibility in manufacturing a wide variety of materials
- Easier loading and unloading of material
- Lower cost and complexity than competing technologies
- Simpler, ease-of-use operation with no tool or setup changes
- Faster cutting of thin-gauge material than conventional pressure waterjets
- No heat-affected zone (HAZ)

"The HyperJet is a breakthrough that makes Flow's waterjets highly competitive against laser cutting and punch presses in nearly all applications, greatly expanding the available market," says Ron Tarrant, chairman, president and chief executive officer of Flow International. "This technology provides manufacturers a solution that can make lean and just in time production a practical reality."

For more information, visit www.flowcorp.com or call (253)850-3500.

Questions From The Internet, from page 16

machining, because in our country waterjets are little known. We are studying its principles, theoretical foundations and industrial applications. We designed and built a nozzle for waterjet machining in order to adapt it to a hydroblasting machine and to run experimental testing for cutting and cleaning.

The nozzle was tested by using two different jewel designs. The experiments were carried with nozzle exit diameters of 0.2 and 0.5 mm. The running tests were made for cutting cardboard, thin wood, thin sheets of aluminum and a sheet of acrylic, and for a hydroblasting application.

In addition, I am writing a paper concerned with our nozzle design, results reached and experience required.

I am looking for a standard on hydroblasting, since it could be used as a guide with the objective of continuing with our learning process.

I look forward to hearing from you.

Q

I would like to know if you might help me in getting the name of a norm or standard for the hydroblasting process.

Q

As we are going to export garnet I will be thankful if there is any reference laboratory in Europe to test and evaluate our abrasive.

Q

We are studying different material cutting technologies and would like to use the latest in metal cutting for some of our applications. For this we require some of the latest technical papers on the subject, the machine manufacturers, the process and machine parameters.

Q

We are looking for low (or lower) noise-emission nozzles for hydrodemolition and/or

(continued on page 19)

Four Keys To Quality Cleaning Jets, from page 6

pump horsepower into 6 to 12 relatively low-powered jets. Greater power is delivered to the surface with fewer, more powerful jets, rotated to cover the entire surface in a helical jet path. In a nozzle using, for example, three or five jets, each jet is 2 to 2.5 times as powerful as the non-rotating alternative.

3. Control rotation speed

The third important factor is to control rotation rate to avoid unnecessary jet quality deterioration, and to provide enough dwell time so that the jet can do its work.

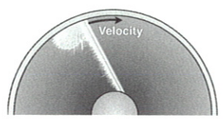
A good rule of thumb is to provide about 15 mph transverse jet velocity along the surface being cleaned. This rule works whether the tool is cleaning a one-inch-diameter heat exchanger tube, a 12-inch sewer pipe, or a 40-foot-diameter crude oil storage facility.

Jet Movement at the Wall

Rotation	Transverse Jet Velocity 8" Ø Pipe	12" Ø Pipe
300 rpm	7 MPH	22 MPH
3,000 rpm	71 MPH	224 MPH
10,000 rpm	240 MPH	358 MPH

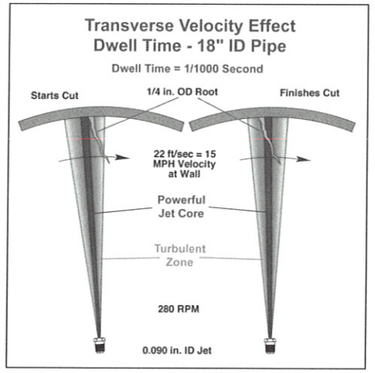
Max. Transverse Velocity = 15 MPH = 22 ft/sec

Pipe ID	4"	8"	18"	36"	60"	180"
Max. RPM	1240	620	280	140	80	27



Effective pipe cleaning depends on maintaining the proper transverse jet velocity.

Now consider the dwell time for a typical jet in the case of a quarter-inch-diameter root coming through a crack in the wall of an 18-inch-diameter sewer. At 280 rpm, or 15 mph transverse velocity, the powerful core of the jet contacts the root for only one thousandth of a second. Clearly, rotating too fast impairs results. Besides reducing dwell time, rapid rotation increases turbulence in the jet.



At 15 mph jet transverse velocity, the powerful core of the jet contacts the root for just .001 second.

The bigger the diameter, the slower the rotation required. Large pipes or vessels may require air-motor-powered gearboxes to keep rotation slow enough to maintain the necessary transverse velocity at the wall.

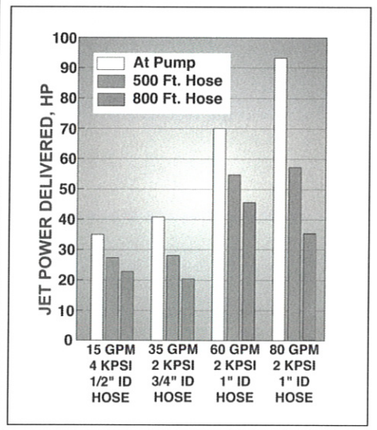
Unfortunately, rotation speed control adds complexity and expense to a jetting tool. Some nozzles rely on a viscous fluid governor to brake the rotation speed, but other technologies work too. For example, centrifugal and magnetic mechanisms are also effective. Users need to recognize when the rotation control system needs repair. The best tool is the human ear. If the rotating nozzle sounds like a jet aircraft engine, it's too fast, and repairs must be done before the seals and bearings burn out.

4. Manage hose pressure drop

The fourth important factor is to balance hose pressure drop for the pump being used. Hose pressure drop — a direct, proportional loss in power — is caused by friction as water molecules slide across the wall of the hose and against other water molecules in the hose. The only ways to reduce pressure drop are to use shorter or larger-diameter hose.

Sewer cleaning requires relatively long hoses, and larger diameter hose is heavier and so more difficult to pull through the pipe. So even in the best case, 20 to 25 percent of a jetter's power is lost to hose pressure drop.

Most contractors replace worn-out hose with a long section, cutting it off as the end wears or gets damaged. If you notice more powerful jetting with old hose, that's because it is a shorter hose with less pressure drop. It can make sense to buy shorter lengths as replacements.



Power delivered decreases with the length of the hose.

Higher-pressure, lower-flow pump combinations lose proportionately less power to hose pressure loss. That's because less flow has to go through the hose, and pressure loss is a smaller fraction of the initial pressure.

(continued on page 9)

Succession in Place As Tarrant Resigns Board and CEO Positions

Flow International's CEO Retires

Flow International Corporation has announced that Ron Tarrant has stepped down as chairman, CEO and board member.

Tarrant, age 65, announced his intention to retire last month. He will continue to serve as president, focusing on customers, sales and marketing while the company continues its search for a new president and CEO. The company has been working with the SpencerStuart executive search firm and expects to appoint a successor by the end of the year. Until then, day-to-day company operations will be overseen by a chief operating office reporting to an interim chairman. The office of the COO will consist of four FLOW senior executives: Pat Adams, president and CEO of Avure Technologies; Tom Johnson, SVP – Global Manufacturing of Flow International; Bruce Carlson, VP – Information Technology of Flow International; and Dick LeBlanc, EVP – Sales & Marketing of Flow International. Together, these four executives have more than 26 years of experience at FLOW.

Tarrant was appointed president, CEO and member of the board in 1991. He has been chairman of FLOW since 1994. FLOW's board of directors has appointed Kathryn Munro as interim chairman. Munro has been a member of the FLOW board since 1996. She sits on a number of corporate and community boards and is chairman and CEO of Bridge West, a technology investment company.

"We greatly value Ron's many contributions to Flow International and thank him for his efforts in building a successful global enterprise," comments Munro. "Ron has been instrumental in cultivating the company's industry-leading technology into two distinct lines of business – waterjet cutting and food safety. We look forward to his ongoing advice and counsel."

Tarrant adds, "I am grateful to everyone at FLOW for their hard work and dedication to achieving our vision. Together, we have accomplished a great deal, and I look forward to a bright future for the company."

The *Jet News* is published by the WaterJet Technology Association (WJTA) and is a benefit of membership in the Association.

Questions From The Internet

The WJTA office frequently receives questions from all areas of industry regarding waterjet technology. Many of these questions are posted to the WJTA ListServ to gather input from ListServ participants.

Reprinted below are several of the questions that have appeared on the WJTA ListServ. We welcome your practical suggestions and input.

Q

I was thrilled to find your web page! I am an artist working in glass and metal and was looking for information on waterjet equipment for cutting those materials. I am considering starting a business. Though I've no idea how expensive waterjet equipment is, it cannot be as involved as metal welding and safety equipment. I have a couple of questions.

First, is there a waterjet company in the New Orleans, Louisiana, area?

Second, I know that waterjets cut through glass. Do they also cut through metal, and if so, what kind and what thickness? (Though I imagine it all depends on the size of the waterjet and its pressure.)

Third, if there is not a business already established in this area, and I was to get a business loan to begin such a business is there information available to help?

Q

I am a mechanical engineering student. I am working in the 3rd Automation and Experimental Manufacturing Research Seminar at the Universidad Nacional de Colombia. In this seminar, it was decided to learn about waterjet

(continued on page 18)

Versatile High-Pressure Industrial Water Jetting 900G Series

Gardner Denver Water Jetting Systems, Inc. offers the most complete line of high pressure water jetting units in the industry with more choices to solve your cleaning problems. The Liqua-Blaster 900G Series was developed in response to the need for high flow rates at high pressure in a rugged, cost-effective packaged unit.

The Liqua-Blaster 900G Series is equipped with our TG-600HB/S pump, which combines a Partek fluid end and a Geoquip power end, representing two Gardner Denver product lines. The Liqua-Blaster 900G Series is ideal for power plants or other locations that utilize semi- or fully-automated systems.

All units are variable speed, and include diesel engine, five-speed transmission, fuel tank, pump filtration, pump instrumentation, and safety relief systems.

Standard Equipment

Instrumentation. Convenient, large engine-mounted instrument panel includes key ignition, vernier or automatic throttle control, low oil pressure and high water temperature shut down for maximum engine protection.

300 Gallon Fuel Tank. 300-gallon fuel tank combined with the low fuel consumption of the engine provides more hours of run time.

Power. The Liqua-Blaster 900G is equipped with a powerful water-cooled diesel engine (450-540 HP). Parts and service are available worldwide with engine emissions that meet or exceed most worldwide regulations.

Drive System. The Liqua-Blaster 900G uses a heavy-duty shaft-mounted gear box for longer life.

Transmission. The Liqua-Blaster 900VS is equipped with a five-speed heavy duty transmission. This provides five distinct pump speeds without changing plungers or fluid ends. Power is transmitted to the pump through a short-coupled drive shaft, which provides low vibration operation, and reduces maintenance.

Lubrication Systems. Incorporate power end/gear and transmission, 10 micron oil filters, oil circulation pumps, oil coolers, and safety system shutdown.

Discharge Plumbing. All high pressure connections are rated for at least 2.5 times the working pressure. Fluid end is equipped with stainless steel relief valves and rupture discs.

Suction Plumbing. Dual stainless steel filters delivers clean water to the pump.

For more information, call (281)448-5800 or visit the new Gardner Denver web site: www.gardnerdenver.com. The waterjetting.com and crspowerflow.com are in the process of being rerouted to the new corporate site. All of the Gardner Denver Water Jetting products will be featured on the site, with PDF files to explain the more technical aspects of each product.

Four Keys To Quality Cleaning Jets, from page 8

The illustration suggests an important way to manage hose pressure loss. Compare the 60 gpm, 2,000 psi and the 80 gpm, 2,000 psi cases. More power is delivered by jetting the bigger pump at 60 gpm than at 80 gpm.

Engineers call this optimization. Since the jets control the flow, it's easy to accomplish. The pump will operate throttled back a bit from maximum power, but more power will be delivered to the sewer jetting tool.

Getting to work

In summary, a few excellent-quality jets with minimum turbulence, rotated at controlled rates, with enough but not excessive hose length, can dramatically improve jetting results. Now, here's a look at some specific applications for water jetting technology.

Cutting roots. Water jets will cut roots, but real roots are not clamped in exactly the right position in front of the nozzle. Roots bigger than about 3/16 inch diameter require waterblast pressures to cut with confidence. The real challenge is nozzle placement — the jets must hit the roots to have an effect. TV inspection equipment has been used to place the nozzle in perfect position, and amazing root cutting can result. On the other hand it's possible to pass the nozzle through the root mass so quickly that the roots are left very clean, but not cut.

Descaling. Corrosion products and mineral deposits often need to be cleaned to restore sewer capacity, or to allow lining. Mineral scale can be particularly difficult to remove, requiring in some cases up to 10,000 psi. Fortunately that's not always the case, and typical sewer jetting pumps are successful. Best results are delivered by jets that impinge almost directly on the pipe walls (a slight angle helps the deposits flake off). The problem is that this jet geometry will not allow the nozzle to pull itself. The most powerful approach is to use conventional pulling jets to pull the hose and nozzle to the next manhole or access point, then plug the pulling jets, and jet the line while retracting the hose with jets installed at the preferred geometry. If there's no access at the end of the run, then power will have to be diminished by what it takes to pull the hose.

Concrete removal. Water jets are used for concrete demolition, but at 14,000 to 18,000 psi, and 40 gpm or more. That's a 400 hp pump. The feasibility of removing concrete using sewer jetting equipment depends on how

(continued on page 10)

Four Keys To Quality Cleaning Jets, from page 9

well water, sand, silt, and other debris in the sewer have diminished the strength of the concrete mix. Sometimes a fortunate accident occurs, allowing removal at relatively low pressures attainable with sewer jetters. Each case requires a trial-and-error approach, with custom jet geometry and multiple passes to tunnel through the plug, then bore it out to the sewer walls.

Manhole repair. Infiltration of storm water into sewer systems overloads treatment facilities, causing effluent flows to exceed permitted levels. Manholes are a major cause of infiltration, and manhole repair projects are in progress all over the United States. The typical jet-vac sewer truck is ideal for cleaning manholes using the properly selected sewer nozzle with some custom accessories.

Big-diameter lines. Fortunately, most of the sand, silt and debris that collects in sewers lies in the bottom of the pipe, making it unnecessary to clean the top walls. Roots, scale, and big grease plugs are exceptions. When it is necessary to clean both top and bottom, then centralizing devices are used to place the jetting nozzle near the sewer centerline. In such cases, extension nipples can be used to place the jets close enough to the sewer wall that a high fraction of the jet's initial power is delivered to the surface. In lines larger than about 3 feet diameter, rotation speed control are required.

Mark House is Marketing Manager with StoneAge Waterjet Tools of Durango, Colo., a manufacturer of rotating nozzles, swivels and systems for water blasting and sewer cleaning contractors. He can be reached at 970/259-2869 or mark@stoneagetools.com.

This article first appeared in Cleaner magazine, August 2002. It is being reprinted by permission of COLE Publishing, Inc., P.O. Box 220, Three Lakes, WI 54562 800-257-7222 / www.cleaner.com Three Lakes, Wisconsin.

ESAB Cutting Systems Releases Columbus Software For Cutting Machines

ESAB Cutting Systems, Florence, South Carolina, has announced the release of their new Columbus software. Columbus is an integrated software package designed specifically for cutting machines. Columbus is the first cutting system software designed by a cutting machine manufacturer specifically to meet the needs of the cutting industry. Designed by ESA, the software was first introduced in Europe and has been proven in thousands of installations throughout the world over the past 15 years.

The Windows®-based programming package offers simple set-up and full process control for every cutting machine in a shop, plus part programming, true shape nesting, common line cutting, plate and inventory management, parts management and machine-specific estimating in a single integrated package. Columbus software modules can run on a desktop workstation or the basic package (Vision Plus CNC) can run directly on an ESAB Vision PC or NT control In addition, Columbus will support other manufacturers' cutting systems.

An intuitive, user-friendly graphic interface, customized functions and automatic processes make programming easy. Columbus software allows users to control every cutting machine in a shop with the click of an icon. Set up and run programs for multiple machines with a single software package rather than learning and maintaining several packages. Columbus also allows the user to create their own post-processors to add machines or additional processes without requiring additional programming from ESAB.

Columbus supports straight or bevel cutting with waterjet, oxyfuel, plasma, and laser, plus all current marking devices, in numerous combinations. Users can make an interior cut using waterjet, laser or Precision Plasma and change to the standard Plasma Process for outside perimeter cuts by simply selecting a few icons. Because ESAB holds patents on many multi-process systems, the company has integrated its technical knowledge into the Columbus software to program multiple processes in the same file. Columbus also supports and simplifies bevel cutting or laser, plasma or oxyfuel beveling, allowing bevel parts to be programmed and posted in seconds. The software automatically programs the tilt and rotate commands.

When used with ESAB's Vision CNC and ESAB's exclusive programmable cutting parameters (SDP files), Columbus software facilitates fast, easy set up. All process parameters – gas and water flows, pierce time, speed, kerf, height control, cutting amperage, etc. – are stored in the CNC, along with optimum settings for different materials and thicknesses. This feature eliminates guesswork and ensures consistent cutting results even with changing operators.

An estimating module tracks specific information such as the machine's cutting speeds, rapid speeds, lift speeds and pierce times for accurate job costing. This information can be exported to Excel or other databases for customized reporting and costing.

For more information on the new Columbus software and other cutting systems and products, contact ESAB Cutting Systems at 843-664-4394 or visit www.esabcutting.com or www.esab.com

Flow's Waterjets Well Received At Chicago Trade Show

Flow International Corporation has announced that its Dynamic Waterjet™ and other waterjet technologies were well received by manufacturers at the recent International Manufacturing Technology Show (IMTS) in Chicago. The Dynamic Waterjet cuts more effectively and up to four times faster than traditional waterjets. At IMTS, FLOW introduced its breakthrough HyperJet™ the world's only commercially viable 87,000 psi abrasive waterjet cutting tool for the sheet metal industry. The HyperJet can cut 30%-40% faster than lower pressure machines and uses 40% less abrasive, reducing operating costs.

"Despite signs in Chicago of broad, ongoing weakness in machine tool spending, we are extremely pleased with the continued commercial acceptance of our waterjets," says Ron Tarrant, chairman, president and CEO of Flow International Corporation. "Sixty percent of our sales at this year's IMTS show were of our Dynamic Waterjet, which we introduced at last year's show. Compared to our best trade event ever two years ago at IMTS, sales were down only 6% on a lower number of units sold. But new product developments resulted in a higher dollar amount per order and higher value for our customers, which demonstrates that even in a weak economy we continue to take market share as manufacturers recognize the savings and other benefits of waterjets, which cut a wider range of materials than lasers or other technologies."

For more information, visit www.flowcorp.com or call (253)850-3500.

Safety Committee Solicits Comments On Improvements To Recommended Practices

The WJTA Safety Committee solicits comments regarding improvements to the publication, *Recommended Practices for the Use of Manually Operated High Pressure Waterjetting Equipment.* While the Recommended Practices is reviewed periodically at the biennial conferences of the WaterJet Technology Association, your comments and suggestions for improving the publication are invited and welcome anytime.

Please address your comments and suggestions to: Safety Committee, c/o WJTA, 917 Locust Street, Suite 1100, St. Louis, MO 63101-1419, fax: (314)241-1449, e-mail: wjta@wjta.org, web site: www.wjta.org.

Welcome WJTA New Members

Corporate

Power Prep International, Ltd.

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Anne Henderson
Tom Earland

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Tulsa, OK 74133
Phone: (918)252-5090
Fax: (918)252-5433

Upcoming Events

March 20-23, 2003

China Stone+Biz, a program and exhibition for the stone industry and related tools and equipment, Xiamen International Conference and Exhibition Center. For more information, visit www.stonebiz.net or contact Xiamen Intop Exhibition Company, Suite 103, No. 141 Nanshan Road, Xiamen, Fujian, China (361009), phone: (86)592-2392333, fax: (86)592-2396880, email: Intop@public.xm.fj.cn

March 24-27, 2003

Coverings 2003, a trade exposition for the ceramic tile, stone and floor coverings industry, Orange County Convention Center, Orlando, Florida. For more information, visit www.coverings.com or contact Coverings, 11940 U.S. Highway One, Suite 200, North Palm Beach, Florida 33408, phone: (561)776-0600 or (800)881-9400, fax: (561)776-7466, email: info@coverings.com

May 18-22, 2003

7th Pacific Rim International Conference on Water Jetting Technology, Seogwipo KAL Hotel, Jeju, Korea. Abstracts are now being accepted for the program. Contact Conference Chairman Prof. Chung-In Lee or Conference Secretary General Dr. Wan-Mo Kim, The Korean Society of Water Jet Technology, Research Institute of Energy & Resources, Seoul National University, San 56-1 Shilim-Dong, Gwanak-Gu, Seoul, 151-742, Korea, phone +82-2-880-7233, fax +82-2-873-2717, e-mail: kswjt@kojet.org, web site: www.kojet.org

August 16-19, 2003

WJTA American Waterjet Conference, Adam's Mark Hotel, Houston, Texas.
Celebrating the 20th Anniversary of the WaterJet Technology Association.
Visit www.wjta.org, email wjta@wjta.org, call (314)241-1445 or fax (314)241-1449.

Letter To The Editor

5,000 PSI SWASJ Drilling In Reinforced Concrete

Dr. Andy Graettinger and I have been working on SWASJ (SUPER-WATER® abrasive suspension jet) drilling in concrete – our results so far are as follows:

Most abrasive-waterjetting systems use an external feed of abrasive. A separate feed of dry abrasive is incorporated into the liquid jet immediately downstream of the nozzle. The advantage of this system is that the mixing occurs at atmospheric pressure, but the requirement for separate liquid and particle streams can be a drawback, and unfortunately this system is not conducive to effective momentum transfer between the liquid and the abrasive. Swanson et al. (1) have shown that external feeds produce an abrasive velocity of only about 25% of the water velocity so external feed systems require very high water pressures to achieve effective cutting.

We were interested in drilling very fine (1/2-inch diameter), deep holes (100 feet), and for that application two feed streams are impractical. After extensive consultation with Dr. David Summers at the University of Missouri-Rolla we designed and built a 5,000-psi system that mixes the abrasive into the water stream between the pump and the nozzle. This system uses an accumulator charged with a concentrated suspension of garnet abrasive in a water solution of SUPER-WATER® to gradually feed the abrasive into the water stream. This is a so-called SWASJ (SUPER-WATER® abrasive suspension jet) as first developed by Hollinger (2,3). Because the abrasive is pre-wet and premixed with the water upstream of the nozzle, momentum transfer is very effective and the tip size can be minimized.

By weight the suspension that we use consists of 0.66% SUPER-WATER®, 66.22% garnet (Barton HPX 80hpx) with a specific gravity of about 4.2 and 33.11% water. Thus the liquid fraction is 2 weight % SUPER-WATER®. That mixture has good flow characteristics, yet samples that have rested on the shelf for as much as a month show little or no tendency for the garnet to settle out.

We are drilling with a total flow of about 2.7 gpm. Under those conditions we have measured the feed rate of garnet to be about 1.3 lb/min, and calculated that the SUPER-WATER® makes up about 0.11 weight % of the total liquid stream.

(continued on page 13)

Waterjets On A Coal Mining Machine, from pg. 1

Longwall shearers such as that shown on the cover of this issue of Jet News produce a significant part of the coal mined in underground mines in the United States. Waterjet sprays are used to knock down a portion of the dust clouds produced in the cutting process and thus reduce the exposure of coal miners to respirable dust. Conventional spray systems operate at 200-300 psi and run continuously.

Research has indicated that dust control can significant be improved in these machines if the following design changes are made to the waterjet system:

1. A waterjet is directed to impinge on the coal immediately in front of the cutter tip.
2. Waterjet pressure increases to 3,000 psi.

Other positive results from making these modifications include increased bit life, reduced frictional sparking and improved cutting efficiency.

Researchers have also demonstrated the feasibility of phasing the water supply to the cutter head so that waterjets operate only when the cutter bits are in contact with the coal. This minimizes water usage by eliminating the water sprayed into the air.

— George A. Savanick, Ph.D.

5,000 PSI SWASJ Drilling In Reinforced Concrete, from page 11

We have tested this system on concrete light poles supplied by a local manufacturer. We chose them because they were the strongest concrete we could find. The details of their manufacture are secret, but they are spun-formed tubes that have exceptionally high compressive strength, dense aggregate packing and steel cable reinforcement. Our system drills very effectively through all components of those poles, and through steel rebar, and using a 1/4-inch o.d. drill rod we have succeeded in making test holes as small as 1/2-inch in diameter and 16 inches deep. We foresee no major difficulties in extending these holes to the full target depth.

— Philip W. Johnson P.E., Ph.D.
— Andrew Graettinger, Ph.D.

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3. R.H. Hollinger and R.J. Mannheimer, "Rheological Investigation of the Abrasive Suspension Jet," Proceedings of the 6th American WaterJet Conference (Houston, Texas, August 24-27, 1991), pp. 515-528.

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