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FIRE EXTINGUISHER PERFORMANCE EVALUATION WITH GELTECH SOLUTIONS, INC.'S FIREICE WATER ADDITIVE ON CLASS 2-A AND 40-A CRIBS AND A TEN-TIRE FIRE IN GENERAL ACCORDANCE WITH UL 711

FINAL REPORT
Consisting of 13 Pages

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ABSTRACT

Southwest Research Institute's (SwRI) Fire Technology Department conducted a fire extinguisher performance evaluation with GelTech Solutions, Inc.'s FireIce water additive on Class 2-A and 40-A Cribs and a ten-tire fire. The evaluations were performed October 16, 2007, - January 16, 2008, in general accordance with the UL 711, *Rating and Testing of Fire Extinguishers*, last revised June 1, 2007.

The FireIce water additive and mixing instructions were provided by GelTech Solutions, Inc. The ratio of additive to water was 1 lb per 10 gal. Fire extinguisher discharge units were provided by Southwest Research Institute with the approval of GelTech Solutions, Inc. Standard fire test cribs were acquired preconditioned from Carr Lumber & Mfg. Co.

The cribs were supported 16 in. over the appropriate-sized heptane ignition pans. The pans were filled with the appropriate quantity of heptane and ignited. The heptane was allowed to burn to completion, and the cribs were attacked with the fire extinguisher when the crib had been reduced to approximately 55% of its original mass. For the tire fire, ten tires were randomly stacked inside a metal pan and ignited with 0.5-gal heptane. The tires were attacked when they had reduced to approximately 55% of their original mass.

Testing showed that the solution in a 2.5-gal extinguisher with a 15° flat fan nozzle, pressurized to 100 psig was capable of extinguishing three consecutive Class 2-A Wood Crib Fires per UL 711. The solution discharged by a pump system with an adjustable 1.5-in. fire nozzle utilizing less than 250 gal of solution at 24 to 29 gpm was capable of extinguishing three consecutive Class 40-A Wood Crib Fires per UL 711. The solution discharged by a pump system with an adjustable 1.5-in. fire nozzle at 25 gpm flowed for 2 min was capable of extinguishing a ten-tire fire (random stacking).

A set of 90-day metallic corrosion tests was also performed in order to determine the solutions compatibility with mild steel, brass, and aluminum. A total of 18 metallic samples were submerged in GelTech Solutions, Inc.'s FireIce solution under different conditions to determine the corrosion rate in accordance with NFPA 18A. The average corrosion rates for mild steel, brass, and aluminum were all below the limits established by the US Department of Agriculture Forest Service Specification 5100-306a, *Specification for Water Enhancers (Gels) for Wildland Firefighting*, June 1, 2007.

INTRODUCTION

The objective of this fire extinguisher performance evaluation was to determine whether GelTech Solutions, Inc.'s FireIce water additive could successfully extinguish Class 2-A and 40-A Cribs. An additional test was performed to determine the ability of the FireIce water additive to extinguish tire fires. The evaluations were performed October 16, 2007, - January 16, 2008, by Southwest Research Institute's (SwRI) Fire Technology Department in general accordance with UL 711, *Rating and Fire Testing of Fire Extinguishers*, last revised June 1, 2007. A representative of SwRI's Listing, Labeling, and Follow-Up Inspections Section witnessed these tests.

The test methods described in this report are intended to measure and describe the properties of materials or products in response to heat and flame under controlled laboratory conditions. Fire extinguishers and agents shall also comply with requirements for construction and performance as applicable to specific types, designs, sizes, and arrangements, which are outside the scope of UL 711.

The results presented in this report apply only to the materials tested, in the manner tested, and not to any similar materials or material combinations.

TEST SPECIMEN

SwRI received the water additive on August 17, 2007, from GelTech Solutions, Inc. The sample consisted of a 25-lb bag of the FireIce additive, identified as having been from Lot No. GSL349E. The sample consisted of a free-flowing white powder. The water additive was mixed in a 1-lb powder to 10-gal water ratio. Mixtures for the Class 2-A fire tests were made in 2.5-gal batches, and mixtures for the Class 40-A and tire fire tests were made in 250-gal batches.

The Class 2-A and 40-A Cribs were manufactured and acquired from Carr Lumber & Mfg. Co. The cribs were constructed of Douglass fir in accordance with UL 711. The cribs were verified to be within the 9%–13% moisture content required by the standard prior to testing.

The portable extinguisher used for the Class 2-A fire tests was a standard 2.5-gal extinguisher equipped with a 15° flat-fan nozzle. The extinguisher was filled with the solution and pressurized to 100 psig prior to each test trial.

The extinguisher used for the Class 40-A fire tests and tire fire tests consisted of a 250-gal reservoir and pump system. The pump was equipped with a bypass to adjust flow and ensure good mixing of the solution. The pump discharged the solution through a 1.5-in. fire hose equipped with a 1.5-in. fire nozzle with an adjustable spray angle and flow rate.

Metal samples measuring $1 \times 4 \times \frac{1}{8}$ in. for corrosion testing were obtained from Alabama Specialty Products, Inc. Eight samples of each 4130 mild steel, CDA 268 yellow brass, and 2024-T3 aluminum were received, each uniquely identified and pre-drilled for suspension in the tests.

TEST PROCEDURE

The UL 711 wood crib fire tests are used to rate a fire extinguisher and agent based on the size of crib fire they are able to extinguish. The wood crib is supported on an angle iron frame approximately 16 in. above a heptane pool fire which is sized proportionately with the crib. The heptane is ignited and allowed to burn out. Extinguishment of the fire begins when the mass of the crib has reached approximately 55% of its initial mass. Crib extinguishment begins 6 ft from the front of the crib face and continues uninterrupted along that face and the two sides, top, and bottom while the distance of attack is reduced at the discretion of the operator. Once discharge of the agent is completed, if the crib has been extinguished, it is observed for an additional 15 min to ensure reignition does not occur.

The tire fire test was performed similar to the crib fire tests. Ten used tires were piled randomly in a generally-pyramidal fashion, inside an 8-ft diameter pan. Heptane (approximately 0.5 gal) was poured in the center of the tire pile as the ignition source. The heptane was ignited and allowed to burn out.

Extinguishment of the fire begins when the tire pile has reached approximately 55% of its initial mass in the same manner as the crib fire (although the operator can attack from the rear of the pile as well). Once discharge of the agent is completed, if the tire pile has been extinguished, it is observed for an additional 15 min to ensure reignition does not occur.

The NFPA 18A Uniform Corrosion tests are used to determine the compatibility of fire-fighting solutions with metallic materials. For each cleaned test metal, three samples are fully submerged, and three samples are partially submerged in the solution by suspension with a Dacron string. The samples were stored in a condition chamber held at 72 °F for a period of 92 days. The weight loss during the submersion is compared to the weight loss of samples suspended in air and used to determine the yearly corrosion rate. Typical acceptable limits for corrosion are outlined in the US Department of Agriculture Forest Service Specification 5100-306a, *Specification for Water Enhancers (Gels) for Wildland Firefighting*, June 1, 2007.

RESULTS

Table 1 outlines the parameters for each fire test and includes an indication of pass or fail. Appendix A has selected photographs of the tests. Table 2 outlines the observations taken during each test. Table 3 outlines the results of the corrosion tests.

Table 1. Test Matrix.

Test ID	Test Date	Extinguisher	Flow Rate and Flow Duration	Notes
UL 711 2-A Crib Test No. 1	November 12, 2007	2.5-Gal Extinguisher with 15° Flat Fan Nozzle	58 s	1 st Pass
UL 711 2-A Crib Test No. 2	November 12, 2007	2.5-Gal Extinguisher with 15° Flat Fan Nozzle	55 s	2 nd Pass
UL 711 2-A Crib Test No. 3	November 12, 2007	2.5-Gal Extinguisher with 15° Flat Fan Nozzle	58 s	3 rd Pass
UL 711 40-A Crib Test No. 1	November 13, 2007	Pump System with Adjustable 1.5-in. Nozzle	27 gpm for 8 min 4 s	218 gal 1 st Pass
UL 711 40-A Crib Test No. 2	November 14, 2007	Pump System with Adjustable 1.5-in. Nozzle	24 gpm for 9 min 44 s	234 gal 2 nd Pass
UL 711 40-A Crib Test No. 3	November 30, 2007	Pump System with Adjustable 1.5-in. Nozzle	29 gpm for 6 min 40 s	193 gal 3 rd Pass
Custom Ten-Tire Fire Test	November 14, 2007	Pump System with Adjustable 1.5-in. Nozzle	25 gpm for 120 s	No Reignition after 15 min

Table 2. Test Observations (Time in min:s)

Test ID	Heptane Extinguished	Extinguishing Begins	Crib (Tires) Extinguished	Extinguishing Stops	Reignition
UL 711 2-A Crib Test No. 1	3:10	7:05	7:25	8:03	No
UL 711 2-A Crib Test No. 2	3:15	7:43	7:57	8:38	No
UL 711 2-A Crib Test No. 3	3:10	7:37	7:53	8:35	No
UL 711 40-A Crib Test No. 1	4:00	7:11	9:20	15:15	No
UL 711 40-A Crib Test No. 2	3:55	7:11	9:04	16:15	No
UL 711 40-A Crib Test No. 3	4:25	6:50	8:20	13:30	No
Custom Ten-Tire Fire Test	1:04	10:05	10:59	12:05	No

Table 3. Uniform Corrosion Test Results

C4130 Mild Steel					
Sample No.	Condition	Initial Weight (g)	Final Weight (g)	Weight Loss (g)	Corrosion Rate (mpy)
1	50% Submerged	71.104	70.404	0.700	2.2
2	50% Submerged	71.144	70.523	0.621	1.9
3	50% Submerged	71.099	70.529	0.570	1.7
4	Fully Submerged	71.221	70.832	0.389	1.1
5	Fully Submerged	71.182	70.818	0.364	1.0
6	Fully Submerged	71.088	70.844	0.244	0.6
7	50% in Water	70.879	70.568	0.312	0.9
8	Air Only	70.932	70.883	0.049	
Average 50% Submerged Corrosion Rate (mils per year):				1.9	Allowable Limit - 5.0
Average Fully Submerged Corrosion Rate (mils per year):				0.9	Allowable Limit - 5.0
CDA 268 Yellow Brass					
Sample No.	Condition	Initial Weight (g)	Final Weight (g)	Weight Loss (g)	Corrosion Rate (mpy)
1	50% Submerged	68.249	68.189	0.060	0.2
2	50% Submerged	67.741	67.691	0.050	0.1
3	50% Submerged	67.663	67.622	0.041	0.1
4	Fully Submerged	68.085	68.048	0.037	0.1
5	Fully Submerged	68.065	68.021	0.044	0.1
6	Fully Submerged	68.604	68.567	0.037	0.1
7	50% in Water	67.949	67.934	0.015	0.0
8	Air Only	67.700	67.690	0.010	
Average 50% Submerged Corrosion Rate (mils per year):				0.1	Allowable Limit - 5.0
Average Fully Submerged Corrosion Rate (mils per year):				0.1	Allowable Limit - 5.0
2024-T3 Aluminum					
Sample No.	Condition	Initial Weight (g)	Final Weight (g)	Weight Loss (g)	Corrosion Rate (mpy)
1	50% Submerged	22.707	22.652	0.055	0.5
2	50% Submerged	22.786	22.734	0.052	0.5
3	50% Submerged	22.796	22.752	0.044	0.4
4	Fully Submerged	22.713	22.669	0.044	0.4
5	Fully Submerged	22.702	22.669	0.033	0.3
6	Fully Submerged	22.788	22.755	0.033	0.3
7	50% in Water	22.669	22.668	0.001	0.0
8	Air Only	22.797	22.795	0.002	
Average 50% Submerged Corrosion Rate (mils per year):				0.5	Allowable Limit - 2.0
Average Fully Submerged Corrosion Rate (mils per year):				0.3	Allowable Limit - 2.0

CONCLUSION

The FireIce water additive, mixed at a ratio of 1 lb per 10 gal, was capable extinguishing fires in the following scenarios:

- 2.5-gal extinguisher with a 15° flat fan nozzle, pressurized to 100 psig
Extinguished three consecutive Class 2-A Wood Crib Fires per UL 711
- Pump system with adjustable 1.5-in. fire nozzle
Utilizing less than 250 gal of solution at 24 to 29 gpm
Extinguished three consecutive Class 40-A Wood Crib Fires per UL 711
- Pump system with adjustable 1.5-in. fire nozzle at 25 gpm flowed for 2 min
Extinguished ten-tire fire (random stacking)

Additionally, the FireIce water additive, mixed at a ratio of 1 lb per 10 gal, showed corrosion levels for mild steel, yellow brass, and aluminum within the limits set forth by US Department of Agriculture Forest Service Specification 5100-306a.

Appendix A
Photographic Documentation
(Consisting of 5 Pages)

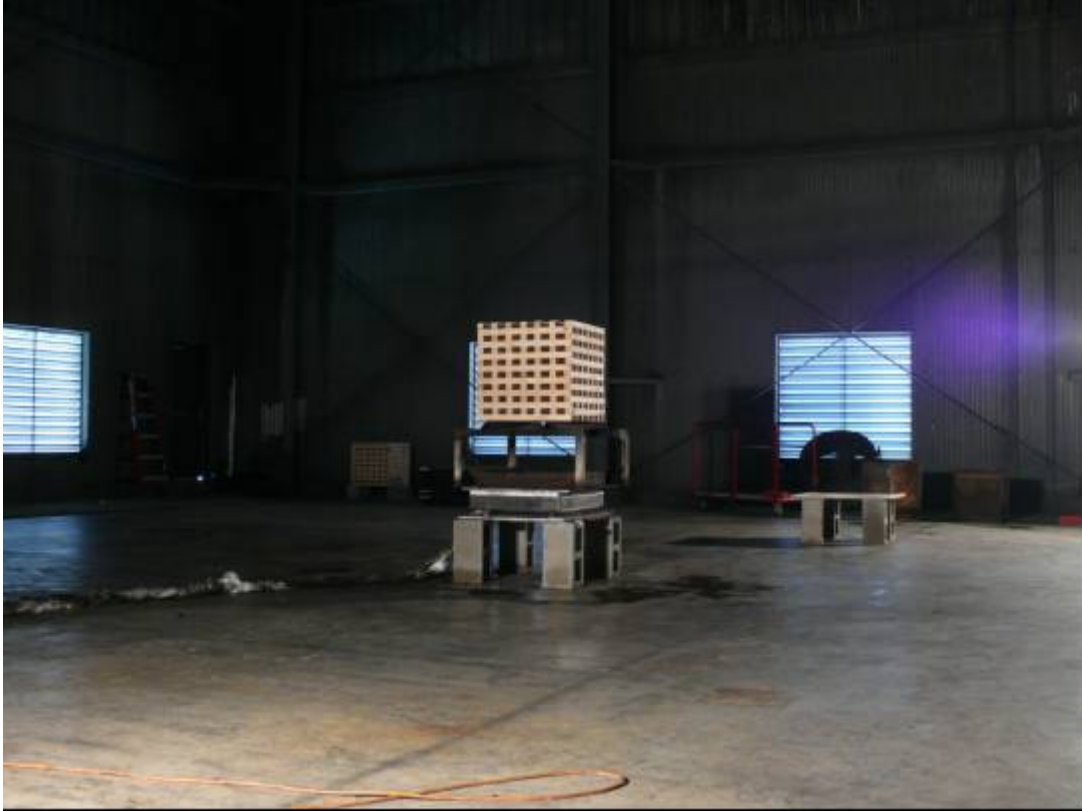


Figure A-1. General Test Setup for Class 2-A Crib.



Figure A-2. Preburn of Class 2-A Crib.



Figure A-3. Extinguishment of Class 2-A Crib.



Figure A-4. General Setup of Class 40-A Crib.



Figure A-5. Preburn of Class 40-A Crib.



Figure A-6. Extinguishment of Class 40-A Crib.



Figure A-7. Class 40-A Crib following Extinguishment.



Figure A-8. Ten-Tire Fire at Initiation.



Figure A-9. Extinguishment of Ten-Tire Fire.



Figure A-10. Ten-Tire Fire at End of Extinguishment.