

201-14931A

TEST PLAN FOR BENZENE, ETHENYL-, ARYL-BROMO DERIVS.  
(CAS NO. 125904-11-2)

OVERVIEW

Great Lakes Chemical Corporation agrees to sponsor Benzene, ethenyl-, aryl-bromo derives. (CAS NO. 125904-11-2) under the Environmental Protection Agency's (EPA) High Production Volume (HPV) Chemical Challenge Program. The company hereby submits a test plan for this substance. It is the intent of the sponsoring company to use existing data combined with new studies specified in the test plan to fulfill the Screening Information Set (SIDS) endpoints for environmental fate, ecotoxicity and human health effects.

RECEIVED  
OPPT/CRIC  
03 DEC 19 PM 1:19

**TEST PLAN**

**CHEM**

**Benzene, ethenyl-, ar-bromo derivs.**

**CAS #**

**125904-11-2**

<b>Study Type</b>	<b>Data Available</b>	<b>Data Acceptable</b>	<b>Testing Required</b>
<b>Physical/Chemical Properties</b>			
Melting Point	Y	Y	N
Boiling Point	Y	Y	N
Vapor Pressure	Y	Y	N
Partition Coefficient	Y	Y	N
Water Solubility	Y	Y	N
<b>Environmental Fate</b>			
Photodegradation	Y	Y	N
Stability in Water	Y	Y	N
Biodegradation	Y	Y	N
Fugacity	Y	Y	N
<b>Ecotoxicity</b>			
Acute Toxicity to Fish	N	N	Y
Acute Toxicity to Aquatic Invert.	N	N	Y
Toxicity to Aquatic Plants	N	N	Y
<b>Human Health Effects</b>			
<b>Toxicity</b>			
Acute Toxicity	Y	Y	N
General Toxicity (repeated dose)	Y	Y	N
<i>In vitro</i> - Genetic Toxicity Mutation	Y	Y	N
<i>In vitro</i> – Genetic Toxicity Chromosomal Aberrations	Y	Y	N
Reproductive Toxicity	Y	Y	N
Developmental Toxicity	Y	Y	N

## TABLE OF CONTENTS

1.	Introduction.....	4
2.	Designation of Test Substance .....	4
3.	Criteria for Determining Adequacy of Data .....	4
4.	Discussion of Available Test Information.....	5
4.1	Chemical and Physical Properties.....	5
4.1.1	Melting Point .....	5
4.1.2	Boiling Point .....	5
4.1.3	Vapor Pressure .....	5
4.1.4	Octanol/Water Partition Coefficient .....	5
4.1.5	Water Solubility.....	5
4.1.6	Summary/Test Plan for Physical Properties .....	5
4.2	Environmental Fate/Pathways .....	6
4.2.1	Photodegradation .....	6
4.2.2	Stability in Water .....	6
4.2.3	Fugacity.....	6
4.3.4	Biodegradation.....	7
4.3.5	Bioaccumulation .....	7
4.3.6	Summary/Test Plan for Environmental Fate Parameters .....	7
4.3	Ecotoxicity .....	7
4.3.1	Acute Toxicity to Fish .....	7
4.3.2	Acute Toxicity to Aquatic Invertebrates .....	7
4.3.3	Acute Toxicity to Aquatic Plants.....	7
4.3.4.	Summary/Test Plan for Ecotoxicity.....	7
4.4	Human Health Data.....	7
4.4.1	Acute Mammalian Toxicity .....	8
4.4.2	Repeated Dose Mammalian Toxicity.....	8
4.4.3	Genetic Toxicity.....	8
4.4.4	Reproductive Toxicity.....	9
4.4.5	Developmental Toxicity.....	9
4.5	Additional Data .....	9
4.5.2	Skin and Eye Irritation.....	9
4.5.3	Sensitization.....	9
4.5.5	Summary/Test plan for mammalian toxicity .....	10
5.	Summary.....	10
6.	References .....	10
7.	Appendix I – Robust Summaries.....	11

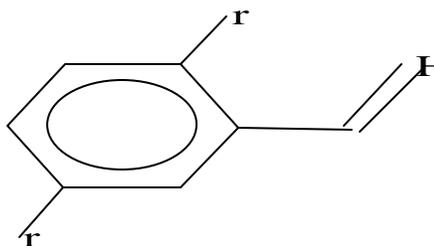
## 1. Introduction

Great Lakes Chemical Corporation submits this test plan for Benzene, ethenyl-, aryl-bromo derives. (CAS NO. 125904-11-2) for hazard review under the Environmental Protection Agency High Production Volume Chemical Program. The technical contact at this company is:

Richard Henrich  
Great Lakes Chemical Corporation  
West Lafayette, IN 47906  
Phone (765) 497-6114

## 2. Designation of Test Substance

The test substance presented in this test plan is Benzene, ethenyl-, aryl-bromo derives. (CAS NO. 125904-11-2). The chemical structure is as follows:



This chemical is also known as: Dibromostyrene; DBS; CN-19; Step III; Brominated Styrene

The chemical is also sold under the trade names Great Lakes DBS-64, Great Lakes DBS, and Great Lakes PDBS-80.

The primary use of this chemical is incorporation in engineering thermoplastics as a flame retardant. Typically the material is polymerized then added to the plastic in such a way that extraction is very unlikely.

## 3. Criteria for Determining Adequacy of Data

All available studies were reviewed and assessed for adequacy according to the standards of Klimisch et al. (1997). Studies receiving a Klimisch rating of 1 or 2 were considered to be adequate.

## 4. Discussion of Available Test Information

### 4.1 Chemical and Physical Properties

The results of chemical/physical property testing are shown in Table 1.

Table 1. Chemical/physical properties of Dibromostyrene

Endpoint	Value
Melting point (° C)	-37
Boiling point (° C)	95
Vapor pressure (mmHg at 25° C)	0.075
Partition coefficient (Log Pow or Kow)	4.43
Water solubility (mg/l at 20 ° C)	6.91

#### 4.1.1 Melting Point

A melting point of -37° C is an estimated value based on extrapolation from the viscosity test data. The viscosity of the test substance rapidly increases in the range of temperatures from -18 to -23° C.

#### 4.1.2 Boiling Point

The boiling point of 95 °C was determined in Great Lakes Chemical Corp. Department of Research and Development.

#### 4.1.3 Vapor Pressure

The vapor pressure of the test substance was determined in Great Lakes Chemical Corp. Department of Research and Development.

#### 4.1.4 Octanol/Water Partition Coefficient

A log Pow of 4.43 was measured (Wildlife International, 2003) according to OECD guideline 107, "Partition Coefficient (n-octanol/water), Flask-shaking method".

#### 4.1.5 Water Solubility

A measured value of 6.91mg/L (Wildlife International, 2003) was obtained according to the OECD Guideline 105 "Water Solubility".

#### 4.1.6 Summary/Test Plan for Physical Properties

The physical properties of dibromostyrene have been adequately assessed and no further testing is needed.

## 4.2 Environmental Fate/Pathways

Results of environmental fate modeling and studies are summarized in Table 2.

Table 2. Environmental fate parameters for Dibromostyrene.

Endpoint	Value
Photolysis <sup>b</sup> (Atmospheric T <sub>1/2</sub> ) <sup>b</sup>	0.402 days
Indirect Photolysis (OH sensitizer) (Hydroxyl Radical Rate Constant) <sup>b</sup> (Atmospheric T <sub>1/2</sub> ) <sup>b</sup>	27 x 10 <sup>-12</sup> cm <sup>3</sup> /molecule-sec 0.402 days
Stability in Water <sup>a</sup>	1/2 life 39 - 59 days at pH 7
Biodegradation <sup>b</sup>	Not readily biodegraded
Henry's Law Constant <sup>b</sup>	0.00044 atm/m <sup>3</sup>
Log Koc <sup>a</sup>	3.79
Environmental transport (Fugacity Level III mass percentages) <sup>b</sup>	Air = 0.616 Water = 16.2 Soil = 73.2 Sediment = 10

<sup>a</sup> Measured value

<sup>b</sup> Estimated using EPIWIN v3.11

### 4.2.1 Photodegradation

A hydroxyl radical-induced photodegradation rate constant of ca. 27 x 10<sup>-12</sup> cm<sup>3</sup>/molecule-sec has been estimated using EPIWIN (v3.11). The same program estimates a half-life of 4.8 hours for photodegradation. The strictly limited volatility of the test substance suggests that atmospheric photodegradation is not an important degradative pathway.

### 4.2.2 Stability in Water

The stability of dibromostyrene in water as a function of pH was measured by Wildlife International 2003. Dibromostyrene was determined to be hydrolytically stable at 19 degrees C, pH 4 and 7, but was marginally hydrolytically unstable at pH 9 (t<sub>1/2</sub> = 177 days). At 25 degrees C, dibromostyrene degraded at all pH levels half-life ranged from 39-59 days.

### 4.2.3 Fugacity

Level III fugacity modeling has been conducted on the test material using EPIWIN v3.11. The results indicate that the test substance will partition preferentially to soil, water, and sediment. A calculated Henry's Law Constant of 4.88 x 10<sup>-4</sup> atm-m<sup>3</sup>/mol suggests that the test substance will not rapidly volatilize from water. Volatilization from soil or sediment is also strictly limited. A water soil partition constant (Koc) of 6166 has been estimated using EPIWIN PCKOC. This high value indicates that the test substance possesses poor soil mobility.

#### **4.3.4 Biodegradation**

EPIWIN v3.11 Level III Fugacity Model has predicted that dibromostyrene is expected to be found predominantly in soil and its persistence estimate is based on its transformation in this medium. Its half-life in soil is expected to be ca. 75 days. The overall persistence takes into account both a chemical's media-specific half-life as well as its rate of transport into and out of that compartment. The overall persistence of dibromostyrene is predicted to be ca. 49 days using the default emission scenario of the Level III multimedia model.

#### **4.3.5 Bioaccumulation**

The estimated bioconcentration factor (BCF) of dibromostyrene is 790 (EPIWIN v3.11). This value does not exceed the EPA bioconcentration criteria, therefore, it is not expected to bioaccumulate in the food chain.

#### **4.3.6 Summary/Test Plan for Environmental Fate Parameters**

Dibromostyrene is not expected to biodegrade rapidly and is expected to partition primarily to soil with little to no potential for significant mobility. It is not expected to bioaccumulate or biomagnify based on the EPIWIN model. Sufficient environmental fate information is available to adequately characterize environmental fate endpoints for screening purposes. No additional testing is necessary.

### **4.3 Ecotoxicity**

#### **4.3.1 Acute Toxicity to Fish**

No data are available.

#### **4.3.2 Acute Toxicity to Aquatic Invertebrates**

No data are available.

#### **4.3.3 Acute Toxicity to Aquatic Plants**

No data are available.

#### **4.3.4. Summary/Test Plan for Ecotoxicity**

No ecotoxicity data are available for dibromostyrene. As the test plan indicates, acute toxicity studies in fish, daphnia, and algae will be conducted in order to better characterize the ecotoxicological data for dibromostyrene.

### **4.4 Human Health Data**

#### **4.4.1 Acute Mammalian Toxicity**

The acute oral toxicity of dibromostyrene has been characterized by WIL Research Laboratories (1983). The calculated LD50 from this study was 5.69 g/kg for males, 6.9 g/kg for females, and 6.33 g/kg combined. The acute oral toxicity of this compound is therefore considered to be very low. The acute inhalation toxicity of dibromostyrene was also assessed (Raltech Scientific Services, 1981) in a DOT Class B poison test. In this study, the LC 50 of dibromostyrene was determined to be > 3.1 mg/L. Thus, the acute inhalation toxicity potential of this compound is also very low. Finally, the acute dermal toxicity of dibromostyrene was determined by WIL Research Laboratories (1983). In this study the acute dermal LD50 was determined to be > 2000 mg/kg (WIL Research, 1983), therefore, the dermal toxicity of dibromostyrene is very low as well.

#### **4.4.2 Repeated Dose Mammalian Toxicity**

A 28-day range-finding oral gavage study of dibromostyrene revealed no effects on survival or other observed parameters at doses of 1, 10, 50, or 100 mg/kg/day (WIL Research Laboratories, Inc., 1987). Therefore, a 90-day repeated dose study with a 4-week recovery period was conducted by oral gavage with dibromostyrene at doses of 130, 300, 700, or 1600 mg/kg/day by WIL Research Laboratories, 1989. Hematological and metabolic effects were observed at doses of 300 mg/kg and higher. The NOAEL for systemic toxicity of dibromostyrene was determined to be 130 mg/kg bw.

#### **4.4.3 Genetic Toxicity**

##### **4.4.3.1 Mutagenicity**

Dibromostyrene has been tested for mutagenicity in *S. typhimurium* strains TA98, TA100, TA1535, TA1537 and TA1538 as well as in the CHO/HGPRT mammalian cell gene mutation assay in the absence and presence of a metabolic activation system. Results of both studies were negative (Litton Bionetics, Inc., 1982 and Microbiological Associates, Inc., 1987). This material was also evaluated in the unscheduled DNA synthesis assay in rat primary hepatocytes with and without metabolic activation. Dibromostyrene did not induce a significant increase in the number of net nuclear grain counts at any dose level, (Microbiological Associates, Inc., 1987).

##### **4.4.3.2 Chromosomal aberration**

Four chromosomal aberration studies in Chinese hamster ovary cells have been conducted with and without metabolic activation (Microbiological Associates, Inc., 1987; Pharmakon Research International, Inc., 1987; Pharmakon Research International, Inc., 1987; and Pharmakon Research International, 1987). The first study which included concentrations of 0.005, 0.01, 0.02, and 0.04 µL/mL gave an “ambiguous” result with and without metabolic activation. In the following three studies, all conducted at concentrations between 1 to 90 µg/mL, the material was found to be negative in its ability to induce chromosome aberrations (clastogenicity). These studies were all conducted over a 4-month time period, therefore it is unlikely that the formulations were significantly different to account for the “ambiguous” outlier. The

overwhelming body of literature for this endpoint indicates that dibromostyrene does not possess the potential to induce chromosomal aberrations.

#### **4.4.4 Reproductive Toxicity**

A two-generation reproduction study was conducted in rats with dibromostyrene administered by oral gavage at doses of 100, 400, or 1600 mg/kg/day (WIL Research Laboratories, 1987). A slight effect on fertility was observed among the F1 males at 1600 mg/kg (decreased mean testes weights). No other effects on reproductive parameters were observed in either the F1 or F0 generations. The NOAEL for reproductive toxicity was concluded to be 400 mg/kg/day. Neonatal toxicity was observed among pups in the 400 or 1600 mg/kg/day dose groups in both the F1 and F2 generations. These effects included slightly (not statistically significant) decreased litter size, decreased pup viability, changes in the clinical condition of the pups and decreased pup body weights. The NOAEL for neonatal toxicity was 100 mg/kg/day. Parental toxicity was apparent in the 400 and 1600 mg/kg/day treated groups. Based on renal and liver effects, the NOAEL for adults was determined to be < 100 mg/kg/day.

#### **4.4.5 Developmental Toxicity**

There are developmental toxicity studies for dibromostyrene in rats and rabbits. In rabbits, dibromostyrene was administered by oral gavage to pregnant dams at doses of 25, 75, 150, or 350 mg/kg/day on gestation days 6-18 (WIL Research Laboratories, 1993). Maternal toxicity was evident at 350 mg/kg/day and included mortality, clinical signs, body weight loss, and decreased food consumption. No fetal toxicity was observed at any dose. Therefore, the NOAEL for maternal toxicity was 150 mg/kg/day and 350 mg/kg/day for fetal toxicity. In rats, pregnant dams were administered 100, 400, 800, or 1600 mg/kg/day by oral gavage on gestation days 6-15 (WIL Research Laboratories, 1993). Maternal toxicity (reduced body weight gains and food consumption) was noted at all dose levels. Developmental toxicity was observed at 400 mg/kg/day and higher and included developmental variations such as unossified ribs and sternebrae. The NOAEL for maternal toxicity was < 100 mg/kg bw and for developmental toxicity it was 100 mg/kg bw.

### **4.5 Additional Data**

#### **4.5.1 Skin and Eye Irritation**

The primary dermal and eye irritation for dibromostyrene has also been determined. Dibromostyrene was moderately to highly irritating (WIL Research 1983 and 1987) to the skin of rabbits and slightly irritating (WIL Research, 1987) to the eyes of rabbits.

#### **4.5.2 Sensitization**

Dibromostyrene was not a sensitizer in guinea pigs (WIL Research 1987).

### **4.5.3 Summary/Test plan for mammalian toxicity**

Adequate acute and repeated dose oral toxicity studies show ingestion of fairly large amounts of dibromostyrene is required to produce toxicity. The material is also not irritating to the skin or eyes, and is not sensitizing to humans.

Adequate studies show that dibromostyrene is not a mutagen and does not possess the potential to produce chromosomal aberrations. Developmental studies in the rat and rabbit have adequately characterized the teratogenic potential of dibromostyrene. A two-generation reproduction toxicity study in rats has also provided adequate information on the reproductive effects that may be expected when dibromostyrene is administered orally in fairly large doses.

## **5. Summary**

In summary, valid data are present to satisfy all physical/chemistry and environmental fate toxicity endpoints. No ecotoxicity data are available on aquatic vertebrates, invertebrates, or plants. This testing is necessary and will be performed as indicated in the test plan.

Existing studies on acute, repeated dose, genetic (mutations and chromosomal aberrations), reproductive and developmental toxicity are sufficient to satisfy these endpoints. Data for eye and skin irritation and sensitization are adequate (although not required).

## **6. References**

See IUCLID reference set.