TEST REPORT

REPORT NUMBER: 100243360MID-001
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EVALUATION CENTER
Intertek Testing Services NA Inc.
8431 Murphy Drive
Middleton, WI 53562

RENDERED TO
Fabral Inc
3449 Hempland Rd
Lancaster PA 17601

PRODUCT EVALUATED: Phasechange Energy Solutions
Phasechange Material
EVALUATION PROPERTY: Smoke Toxicity *ASTM E 800 – 07 Standard Guide for Measurement of Gases Present of Generated During Fires*

Report of Testing Phasechange Energy Solutions Phasechange Material for compliance with the applicable requirements of the following criteria: ASTM E 800 - 07 Standard Guide for Measurement of Gases Present of Generated During Fires

1 Table of Contents

2 Introduction

Intertek Testing Services NA (Intertek) has conducted testing for Fabral Inc, on Phasechange Energy Solutions Phasechange Material to evaluate smoke toxicity. Testing was conducted in accordance with, and following the standard method of ASTM E 800 -07. This evaluation began Oct 19, 2010 and was completed Oct 19, 2010.

3 Test Samples

3.1. SAMPLE SELECTION

Samples were selected by Fabral Inc. Samples were received at the Intertek Middleton Evaluation Center in October 2010 in good condition.

Samples were submitted to Intertek directly from the client. Samples were not independently selected for testing.

3.2. SAMPLE AND ASSEMBLY DESCRIPTION

Phasechange Energy Solutions Phasechange Material

White plastic 3” x 3” sample with 1 inch pouches. These samples were cut as specified in the ASTM E 800.

Samples were preconditioned at 75℉ and 50% humidity.

4 Testing and Evaluation Methods

4.1. Overview

This test method employs an electrically heated radiant energy source mounted within an insulated ceramic tube and positioned so as to produce an irradiance level of 2.2 Btu/s·ft^2 (2.5 W/cm^2) averaged over the central 1.5-in. (38.1-mm) diameter area of a vertically mounted specimen facing the radiant heater. The nominal 3 by 3-in. (76.2 by 76.2-mm) specimen is mounted within a holder which exposes an area measuring 29⁄16 by 29⁄16 in. (65.1 by 65.1 mm). The holder is able to accommodate specimens up to 1 in. (25.4 mm) thick.

For the flaming condition, a six-tube burner is used to apply a row of equidistant flamelets across the lower edge of the exposed specimen area and into the specimen holder trough. This application of flame in addition to the specified irradiance level from the heating element constitutes the flaming combustion exposure.

The test specimens are exposed to the flaming and non-flaming conditions within a closed chamber. A photometric system with a vertical light path is used to measure the varying light transmission as smoke accumulates. The light transmittance measurements are used to calculate specific optical density of the smoke generated during the time period to reach the maximum value. A Fourier Transform Infrared Detector (FTIR) is used to detect toxic smoke compounds. The FTIR is equipped with a 0.2 L chamber to allow detection of the gas compounds.

This test method provides a means for determining the specific optical density of the smoke generated by specimens of materials and assemblies under the specified exposure conditions. Values determined by this test are specific to the specimen or assembly in the form and thickness tested and are not to be considered inherent fundamental properties of the material tested. Thus, it is likely that closely repeatable or reproducible experimental results are not to be expected from tests of a given material when specimen thickness, density, or other variables are involved.

4.2. Instrumentation

The test chamber (Newport Scientific, Inc.) is composed of laminated panels that provide inside dimensions of 36 by 24 by 36 in. (914 by 610 by 914 mm) for width, depth, and height, respectively. The interior surfaces consist of porcelain enameled metal, resistant to chemical attack and corrosion, 2 sealed windows accommodate a vertical photometric system. When all openings are closed, the chamber is capable of developing and maintaining positive pressure during test periods.

An electric furnace with a 3-in. (76.2-mm) diameter opening is used to provide a constant irradiance on the specimen surface. The furnace is located along the centerline equidistant between the front and back of the chamber, with the opening facing toward and about 12 in. (305 mm) from the right wall. The centerline of the furnace is about 73⁄4 in. (195 mm) above the chamber floor. The furnace control system maintains the required irradiance level, under steady-state conditions with the chamber door closed, of 2.20 Btu/ft^2·s (2.50 6 0.05 W/cm2) for 20 min. The control system consists of an autotransformer and a voltmeter for monitoring the electrical input.
Specimen holders expose a 29⁄16 by 29⁄16-in. (65.1 by 65.1-mm) specimen area. For the flaming exposure test, a six-tube burner is used. The burner is centered in front of and parallel to the specimen holder. A radiometer is used to standardize the output of the radiant heat furnace.

The photometric system consists of a light source and photodetector, oriented vertically to reduce measurement variations resulting from stratification of the smoke generated by materials under test. The light source is an incandescent lamp operated at a fixed voltage in a circuit powered by a constant voltage transformer. The light source is mounted in a sealed box and provides a collimated light beam passing vertically through the chamber. The light source is maintained at an operating voltage required to provide a brightness temperature of 2200°K. The photodetector is a photomultiplier tube, with an S-4 spectral sensitivity response and a dark

current less than 10^{-9} A. A set of nine gelatin compensating filters varying from 0.1 to 0.9 neutral density are mounted one or more as required in the optical measuring system to correct for differences in the luminous sensitivity of the photomultiplier tube. These filters also provide correction for light source or photomultiplier aging and reduction in light transmission, through discolored or abraded optical windows. A light-tight box is located directly opposite the light source holds the photodetector housing and the associated optics. A glass window is used to isolate the photodetector and its optics from the chamber atmosphere. In addition to the above compensating filter, a neutral density range extender filter permitting the system to measure to Optical Density is mounted below the photodetector.

The toxic gas analysis system consists of a FTIR (Bruker Tensor 27) equipped with a 0.2 L cell (Infrared Analysis Inc.) to measure the gaseous compounds. Smoke from the Smoke Density Chamber is transferred to the FTIR by a heated PTFE line of 2 meters. The heated gas line is inserted at the center of the gas chamber top. A cylindrical filter of 140 mm by 45 mm is placed in line. The filter material is PTFE staple fiber. A second filter is placed in line containing a flat PTFE 25 mm filter 1 micron. The smoke from the density chamber is pumped through the system with a piston pump. The gas is drawn through the system at approx. 2 L/min.

4.3. ASTM E 800 -07

The test is conducted under flaming exposure. Prior to each test, weight of each sample is recorded. Comparison of the weights with the individual toxicity results has the potential to assist in assessing the reasons for the variability in measurements.

The chamber is cleaned with isopropyl alcohol (NH3 if previous sample contained acidic gases) and gas line flushed. Nitrogen is pumped through the line to evaporate any water condensation. The chamber is aired to clear any fumes from the cleaning solutions.

The chamber and the gas line are heated. The gas pump is started.

Before positioning the test specimen, the chamber is flushed with the door, and exhaust and inlet vents open for about 2 min. The exhaust vent and blower are closed. Once the system has reached steady-state conditions, the baseline for the FTIR readings is run. The specimen holder is placed on the bar support and pushed into position in front of the furnace (with burner in position for flaming exposure). The chamber door is closed while simultaneously starting the recorder for the FTIR. The inlet vent is closed completely when the photometer indicates the presence of smoke. All observations pertinent to the burning and smoke generating properties of the material under test are recorded. The test is run for a period of 20 min. One minute after the run has completed the chamber vents are opened. The FTIR data is processed and analyzed.

Testing and Evaluation Results

4.4. RESULTS AND OBSERVATIONS

Data for the ASTM E 800 – 07 Smoke Toxicity

Sample: Phasechange Energy Solutions Phasechange Material

Radiant Heat

Gas Compound	Maximum Observed (ppm)	Analysis Detection Limits (ppm)	Critical Concentrations (ppm)
Carbon Monoxide	89	50	3500
Carbon Dioxide	1500	500	90000
Oxides of Nitrogen	0	25	100
Sulfur Dioxide	0	10	100
Hydrogen Chloride	0	55	500
Hydrogen Fluoride	0	35	100
Hydrogen Bromide	0	75	100
Hydrogen Cyanide	0	15	100
Nitrous Oxide	0	25	NA

Radiant Heat and Flame

Gas Compound	Maximum Observed (ppm)	Analysis Detection Limits (ppm)	Critical Concentrations (ppm)
Carbon Monoxide	0	50	3500
Carbon Dioxide	1700	500	90000
Oxides of Nitrogen	0	25	100
Sulfur Dioxide	0	10	100
Hydrogen Chloride	0	55	500
Hydrogen Fluoride	0	35	100
Hydrogen Bromide	0	75	100
Hydrogen Cyanide	0	15	100
Nitrous Oxide	0	25	NA

Critical Concentration limits are taken from the SMP 800C

4.5. EXAMINATION OF RESULTS

The observations of the burn for each sample were as follows:

Radiant:

Sample bubbles and melts within one minute. Slight smoke is emitted from the sample. At 30 seconds the blisters popped and at 45 second the sample melts as the chamber from the sample breaks open. Sample never flames.

Flaming:

Sample flames immediately in the flame portion of the test. Once the chamber of the sample burns through the flames rise significantly. Flames are about 6 inches above the sample holder. Material sputters in flames in the chamber. Sample burns out completely at 10 minutes.

Conclusion

Intertek Testing Services NA (Intertek) has conducted testing for Fabral Inc, on Phasechange Energy Solutions Phasechange Material to evaluate smoke toxicity. Testing was conducted in accordance with and following the standard method ASTM E 800 -07.

Smoke Toxicity was determined using the Newport Scientific Inc Smoke Density Chamber and the Bruker Tensor 27 FTIR. The FTIR is equipped with an Infrared Analysis Inc. Gas Cell and Pike Industries heated gas transfer line and filter housings. The smoke toxicity for all gases for all samples was within the concentration limits set by the SMP 800C.

The conclusions of this test report may not be used as part of the requirements for Intertek product certification. Authority to Mark must be issued for a product to become certified.

INTERTEK TESTING SERVICES NA

Reported by:

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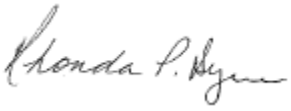
Reviewed by:



Rhonda Byrne
Operations Manager

REVISION SUMMARY

DATE	SUMMARY
October 19, 2010	Original date of report