Composite Repair Wrap for Polyethylene Systems

Researchers are evaluating a new composite pipe wrap system for the repair of mechanically damaged polyethylene gas pipe. The repair system has the potential to lower repair costs, reduce repair times, and minimize service disruptions.

Project Description

With existing polyethylene (PE) pipe repair methods, typically a short section of the distribution system is shut down and bypassed while the damaged pipe section is cut out and replaced. This approach is time consuming, expensive, and requires multiple excavations and complicated procedures.

In this project, researchers are investigating a new pipe wrap system for the repair of PE pipe components that shows promise of being a fast, easy-to-use, durable, and cost-effective method for PE pipe repair. This method provides direct bonding of composite materials to the PE pipe surface with minimal surface preparation. The composite material may be either resin pre-impregnated fiberglass cloth or field-impregnated fiberglass that adheres to PVC, fiberglass, concrete, and all metal pipes. According to the manufacturer, the PE pipe repair method and materials will also provide abrasion and impact resistance to the PE pipe. A single system can be used to repair pipes and/or fittings of various diameters, sizes, and shapes.

Although composites have been used for more than 20 years to remediate steel piping, the ability to repair PE pipe was limited due to the inability of composites to bond to the PE material. The patent-pending pipe wrap technology overcomes this limitation.

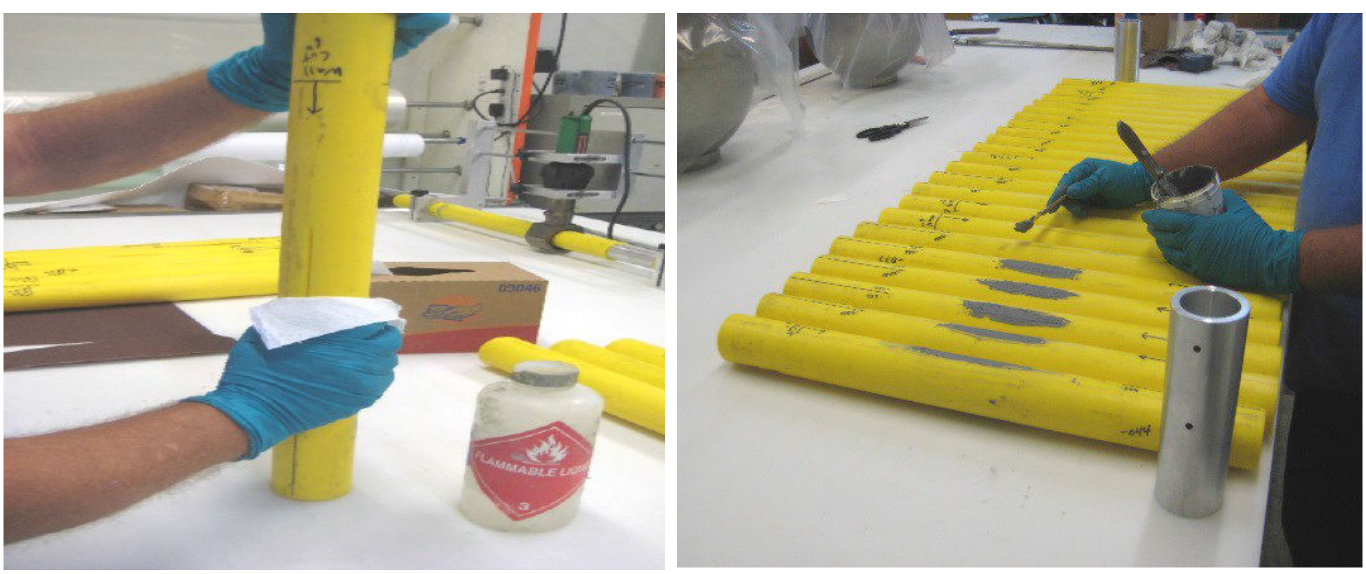
In this project, a research team is conducting a thorough evaluation of the pipe-wrap system to develop information on the permanency and life expectancy of the repairs.

Deliverables

The deliverables for this project include testing reports detailing the performance of repairs made with the pipe-wrap system.

Benefits

PE pipe systems experience two common types of damages. The first type is third-party mechanical damage that results in pipe wall loss that requires immediate remediation where the only available option is to remove and replace the damaged section. The second type is longer-term damage which manifests from either crimp-type fittings or the crimping operation required to conduct a cut-and-replace operation, which introduces micro-cracks into the pipe wall. These micro-cracks can become problematic and can be considered as deferred remediation projects. Both types of damage, if left in their natural state, will result in leaks and/or other hazards.



Sample preparation.

In some situations, the currently used repair systems were never designed for outdoor atmospheric exposure, and when used under these environments may prematurely degrade, leading to the reoccurrence of a leak. In addition, some of these repair systems are complex to install properly and their inherent designs produce a large degree of variability in the installation and, therefore, performance quality.

A practical PE permanent repair system will save time and money while minimizing service disruptions.

"OTD works for the benefit of gas system operators and ultimately our gas customers by creating innovative solutions that address operational needs in a cost-effective manner. This project to develop a repair wrap for damaged PE pipe is one such effort. We look forward to a successful outcome so our field crews can have an easily applied repair option that would improve our operations by decreasing the time and the cost of repairs to our small-diameter PE distribution system."

- Richard J. Trieste, Jr.
Department Manager, Research & Development
Consolidated Edison Company of New York

Technical Concept & Approach

The investigation of the pipe-wrap PE pipe-repair system focuses on applying the repair technique to different gas system components to evaluate effectiveness. Simulated defects are machined in each pipe specimen. The mechanical properties of pipe wrap will be evaluated by determining lap shear strength in accordance with ASTM testing procedures.

Prepared samples undergo the following:

- Short-term hydrostatic burst testing.
- Rate Process Method (RPM) analysis by performing long-term hydrostatic pressure testing at elevated temperatures. Then, failure data obtained at all temperatures will be used to predict the performance of the repaired pipe samples at end-use temperature and pressure conditions.
- Impact testing in general accordance with ASTM D2444 Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (falling weight).

Results

Through 2014-2016, various pipe specimens were prepared with simulated defects and subjected testing. Based on specimens prepared and subjected to hydrostatic burst testing to date, it appears that the repaired two-inch-diameter pipe samples, irrespective of the pipe sample being heated or not during the repair process, are performing well.

Specimens were notched during preparation with generally four-inch-long longitudinal notches milled in the center of the pipe specimen to a depth of 80% of the measured minimum wall thickness of the specimen. Repair-system applications were conducted while the pipe was both heated and unheated.

Plaques of high-density polyethylene measuring 12 inches x 12 inches x ¼ inch were prepared and underwent lap shear testing.

A non-disclosure agreement was established with the pipe-wrap manufacturer. Notched (gouged) pipe specimens were sent to the manufacturer, who designed and built a prototype heat-gun field tool used to apply the repair technology. This device is designed to clamp onto a pipe at either end of the repair area. The device has a variable temperature heating device and a custom-built nozzle that applies a constant temperature heat circumferentially around the pipe. The heater is attached to linear motion bearings allowing the nozzle to be moved over the repair area.

The project team initiated RPM testing and performed tensile pull testing on butt-fusion specimens.

Test results were provided in a report to project sponsors. The test results were compared with those of a control pipe (i.e., straight pipe) and an actual butt-fused pipe. It was shown that the adhesive is required to make an adequate bond to the pipe and the wrap. It was also shown that the butt-joint has a higher peak load than those of the control and butt-fused samples. For all the eight butt-joint specimens tested, the ultimate failure occurred by yielding of the pipe material outside the repair area.

Status

Testing is ongoing and researchers are monitoring the status of specimens under long-term hydrostatic pressure testing. Efforts are under way to establish the correct combination of adhesive and wrapping material by preparing additional specimens, some with simulated defects, and subject them to mechanical-properties testing such as lap-shear-strength and tensile testing.

For more information:

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