United States Testing Company, Inc.
Biological Services Division
1415 PARK AVENUE • HOBOKEN, NEW JERSEY 07030 • 201/792-2400

EST. 1880

# REPORT OF TEST

Acute Inhalation Toxicity of
Thermal Degradation Products
Using The NYS Modified
Pittsburgh Protocol
on
BLAZEMASTER CPVC SPRINKLER PIPE

Conducted for:

The BF Goodrich Company
Specialty Polymers & Chemical Division
6100 Oak Tree Boulevard
Cleveland, Ohio

December 8, 1989

*TEST REPORT NO.* 062305

*SIGNED FOR THE COMPANY*

*BY*

Prepared by:

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# United States Testing Company, Inc.

Client: The BF Goodrich Company

062305
12/8/89

Subject: Sample submitted and identified by the Client as:

BLAZEMASTER CPVC SPRINKLER PIPE
from Atlantic American Fire Equipment Company
Huntington Valley, Pennsylvania

Sample Description:

Orange CVPC pipe - approximately 1" inside diameter
and 1 5/16" outside diameter

Project:

An inhalation test with laboratory mice was conducted in order to evaluate the acute inhalation health hazards associated with combustion products generated from certain building materials and interior finishes. The test used was based on a method developed by Dr. Yves Alarie of the University of Pittsburgh and is performed in accordance with the protocol and methodology as outlined and specified in the New York State Uniform Fire Prevention and Building Code, Article 15, Part 1120, Combustion Toxicity Testing, 9 NYCRR 1120 (2).

Summary:

When tested as specified, the "BLAZEMASTER CPVC SPRINKLER PIPE" has an LC50 of 19.67gm (CI, 18.19-21.26). The results obtained in this study, therefore, indicate that the sample tested can be considered as not more toxic than wood according to the procedure and criteria filed by Dr. Y. Alarie for this test with the City of New York on January 22, 1987 and appended to this report. Additional data are presented in Tables 1 and 2.

Introduction:

The purpose and intent of this safety test is to evaluate acute inhalation health hazards associated with combustion products generated from certain building materials and interior finishes. In this bioassay test procedure, laboratory mice are exposed to thermal decomposition products generated from the test article under standard conditions to evaluate the lethal potential of such thermal decomposition products (1).

This procedure is performed in accordance with the protocol and methodology as outlined and specified in the New York State Uniform Fire Prevention and Building Code, Article 15 Part 1120 Combustion Toxicity Testing, 9 NYCRR 1120 (2), and documented in United States Testing Co., Inc. Test Procedure PRO/TOX PITT/096-7.

Client: The BF Goodrich Company

062305
12/8/89

Principals of the Test

Groups of laboratory mice are restrained in an all-glass chamber (head only exposure) and exposed for 30 minutes to thermal decomposition products generated from the test article under controlled heating conditions. By combusting different sample charge masses, a "dose"-lethality profile for the thermal decomposition products is obtained. These data can then be transformed by appropriate statistical methods to calculate a median lethal concentration (LC50) for the thermal decomposition products generated from the test article. In addition to the calculated LC50 value, ancillary data regarding exposure conditions and the production of certain toxic gases are recorded and amended to the report. Such information serves to validate the test procedure and is part of the data required for registering materials with the New York State Department of State, Office of Fire Prevention and Control.

Materials and Methods:

Apparatus/Equipment: Refer to Figure 1 for configuration of test apparatus.

Furnace, Programmer, Sample Holder and Mass Sensor

Lindberg Model 51894-5 special box furnace (22.9x22.9x35.6cm) with Model 59344-ES-B programmable control console. This special order furnace with access holes has a 3,500 W output with a maximum operating temperature of 1100°C.

The programmer is capable of heating the furnace at a linear rate of 20°C/min from ambient temperature to 1000°C. Temperature is monitored by a Type K thermocouple. Within the furnace, a ceramic crucible sample holder is placed on a quartz pedestal. The pedestal extends through the bottom wall of the furnace and rests on a balance mass sensor. This balance, Scientech Model 3340, with a remote sensor unit, measures sample mass loss as the sample degrades the box furnace.

Both the furnace temperature and the sample mass are recorded continuously via output to a two-channel Linseis Model L 601 flatbed strip chart recorder.

Glassware and All-glass Exposure Chamber - These custom made items were manufactured by Kontes Scientific Glassware, Vineland, N.J. to specification as directed in NYS UFPBC Article 15 and modified as shown in figure 1.

Exposure Chamber Atmosphere Monitoring - Temperature within the animal exposure chamber is monitored with a 0-60°C NBS traceable thermometer. Atmosphere concentrations of a carbon monoxide (CO) and carbon dioxide ($CO_2$) are continuously monitored using a non-dispersive infrared analyzer, a Horiba MEXA 311-GE. These gas concentration measurements are continuously recorded with another Linseis two-channel recorder. Oxygen

Exposure Chamber Atmosphere Monitoring (continued)

concentrations in the exposure chamber are monitored at defined intervals with a Beckman D-2 oxygen analyzer. Optional atmospheric analysis includes hydrocarbons measured with Horiba MEXA 224-GE HC analyzer. Hydrogen cyanide (HCN), hydrogen chloride (HCL) or other toxic gases are quantitated by the use of direct sample Drager detector tubes or by taking grab samples of the atmosphere for analysis by specific ion electrode potentiometry or other suitable analytical methods.

Control of Dynamic Inhalation System - The Pittsburgh test is a dynamic inhalation system and is driven by a vacuum pump (Cole-Parmer Model DOA-P104BAA) capable of pulling a mixture of air from furnace (11 LPM) and chilled dilutant air (9 LPM) through the exposure chamber for a total of 20 LPM. Airflows are controlled by 0-20 and 0-30 LPM flowmeters (Dwyer).

Test Animals

The animal model for the bioassay is the Swiss-Webster albino male mouse (22-30gm). Animals are housed and cared for following standard procedures (3). Test animals 5 to 7 weeks old are ordered from a registered USDA supplier. Upon receipt, animals are housed in groups of four in clear polycarbonate caging (29 x 19 x 13cm) with wood shaving bedding. Pelleted food and water are available ad libitum. Animals are held for observation for at least 7 days prior to testing to ensure healthy subjects are used in testing.

Preparation Prior to Testing:

Sample Preparation

Prior to initiating testing, all samples evaluated by this procedure are stored for at least 48 hours in a controlled (40%-60% relative humidity) environment.

Test Apparatus

All glassware and the exposure chamber are cleaned and dried between test runs. The furnace and programmer and all electrical equipment are switched on and allowed to stabilize for 15 minutes prior to adjustments or calibrations. The air chiller ice bath is filled with ice and tap water. All gas concentration analyzers ($O_2$, CO, $CO_2$) are calibrated on a regular basis per our SOP using certified standard calibration gases. The test sample mass balance is also calibrated on a regular basis.

Test Procedure

Using four test animals in the 22 to 30gm range for each run, each of the four is placed in an animal holder with the head extending through the perforated rubber dental dam seal (reinforced with duct tape) into the exposure chamber. The animals are secured and acclimated for 10 minutes with room air-pulled through the system. During acclimation, air flowmeters are adjusted to allow 9 LPM of air to come through the chiller and 11 LPM from the furnace for a total air flow through the exposure system at 20 LPM.

The test sample is placed in the sample holder within the furnace. For the initial run, a sample mass of 10gm is used unless it is anticipated that 100% lethality will result. Upon verification that the sample weight sensor and recorder are correct and match, the temperature programmed furnace is activated from ambient temperature to increase at 20°C/min. The temperature at which 1% of the sample weight is lost is recorded. At this time, the exposure chamber is quickly connected to the furnace and the 30 minute exposure run is initiated.

During the 30 minute exposure, the furnace temperature, the sample ignition temperature and exposure chamber atmospheric conditions ($CO_2$, CO, $O_2$ and temperature °C) are monitored. At the end of the 30 minute exposure, the final sample weight is noted and the exposure chamber is disconnected from the furnace. Room air is drawn through the exposure chamber at 20 l/min for a 10 minute recovery period for the animals. Animals are then removed from the chamber and the eye of the surviving are examined for corneal opacities. The number of dead animals is recorded.

After a dose-lethality relationship has been established for a test article by exposing groups of mice to at least four different sample charges, the $LC_{50}$ value, in grams, is calculated by the method of Weil (4). Using this calculated sample charge, one additional test run, without animals, is performed to obtain representative test temperatures and gas analyses for the test article.

Experimental Results

The results of this sample are presented in Table 1 and 2. The sample began to decompose at 301°C and decomposed throughout with 26.1% of the sample remaining after the 30 minutes of heating. Flaming ignition occurred at 301°C in one of six runs.

The $LC_{50}$ was estimated to be 19.67gm. The maximum level of CO, $CO_2$ are 1,000ppm and 0.3% respectively at the $LC_{50}$ sample run. Oxygen level consistently remains above 20.6%.

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062305
12/8/89

Table 1

Summary of Results

Description of Test Article: Orange CPVC Piping

Number of Test Performed: 6

$LC_{50}$: 19.67gm (95% CI, 18.19-21.26)

Furnace Temperature at 1% Sample Mass Loss (°C): 301

Mean Furnace Temperature of Sample Autoignition (°C): 301*

Furnace Temperature range of most rapid weight loss (°C): 330-550

Number of time and average duration exposure chamber exceed 45°C: None

Post-exposure condition of test animal eyes: Opacities

Mean Residue (%): 26.1

*Detectable autoignition in one of six runs

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062305
12/8/89

Table 2

Test Run with $LC_{50}$ Sample

| Variables Measured | Sample: BLAZEMASTER CPVC SPRINKLER PIPE |
|---|---|
| Decomposition and Exposure start at (°C) | 301 |
| $LC_{50}$ (Grams) (95% C.I.) = | 19.67<br>18.19-21.26 |
| $LT_{50}$ (Minutes) | 10:30 |
| (Temp. °C) | 490 |
| Size of Sample (inches) | 2" length, 1 5/16" O.D., 1" I.D. |
| Max CO (ppm) | 1,000 |
| Time (min) | 10:00 |
| Temp (°C) | 484 |
| Min $O_2$ (%) | 20.6 |
| Time (min) | 12:00 |
| Temp (°C) | 527 |
| Max $CO_2$ (%) | 0.3 |
| Time (min) | 24:00 |
| Temp (°C) | 784 |
| Residue After Burning (%) | 26.0 |
| Flaming Ignition (°C) | Non-detected |

References:

1. Alarie, Y. and Anderson, R.C., "Toxicology and acute lethal hazard evaluation of thermal decomposition products of synthetic and natural polymers", Toxicology and Applied Pharmacology, Vol. 51, 1979, pp. 341-362.

2. Criteria and Procedures for Designation of Testing Laboratories Acceptable to the Secretary of State (in the manner set forth in 19 NYCRR 431).

3. Guide for the Care and Use of Laboratory Animals, DHHS Publications No. (NIH) 85-23.

4. Weil, C.S., "Tables for convenient calculation of median-effective dose ($LD_{50}$ or $ED_{50}$) and instruction for their use", Biometrics, Vol. 8, 1952, pp. 249-261.

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062305
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# APPENDIX

University of Pittsburgh
Toxicity of Thermal Decompositon Products

Comparison to Wood

A. Previous classification

To compare the toxic potency to wood (Douglas fir) the $LC_{50}$ for a single experiment with wood was taken. For this experiment the $LC_{50}$ was found to be 64 grams. Dividing the value by 3, gives 21.1 and this was rounded to 20. Thus, materials with an $LC_{50}$ below 20 were considered more toxic than wood.

This was published in Toxicology and Applied Pharmacology, Volume 57, pages 181-188, 1981, and the basis for using a factor of 3 is given in this paper.

B. Current classification

Since we now have more data for wood from four different laboratories, we can use these data for a better classification.

The $LC_{50}$ results currently available are as follows:

64, 78, 56, 57, 61, 64, 59, 50, 30, 39, 54, and 42.

The average of these 12 values is 54.5, and the standard deviation is 12.8.

We can divide 54.5 by a factor of 3 which gives 18.2. Thus, a value below 18 can be said to be more toxic than wood.

Since we have the standard deviation for the 12 above values, we can also multiply the standard deviation by 3 which would give a value of 38.4. If we then take the average, 54.5, and subtract 38.4 from it we obtain 16.1. We can then say with great confidence that an $LC_{50}$ value lower than 16 is more toxic than wood.

By the first procedure, a value of 18 is obtained while a value of 16 is obtained with the second procedure.

University of Pittsburgh

GRADUATE SCHOOL OF PUBLIC HEALTH
Department of Industrial Environmental Health Sciences
Office of the Chairman

January 22, 1987

Mr. Marvin Hassman
MEA Division
Department of Buildings
60 Hudson Street, 14th Floor
New York, NY 10013

Dear Mr. Hassman:

I mailed the latest version of the University of Pittsburgh test to you at your old address last week. Let me know if you do not receive it within a week. The description is according to the fifth draft written for ASTM, dated August 26, 1986. This has been widely distributed and also filed with the State of New York. There will be some changes in it in regards to wording, etc., but no change in the basic procedure.

In terms of classifying products as more toxic than wood or similar to wood, you can use the attached with confidence. I am also sending a copy to the laboratories who are currently using the method or those who are planning to use the method for filing with your office.

If there is any question, please call.

Sincerely,

Yves Alarie

Yves Alarie
Professor and Chairman

YA/lsk

Enclosure

cc: Dr. R. Anderson, A. D. Little, Inc.
Mr. M. Goldam, A. D. Little , Inc.
Mr. H. Stacy, Southwest Research
Dr. J. Norris, Weyerhaeuser Company
Dr. B. Roberts, U. S. Testing Company, Inc.

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