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TOXIGENICS 428-1383



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TOXIGENICS' STUDY 428-1383



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ONE HOUR ACUTE DUST  
INHALATION TOXICITY STUDY  
IN RATS OF  
SAYTEX 111 (UNMILLED)

SUBMITTED TO:

ETHYL CORPORATION  
ETHYL TOWER  
451 FLORIDA  
BATON ROUGE, LA 78801

SUBMITTED BY:

TOXIGENICS, INC.  
1800 EAST PERSHING ROAD  
DECATUR, IL 62526

January 31, 1984

**ToxiGenics**  
A Subsidiary of Whittaker Corporation

0003

Study No. 420-1383

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I. Summary

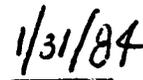
The initial exposure (T-I) was below the target concentration and was therefore terminated. The T-II exposure was conducted at the maximum attainable concentration, as reported herein.

One group consisting of 5 male and 5 female rats was exposed to a dust atmosphere of Saytex 111 (Unmilled). The gravimetric concentration of test article in the test atmosphere was 17.3 mg/l. This represents the maximum attainable concentration. The values for mass median diameter and geometric standard deviation for the test atmosphere were 6.46 micrometers and 2.50, respectively. The 5 male test rats weighed between 248 and 271 grams and the 5 female test rats weighed between 190 and 246 grams on the day of exposure. The duration of the exposure was 1 hour followed by a 14 day observation period. None of the test animals died during the study. Crusty eye was observed in one test female and crusty nose in one male each on one day post exposure. No other reactions were noted among any test rats during the course of the investigation. Necropsies revealed no gross lesions in 9 of 10 test animals. A lung abnormality was observed in the remaining test rat.

Under the conditions tested, the  $LC_{50}$  for Saytex 111 (Unmilled) is greater than the gravimetric concentration of 17.3 mg/l.



B. Richard Dudek, Ph.D.  
Study Director

  
Date

All work relating to this study was done in conformity with the FDA - Good Laboratory Practice Regulations (21 CFR 58).

The study was inspected by a Quality Assurance Specialist on the dates shown below. Management, including the Study Director, was informed of the results of these inspections/audits on the dates shown.

The data in the report were compared with the raw data and are in agreement. The report and study file were examined to assure that if any problems were found during Quality Assurance inspections they were corrected and, if necessary, their effect on the study documented.

1. Phase Inspection - conducted January 12, 1984.
2. Final Data and Report Audit - conducted January 31, 1984; reported to Management, including the Study Director, January 31, 1984.

Donald G. MacKellar  
Donald G. MacKellar, B.A.  
Director, Quality Assurance  
and Regulatory Affairs

1/31/84  
Date

The raw data relating to this study are stored at ToxiGenics, Inc. Storage is as per FDA, GLP's and may include volume reduction by conversion to certified microform.

Date of Report: January 31, 1984

## II. Introduction

The target concentration was not attained on the initial exposure (T-I). Therefore, a second exposure (T-II) was conducted at the maximum attainable concentration. Herein are reported the results of the T-II exposure.

A 1 hour exposure followed by a 14 day observation period was conducted using albino rats to determine the acute inhalation toxicity of Saytex 111 (Unmilled). The study was performed at ToxiGenics, Inc., 1800 East Pershing Road, Decatur, IL 62526 from January 2, 1984 through January 16, 1984.

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**III. Personnel**

Below is a list of the individuals involved in this study.

B. Richard Dudek, Ph.D., Study Director

Larry L. Horath, B.S., Section Head, Acute Inhalation  
Toxicology

Patrick M. McKeown, B.S., Inhalation Toxicology

William J. Koretke, B.S., Inhalation Toxicology

**IV. Procedure**

**A. Test System**

Ten (10) young adult albino rats<sup>1</sup> (5 males 248 to 271 grams and 5 females 190 to 246 grams) were used to determine the acute inhalation toxicity of the test article.

As the animals were removed from the shipping crate(s), they were randomly assigned to cages using a computer generated random list. The animals were then sequentially tagged with an identification number unique within ToxiGenics, Inc. In assigning animals to a study, the required number of animals were taken in a sequential manner from the number of animals that were available at the time.

The animals were quarantined for at least 7 days after receipt. During this time, Veterinary Sciences examined the

<sup>1</sup> Rattus norvegicus, Cr1:CD<sup>®</sup> (SD)BR, Charles River Breeding Laboratories, Portage, MI (Commonly accepted laboratory rat for acute studies)

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animals for health status. The animals were observed at least once each day for mortality, morbidity, and abnormal signs. Only healthy animals were used in this study.

Each animal was individually housed. No other species were housed in the same room. The cage size conformed to the standards specified in DHEW Publication (NIH) 78.23.

The quarantine and study chambers were cleaned daily as specified in ToxiGenics' Standard Operating Procedures and were well ventilated and air-conditioned. The temperature (68 to 75°F) and humidity (27 to 72%) were monitored continuously in the quarantine and study rooms and the light/dark cycle was 12 hours light (6:00 AM to 6:00 PM)/12 hours dark (6:00 PM to 6:00 AM). Individual temperature and humidity readings are not included in this report, however, these data are available in the study file.

Purina Certified Rodent Chow 5002 was fed to the animals ad libitum during the quarantine and study period, except during exposure. Filtered tap water was provided ad libitum, except during the exposure, via an automatic watering system. The water was assayed periodically as specified in ToxiGenics' Standard Operating Procedures.

#### B. Test Article

A powder identified as Saytex 111, Lot number 20-1737A was received from the Ethyl Corporation on November 21, 1983 and was assigned ToxiGenics' Test Article Code Number 11/83-622.

Upon receipt of the test article, a sample was removed and designated as a retainer sample. Test article absorption determinations were not conducted for this study. No other test article information was necessary for the conduct of this study.

C. Experimental Design

1. Test Article Administration

The duration of exposure was 1 continuous hour followed by a 14 day observation period. The exposure was conducted in a stainless steel and glass inhalation chamber.

The test atmosphere dust was generated by passing a stream of air through the test article contained in a dust shaker mechanism. The resulting air-dust mixture entered the top center of an 80-liter stainless steel and glass inhalation chamber (containing the test rats) and was exhausted at the bottom of the chamber. A stream of additional air was added to the chamber to achieve the desired concentration and to aid in test article dispersion.

The chamber was pre-calibrated for total air flow (measured at the exhaust) by means of pressure drop across an orifice placed in the exhaust line.

The temperature was measured in the chamber using an ASTM thermometer<sup>2</sup>. The relative humidity of supply air was measured in an empty inhalation chamber run concurrently with the test

<sup>2</sup> Scientific Products, Chicago, IL

chamber. The negative pressure of the test chamber was measured with a minihelic pressure gauge and maintained at 0.10 inches of water. The test atmosphere was diluted prior to release to the outside atmosphere via an exhaust blower. For a diagram of the test chamber, see Figure 1.

The barometric pressure (29.88 inches Hg) was recorded on the day of exposure while room and chamber temperature readings, and supply air humidity were monitored continuously and recorded approximately every 30 minutes during exposure.

The gravimetric concentration was calculated by dividing the amount of test article collected on a glass fiber filter<sup>3</sup> by the total air sampled.

The nominal concentration was calculated by dividing the amount of test article used by the total air passing through the chamber during exposure.

Particle size determinations were conducted for the exposure using a Delron Cascade Impactor, Model No. DCI-6<sup>4</sup>. A sample was collected from the breathing zone of the test animals. Particle size distribution (by mass), mass median diameter, geometric standard deviation for the mass median diameter, and the calculated count median diameter were determined for the exposure.

<sup>3</sup> Gelman Instrument Co., Ann Arbor, MI

<sup>4</sup> Delron Research Products Co., Powell, OH

## 2. Observations

Observations with respect to incidence of mortality and reactions displayed were recorded at least every 15 minutes during the one hour of exposure. Animals were observed at least once daily during the 14 day observation period.

Each animal was weighed immediately prior to exposure and on days 7 and 14 of the observation period.

## 3. Pathology

All animals sacrificed at the end of the observation period were subjected to gross necropsy as described below.

At the termination of the 14 day observation period, all surviving animals were anesthetized with carbon dioxide and then exsanguinated using humane methods.

Necropsy examination included the following: external and internal portions of all hollow organs; cranial cavity and external surfaces of the brain and spinal cord; nasal cavity and paranasal sinuses; neck with associated organs and tissues; thoracic, abdominal, and pelvic cavities with their associated organs and tissues; and the muscular/skeletal carcass. The specific condition of the nasal passages, trachea, liver, kidneys, bronchi, and lungs were recorded. Any abnormal tissues and/or organs were saved.

All necropsies were conducted under the supervision of a qualified pathologist.

V. Results

A. Exposure Conditions: The schedule and time are given below for the exposure.

| Test Group | Exposure Date | Exposure Time Start | Hours Stop |
|------------|---------------|---------------------|------------|
| Test       | 1/02/84       | 1320                | 1420       |

The test article utilization and airflow data for the exposure are given below.

| Test Group | Total Test Article Dispersed (grams) | Rate of Test Article Dispersal (g/min) | Air Flow Rate (lpm) | Total Air (l) |
|------------|--------------------------------------|--|---------------------|---------------|
| Test       | 539                                  | 8.98                                   | 13.4                | 804           |

The mortality summary and nominal concentration are presented below for the exposure.

| Test Group | Mortality |        | Nominal Concentration (mg/l) |
|------------|-----------|--------|------------------------------|
|            | Male      | Female |                              |
| Test       | 0/5       | 0/5    | 670.4                        |

B. Outline of Results

The gravimetric and nominal concentrations, room and chamber temperatures, and supply air humidity are presented in Table 1.

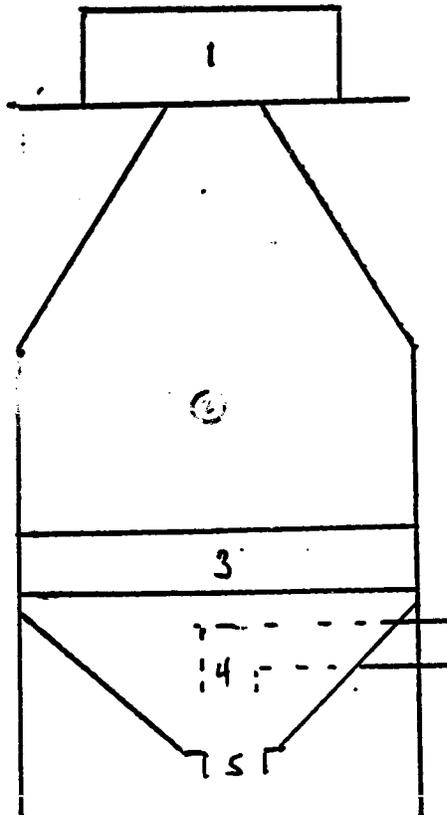
Particle size analysis of the exposure chamber revealed a mass median diameter of 6.46 micrometers and geometric standard deviation of 2.50. Particle size data are presented in Table 2.

One female test rat (AF1370) exhibited crusty eye and one male (AF1245) exhibited crusty nose, both on one day of the post exposure observation period. No other test rat reactions were observed during the course of the investigation. None of the test rats died during the investigational period. All test animals exhibited body weight gains. Individual body weight data for test animals are presented in Table 3.

Gross examination of tissues and organs of 9 of 10 test rats showed normal appearance. Diffuse discoloration of the lung was noted in one test male rat (AF1243). This abnormality appeared not to be related to exposure to test article.

Figure 1.

Diagram of Test Chamber  
Front View



Dimensions  
12" High  
18" Wide  
18" Deep

1. Generation apparatus - including dust generator, rotameters, pressure gauges.
2. Sample port.
3. Cage, housing test animals.
4. Exhaust.
5. Drain.

TABLE 1: CHAMBER CONDITIONS  
ACUTE DUST INHALATION TOXICITY STUDY IN RATS  
TEST ARTICLE: SAYTEX 111 (UNMILLED)

| OBSERVATION SEQUENCE | RELATIVE HUMIDITY* (%) | ROOM TEMP (F) | CHAMBER TEMP (F) | SAMPLE NUMBER | GRAVIMETRIC CONCENTRATION (MG/L) |
|----------------------|------------------------|---------------|------------------|---------------|----------------------------------|
| 0                    | 38                     | 69            | 68               | 1             | 20.32                            |
| 1                    | 38                     | 69            | 69               | 2             | 15.82                            |
| 2                    | 38                     | 69            | 69               |               |                                  |
| MEAN -               | 38.0                   | 69.0          | 68.7             |               |                                  |
| S.D. -               | 0.00                   | 0.00          | 0.58             |               |                                  |
| S.E. -               | 0.00                   | 0.00          | 0.33             |               | TWA = 17.3                       |

NOMINAL CONCENTRATION = 670.4 mg/l

\* Measured in an empty chamber run concurrently with the test chamber.

S.D. = Standard Deviation  
S.E. = Standard Error  
TWA = Time-Weighted Average

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TABLE 2: PARTICLE SIZING DATA  
 ACUTE INHALATION TOXICITY STUDY IN RATS

TEST ARTICLE: SATTEN 101 (UNMILLED)

Sample No.: 1

| Upper Size Limit (micrometers) | Weight of Material Collected (mg) | Weight of Material Collected (percent of total) | Cumulative Weight (percent) |
|--------------------------------|-----------------------------------|---|-----------------------------|
| 0.5                            | 0.1                               | 0.4   | 0.4                         |
| 1.0                            | 0.4                               | 1.8   | 2.2                         |
| 2.0                            | 3.0                               | 4.0   | 6.2                         |
| 4.0                            | 3.2                               | 14.2  | 20.4                        |
| 8.0                            | 12.6                              | 55.8  | 76.1                        |
| 16.0                           | 1.2                               | 5.3   | 81.4                        |
| 32.0                           | 4.2                               | 18.6  | 100.0                       |

Total: 22.6

16% Level: 2.5775 micrometers

50% Level: 6.4565 micrometers

84% Level: 16.1661 micrometers

68.32% of the particles are less than or equal to 10 micrometers.

Mass Median Diameter = 6.4565 micrometers

Geometric Standard Deviation = 2.5039

Hatch-Choate Transformation Equation

$$\text{Log DGC} = \text{Log DGM} - 6.908 \times (\text{log GSD})^2$$

Where:

DGC = Count Median Diameter,

DGM = Mass Median Diameter, and

GSD = Geometric Standard Deviation.

Count Median Diameter = 0.5157 micrometers

TABLE 3: INDIVIDUAL BODY WEIGHT DATA  
 ACUTE DUST INHALATION TOXICITY STUDY IN RATS  
 TEST ARTICLE: SAYTEX 111 (UNMILLED)

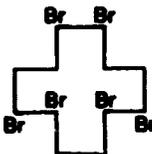
| Animal Number | Sex  | Interval (Day) |            |            |
|---------------|------|----------------|------------|------------|
|               |      | 0              | 7          | 14         |
| AF1242        | M    | 263            | 297        | 337        |
| AF1243        | M    | 270            | 296        | 333        |
| AF1244        | M    | 253            | 285        | 320        |
| AF1245        | M    | 271            | 309        | 342        |
| AF1246        | M    | <u>248</u>     | <u>273</u> | <u>306</u> |
|               | Mean | 261.0          | 292.0      | 327.6      |
|               | S.D. | 10.2           | 13.6       | 14.6       |
| AF1305        | F    | 233            | 244        | 264        |
| AF1306        | F    | 233            | 245        | 256        |
| AF1307        | F    | 204            | 224        | 226        |
| AF1308        | F    | 246            | 248        | 263        |
| AF1309        | F    | <u>190</u>     | <u>205</u> | <u>220</u> |
|               | Mean | 221.2          | 233.2      | 245.8      |
|               | S.D. | 23.3           | 18.4       | 21.1       |

M = Male  
 F = Female  
 S.D. = Standard Deviation

# Saytex®

## FLAME RETARDANTS

### SAYTEX® HBCD



SAYTEX® HBCD, hexabromocyclododecane, is an additive flame retardant containing 74% by weight aliphatic bromine. It offers these advantages:

- high melting point
- good thermal stability
- free flowing powder
- soluble in common solvents

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#### SUGGESTED USES:

- low density expandable and extrudable polystyrene foam
- adhesives and coatings intermediate
- high density molded crystal and impact polystyrene
- additive for polyurethane foams

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#### TYPICAL PROPERTIES:

|                             |                              |
|-----------------------------|------------------------------|
| Appearance .....            | off-white crystalline powder |
| Bromine Content .....       | 74%                          |
| Melting Range .....         | 185-195°C                    |
| Water Soluble Halides ..... | 300 ppm                      |

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#### SPECIFICATIONS:

|                                   |                |
|-----------------------------------|----------------|
| Melting Point (Initial) .....     | 185° minimum   |
| Iron .....                        | 25 ppm maximum |
| Volatility, 2 hours @ 100°C ..... | 1% maximum     |

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## SUGGESTIONS FOR USE:

### STYRENICS

- The major application for SAYTEX® HBCD is in styrenic polymers. Typical use levels to achieve the desired UL 94\* test rating are as follows:

|   | SAYTEX HBCD<br>(wt. %) | UL 94*<br>RATING |
|---|------------------------|------------------|
| Expandable or extrusion low density foam (1-4#/ft. <sup>3</sup> ) | 0.5-1.5                | V-2**            |
| Profile foam extrusions (4-20#/ft. <sup>3</sup> )                 | 1.5-5.0                | V-2**            |
| Solid or structural foam moldings (20-65#/ft. <sup>3</sup> )      | 3.0-5.0                | V-2              |

### OTHER APPLICATIONS

- Flame retarding of adhesives, coatings and urethane foams is a matter of individual formulation. Typical formulations require 7-20% SAYTEX® HBCD.
- Although antimony oxide is commonly used as a synergist with halogenated flame retardants, it is not recommended for use with SAYTEX® HBCD in foam styrenic applications.
- Antimony oxide as a synergist should be considered in formulation work with other resins. A ratio of 3 parts of SAYTEX® HBCD to 1 part antimony oxide in place of SAYTEX® HBCD alone will indicate if the synergistic approach may be useful in the specific application.

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## SAFETY AND HANDLING:

Reasonable precautions should be taken to avoid undue exposure. Avoid prolonged or repeated skin contact. Avoid inhalation of dust or contact with eyes. Protective gloves, chemical safety goggles, and approved dust respirators should be worn where there is a chance of exposure.

Smoking and eating should be avoided when handling the product. Complete material safety data sheet and a summary of toxicological evaluations are available upon request.

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\*The data reported above is based upon laboratory flammability tests and should not be used to predict performance under actual fire conditions.

\*\*In construction applications, materials may be subject to other flammability tests such as ASTM E-84. Values of additive suggested typically meet the ASTM E-84 code requirements.

The facts stated and the recommendations made in this publication are based on our own research and the research of others, and are believed to be accurate. However, no guarantee of their accuracy is made because we cannot cover every possible contingency in manufacturing equipment and methods. For the same reason, the products discussed are sold without warranty, express or implied, and on the condition that purchasers shall make their own tests to determine the suitability of such products for their particular purposes. Statements concerning the possible use of our products are not intended as recommendations to use our products in the infringement of any patent.