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FIRE PERFORMANCE EVALUATION IN ACCORDANCE WITH NFPA 259, *STANDARD TEST METHOD FOR POTENTIAL HEAT OF BUILDING MATERIALS*

MATERIAL ID: ***SWP***

FINAL REPORT
Consisting of 4 Pages

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Prepared for:

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1.0 INTRODUCTION

The objective of this test program was to perform a fire performance evaluation for Green Products Imdustries WLL, located in Kingdom of Bahrain. The material was identified by the Client as *SWP*. The material was tested in accordance with National Fire Protection Association (NFPA) Standard 259, *Standard Test Method for Potential Heat of Building Materials*, 2013 Edition. Testing was conducted on January 2 and 3, 2018, at Southwest Research Institute's (SwRI) Fire Technology Department, located in San Antonio, Texas.

This test method is intended to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a particular end use. The results apply specifically to the specimens tested, in the manner tested, and not to similar materials, nor to the performance when used in combination with other materials.

2.0 TEST PROCEDURE

The gross and net calorific potential of materials are determined as described in NFPA 259-13. The apparatuses, specimen preparation, and test protocol are described in detail in this standard. There are two test procedures used in this standard to determine the potential heat of a material.

The first procedure is the oxygen bomb calorimeter test procedure. For this test, a specimen weighing nominally 1.0 g ± 0.9 g is placed in a metal crucible, which is then placed in a stainless steel bomb. If necessary, benzoic acid with a heat of combustion of 11,373 Btu/lb is used as a combustion promoter. The sample is tested in general accordance with ASTM D5865-07a, *Test Method for Gross Calorific Value of Coal and Coke* (The NFPA 259-13 references ASTM D3286, *Standard Test Method for Gross Calorific Value of Coal and Coke by the Isoperibol Bomb Calorimeter*, but this standard was withdrawn and replaced by ASTM D5865). This procedure yields a gross heat of combustion. Two tests are conducted for repeatability. If the first two tests do not agree to within 10%, a third test is performed.

The second test procedure, the electric muffle furnace test procedure, requires a test specimen cut in the shape of a rectangular prism measuring 13 × 19 × 64 mm (W × L × H) height to be placed on the wire specimen holder, which is placed in the specimen container. The specimen container has a cap on one end and a hole on the other end, which allows fresh air to circulate around the test sample to promote complete combustion. The test sample is exposed to a temperature of 750 °C ± 10 °C for 2 hr with a regulated airflow supplied at 47 cm^3/s referenced to 20 °C and 101 kPa, i.e., standard temperature

and pressure. After 2 hr, the test sample is removed from the furnace and placed in a desiccator to cool. Once the specimen has cooled to room temperature, the mass is measured.

If the mass of the residue remaining after the electric muffle furnace test procedure is not more than 5% of the initial mass of the test specimen, then the gross heat of combustion measured in the oxygen bomb calorimeter test procedure is considered to be the potential heat of the material tested.

If the mass of the residue is greater than 5% of the initial mass of the test specimen, then the residue must be tested according to the oxygen bomb calorimeter test procedure. Two tests must be performed, and if the results differ by more than 10%, a third test is performed. The potential heat of the material is the difference between the gross heat of combustion measured in the first test procedure and the gross heat of combustion of the residue (as defined in NFPA 259) from the second procedure.

The parameters measured are as follows:

Gross Heat of Combustion (Q_{gr}) – The amount of heat released by the complete combustion of a unit of mass of the material, corrected for the heats of formation of H_2NO_3 and H_2SO_4, and for the heat of combustion of the firing wire and combustion promoter (if required). The gross calorific potential has a different value when combustion occurs in a constant pressure environment from that obtained in a constant volume environment. Tests are performed in a constant volume.

Potential Heat (Q_p) – The difference between the gross heat of combustion per unit mass of a representative specimen of the material and the heat of combustion per unit mass of any residue remaining after exposure of a representative specimen of the material to a defined heat source, i.e., muffle furnace, using combustion calorimetric techniques.

3.0 DESCRIPTION OF TEST SPECIMENS

Table 1. Test Sample Description.

Trade Name	Material ID	Description of Material	Nominal Received Dimensions *	Nominal Density	Color
Smart Wall Panel	*SWP*	Rigid foam insulation wall panel	1200 ×600 ×50 mm	35-40 kg/m^3	White/grey

*Measured by SwRI personnel

SwRI personnel prepared specimens for bomb the calorimeter testing in accordance with NFPA 259. Samples were prepared without a combustion promoter. For the electric muffle furnace test procedure, specimens were cut to the appropriate dimensions (approximately 13 × 19 × 64 mm), per NFPA 259.

Samples were placed in a conditioned environment maintained at 23 °C ± 2 °C and 50% ± 5% relative humidity, until specimen preparation, and then again, until just prior to testing.

4.0 TEST RESULTS

The electric muffle furnace and the oxygen bomb calorimetry testing was conducted on January 2 and 3, 2018, by A. Mata, Senior Technician. Constant mass was achieved on January 2, 2018.

Table 2. NFPA 259 Bomb Calorimeter Results of Raw Material.

	Run 1	Run 2	Average
Total Initial Mass (g)	0.992	0.995	0.994
Final Mass (g)	0.601	0.596	0.599
Gross Heat of Combustion (Btu/lb)	3490	3540	**3520**

Table 3. NFPA 259 Electric Muffle Furnace Results.

	Run 1	Run 2	Run 3	Average
Initial Mass (g)	4.202	4.456	4.151	4.329
Final Mass (g)	2.933	3.128	2.926	2.996
Percent Residue	69.8%	70.2%	70.5%	70.2%

Table 4. NFPA 259 Residue Bomb Results from Muffle Furnace.

	Run 1	Run 2	Run 3	Average
Initial Residue Mass (g)	0.493	0.492	0.496	0.494
Combustion Promoter (g)	0.493	0.492	0.496	0.494
Total Initial Mass (g)	0.986	0.984	0.992	0.987
Final Bomb Mass (g)	0.456	0.443	0.470	0.456
Gross Heat of Combustion (Btu/lb)	14	9	-103	**-27**

Two oxygen bomb test runs were performed, and the average gross heat of combustion was calculated. The percent difference was greater than 10%, so a third test was run in accordance with the standard. The material residues from the electric muffle furnace test runs were greater than 5%; thus, a third residue test was run in the bomb calorimeter. The potential heat of combustion was calculated according to the following equation:

$$P = G - cR$$

given P is the potential heat of combustion, G is the gross heat of combustion, as calculated by bomb testing of the raw material, c is the ratio of the weight of the residue to the weight of the initial sample from the muffle furnace exposure, and R is the gross heat of combustion of the residue. We find the potential heat of combustion of *SWP* to be **3540 Btu/lb**.