REPORT

G T I   T E S T I N G   L A B O R A T O R I E S
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Evaluation of Aerosol Static Suppressor

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BACKGROUND

Electrostatic buildup on plastic pipe is a very hazardous problem in the natural gas industry. This causes accidents that range from shocking operations personnel to gas explosions during repair. Buildup generally occurs by friction due to the particles (dust, rust, etc.) that are flowing in the gas stream inside the pipe. Polyethylene (PE) pipes can store a large amount of electrical charge due to its high resistivity.

Procedures have been implemented by gas utilities in order to mitigate this problem. One conventional way that technicians discharge plastic pipe is by wrapping the pipe with soapy burlap. Ionix Gas Technologies (IGT) has developed a static suppresser that can be sprayed directly onto plastic pipe. Gas Technology Institute (GTI) was asked to perform an evaluation of IGT's spray to ensure that it works, and will not have adverse effects on the pipeline infrastructure.

TEST METHODS USED

Table 1 - Test Methods Used

	Test Method Number	Revision	Title
1	ASTM D543*	06	Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
2	ASTM D638	03	Standard Test Method for Tensile Properties of Plastics
3	ASTM D1599	99(2005)	Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings
4	Static Dissipation*		GTI Internal Method for Static Dissipation on Plastic Pipe
5	Flammability*		GTI Internal Method for Flammability Testing
6	ASTM F905*	04	Standard Practice for Qualification of Polyethylene Saddle Fusion Joints**

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TEST RESULTS

Chemical Resistance

In this test, we evaluated the chemical resistance of the plastic pipe to IGT's static suppressor by comparing the resistance to cracking of the sprayed pipes to a control group that was not sprayed with the suppressor fluid. Standard test method ASTM D543 Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents portrays the bend test jig as shown in figure 1. The plastic pipe that was used for this test was 2" IPS UPONOR UAC2000 PE 2406 T03111203 UPC vintage. A bend radius of 10 times the outside diameter (OD) was used on the pipes in each jig. Since the OD of the pipes are roughly 2.5", the total radius of each jig is approximately 25".

Three (3) pipes were thoroughly sprayed with the IGT static suppressor, and three (3) pipes were control samples for a total of six (6) pipes. The three (3) sprayed pipes were allowed to dry before subjected to bend test. The pipes were monitored at 1 hr, 12 hr, 5 day, and 12 day marks. Neither the sprayed pipes nor control pipes exhibited any cracking of the pipe material at any of these intervals. This test was video documented.

In addition, die cut samples were taken from other pipes of the same vintage that were conditioned in our ASTM room (23ºC, 50% RH) to perform ASTM D638 Standard Test Method for Tensile Properties of Plastics. These samples were immersed in a covered bath of the IGT suppressor fluid as prescribed in ASTM D543. See figure 2.

Tensile Test

After the samples were allowed to soak for the required 40 hours, the samples were allowed to dry before being subjected to ASTM D638 Standard Test Method for Tensile Properties of Plastics. Four (4) sets of samples were tested altogether. There were three (3) sets of samples in the bath: sprayed, unsprayed, and butt fusion samples that were sprayed prior to fusing. The last set of samples was a control sample (not sprayed or soaked). The results are tabulated in the Tables 1 through 4. Table 5 shows the parameters put into the MTS software for these tests. Figure 3 shows the MTS apparatus.

Table 1: Control Sample Tensile Test Results

Specimen #	Specimen ID	Width in	Thickness in	Tensile Strength psi	Percent Elongation at Break %	% Elongation @ Yield %	Modulus psi	Break Stress psi
1	C3	0.475	0.193	3702.3	694.935	11.717	186390.5	2858.506
2	C4	0.475	0.195	3797.6	682.975	11.772	212518.9	2856.273
3	C5	0.475	0.196	3806.2	702.072	12.427	202086.2	2846.836
4	C6	0.475	0.196	3812.7	677.214	12.250	217314.2	2781.402
Mean		0.475	0.195	3779.7	689.299	12.041	204577.5	2835.754
Std. Dev.		0.000	0.001	52.0	11.269	0.351	13690.2	36.586

Table 2: Soaked Control Sample Tensile Test Results

Specimen #	Specimen ID	Width in	Thickness in	Tensile Strength psi	Percent Elongation at Break %	% Elongation @ Yield %	Modulus psi	Break Stress psi
1	C7	0.475	0.193	3884.3	299.408	11.662	213632.7	2404.344
2	C8	0.475	0.192	3814.5	697.313	11.568	211856.2	2897.094
3	C9	0.475	0.194	3841.9	675.661	11.858	134001.0	2887.081
4	C10	0.476	0.194	3880.3	599.671	11.936	209861.8	2867.386
5	C11	0.475	0.195	3790.9	684.348	10.139	160775.0	2804.775
6	C12	0.475	0.191	3809.9	686.797	11.466	145807.5	2848.618
Mean		0.475	0.193	3837.0	607.199	11.438	179322.4	2784.883
Std. Dev.		0.000	0.001	38.7	154.847	0.660	36577.6	189.267

Table 3: Sprayed and Soaked Sample Tensile Test Results

Specimen #	Specimen ID	Width in	Thickness in	Tensile Strength psi	Percent Elongation at Break %	% Elongation @ Yield %	Modulus psi	Break Stress psi
1	R1	0.475	0.197	3684.3	679.263	11.976	193320.4	2750.301
2	R2	0.475	0.199	3796.5	664.956	12.195	218529.1	2743.547
3	R3	0.476	0.195	3768.6	666.337	12.423	199008.5	2805.791
4	R4	0.476	0.196	3775.1	681.413	11.575	140553.7	2940.082
5	R5	0.475	0.198	3754.1	686.381	11.403	167334.4	2856.313
6	R6	0.476	0.195	3806.4	672.755	12.594	157136.5	2841.410
Mean		0.476	0.197	3764.2	675.184	12.028	179313.8	2822.907
Std. Dev.		0.001	0.002	43.5	8.597	0.470	29187.6	73.554

Table 4: Butt Fusion Sample Tensile Test Results

Specimen #	Specimen ID	Width in	Thickness in	Tensile Strength psi	Percent Elongation at Break %	% Elongation @ Yield %	Modulus psi	Break Stress psi
1	F1	0.475	0.196	3751.2	216.904	10.179	210785.7	2681.815
2	F2	0.475	0.197	3744.1	213.938	12.070	163650.7	2699.776
3	F3	0.475	0.197	3810.1	383.091	11.747	165336.2	2856.490
4	F5	0.476	0.197	3746.1	328.203	11.585	171871.6	2824.185
5	F6	0.476	0.197	3835.8	362.409	11.591	167371.5	2869.100
Mean		0.475	0.197	3777.5	300.909	11.434	175803.1	2786.273
Std. Dev.		0.001	0.000	42.6	80.471	0.729	19796.2	88.912

Table 5: Tensile Testing Parameters

Name	Value	Units
Grip Separation	4.500	in
Nominal Gage Length	2.000	in
Slack Pre-Load	0.500	lbf
Yield Offset	0.200	%

As can be seen from the tensile test data, all average modulus results are within 30 ksi of the control samples, and all average break stresses are within 100 psi of the control samples. All mean percent elongations from each sample set are fairly similar at yield (11-12 %). The only major anomaly with the data arises in the percent elongation at break for the fusion samples. This is because the failure in the butt fusion samples occurs in the pipe material itself, as opposed to the fused area. A more clear depiction of this phenomenon is described in the impact test section.

All butt fusions were performed at NICOR. Standard NICOR procedures were used, following tip cards that are required for use by NICOR personnel and include an alcohol wipe to clean the mating pipe surfaces prior to fusion.

Quick-Burst Test

More butt fusion samples were tested, this time using standard test method ASTM D1599 Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings, Butt Fusions. Results from this test are tabulated in table 6.

Table 6: Quick-Burst Test Results

Pipe: Butt Fusion

Print line: 2" IPS SDR-11 UPONOR UAC2000 FOR GAS ONLY PE 2406 CEC ASTMD2513 T03111203 UPC

Standard: ASTM D1599

Specimen ID	Minimum Wall (inch)	Outside Diameter (inch)	Time To Failure (seconds)	Maximum Pressure (psig)	Hoop Stress (psi)
S1	0.230	2.375	59.6	651.3	3037
S2	0.230	2.376	64.7	654.9	3055
N1	0.231	2.375	67.9	642.6	2982
N2	0.230	2.374	70.0	651.0	3034
N3	0.231	2.375	64.0	650.2	3017

‘S’ denotes samples that the IGT static suppressor was used prior to the butt fusions, whereas ‘N’ samples are used as a control for comparison. Results show very little deviation between ‘S’ and ‘D’ samples. Generally they failed slightly quicker, but were able to hold slightly more pressure.

Static Dissipation

PE pipe material was subjected to a static dissipation test. Simco electrostatic field meter was used to measure electrostatic voltage on pipe. It uses two circles to accurately measure the distance. Once the circles are aligned on top of each other, the meter takes a reading. The distance needs to be perfect for an accurate reading because the voltage measured by the sensor is proportional to 1/r. There is also video documentation of this test.

A baseline measurement of 0.00 V on the PE pipe is shown in figure 4. Cotton material was used to create a static charge ranging from 12 to 20 V. After it was sprayed with the IGT static suppressor, the fluid was allowed to evaporate for 20 min. A measurement was taken at this point, reading very close to 0 V (approximately 0.1 V). The same test was done using a soapy burlap wrap. Application of the wrap can be seen in figure 5. After this was complete, the wrap was taken off and the static charge was measured again. The results of this test were also approximately 0.1 V.

Flammability

The IGT static suppressor was sprayed over an open flame with caution. Once it was realized that the fluid did not ignite, full sprays were shot on the open flame without ignition of the fluid. Figure 6 shows a picture of the test.

Impact Test

Impact testing was performed in accordance with ASTM F905 Standard Practice for Qualification of Polyethylene Saddle Fusion Joints. All saddle electro-fusions were performed at NICOR. Standard NICOR procedures were used, following tip cards that are required for use by NICOR personnel. The pipe used in this test was sprayed with the IGT static suppressor, and was allowed to dry. Standard NICOR procedures were used, and included an alcohol wipe followed by scraping to clean the mating pipe surface prior to fusion. The electro-fusion process was video documented.

This fusion passed the impact test, which requires no failures at a minimum of 500 ft*lbf of drop force on the tee. A 300 lb weight was used, and the tee failed after a height of 30”. This calculates to 750 ft*lbf. As was described in the tensile tests, the pipe material itself fails before the fusion. Figures 7 and 8 show how the stem was completely torn off of the tee. This is because a correctly formed fusion bond is stronger than the pipe material itself.

SUMMARY AND CONCLUSIONS

The PE pipe material exposed to the IGT static suppressor passed all of the following tests:

- Chemical Resistance (ASTM D543)
- Tensile Test (ASTM D643)
- Hydraulic Quick-Burst (ASTM D1599) on Butt Fused MDPE pipe
- Static Dissipation on MDPE pipe
- Flammability (spray did not ignite over open flame)
- Impact Test on Electro-Fusion MDPE Saddle Tee

Use of this product can save the operator time out in the field over traditional “soapy burlap” application to the pipe. The static suppressor can simply be sprayed directly on the pipe without prior cleaning and has equivalent static dissipation potential to soapy burlap.
It is recommended that the pipe be sprayed before coming in contact with it."

Respectfully Submitted,

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The results within this report relate only to the items tested.

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FIGURES

Figure 1. ASTM D543 Chemical Resistance: Pipe Bend Test Fixture set at 10 times the outside diameter. Sprayed pipes were compared to control pipes of same 2" UPONOR MDPE 2406 vintage.

Figure 2. IGT spray bath with dye cuts to compare the modulus, and yield strength to control samples from the same pipe.

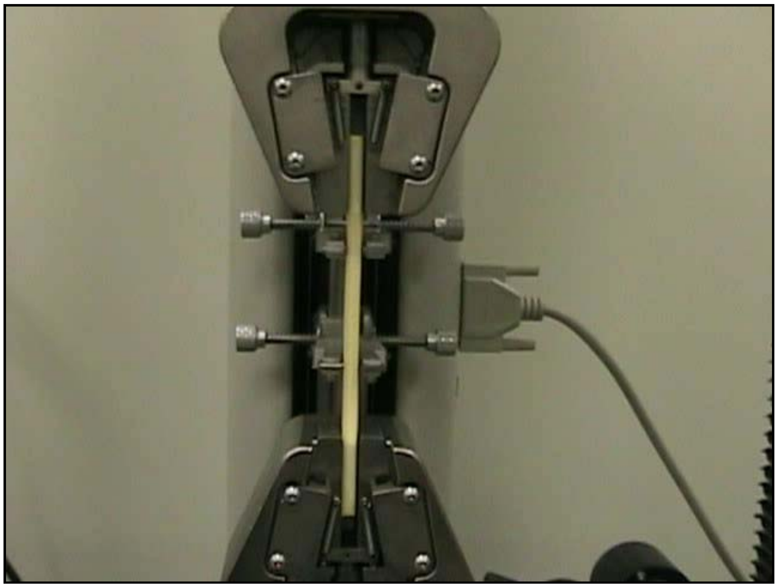

Figure 3. ASTM D638 Tensile Test: MTS Machine used for testing.

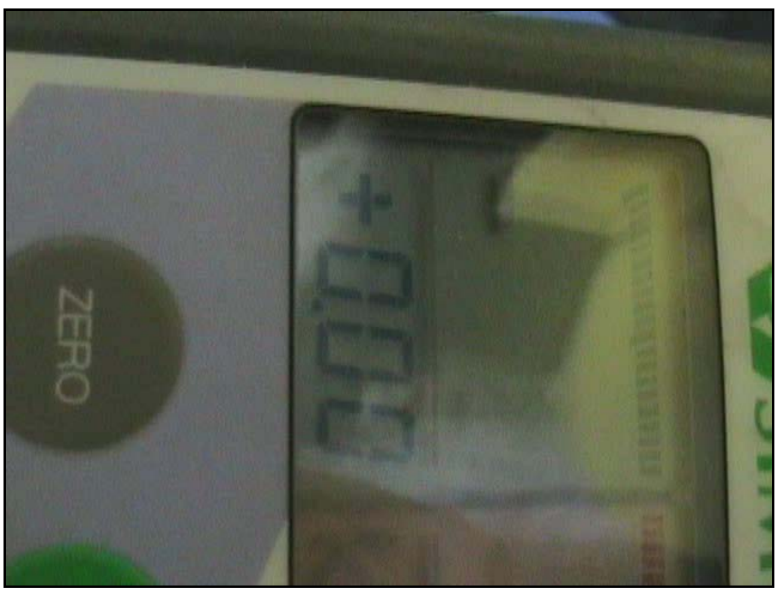

Figure 4. Static Suppressor Test: Baseline reading of electrostatic voltage on pipe using Simco electrostatic field meter.

Figure 5. Static Suppressor Test: Soapy burlap application.

Figure 6. Flammability Test. Note that the flame does not increase when sprayed with IGT static suppressor.

Figure 7. Impact Test on electro-fused saddle tee to ASTM F905.

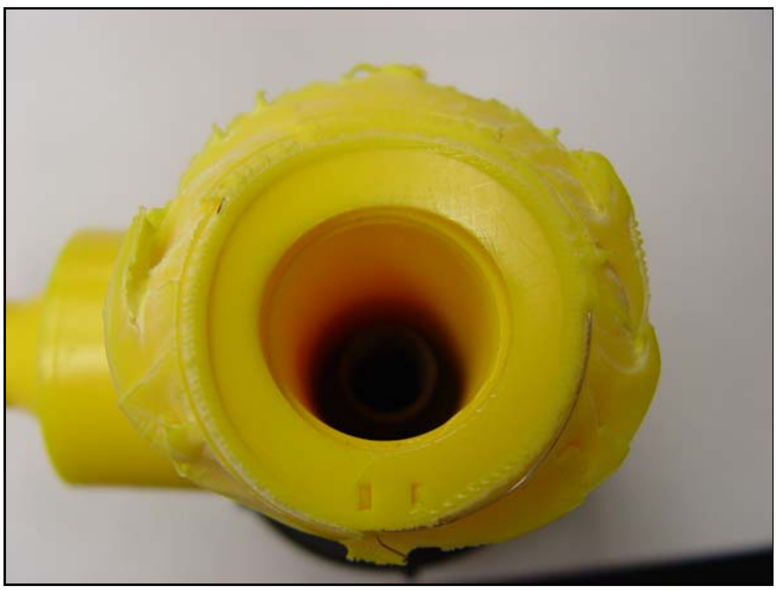

Figure 8. Impact Test: Close-up look at tee. Note how the weight completely tore the stem off of the central gas electro-fusion saddle tee. This is consistent with properly fused PE material (plastic material itself failed, not the fusion).

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