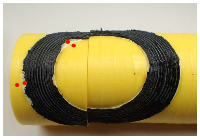
Solvent Cleaning and PE Joining Procedures



This project focuses on efforts to gain a greater understanding of the issues related to the use of solvent cleaning as a part of polyethylene (PE) pipe-joining procedures. The project includes a comprehensive testing program to develop information to help optimize cleaning and surface-preparation operations.

Project Description

While gas industry procedures and training for polyethylene (PE) pipe fusion have been enhanced over the years, failures can still occur even though procedures are followed by trained operators.

One concern the industry is facing is with cleaning procedures used by utilities and the protocols used to qualify PE joining procedures. When a solvent cleaning procedure is used as a sub-procedure for a qualified joining procedure, there is less clarity regarding the responsibility of the operators to ensure that a uniform cleaning procedure is implemented per code. This situation is made more complex since not all PE joining situations will require cleaning and that in instances in which cleaning is deemed necessary, surfaces will not be uniformly dirty. One might reasonably anticipate difficulties in any attempt to create a single uniform process for field cleaning of joining surfaces.

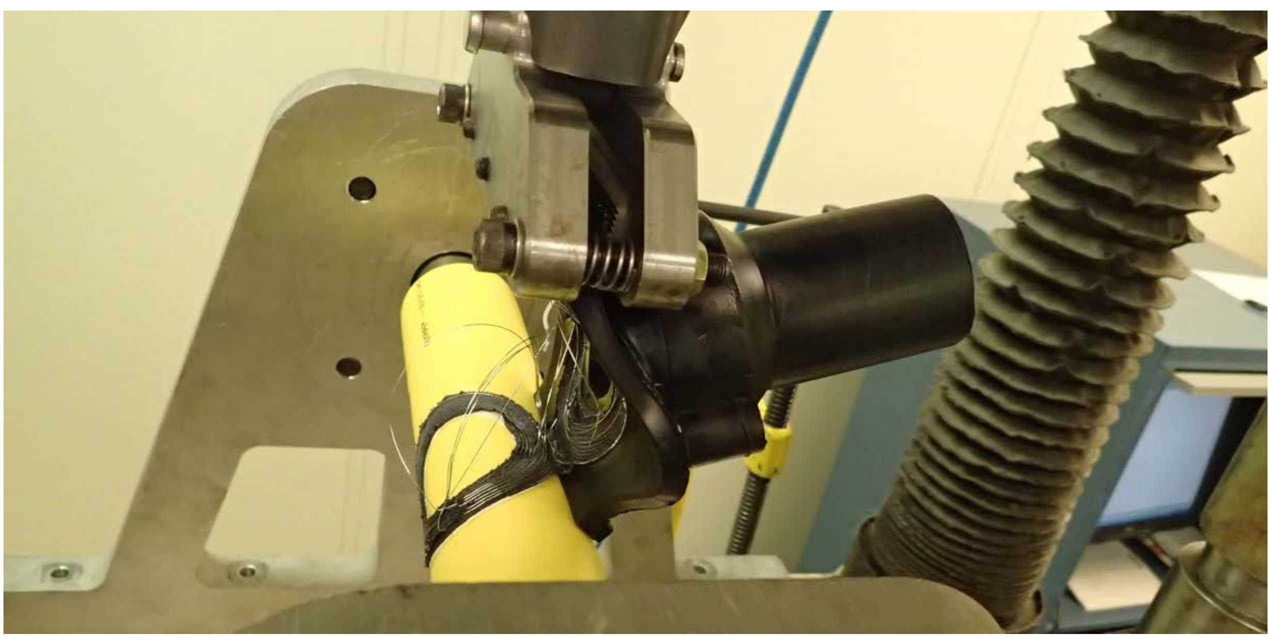
Another concern relates to the *ASTM F2620 Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings*, which includes guidance in non-mandatory cleaning practices. Experts suggest that this appendix should be moved to the mandatory sections of the standard practice, given the criticality of the cleaning procedures to the joint integrity. Additionally, it is not clear how far operators and manufacturers must go to verify/validate these cleaning procedures and what the expectations of the regulators are.

There is also a need for preventing contamination. Component packaging currently varies from manufacturer to manufacturer, and industry specifications and procedures are not in place to manage part cleanliness. Utilities must manage fitting cleanliness up until the time of installation, and that is best managed by maintaining the integrity of factory packaging.

The focus of this project is on qualitative and quantitative testing and the development of data-driven, "Best Practices" to optimize the surface preparation process and prevent potential PE joining issues.

Deliverables

The main deliverable from this project is a report that includes a comprehensive set of guidelines/best practices to create a greater understanding of the variables, practices, and cleaning agents that can be used to improve fusion consistency/performance.



Example of saddle decohesion test.

Benefits

The use of solvent cleaning in PE joining procedures is a quality-control matter that involves manufacturers, operators, state and federal regulators, as well as several interrelated procedural concerns, including: the chemical composition of the cleaning solvent (i.e., alcohol or acetone), the types of wet or dry cloths used, additives in the PE pipe and their ability to be extracted by the solvent, re-rounding practices, and the heat-fusion portion of the joining procedures. By reviewing industry code requirements, standards, and best practices – and adopting a common quality framework – the industry can benefit from combined efforts.

Technical Concept & Approach

For this project, a research team developed and executed a testing matrix that includes qualitative and quantitative comparative approaches via physical, chemical, and instrumental analyses, and simulation based on standard industry methods using statistically significant test specimen quantities.

Results

A test matrix was developed comprised of 120 contamination removal/fusion test runs with electrofusion saddle fittings. The test matrix covered combinations of contaminants (talc powder, bentonite powder, silicone grease), cleaning agents (99% isopropyl alcohol, 91% isopropyl alcohol, acetone), and cleaning tools (lint-free wipe, cotton cloth rag, paper towel).

In 2017, each combination was tested four times – twice on medium-density PE pipe and twice on high-density PE pipe. Preliminary contamination removal tests on pipe rings, separate from the 120 contamination removal/fusion tests, were conducted to obtain baseline data.

Testing results led to the following observations:

- The preliminary contamination removal tests on non-scraped pipe rings indicated that solvent cleaning is fundamentally effective at removing talc and bentonite powders on a relatively small and smooth surface; silicone grease is particularly difficult to remove regardless of solvent and cleaning tool combination.
- The contamination removal/fusion tests indicate that in pipe-cleaning scenarios any given wiping pass will *not* uniformly remove surface contamination. The variability in cleaning is due to outer surface roughness, non-uniform wiping contact, physical variability of the cleaning tool, and contaminant distribution on the surface.
- Solvent cleaning will remove loose contamination such that the pipe will look clean.
- The pipe-cleaning protocol employed in this project produced highly variable decohesion test results, and no 100% ductile joints.

These observations led to the following conclusions and recommendations:

- Solvent cleaning should be used to remove loose dirt and the bulk of surface contaminants before scraping.
- More than a single wiping pass should be required due to the variability in contamination removal of any single pass. Each subsequent wiping pass should be within the area of the preceding wiping pass to avoid reintroduction of contamination from outside of the first wiping pass area.
- Any wiping pass should be made with a new cleaning tool to avoid reintroduction of contamination from a used cleaning tool.

Based on the inconsistency in contamination removal, it is not clear if post-scraping solvent cleaning will be sufficiently effective at removing contaminants introduced after scraping. Additional testing is required to resolve the acceptability of post-scraping solvent cleaning – specifically, multiple wiping passes, water washing, and degree of contamination need to be evaluated.

The findings in this project and OTD Project 2.14.e *Guidelines/Best Practices for Scraping PE Pipe and Fittings* led to the suggestion of a preparation technique where the pipe is thoroughly washed and cleaned prior to scraping and where the time between scraping and assembling of the fitting is minimized. The procedure is outlined in a report issued in January 2018.

Status

The research team proposed follow-on testing with 82 test runs. The test preparation procedure will be altered such that pipe scraping will be performed after solvent cleaning to assess the combined effect of cleaning and scraping in the removal of surface contamination.

For more information:

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