HIGH DENSITY POLYETHYLENE PULLED THROUGH LINERS FOR STEEL PIPELINES EXPERIENCING INTERNAL AND EXTERNAL CORROSION PROBLEMS

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History of HDPE Liners

High Density custom designed pull through polyethylene liner programs for new and existing steel pipelines started in Canada in the late 70's. High pressure salt water injection steel pipeline buried 6 to 7 feet deep in Northwestern Alberta prompted a major manufacturer of HDPE pressure pipe to try custom sizing a thin wall liner pipe. Custom tooling first had to be programmed to the front of the pipe extruder at the plant to fit all the various steel sizes and wall thicknesses. Once this was done the technology came along to install the system inside existing steel pipelines for renovation of the pipeline. This system development was the start of pipe rehabilitation for pipelines buried and suffering from internal corrosion.

The polyethylene plant made the outside diameter of the thin wall liner pipe 2 to 5% smaller than the inside diameter of the steel pipeline inside diameter. Excavations where dug at each end of a section of the pipeline (normally 2,500 to 3,000 ft). Modified steel flanges were welded at each end to house a custom liner flange. A weld-o-let or thread-o-let was also welded to the top of the steel line and a small hole drilled through the steel pipeline wall. This weld-o-let or thread+-let played an important role because this first system of HDPE liners would be "expanded" against the host pipe carrier by using air, water, or gas pressure inside to expand the HDPE liner. This "vent station" played an important part in vacating the annulus of any trapped air or produced water to the atmosphere as the liner expanded against the steel pipe wall. This system came to the USA in 1981 and was perfected as the "EXPANDED LINER SYSTEM" for the oil, gas and petro-chemical industry. It is still being used today as a pipe rehabilitation technology with some variations and also has applications for the water and sewer trenchless techniques.

In 1986, a newer method of HDPE Poly liners entered the commercial market place with a technology that places the custom liner "AGAINST THE STEEL WALL" after its insertion. Excavations, welding steel flanges that will house a custom liner flange to tie each pull section together are the same as the previous systems. This system changes at the liner pipe manufacturing plant, however in that the outside diameter of the liner is made slightly larger than the inside diameter of the steel host pipe. This system uses a series of power driven rollers to temporarily size down the outside diameter of the Poly Liner as the winch truck pulls it inside the steel host pipeline. After it is positioned in the steel pipe line, it reverses to a snug fit.

In the 90's two more systems using "AGAINST THE STEEL WALL" technology were commercially developed. The first system uses a "Folding Technique". This form is manufactured at the Poly Liner plant typically a "U-Shape" sometimes with structural reinforcement tape around the outside to maintain its reduced diameter until it is inserted. The latest newest system employs a series of hydraulic downsizing "cells" that are controlled by pressure and lubrication to reduce the outside diameter as it is inserted into the steel pipeline. It is called "PRESSURIZED DIE SYSTEM" or "PDS" .

The "PDS" system is easier to change equipment from one size to other on different sized steel pipelines. It also shows great potential when dealing with different steel wall thickness from a repair or liner rehabilitation for "cement lined" steel pipelines. All of the liner systems presented here use a "modified" winch or wireline truck to pull the liner pipe inside the steel host.

Economics Of Using HDPE Liners

All of the liner systems discussed deal directly with Internal Corrosion problems. Rehabilitating existing pipelines instead of replacing them with new liners makes sense from a cost savings point of view. Right of way damage generally runs less because depending on which system is employed excavations between pull sections are normally 100 to 200 feet long. Most of the HDPE Liner systems can allow for pulls using a modified winch truck between 2,000 to 3,000 feet. This economic factor will depend largely on the terrain of the Right of Way and the number of turns or bends (pi's) . All of the liner systems presented follow a "general rule of thumb" that welded fittings or miters must be replaced with new flange by flange custom coated internal fittings.

Generally an operator can rehabilitate the existing pipeline for 40 to 60% less than total new replacement. Sometimes the cost of installing a liner does not include cleaning the line to remove heavy scale build up, sludge, wax, or iron powder scale. Yes, replacement costs can be reduced if chemical cleaning is required before the liner is pulled inside. Most of the professional pipeline chemical cleaning companies can help by blending chemicals that reduce the problem with professional pigging assessment.

In areas where land owners are very unrelenting to the idea of installing a total new pipeline system because of crops in the field. The pulled in placed liner systems are very valuable and the economic savings are even higher. Environmental groups, government agencies, state and local regulations are increasing leverage on operating pipeline companies to "stop the leaks". New laws on operations of cross country pipelines, product lines, and in field gathering lines are causing the "Owner - Operator" to do something new each day. This is where the real cost savings for the "Owner - Operator" will pay off by using a liner as rules and regulations get tougher.

For a new steel pipeline installation which will operate under an environment that will produce "Internal Corrosion", a thinner wall steel pipe can be used because the steel wall loss is eliminated. ERW pipe with a higher X - grades or yield strength with a thinner wall thickness can be used and the hard working HDPE Liner fully protect the "Internal steel" from corrosion pitting, and wall loss. This economic cost savings on a new steel pipeline will pay for itself each day of operation. Liners give a broad range of operating temperatures, good chemical resistance to corrosive waters, corrosive gases and are good economical solution as your leak frequency increases. The cost savings are both today and in the future with Poly liners, for both new and existing lines. They can save millions on costly inhibitors which are not required.

Liners For External and Internal Corrosion Control

Recently another exciting technology has advanced into the commercial Poly liner industry. "Grooves" are manufactured to the outside surface of the custom Poly liner during manufacturing, for a new turn of the century solution to "External Corrosion" problems for steel pipelines. This newest advancement has entered into the Poly Liner industry and is called the "Safetyliner"™ System. Not only does this new technology protect the steel host pipeline from "Internal Corrosion" but it has a monitoring and leak containment system which can be linked directly to a "Scada Systems" as an internal notification system for an "External leak". This liner system has "grooves" 360 degrees around the outside diameter overall, slightly thicker in wall than the "smooth" liners above, but you will see that this system is virtually a dual containment system to ensure full protection. A monitoring collection device is welded in at each end of a pull section

so that all the external "grooves" in the liner are joined to "communicate" providing a signal up through the "weld-o-let or thread-o-let" station. In turn these sections can be linked together for continuous monitoring of the whole line.

After installation and testing, a vacuum is applied in the annulus between the inside diameter and the outside diameter of the grooved liner. During operation if an "External Corrosion" problem corrodes through the steel host pipe the vacuum in the annulus is lost, sending a signal into Scada System . The owner - operator is immediately informed that an "External Leak" has occurred. This patented grooved liner will also temporarily bridge across small holes in the pipeline, preventing a fluid release. This allows time for long term repairs to be made before any leak to the environment occurs; effectively zero tolerance no - spill technology. Any potential problem is automatically isolated between two sensor points. Traditional locating efforts can be employed, or a "real time" electronic monitoring option can pinpoint the event to within 100 feet over a 10 mile section.

Another advantage this new technology offers is the ability to re-qualify the steel pipeline while the line is in service delivering product in transit to customers. As new regulations for the cross country interstate pipelines are established by the regulatory mandated laws the "Owner - Operator" can place a test fluid in the annular channels. Pressure can be applied directly to the host pipe via the annulus, avoiding a generic liner's load-spreading effect if this is done on the inside only. In many cases, the line need not be evacuated during the test since the contents are fully contained. Costly removal and refilling charges are eliminated, and downtime is minimized.

There is also one more new technology advancement that fits like a glove with this system and smooth liner systems too. It is the new "Bolt - Free" flange. With all the other liner systems the pull sections must be incorporated with a bolted type ANSI steel flange, requiring bolting . This new patented connection restores full welded integrity to the entire lined steel pipeline and brings the line back to code. Communication system between the outside diameter of the groove liner and inside steel host continues across the welded bolt-free flange joint. This allows monitoring over long distances as multiple liner sections are connected in series.

Conclusions

- High Density Polyethylene pulled through liners have established themselves very strongly for the future with regards for pipe rehabilitation in new or existing steel pipelines.
- Economics of using HDPE Liners generally can rehabilitate the older pipelines that normally would be placed out of service.
- New pipelines will have a longer life span with zero internal corrosion steel wall loss and thinner wall higher yield steel can be used for additional economic savings.
- New patented liner technology has advanced into new corrosion control solutions for both internal and external concerns, by a monitoring communications systems for providing an effective no - spill technology with no buried bolted steel flanges.

References

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