POLYFLOW

Water Injection Line Rehabilitation in New Mexico

Background:

A two inch fiberglass 2,000PSI fiberglass water injection line was not holding pressure during a routine hydrostatic test resulting in the required replacement of the line. Because there were many crossings, the superior cyclic loading resistance and the line only had one 45 degree turn, the option of running a 1.75" Thermoflex 2,000PSI line was chosen to pull through the existing line. The flow rate required for the injection line was determined and pressure drop curves were calculated to verify the pressure drop of the line.

Procedure:

The injection line had a straight run of approximately 900 ft followed by a 45 degree turn and another straight run of approximately 1550ft. Because of the potential for H2S in excess of 5,000PPM, a Fortron lined 2,000PSI rated 1.75" Thermoflex tube was selected. Figure one shows the pressure drop for the line based upon the required flow rate.

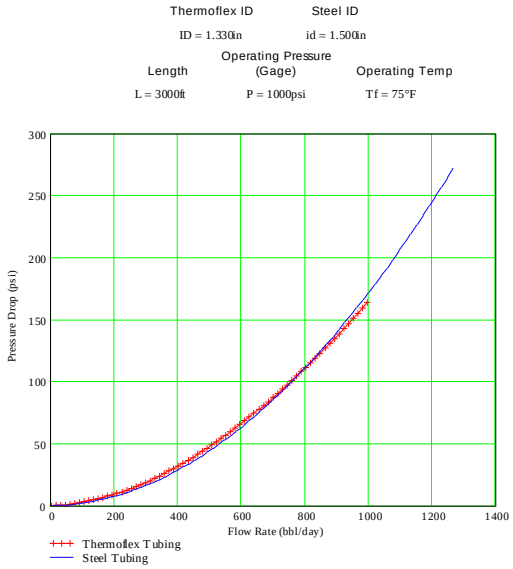

Figure 1: 1.75" Thermoflex (1.33" ID) vs. 1.5" ID Steel

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Because the Thermoflex will not go through a standard fiberglass 2” 45 degree elbow the line had to be pulled at two segments. The line was dug out at each end and at the 45 degree elbow. The Thermoflex tubing was to then be pulled from each termination end of the line to the 45 degree elbow with two separate lines then attached with a 45 degree elbow.

The equipment required for the project was a pigging system, cable to attach to the pig with appropriate pulling force to pull the line, winch to pull back the cable, backhoe to dig out the ends of the line and to handle the Thermoflex spools, tubular A-frame and a coupling machine (supplied by Polyflow) to attach the flange terminations onto the Thermoflex tubing. The tubing is extremely light weight (.48lbs/ft, .32 kg/m) so no special material handling equipment is required. Figure two shows the handling of a 96” spool with a backhoe.

Figure 2: Backhoe setting the spool on the A-frame

The light weight also minimizes pull force required to insert the pipe through the existing fiberglass line. Polyflow models the pull force for the longest pull to make sure the winch and the cable have sufficient force to accomplish the task. In this case the longest pull is 1,300ft and Polyflow’s model determined the required force is only 306 lbs.

Total force required is based on the assumptions that all included angles occur at the end pull. This provides a worst case estimate for the total force required.

Total Force Required	Ft = 306.122lbf	
Minimum Bend Radius in System	Rc = 2.021ft	**No Factor of Safety Applied!**

The 1,300ft run was pulled through first. Since the annular space between the existing fiberglass and the new Thermoflex tubing was tight, Polyflow’s standard pulling cone would not fit. The end of the Thermoflex had several holed drilled into it and wire was threaded through to serve as the pulling cone. The holes were up to 1 ft from the end of the tubing to make sure that the cables would be pulling with the fibers in the tubing. Figure 3 shows the set up.

Figure 3: Pulling Cable compared with the Pulling Cone

The pipe is hand fed into the existing line to start the pull and then the winch pulls the pipe through the line. There should be at least twenty feet from the entrance of the existing line to the un-spooler and in a straight line to minimize the potential for "hang-up" as the tubing is pulled through. See figures 4 and 5.


Figure 4: Feeding the tubing into the existing pipe

Figure 5: Pulling straight into the Existing Pipe

The pigging and pulling process occurred over an afternoon taking approximately four hours. The pull itself took approximately 20 minutes. The line was then coupled and hydro tested at 2,000PSI overnight. The line was only to run at 1,000PSI so the line was tested at two times maximum operating pressure.

The second line repeated the process but when pigging the cable a hang up occurred. The spot was located dug up and an additional elbow was found and removed.

Conclusions:

The Thermoflex pull through significantly reduced costs versus digging up the existing line and replacing it. A process that may take 10 days was reduced to four. It should be emphasized that this time would be reduced further if the line was pigged ahead of time to determine if any unknown elbows existed. In this case two extra days were required.

Thermoflex is light weight, flexible, abrasion resistant requiring very little installation equipment versus alternative piping systems, thus significantly reducing the capital costs for a project.