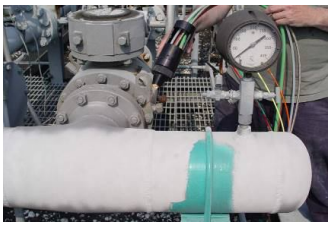
50- To 70-Year Maintenance-Free Pipeline Coatings for Critical Locations



Researchers have investigated the use of thermal spray coatings (TSC) for long-term pipeline corrosion protection. Applicable in various pipeline environments, the technology is especially beneficial for use in critical locations and on pipelines that are difficult to access. Data developed through this project will advance TSC technology and provide pipeline operators with information to enhance the integrity of their systems.

Project Description

Thermal spray coatings (TSCs) have provided maintenance-free corrosion protection for some of the industry's most aggressive service environments (e.g., offshore oil platforms, above-ground pipelines, bridges, piers and shore facilities, lock and dam gates, communication towers, and power transmission poles).

Although TSCs have been produced for at least 20 years, the last 10 years have seen significant advancements in the capability of the technology to produce high-performance coatings on a wide range of materials on many different substrates.

TSCs have projected maintenance-free service lives of up to 50 years if the coating is unsealed, and up to 70 years if it is sealed. These thin, metallic coatings provide the benefit of sacrificial protection to the steel substrate throughout its service life and offer strong resistance to mechanical damage and rough handling.

Although there is growing interest within the natural gas community regarding the use of TSCs, there is no published research available regarding their use for buried pipeline applications.

Deliverable

The objective of this project was to take a relatively mature coating technology — with superior corrosion and mechanical damage resistance — and move it successfully into below-ground (and select above-ground) pipeline applications.

Reports on this project provide OTD participants with information on:

- Surface preparation
- Preheating requirements
- Specific alloy selection
- Film-build thickness
- Seal-coat selection (if necessary)
- Acceptance and quality testing.

A set of laboratory and field testing data validateed the best application and material systems for underground/buried applications.

Benefits

Information developed through this project will allow operators to properly specify a TSC system based on sound, scientific research.

With new requirements for ongoing pipeline management, operators are faced with continuing challenges when assessing their pipelines' integrity. TSCs can help the industry reduce the costs of ongoing maintenance of difficult-to-reach pipes to a one-time-only event.

By using TSCs as the final step in the repair and maintenance process, utilities will be able to confidently rely on 50 to 70 years of maintenance-free pipe.

Potential TSC applications include:

- Areas that are difficult or costly to repair (e.g., road, river, rail, and expressway crossings) and congested urban areas
- Aggressive environments (e.g., rocky locations and areas with hydrocarbon-contaminated soil, microbiologically influenced corrosion, and acidic soils
- Compressor outlets
- Above-ground crossings (e.g., bridges, overpasses, and other supported or cased pipe segments).

Researchers investigated a flame powder system, which has been shown to provide coatings strong enough to withstand hammering (inset).

Technical Concept & Approach

The project included the following tasks:

- **Research, Evaluate, and Identify Two Thermal Spray Coating Materials (Alloys) for Testing**

Thermal spray coatings can be applied in one of several forms – wire, powder, or rod – using various materials, including metals, ceramics, numerous polymers, and combinations of these various materials. This task focused on metallic coatings that provide an inherently galvanic/sacrificial protective layer in addition to standard barrier protection from the environment.

As part of this task, Gas Technology Institute (GTI) developed a list of desirable properties for TSCs in buried pipeline applications, based on testing that GTI has performed on other non-TSC materials in the past. The best candidate TSC systems were identified for further screening.

- **Perform Laboratory Testing to Screen and Select Four Candidate Systems for Field Testing**

The screening process involved subjecting materials to laboratory performance testing that included: cyclic salt-fog testing (with and without scratch/scrape damage); impact resistance testing; abrasion resistance testing; testing to determine adhesion to the substrate; and hardness testing.

- **Perform Field Testing on Four TSC Application Systems**

The selected systems were applied to pipe sections and then buried in several soil types with and without seal coats and with and without cathodic protection.

Variations in procedures to coat new pipe versus existing pipe sections were also developed during this task.

Results

This project began in the spring of 2005 with a survey of OTD participants to gather background information and document the advantages and disadvantages of the various TSC systems in use. A testing protocol was developed. Major TSC system providers were identified and contacted for project involvement.

A literature search was performed to gather information about: TSC materials being used in above-ground structures; sealing and painting of TSCs; surface preparation requirements; and standards and quality-control methods.

In addition, researchers finalized the specifications for TSC procedures and material selection.

Surface preparation for tests of flame powder system.

Status

This project was completed in December 2007. A Final Report was submitted to OTD that included a detailed procedural recommendation on flame-spray application, field trial results, and material-testing results.

For more information:

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