OTD Operations Technology Development

Evaluation of Flowable Fill Around Buried Pipes

Flowable fill is required by some agencies for use as backfill material in restoration activities following pipe repairs, rehabilitations, and other operations. While flowable fill may demonstrate several benefits, specific concerns of gas utilities are being addressed in this project through a series of laboratory and field tests. Results will help utilities, manufacturers, and government agencies make decisions about the use of flowable fill based on its performance and the safety of the utility system.

Project Description

Utility companies continuously face challenges in providing durable pavement restorations. Adding to the concern is the fact that, in many jurisdictions, regulations are in place that specify the selection of backfill materials and compaction requirements.

One approach to this issue is through the use of controlled, low-strength slurry, commonly known as "flowable fill." Flowable fill is usually mixed by a contractor and delivered to the jobsite in a cement mixer. Since it is self-leveling and requires no compaction, local governments tend to favor its use because of its uniform density and adequate pavement support.

Deliverable

While flowable fill is increasingly being used, there has been little scientific research on its effect on corrosion of cast-iron and steel pipes, gas flow and leak detection through backfill, its performance during freeze-thaw cycles, and construction control to ensure re-excavation of the backfill. In response, investigators at Gas Technology Institute (GTI) have completed a comprehensive study on the topic. The results are presented in a detailed report.

Benefits

Data generated from this project will help the gas industry make informed decisions on the use of flowable fill and provide recommendations to local governments with regard to possible effects of flowable fill around gas pipes.

Technical Concept & Approach

Most of the previous research by manufacturers on the use of flowable fill as backfill has focused on design properties and performance optimization (flowability, density, segregation, and strength gain). However, this previous research did not address many of the other concerns of gas utilities.

In this project, the goal was to expand the knowledge base through the investigation of:

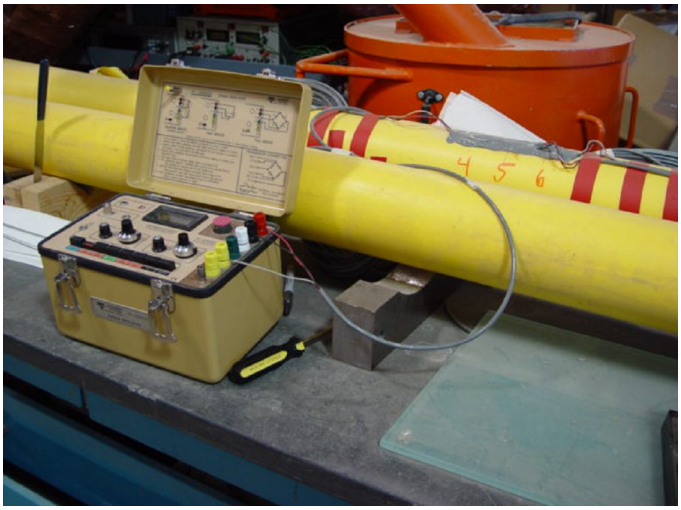
- The long-term strength performance of flowable fill
- The possible corrosive effects of flowable fill on pipe (steel and cast iron) and pipe coatings
- The impact on the ability to detect gas leaks in areas where flowable fill is used due to the inability of gas to migrate to the surface through sections of flowable fill
- The performance of flowable fill during freeze-thaw cycles (e.g., loss of strength and the possibility that the flowable fill section may heave above the pavement)
- The long-term hardness of the flowable fill and its impact on re-excavating to make repairs
- How the lack of standards affects the quality of flowable fill and the potential of having different constituents from batch to batch.

To address these concerns, researchers conducted extensive studies and tests on various types of flowable fill materials. Testing included monitoring instrumented trenches containing various types of flowable fill mixes in full-scale field tests; tests at the GTI Pipe Farm under controlled traffic and environmental conditions; and laboratory tests to evaluate the long-term properties of various types of flowable fill.

Installation of pressurized plastic pipes in the trenches for gas-leak detection.

Testing was designed to:

- Evaluate the stresses in conventional backfills and in flowable fill
- Measure pavement settlement to determine the compatibility between the flowable fill and the adjacent backfill
- Determine flowable fill durability and strength gain over time
- Determine performance of flowable fill during freeze-thaw cycles
- Monitor gas leakage in flowable fill backfill
- Evaluate the long-term effects of flowable fill on pipe corrosion and cathodic protecton.

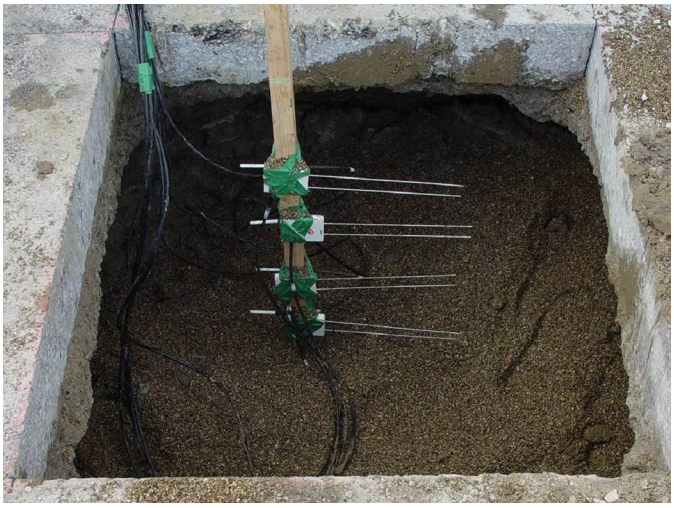


String gages were installed on buried pipe in the backfill to monitor its deformation.

Results

Gas flow and leak-detection tests were performed on various types of flowable fill and soil in instrumented trenches in the field. Gas leaks were initiated in pressurized plastic pipes in the trenches and gas leaks were monitored at the surface with time.

Laboratory tests were also performed to evaluate long-term strength and the effect of freeze-thaw on various flowable fill types. These tests were contracted at the Cold Regions Laboratory (CRREL) of the U.S. Army Corps of Engineers, and GeoTesting Soil Laboratory. The results were presented at the International Gas Research Conference in Vancouver in 2004. Results showed that flowable fill with fly ash have measurable heave during freeze and lower permeability than conventional backfill.



Moisture and temperature instrumentation in a bellhole.

Status

The Final Report — which includes details on the testing program and the results of the long-term monitoring of the test sections — is complete.

Results of the testing program include information on:

- The effect of the flowable fill on corrosion
- Gas flow and leak detection through the backfill
- Construction control for backfill and long-term strength.

For more information:

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