City of Benton Kentucky Gas System PE Leak Suppression Program Results

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Summary

City of Benton Kentucky was experiencing continual pinholes leaks in PE service line pipes which were discovered during leak surveys. Industry funded research of this problem of PE pinhole leaks determined that the cause of these leaks is internal static electricity created by the passage of gas inside the pipe. The City of Benton Gas Department instituted a program of internal static suppression in their PE system. The result was over a 90% reduction in PE leaks of service lines in leak surveys. The reduction in repair costs, reduced risk of static induced ignitions during O & M operations as well as the reduction in unaccounted gas loss is examined.

Background

Beginning in the early 1970's, gas distributors began installing PE pipe to distribute natural gas. The American Gas Association reported gas distributors noticing two problems in PE systems. First, there was a noticeable increase in static in PE pipe. Second, distributors were discovering pin hole leaks in PE pipe for which there was no known explanation other than these leaks were created during the pipe manufacturing process.

The former Gas Research Institute, which was funded for gas distribution research through gas distribution assessment fees, conducted research which determined that it was internal static electricity in the PE pipe that created these leaks. Since both PE and natural gas are electrical insulators, as the gas rubbed against the inside wall of the PE pipe during transport, static electricity would randomly accumulate on the internal PE pipe wall. If the accumulated internal static exceeded the dielectric strength of the PE wall thickness, the internal static arced through the PE pipe wall to the surrounding earth. The static arcing produces heat which melts and burns the PE creating a pinhole leak.

When this phenomenon began to occur, distributors assumed the leaks were created in the manufacturing process of the PE pipe. However, two factors argue against this presumption. First, if the leaks were created during the manufacturing process, when the PE pipe was originally installed and pressure tested, the defective PE pipe should have failed pressure testing. This did not occur since the pipe was placed in service. Second, in several instances of pinhole leaks in PE pipe, pipe sections with pinhole leaks were sent to labs for analysis. In these cases the labs determined static electricity to be the cause of the pinhole leak.

City of Benton Gas System

The City of Benton Kentucky municipal gas system has 6,880 services and 331 miles of pipeline. The PE portion of the PE system consists primarily of 2406 medium density PE pipe with installation beginning in the mid 1980's. The PE pipe in their system was made by at least three different PE pipe

manufacturers. Leaks surveys discovered pin hole leaks in PE pipe from all the manufacturers of PE pipe in their system indicating that pinholing was not specific to a particular PE pipe manufacturer.

One third (1/3) of their system is leak surveyed each year so the entire system is surveyed in 3 years. The following chart is the results of their leaks surveys.

2007 – 1/3 survey	8 total leaks	1 – 1”	2 – ¾”	5 – ½”
2008 – 1/3 survey	18 total leaks	1 – 1’	5 – ¾”	12 – 1/2”
2009 – 1/3 survey	6 total leaks	0 – 1”	5 – ¾”	1 – ½”
2010 – 1/3 survey	14 total leaks	0 – 1”	7 – ¾”	7 – ½”
2011 – 1/3 survey	13 total leaks	0 – 1”	1 – ¾”	12 – ½”
2012 – 1/3 survey	9 total leaks	0 – 1”	2 – ¾”	7 – ½
2013 – 1/3 survey	9 total leaks	0 – 1”	9 – ¾”	0 – ½”

Ionix Static Suppression Cartridges installed at 4” and 3” city gate

2014 – 1/3 survey	2 total leaks	0 – 1”	1 – ¾”	1 – ½”
2015 – 1/3 survey	2 total leaks	0 – 1”	1 – ¾”	1 – ½”
2016 – 1/3 survey	0 total leaks	0 – 1”	0 – ¾”	0 – ½”

The reduction of PE pinhole leaks to virtually zero validate the Gas Research Institute’s research conclusion that internal static in PE systems creates pinhole leaks. The only additional factor in the system to account for the PE pinhole leak reduction was the introduction of internal static suppression.

Note that leak surveying is not 100% foolproof and therefore some legacy leaks not previously discovered will be found. However, once these legacy leaks are found and repaired there should be no further pinhole leak creation if internal static suppression is maintained.

PE Leak Repair Cost Savings

Leak repair costs vary depending on the location of the leak. To determine PE leak repair cost savings, based on the history above, you should be able to expect at least a 90% reduction in current repair costs of pinhole leaks in the PE system areas where internal static suppression is to be installed. Once internal static suppression has begun to treat the system, you should expect that level of repair cost savings to continue as long as internal static suppression is maintained.

Static Ignition Risk Reduction

Since static electricity is created inside the PE pipe during the transport of gas inside the pipe, if the operator suppresses the internal static electricity in the pipe to prevent pinhole leaks, by implication, the operator has also reduced the risk of a static ignition of leaking gas especially during O & M operations.

The dielectric strength of medium density PE pipe is 510 volts per thousandth of an inch. That is to say, the wall of PE pipe will resist the passage of electricity through it depending upon its thickness. Here are the approximate wall thickness and dielectric strength of medium density PE pipe:

½" - .090 @ 510 volts per mil – 45,900 volts

¾" - .095 @ 510 volts per mil – 48,450 volts

1" - .125 @ 510 volts per mil – 63,750 volts

In 2008 there was a leak in a 1" section of medium density PE pipe. To create this hole, based upon the 1" pipe nominal wall thickness, the internal voltage had to reach 63,750 volts.

After internal static suppression was installed, in 2016 there were no leaks surveyed in that section of the system. That means that there was no internal voltages reaching the threshold of 45,900 volts – the voltage necessary to create a pinhole in ½" medium density PE pipe – the smallest pipe size in the system. Since the system had in the past experienced voltages of 63,750 volts to create a pinhole in 1" pipe, this means internal voltages in the system were reduced at a minimum by at least 17,850 volts (63,750 – 45,900 volts) due to internal static suppression.

This reduction is the MINIMUM reduction. The system should be static free with internal static suppression. However, this can only be determined by taking static readings at random locations in the system (such as odorant monitoring locations) since pin holing stops if system voltages drop below 45,900 volts. However, since it is shown empirically that a minimum of a 17,850 volt static reduction has occurred in this system, it follows there is a significant reduction in the risk of a static induced ignition during O & M operations even in the absence of measuring static in the system.

Unaccounted gas loss

While pinhole leaks are small, their cumulative loss of gas in the course of time until discovered in leak surveys and repaired is still a cost to distributors. By preventing pinhole leaks you reduce your unaccounted gas loss from PE pinhole leaks immediately and in perpetuity.

Summary

The ongoing and cumulative cost savings of reduced PE leak repair costs, the reduction of risk of static induced ignitions during O&M operations as well as the reduction in unaccounted gas makes internal static suppression in PE gas distribution systems cost effective to operators.

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