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Keyhole Technology News

KEYHOLE TECHNOLOGY PROGRAM APRIL 2008

Micro-Excavation Provides Major Benefits

Soon to be on the market is a new micro-excavation tool that allows utility crews to safely, rapidly, and conveniently uncover buried facilities by creating soil openings as small as four to six inches in diameter.

Pre-production models of the tool are currently being tested by GTI, Nicor Gas, and Northern Indiana Public Service Company, with an additional 10 companies obtaining models for field use throughout 2008.

Marketed by Concept Engineering Group Inc. under license to GTI, the tool employs a fluid lance to provide micro-openings in nearly all soils. The device uses pressurized air and water, either individually or simultaneously, to excavate small holes for a variety of tasks, including the verification of utility-line location, the direct examination of gas pipelines, tracer wire repairs, general pipe maintenance, and leak repairs.

"This is a very versatile tool that can be used for a wide range of jobs," explains Dennis Jarnecke, GTI manager of the project. "We expect the tool to provide significant benefits by decreasing the costs and time involved with completing both common and complex tasks."

The long-handled lance features an articulating head to facilitate safe excavations around the circumference of buried pipes.

The tool is engineered for the optimal use of air and water, providing superior performance to conventional waterjet or air-lance techniques.

Prior to the current field testing, prototypes were thoroughly evaluated in 2006 and 2007 with the support of project sponsors (Operations Technology Development, NFP, and GTI's Sustaining Membership Program). The new pre-production product was on display and formally introduced to the industry February 27 – March 1, 2008, in Louisville, KY, at the Pumper and Cleaner International Environmental Expo (a major show attended by manufacturers and users of hydro-vacuum equipment).

"By reducing the size of the excavation, we can reduce the overall cost of excavation and restoration activities," says Jarnecke. "Micro-excavation is a less invasive technology than conventional excavation methods such as trenching or even the digging of relatively small bell-holes or keyholes."

Researchers estimate that the annual industry savings using micro-excavation techniques over open excavation for the sole purpose of direct examination of pipelines and mains is $15 million.

At GTI, research into the development of micro-excavation is being linked with the development of new inspection tools to examine the pipe through smaller excavations to determine overall coating integrity and level of corrosion. Jarnecke notes that a variety of sensors (including fiber optics, ultrasonic transducers, and magnetic thickness gages) could be used on the pipe via a micro-hole to measure wall thicknesses, possible coating disbondment, and pitting. Through a more-encompassing effort, researchers are evaluating tools and developing processes to accomplish service abandonment, anode installation, and cast-iron-joint sealing through micro-holes.

Says Jarnecke: "We anticipate that once these applications are proven, the technology can be expanded to be used in conjunction with leak repairs, pipe-coating repairs, tracer-wire repairs and installations, and service-line installations."

For more information, contact: Richard D. Nathenson, P.E., President, Concept Engineering Group Inc. (412/826-8800/ richnathenson@air-spade.com)

Keyhole Coring & Reinstatement Standard Established in Toronto

In November 2007, after more than 15 years of monitoring and testing the keyhole coring and reinstatement process, the City of Toronto established the first comprehensive, keyhole excavation and reinstatement standard in North America.

The *Construction Specification for Keyhole Excavation and Permanent Reinstatement of Keyhole Cores* is applicable to all keyhole excavations in which a circular hole is cored through the roadway pavement or sidewalks using coring equipment.

In 1996, a pilot program involving hundreds of reinstated cores was conducted, first in composite roads (asphalt over concrete base) and then in full-depth asphalt roads. Integral to this "proof-of-process" was a field experiment, jointly conducted in Toronto by the National Research Council of Canada and

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the U.S. Army Corps of Engineers in 2000-2001 that compared the keyhole process with conventional utility-cut excavation and repair methods.

"The results were compelling," says John McGivery, a 40-year veteran of Enbridge Gas who now serves as a company consultant. "Demonstrations showed the keyhole method to be far superior to conventional utility-cut restoration methods."

After the bonding material has been poured into the hole, the core is reinstated and carefully adjusted to be level with the rest of the pavement.

After more than six years of demonstration and hundreds of successful reinstatements – with no failures – the process was formally approved by the City of Toronto in 2002 as a permanent repair for composite pavements and, subsequently, for full-depth asphalt roads. In 2003, Toronto began the development of a performance standard by which the effectiveness of the process could be ensured, and the keyhole standard – TS 4.70 – was finally promulgated in November 2007.

The standard is far reaching and comprehensive. The maximum diameter of the core is specified to be 460 mm or 18 inches, but, with prior approval of the city, larger cores up to 610 mm or 24 inches in diameter, or overlapping cores, may also be cut. The minimum depth of asphalt or flexible pavements in which the process may be employed is fixed at 100 mm or four inches. There is no thickness limitation on other types of pavement or sidewalks.

The standard also requires minimum performance criteria of the high-strength bonding material used to bond the keyhole core or coupon back into the pavement. To be approved, it requires that the bonding material be capable of generating a waterproof bond and, within 30 minutes of application at 70ºF, achieve an equivalent traffic-loadable condition that is at least two times greater than the AASHTO H-25 standard, or 30,000 pounds.

The standard prohibits the reinstatement of defective or damaged cores but allows those cores that have been horizontally delaminated between successive layers of asphalt concrete to be reinstated with the bonding compound. The standard also specifically authorizes the reinstatement of a substitute core of matching size and composition in place of a damaged core.

In the event that the keyhole cut cannot be reinstated within 24 hours (or a temporary covering is required to restore traffic flow), the standard mandates the use of a circular steel road plate, fitted with a collar, that, when inserted into the keyhole, will prevent the hole cover from tipping, tilting, bouncing, or spinning out of the hole.

"This process had its origin in the field, not in the laboratory," notes McGivery. "It was developed by work crews looking for a better and more productive way of performing and repairing utility cuts. Once we had the basic process down, we sought the assistance of the engineers who helped us improve the equipment and the methodology."

The process soon became a standard practice for Enbridge and is now an integral part of the maintenance operations of more than 25 gas distribution companies and their contractors in North America.

"It's not often that you get a chance to play a role in the development of a technology that can have a major impact beyond your own work environment," says McGivery. "Keyhole coring and reinstatement is one of those, and I am proud to see that it has been formally recognized by the city of Toronto, where it all began almost 20 years ago."

For more information, contact: John McGivery (416/753-7845; John.McGivery @enbridge.com)

PRODUCT DEVELOPMENT

Mole Systems Get Smaller & Smarter

Throughout 2008, field tests are being conducted on a new horizontal directional drilling (HDD) system designed for the installation of gas service lines through keyholes as small as 12 inches in diameter.

Researchers estimate that the tool could provide savings of nearly $900 per service installation — mostly by avoiding the need to restore pavement and landscaping.

More compact than common HDD equipment, introduction of the technology adds another tool in the arsenal of equipment utilities can use through small holes.

The small-diameter (1-3/4") piercing tool is both steerable and trackable, can be used to retrofit existing small-diameter piercing tools, and has an operating reach of at least 80 feet in a wide range of soil conditions.

Since 2005, under the sponsorship of Operations Technology Development, NFP, researchers at GTI, Louisiana Tech University's Trenchless Technology Center, and TT Technologies designed, fabricated, and tested a series of increasingly enhanced prototypes, with a primary goal of improving the system's target accuracy.

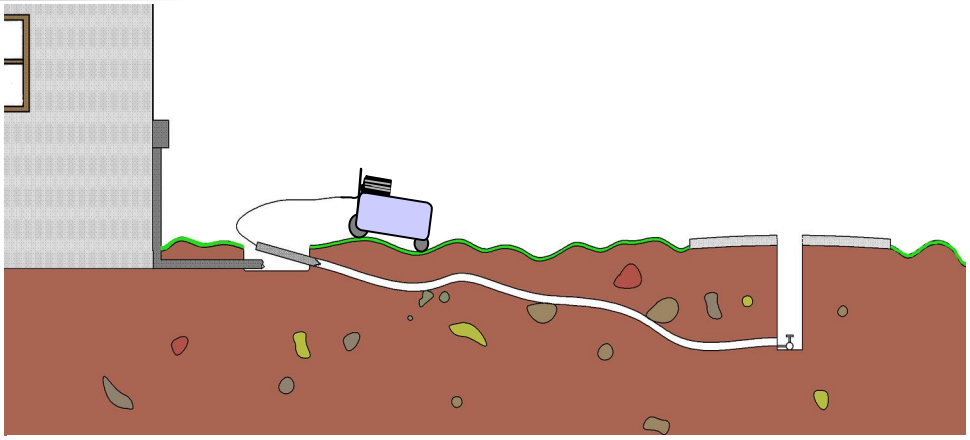
"We've thoroughly tested the tool in the laboratory and have made numerous improvements to the design," notes GTI Senior Engineer, Dennis Jarnecke. "The tool will be tested in controlled, in-ground environments in 2008 and, if successful, ready for commercialization in 2009."

A major achievement for the project was the development of a high-impact-resistant bit-orientation electronic tracking system designed to fit in a small-diameter

tool measuring 42 inches long. While keyhole-accessible piercing systems are available, they are unable to be steered and guided. Another shortcoming with conventional systems is the inability to recover the tool from the keyhole. One of the objectives of the system under development (often referred to the "smart" impact mole) is to allow operators to recover the tool from the keyhole, providing a 50% reduction in installation time.

The prototypes being tested incorporate the new bit-orientation-monitoring system capable of operating effectively in the high-vibration environment that exists at the tip of the pneumatic impact mole, which punches into the soil at a rate of up to 400 strikes per minute. Software and a user interface were developed to link pitch, roll, and inclination measurements to provide the operator with the relative position of the rotating head (thus enabling steering to take place).

The system is powered by the linear hammering action of the piercing tool, eliminating the need for an external power source. In operations, a slotted tip is rotating and the tool follows a straight alignment. When a correction is needed, the slotted tip is oriented in the desired direction, the rotational mechanism is disengaged, and the tool follows the preference path.



Researchers are providing enhancements to a piercing tool to allow for the installation of service lines from keyhole excavations.

"This new tool will allow utilities to more efficiently install service lines and provides a solution to a market niche not addressed by current technologies," says Jarnecke. "We expect the tool to provide significant savings by allowing for the use of keyhole operations for tasks that currently have to be conducted with expensive open-trench methods."

Negotiations to build and market the "smart" impact mole are under way with a major manufacturer of piercing tools.

For more information, contact: Dennis Jarnecke (847/768-0943; dennis.jarnecke @gastechnology.org)

Mueller® NO-BLO® Advantages Enter the Keyhole

Mueller Company reports that the advantages of its NO-BLO® methods for working on live gas lines can now be applied to keyhole operations with the introduction of the new Mueller KD-5™ Keyhole Drilling and Stopping Machine.

This new machine broadens the types of keyhole operations that can be accomplished to include line-stopping operations and line tapping to allow for the launching of inspection cameras.

"The availability of this new machine is expected to advance the use of keyhole operations," says Mueller product manager, Bryan Kortte. "The new technology incorporates the field-proven safety and reliability of Mueller NO-BLO® equipment and procedures, so important when drilling into pressurized pipelines."

Important keyhole capabilities provided by the KD-5 machine include:

- NO-BLO® operation with complete control of gas flow
- Line stopping with by-pass options
- Mueller service tee abandonment
- Live camera inspections of steel and cast-iron lines
- Minimal traffic interruption or ground-surface damage
- Significant savings in restorations and obtaining permits
- Use of existing commercial long-arm keyhole tooling.

This KD-5 machine provides the ability for crews to include drilling operations on existing steel and cast-iron pipelines while maintaining full control over gas escaping to the atmosphere.

Adds Kortte: "This should allow gas utilities and pipeline contractors to gain the time- and cost-saving benefits of keyhole operations across a broader spectrum of their work and hasten wider acceptance of this new technology. Ultimately, wider use of keyhole techniques will support the development of more keyhole tools and capabilities for the entire range of gas utility needs."

The KD-5 machine can perform line-stopping operations, including by-pass

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stop offs on steel pipelines up to four inches in diameter and up to 100 psig. It can also stop off existing Mueller service tees up to two inches in diameter and perform stopping operations on existing three-quarter-inch to four-inch Mueller one-piece stopper fittings. It is compatible with ULC Robotics equipment to launch its PRX250K Keyhole Camera in both steel and cast-iron pipe up to 12 inches in diameter.

The new Mueller machine incorporates existing keyhole long-arm tooling made by Omega Tools. The cutters, stoppers, inserting and extracting devices, holders, and other tools necessary for the drilling and stopping operations are the same as those used with the Mueller D-5™ Machine.

The KD-5 Machine is one of a number of new product developments introduced by Mueller to support the needs of gas utilities and pipeline contractors.

For more information, contact: Bryan Kortte (800/798-3131; bkortte@muellercompany.com)

KEYHOLE PROGRAM NEWS

New Members

Membership in GTI's Keyhole Technology Collaboration Program continues to grow with the addition of three new members:

Dave Gasmovic
President/CEO
McLaughlin Group, Inc.
Greenville, SC

Steve Shafer
Business Development, Hydro Excavation
Vactor Manufacturing
Streator, IL

John Wichmann
General Manager
RAMVAC Vacuum Equipment
Chadwick, IL

For membership information, contact: Dennis Jarnecke at GTI (847/768-0943; dennis.jarnecke @gastechnology.org)

New Program Priorities

At GTI's Keyhole Technology Collaboration Program meeting held in October 2007, attendees established a new set of research priorities to guide funding and development decisions.

Of the wide-range of potential research activities discussed, developing regulatory approval of core reinstatements ranked as the top keyhole need.

Top 10 program priorities are:

1. **Core-Reinstatement Acceptance**
2. **Joint Location**
3. **Tooling**
4. **Polyethylene Scraper**
5. **Training Programs**
6. **Standardization Procedures/ On-Line Guides**
7. **Service Renewals**
8. **Bag Stopper**
9. **Leak Pinpointing**
10. **Coating Repair**

Send Us Your Field Reports

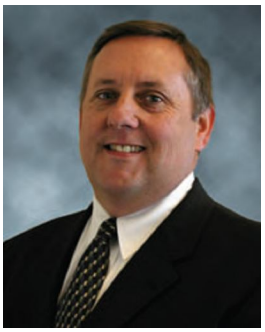
Have you had recent success using keyhole technology? We'd like to know the details.

Share your success with our readers. Send field report story suggestions to: Brian Mattson at Gas Technology Institute at:

brian.mattson@gastechnology.org

New Staff

Brian Mattson has joined GTI as a Strategic Account Manager to serve as a key sales, marketing, and customer service contact for GTI's energy customers in the midwest, west, and southern regions.



A major part of Brian's responsibilities involves the development of technologies for keyhole applications.

Prior to joining GTI, Mattson spent 15 years with T.T. Technologies, Inc., a leader in the manufacture of underground boring products, with his last position as National Sales Manager. Mattson was also a sales representative for J.I. Case Company and Vibra King Inc. and has a long-established working relationship with the GTI team,

Mattson has been a member of the American Water Association, the American Gas Association, and the National Utility Contractors Association for the past 20 years.

He studied business marketing at Montana State University.

Need More Information?

For more information or questions on any of the *Keyhole Technology News* articles, please contact:
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