

RFID Embedded in Coiled PE Pipe

Description: A project to develop and test an antenna and signal processing system using RFID technology to locate coiled PE pipe that has been installed via trenchless operations.

Status: The design tasks are complete. Manufacturing of the tag-laying machine and testing are in progress.

BENEFITS

The overall objective of the project is to develop and test an antenna and signal processing system using RFID technology to locate PE pipe. The RFID tag will be embedded on coiled PE pipes and is intended for use in all soil conditions. Development was first set to address a 63 mm (2.5”) pipe diameter size due to the challenge associated with small diameters (decreased circumferential surface parallel to the ground).

A reliable and accurate method is needed for easier detection of coiled plastic pipe, as tracer wire can become compromised over time. Additionally, one driver for this project was the May 2015 PHMSA Notice of Proposed Rulemaking that outlined requirements for tracking and traceability of plastic pipes. This technology would reduce 3rd party damage, which is the leading cause of pipeline failures. In doing so, it will increase safety in operations as well as enhance the productivity of field crews performing work on the pipeline.

BACKGROUND

Radio Frequency Identification (RFID) technology has been proven and used for other applications such as highway toll readers, retail theft prevention, access control, and asset tracking. A typical system consists of a chip (or tag) and a reader antenna. The chip can operate without a dedicated power source, drawing energy necessary from the reader antenna to transmit and receive data. Information from the chip can be read but also written via the use of an antenna. Eliot Solutions, a subsidiary of European pipe

manufacturer RYB, has a commercially available solution for straight pipe and fittings installed in open trenches that enables operators to accurately identify the location of the pipe as well as certain information of interest.

The operating principles behind this technology and its application in straight pipe are well defined and the system is readily available on the commercial market. However, a pipe installed via trenchless applications presents a unique challenge to the technology in that the orientation of the pipe cannot be controlled during installation. Thus, NYSEARCH, GRTGaz (formerly Engie), and Eliot Solutions created this project to develop RFID technology for use on coiled pipes installed via trenchless applications.

TECHNICAL APPROACH

NYSEARCH and GRTGaz worked together to develop a set of standards and specifications detailing the requisite performance of the tag when installed on the pipe, the manufacturing process, storage, etc. Although the project initially addressed small (2”) diameter pipes, the technology is scalable up to other sizes. Similarly, all prototypes are being built with high-density pipe, but the design is expected to be transferrable to medium and low-density pipe.

As the specification documents were finalized, iterative design, manufacture, and test processes were undertaken. The RFID chip design enables operators to accurately identify the location of pipes by using three RFID tags to fit 360 degrees around the pipe’s outer diameter, therefore

ensuring that the tags are always facing the surface and are readable.



Figure 1: Three RFID Tags for 360° Coverage

To fully evaluate the prototypes, GRTGaz used its indoor facility with bays of differing soil types (clay, sand, gravel, topsoil, and limestone) to conduct various underground tests. The network of underground pipes enabled rapid testing at varying depths and in different soil types. This setup simulates real-world environments in which the pipe may be installed.



Figure 2: Test Facility at GRTGaz

The current design allows three RFID tags to be encased in a soft material that is flexible enough to be wrapped around the outside of the extruded PE pipe, but strong enough to endure the environment while being installed via trenchless applications. These RFID tags encased in the soft material will be installed simultaneously with the manufacturing of the PE pipe.



Figure 3: Soft PVC Housing Prototype

The manufacturing process to extrude the PE pipe and install the RFID housing has also been addressed. To install the RFID housings onto the extruded pipe a tag-laying machine was designed. The tag-laying machine is designed to be integrated into the production line so as not to slow down PE pipe production. The tag-laying machine will secure the RFID housings while simultaneously extruding the PE pipe before being coiled onto the storage drum.

The machine is designed to store enough RFID housings to install a tag every 20 meters (65 feet) for over 800 meters (approximately 900 yards) which is more than the amount of pipe stored on a single drum before the RFID housings needed to be manually replenished.

PROGRAM STATUS

The documentation specifies the tag performance requirements as well as specifications to implement the tag during the extrusion process. This document has been completed.

The manufacturing of the tag-laying machine has been the project focus in recent months. In parallel, with the manufacturing of the tag-laying machine, NYSEARCH and GRTGaz have partnered with a pipe manufacturer in the US to integrate the tag-laying machine into its production line. Horizontal Directional Drilling field tests with this technology are planned in both France and in the United States for the first and second quarters of 2023.

Highlights

This technology can:

- Locate coiled PE pipe installed via trenchless applications
- Obtain Tracking and Traceability data from PE pipelines
- Utilize a system that can extrude PE pipe with parallel means for incorporating the RFID Housing

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