

Technology Brief

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 system is under development.

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 targeted to 63 mm (2.5") diameter pipes due to the challenge (decreased circumferential surface parallel to the ground) associated with small diameters.

The genesis for this project was the May 2015 PHMSA Notice of Proposed Rulemaking that outlined requirements for tracking and traceability of plastic pipe. Additionally, a reliable and accurate method is needed for detecting the depth of plastic pipelines, as tracer wire can become compromised over time. This technology will ultimately reduce 3rd party damage, which is the leading cause of pipeline failures. In so doing, it will increase safety in operations as well as enhance 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 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, 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.



Figure 1: Eliot Reader Antenna

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 pipe, the manufacturing process, storage, etc. Although the project began by addressing small (2.5") 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.

Once the specifications documents were finalized, an iterative design, manufacture, and test process was undertaken to identify the most promising tag geometries for application on coiled pipe. Initial tests were conducted at Eliot's facilities, both in air and in a custom-built trench, which allowed for the simple adjustment of the pipe's orientation. The pipe was reoriented throughout testing such that the tag would be positioned at various angles from the reader antenna. The reader antenna then attempt to excites, or energizes, the tag at each angle.



Figure 2: Coiled PE Pipe with Embedded RFID Tags

The highest performing tag geometries from the extensive laboratory testing were used to create more realistic prototypes for advanced testing. The tags were embedded onto the outer pipe wall with a polypropylene (PP) skin as a protective layer. The advanced prototypes were then sent to GRTgaz for additional testing to characterize the system's performance in different soil conditions and at different depths.

In order to fully evaluate the prototypes, GRTgaz used its indoor facility with bays of differing soil types (clay, sand, gravel, topsoil, and limestone) to conduct the various underground tests. A network of underground pipes enables rapid testing at varying depths and in different soil types. This setup is intended to simulate real-world environments in which the pipe may be installed.



Figure 3: Test Facility at GRTgaz

PROGRAM STATUS

The specifications created at the onset of the project are being updated to better reflect the anticipated performance of the system based upon test results. The final document will include tag performance requirements as well as specifications about implementation during the extrusion process, including details on the custom tag laying machine. Once the specifications have been updated and finalized, GRT Gaz and Eliot will fabricate industrial prototypes in low-rate production.

In parallel with updating the specifications, NYSEARCH and GRTgaz are seeking to partner with a pipe manufacturer in the US to integrate the tag laying machine into its production line. The project will culminate with field testing in both the France and in the United States.

Highlights

Locate coiled PE pipe installed via trenchless applications

Obtain Tracking and Traceability data from PE pipelines

Passive system does not require a dedicated power source

For more information contact:
admin@NYSEARCH.org