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CBI Available - H 20 - 848 0207-1

January 12, 1984

**FYI-0794-001001**

Contains No...

Mr. Martin Greif  
Executive Secretary  
TSCA Interagency Testing Committee  
Environmental Protection Agency (TS-792)  
401 M Street, SW  
Washington, D.C. 20460



FYI-94-001001  
INIT 87/14/94



84940000101

Dear Mr. Greif:

This letter is in response to your letter request for information on four of the chemicals identified in your Federal Register notice of November 9, 1983. Our response for each chemical follows.

2-methyl 1,3-butadiene [78-79-5]. Syn: isoprene IR-403

Shell collects a C<sub>8</sub> fraction from its various olefin units and sends this material to a toll converter who extracts isoprene and returns a percentage to Shell. Shell completely consumes this isoprene in the production of two polymer product lines under the trade names KRATON® thermoplastic rubbers and SHELLVISO® lubricating oil additives. Production volumes are submitted separately under Confidential Business Information. A review of our files for proprietary reports on health and safety information indicates that we have nothing germane to your interests. However, we are also submitting our Material Safety Data Sheets on both isoprene and isoprene concentrate.

Allyl alcohol [107-18-6] IR-423

Shell has not produced allyl alcohol for several years. When produced, it was used in the agricultural business. Although several proprietary reports are available, they predate 1958. We believe these reports are superseded by more recent studies.

di-tert-butyl-peroxide [110-05-04] IR-406B

Shell ceased production of di-tert-butyl peroxide (DTBP) in late 1982 and sold all inventory by early 1983. A review of our files for proprietary literature indicates that we have nothing substantial to contribute.

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Tetrahydrothiophene-1,1-dioxide [126-33-0], Syn: sulfolane

IR-434

Production volumes by Shell are submitted separately as Confidential Business Information. Attached is a technical bulletin on sulfolane which includes end use information. It is estimated that of Shell's sulfolane production, 65-70% is used for Benzene/Toluene/Xylene extraction from paraffins, 25-30% in the manufacture of sulfinol, and approximately 5% to other end uses. We are also enclosing our Material Safety Data Sheet and several proprietary reports which we trust will be helpful.

Please advise if we may be of further assistance.

Very truly yours,



J. P. Sepesi, Manager  
Product Safety & Compliance  
Oil & Chemical Products, HS&ES

HH/rab

Attachments

Attachments

Material Safety Data Sheet 5620-4

Sulfolane-W

Technical Bulletin IC:71-20

Sulfolane

SBTR.81.098

Toxicity Studies With Fine  
Chemicals: In Vitro Genotoxicity  
Studies With Sulfolane.

SBGR.83.100

Toxicity Tests with Daphnia  
Magna: Acute Toxicity of Eight  
Test Materials To A Newly-  
Introduced Strain of D. Magna in  
Reconstituted Fresh Water.

ANGR.0095.73

Determination of Acute Toxicity  
To Fish of Shell Chemicals. I.

WRC 224-82

Biodegradation Of Sulfolane And  
Dimethylsulfone In Refinery  
Wastewater.

CF8336102B

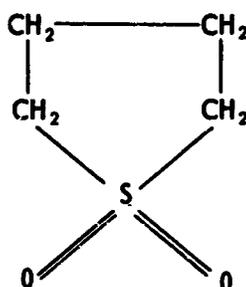
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IR-424  
IC:71-28  
Supplement IC-4851

# Technical Bulletin

## SULFOLANE

(Tetrahydrothiophene 1,1-dioxide)



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## SHELL SULFOLANE

Sulfolane is a highly polar solvent with outstanding chemical and thermal stability. It is miscible with water and is a good solvent for most classes of organic compounds and many common polymers.

The compound is used in the SHELL SULFINOL Process to remove  $H_2S$ ,  $CO_2$ , COS and mercaptans from a variety of gas streams.

Sulfolane is a preferred solvent for the extraction of benzene, toluene, xylenes and other aromatic hydrocarbons from catalytic reformates, and kerosene. It has been found useful in such applications as the separation of low-boiling alcohols, the fractionation of wood tars, tall oil, and other fatty acids, the concentration of sulfur dioxide, and for dehydration. It has been further demonstrated to be an effective reaction and polymerization solvent and to have utility as a polymer solvent for fiber spinning. In addition, sulfolane is a good solvent for polyvinylidene cyanide and polyacrylonitrile fibers.

The compound's unique properties offer further promise as a plasticizer in cellulose esters, cellophane, protein resins and gums; as a solvent in surface coatings, ink, dye, cleaning and paint remover formulations; as a dielectric in electrical condenser fluid; and as a component of hydraulic fluid.

**PHYSICAL PROPERTIES OF HIGH  
PURITY SULFOLANE** <sup>1, 2, 3, 4, 5, 6)</sup>

Molecular Weight	120.17
Boiling Point	285°C
Freezing Point	27.4 – 27.8°C
Flash Point, Cleveland Open Cup	350°F
Critical Temperature	801°K
Critical Pressure	52.2 Atm.
Heat of Fusion	4.9 Btu/lb.
Dipole Moment (benzene)	4.69 Debyes
Dielectric Constant (30°C)	44
Heat of Vaporization	225 Btu/lb. at 100°C 205 Btu/lb. at 200°C

Heat Capacity of Liquid, (cal/g °C, Btu/lb. °F)	°C	°F	
	0.31	30	86
	0.35	100	212
	0.40	200	392

**Liquid Vapor Equilibrium for  
Sulfolane – Water (P = 1 Atm.)**

°C	Temperature		Water in Liquid (%w)	Water in Vapor (%w)	Relative Volatility
	°C	°F			
206.8		404.2	0.55	59.6	267
132.0		269.6	5.0	—	—
121.0		259.8	6.2	97.5	600
115.6		240.1	8.9	97.9	477
114.0		237.2	10.0	—	—
106.4		223.5	19.0	99.1	469
103.2		217.8	39.4	99.5	306

Vapor pressure, viscosity, melting point, density and refractive indices are listed in the following Figures 1 through 5.



FIGURE 2

VISCOSITY OF SULFOLANE-WATER MIXTURES

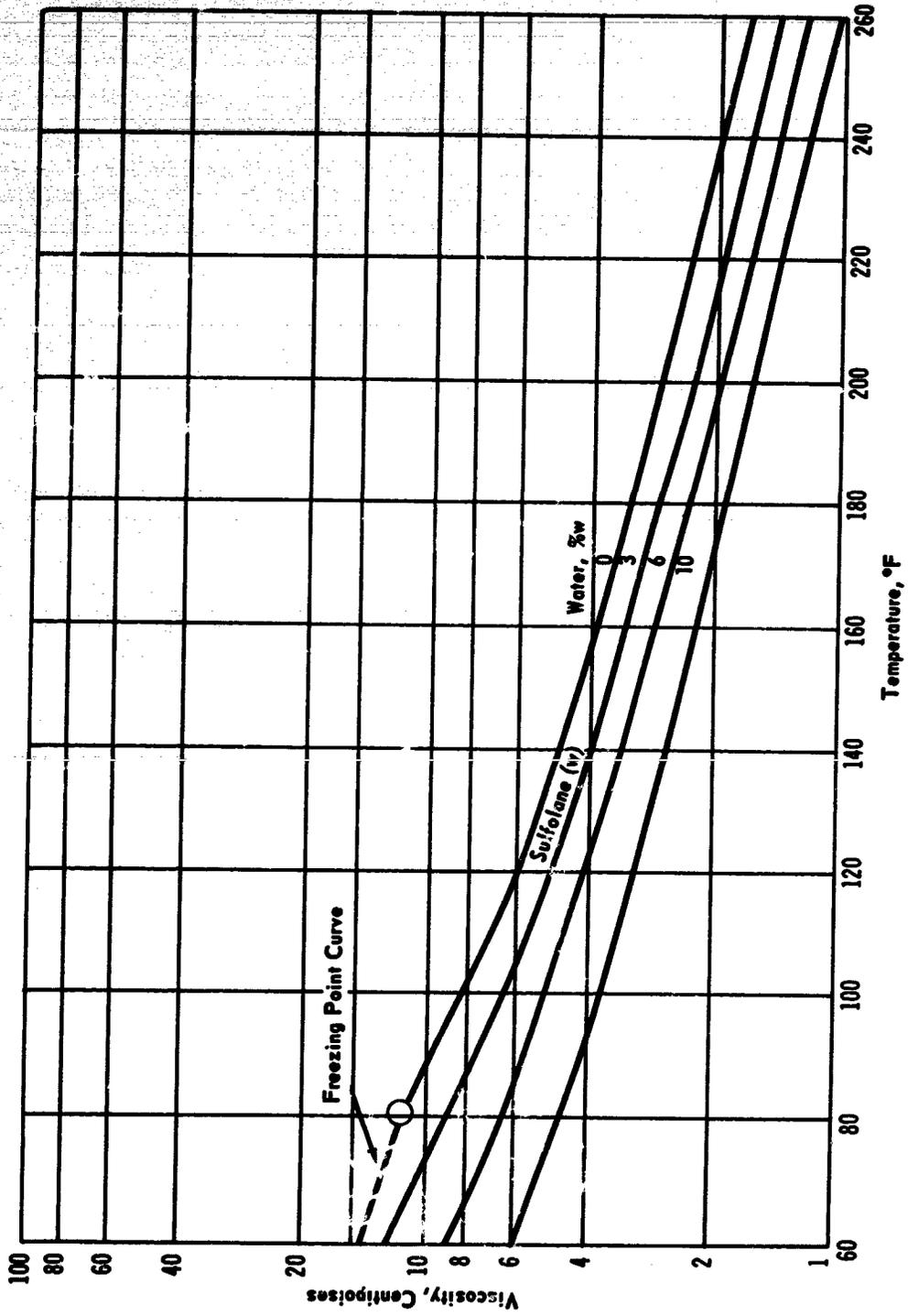


FIGURE 3  
MELTING POINT OF SULFOLANE-WATER MIXTURES

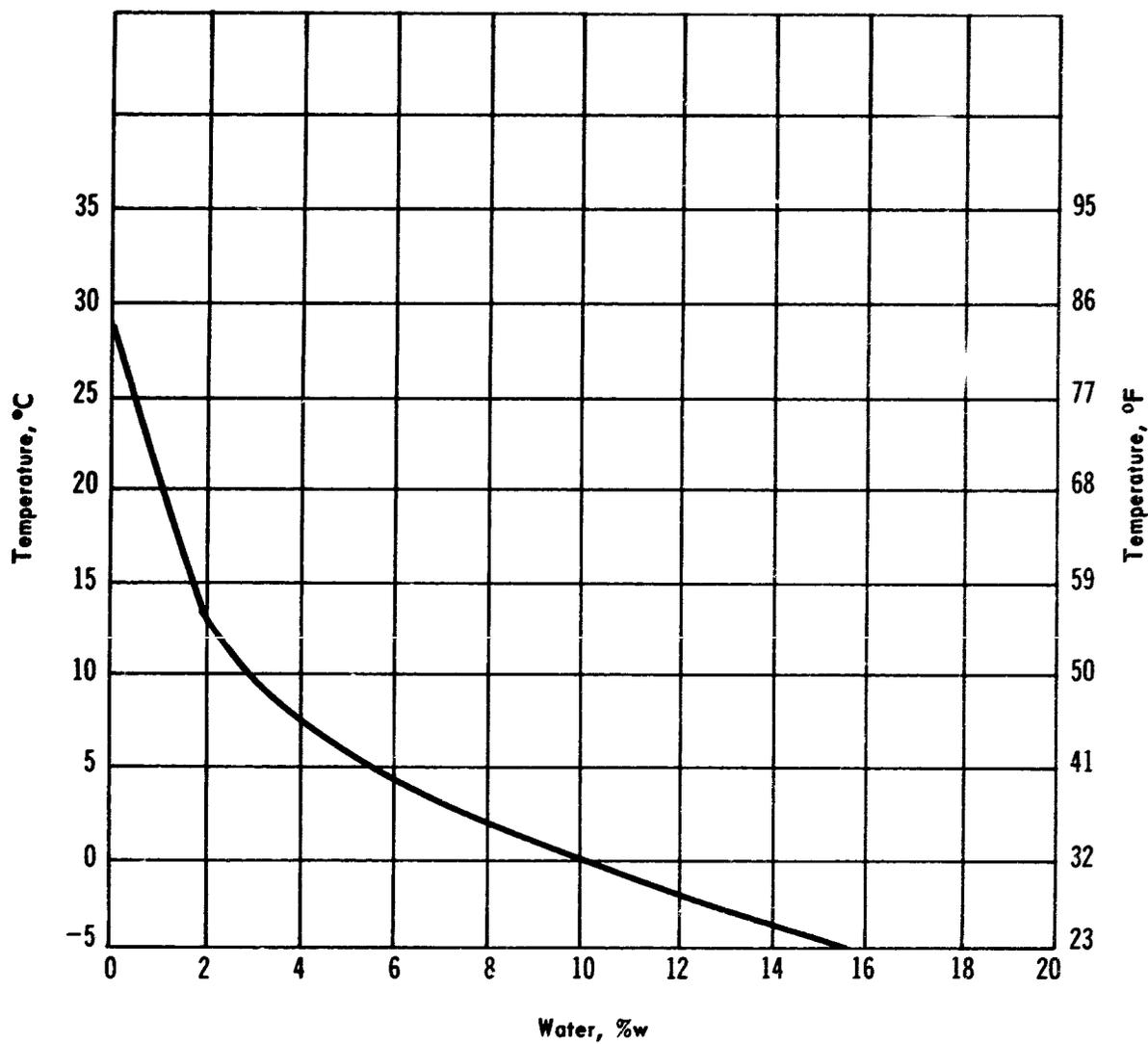


FIGURE 4  
DENSITY OF SULFOLANE

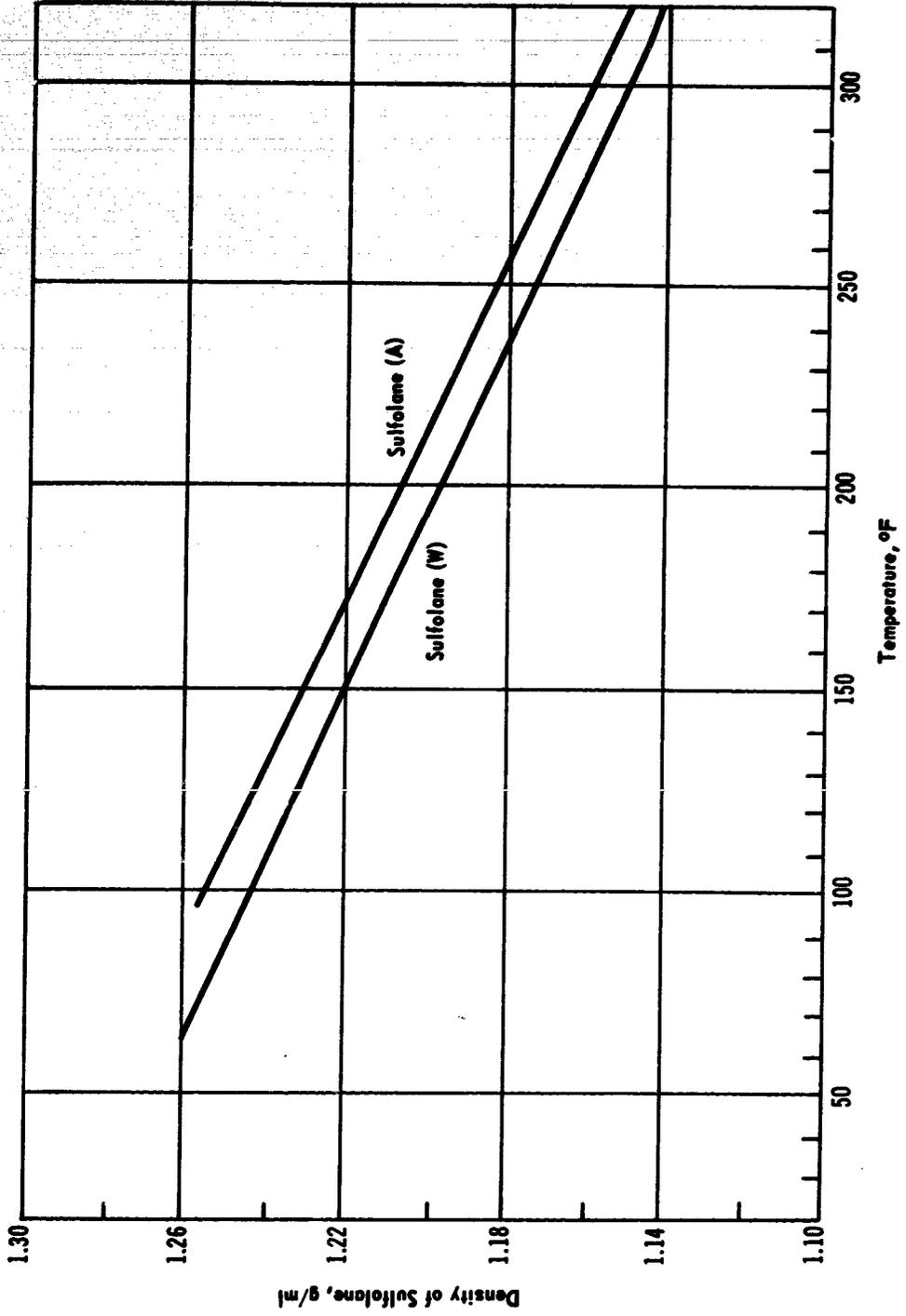
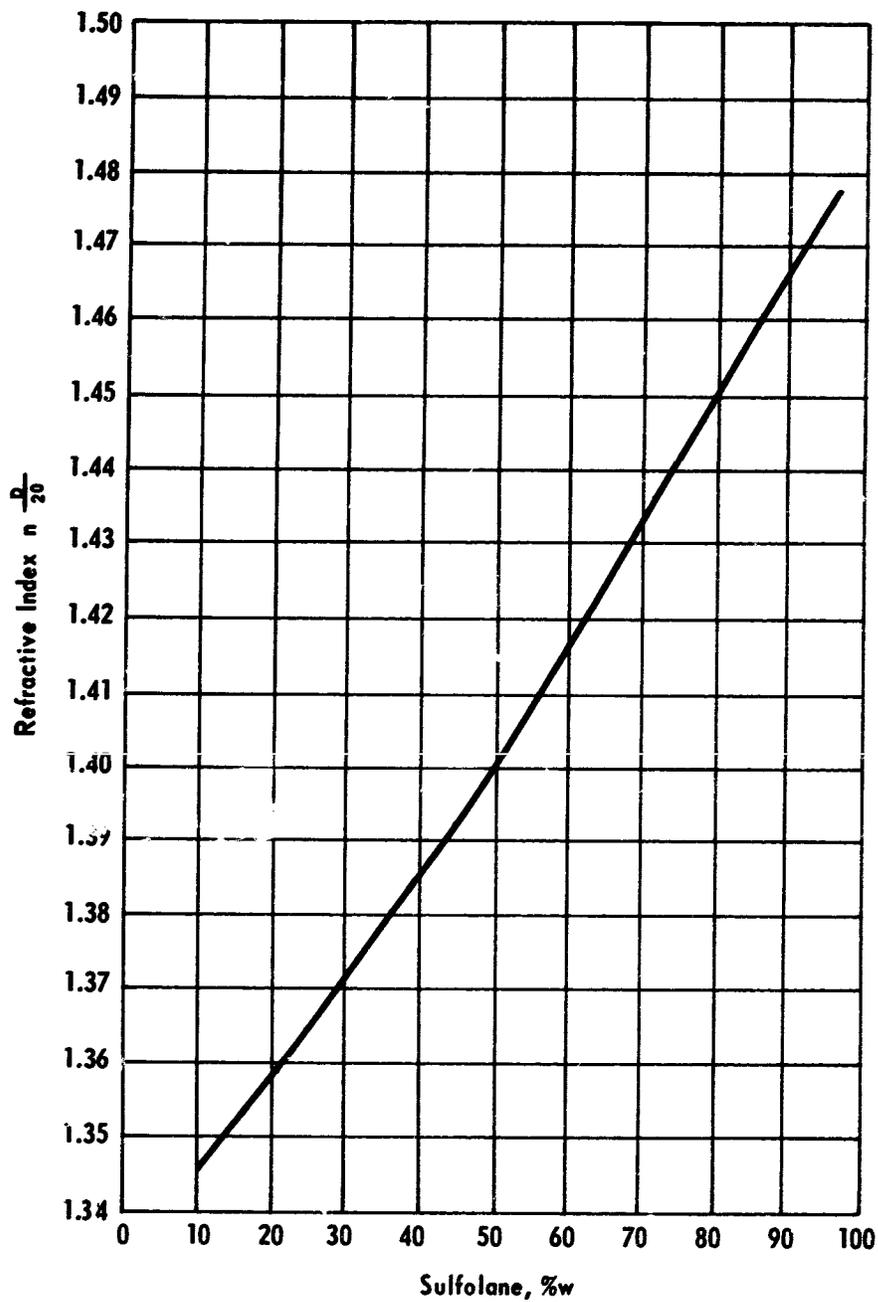


FIGURE 5

REFRACTIVE INDICES  $n_{D}^{20}$  OF AQUEOUS SULFOLANE SOLUTIONS

Refractive index of pure  
Sulfolane (ABBE)

<u>TC</u>	<u>R.I.</u>
30	1.481
50	1.475
70	1.468

## CHEMICAL PROPERTIES

Sulfolane is generally unreactive with chemicals such as acids, mercaptans and diolefins, and will not polymerize or decompose under ordinary conditions in the presence of acids or bases. During five hours at reflux temperatures, no reaction was observed between sulfolane and potassium carbonate, sodium acetate, 25% aqueous sodium hydroxide, and copper or iron strips. Some reaction occurred between sulfolane and 93% sulfuric acid at 140-150°C. At this temperature range sulfolane will react with aluminum chloride and sulfur to evolve hydrogen chloride and hydrogen sulfide.<sup>6)</sup>

Sulfolane is resistant to reduction by metallic zinc and acetic or hydrochloric acid. However, sulfolane may be reduced to the sulfide in 75% conversion by use of lithium aluminum hydride,<sup>7)</sup> and a 40% conversion is reported with vapor phase hydrogenation at 350°C and 150 psig over molybdenum sulfide catalyst.<sup>8)9)</sup>

Reaction of ethyl magnesium bromide (Grignard reagent) with the  $\alpha$ -carbon hydrogens of sulfolane yields the magnesium bromide derivative and ethane. This derivative will react with bromine, iodine, and chlorine to give 2-halosulfolane.<sup>10)</sup> However, reaction with benzaldehyde produced a low yield of the expected benzyl derivative.<sup>11)</sup>

## THERMAL STABILITY AND NON-CORROSIVITY

Sulfolane exhibits good thermal stability up to temperatures of 220°C. At this temperature it slowly produces sulfur dioxide and unsaturated, probably polymeric, material which imparts a brownish color to the product.<sup>2)</sup> The following dissociation rates have been observed for sulfolane in glass with inert gas and air bubbling, measuring decomposition by sulfur dioxide gas generation.<sup>1)</sup>

Temperature °C	Bubbled Gas	Rate Decomposition % Per Hour
200	N <sub>2</sub>	.002
200	CO <sub>2</sub>	.002
200	Air	.009
220	N <sub>2</sub>	.010
230	N <sub>2</sub>	.020

Melting point determinations on the sulfolane samples after prolonged exposures (150-500 hours) under the above conditions showed very little loss of purity although considerable discoloration was observed.

Corrosion tests on sulfolane with and without small amounts of water and hydrocarbon gave negligible results at 200°C (392°F) on carbon steel (about 1 mil/yr).<sup>2)</sup>

## SOLVENT PROPERTIES

Most classes of organic compounds and polymers are soluble in or miscible with sulfolane. Exceptions are paraffinic and naphthenic compounds and methacrylate, styrene, and vinylidene chloride polymers. Specific information which follows include inorganic compounds also.<sup>1,6)</sup>

## SOLUBILITIES OF VARIOUS MATERIALS

### ORGANIC COMPOUNDS

Acetamide	5% (hot)	Cyclohexane	Insoluble
Acetic Anhydride	Miscible	Cyclohexanone	Miscible
Acetone	Miscible	Dibutyl Sebacate	Miscible (hot)
Ammonia (30% Aq. Soln)	Miscible	Diethanolamine	Miscible
Acrylonitrile	Miscible	Diethyl Ether	Miscible (hot)
Aniline	Miscible	Dioxane	Miscible
Benzene	Miscible	Dodecyl Mercaptan	Insoluble
Benzenesulfonic Acid	5% (hot)	Ethyl Acetate	Miscible
n-Butyl Alcohol	Miscible	Ethylene Diamine	Miscible
Carbon Tetrachloride	Miscible	Formamide	Miscible
Carbon Disulfide	Insoluble	Glycerol	Miscible
n-Heptane	1.3% (30°C)	Naphthalene	> 5% (hot)
	40% (100°C)	Pyridine	Miscible
Lauryl Alcohol	Miscible (hot)	Toluene	Miscible
Linseed Oil	Miscible	Triethylene Glycol	Miscible
Methyl Cyclohexane	1.1% (30°C)	Urea	Miscible

### INORGANIC COMPOUNDS

KOH, 50%	Insoluble
NaOH, 10%	Insoluble
Sulfur	5% (hot)
Sulfuric Acid, 93%	Miscible
Water	Miscible

### POLYMERS

Alkyd Resin	10%	Polyvinylidene Chloride	Insoluble (ca 10% @ 200°C)
Phenolic Resin	10% (hot)		
Cellulose Triacetate	> 10% (hot)		
Polyacrylonitrile	> 10% (hot)	Polyvinyl Acetate	> 10%
Polymethacrylate	Insoluble	Polyvinyl Chloride - Acetate Copolymers	> 10%
Polystyrene	Insoluble (ca 10% @ 200°C)		

## SALES SPECIFICATIONS\* FOR SULFOLANE-W\*\*

<u>Property</u>	<u>Limits</u>	<u>Test Method</u>
Specific Gravity, 20/20°C	1.2625 - 1.2640	ASTM 941
Thermal Stability (SO <sub>2</sub> ppm max)	65	UOP***
Water, %wt max	3.0	ASTMD 1364
Ash, %wt max	0.1	ASTMD 1119
Isopropyl Sulfolanyl Ether, %wt	0.3	UOP***
Sulfolene-2, %wt	0.2	UOP***
Distillation (Anhydrous Material)		ASTMD 1078
% Recovered at 282°C	5	
% Recovered at 288°C	95	

\*Specifications are subject to change without notice.

\*\*Sulfolane-W contains 3%wt water.

\*\*\*Test method of Universal Oil Products Company.

### SHIPPING INFORMATION

Sulfolane-W is available in tank trucks and tank car quantities or in 55 gallon drums.

### Sulfolane-W

Pounds per gallon at 60°F	10.536
Flash Point, °F Open Cup	350
ICC Warning Labels	Not Required
Drum container type	Carbon Steel Lined with FUSECOTE

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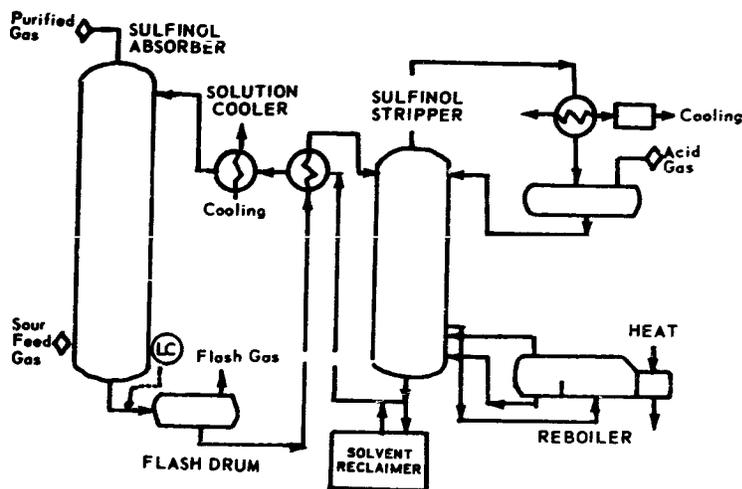
## APPLICATIONS

### Acid Gas Removal

Sulfolane is used in the Shell SULFINOL Process<sup>50,54,56,57,58,59,60</sup> for the removal of acid gases ( $H_2S$ ,  $CO_2$ ,  $COS$ , and mercaptans) from a variety of sour gas streams. The process combines sulfolane with diisopropanolamine for simultaneous selective physical and chemical absorption of acid gases which are subsequently released at ambient pressure and somewhat elevated temperature.

The SULFINOL Process illustrated below has many advantages for certain gas treating applications. These advantages include high acid gas loading of solvent, minimum corrosion of equipment, excellent economics for stripping stream, and excellent mercaptan removal. These advantages translate into lower capital investment and operating costs. More than 80 SULFINOL Process units are in operation with more under construction.

### SULFINOL PROCESS



### Recovery of Sulfur Dioxide<sup>211551</sup>

Sulfur dioxide has been recovered from dilute streams through adsorption in sulfolane at atmospheric or higher pressure. It is isolated by increasing temperature and/or reducing pressure. The solubility of sulfur dioxide in sulfolane at 20°C and one atmosphere is about 0.65 pound per pound of sulfolane; it is about 0.115 pound per pound at 75°C. Advantages over water adsorption are: the recovery of anhydrous sulfur dioxide; the non-corrosive system; the much lower absorptive capacity of sulfolane; and the lower heat requirement of volatilization of sulfur dioxide from sulfolane solution.

### Solvent for Methathesis, Isomerization and Polymerization Reactions

Sulfolane has been studied in a number of cases as a reaction solvent when anhydrous and polar systems were desired. Pyridine, 4-picoline and 4-isopropylpyridine are quaternized quantitatively in sulfolane solvent with n-butyl bromide at 25, 50, and 75°C (second order kinetics). With poly (4-vinyl) pyridine the quaternization starts at the same rate as for the monomeric amines but later decreases. Sulfolane does not give side reactions as do nitrobenzene and dimethylformamide solvents.<sup>24)</sup>

At reaction temperatures up to 250°C a sodium fluoride suspension in sulfolane has been found to exchange halogen readily with such halides as acid chlorides,  $\alpha$ -chloroethers, phosphorus oxychloride and trichloride.<sup>25)</sup>

Olefin isomerization, Friedel Crafts alkylations, carbonium ion rearrangement and hydrogen transfer processes have been effected with  $\text{HBF}_4$  in sulfolane-benzene solvent systems. Detailed studies on octalin isomerization with catalyst-solvent system showed rate increases of many thousand fold over an  $\text{HBF}_4$  benzene-acetic acid system. A 30% solution of  $\text{HBF}_4$  in sulfolane prepared from gaseous HF and  $\text{BF}_3$  is stated to be quite stable for reagent use when stored in polyethylene containers.<sup>26)</sup>

Sulfolane has also been used as the reaction medium for preparation of isocyanates from phosgene and amine salts.<sup>27)</sup>

Sulfolane has also been employed as a polymerization solvent in a number of systems. Water-soluble polysaccharide polymers of 10,000-30,000 molecular weight have been prepared from glucose solution in sulfolane with phosphoric acid catalyst. The reaction temperature was held at 155-175°C for 2-3 hours. Water was continuously removed by reflux under reduced pressure.<sup>28)</sup>

Polymerization of vinylidene cyanide<sup>29)</sup> and acrylonitrile<sup>30)</sup> has been studied in sulfolane solvent. Resulting polymers are soluble in hot sulfolane. Also sulfolane has been investigated as a solvent for condensing glyoxal with tetraamino-compounds and with amine-substituted pentaerythritol. The latter forms linear bis-diazine polymers which are of interest as fiber formers.<sup>31)</sup>

Sulfolane has been used as a solvent for polymerization of diamines and ureas.<sup>34)</sup>

Using sulfolane as a solvent polyether polyols have been prepared from 1, 3, 5-triazines with two amino groups and oxinane compounds.<sup>35)</sup>

### Polymer Processing Solvent

Studies have been made of the use of sulfolane as a spinning and casting solvent for acrylonitrile, <sup>32,33,34,35,36,37,38,39,40)</sup>. As an example, a 15% solution of a polyacrylonitrile homopolymer of 120,000 molecular weight is made from 200-mesh polymer by heating at 140°C for thirty minutes. The solution is clear and has a viscosity of 600 poise at this temperature. This solution can be cast at 150°C on a polished metal surface. At 175°C it

forms thin, tough, transparent and tear resistant films. It can be spun at about 150°C in an evaporative spinning cell to obtain strong flexible fibers.<sup>37)</sup> Studies have also been made of sulfolane in solvent systems for polyvinyl chloride,<sup>41)</sup> polyvinyl fluoride,<sup>42)</sup> and polyvinylidene cyanide<sup>43)</sup> (spinning and casting application).

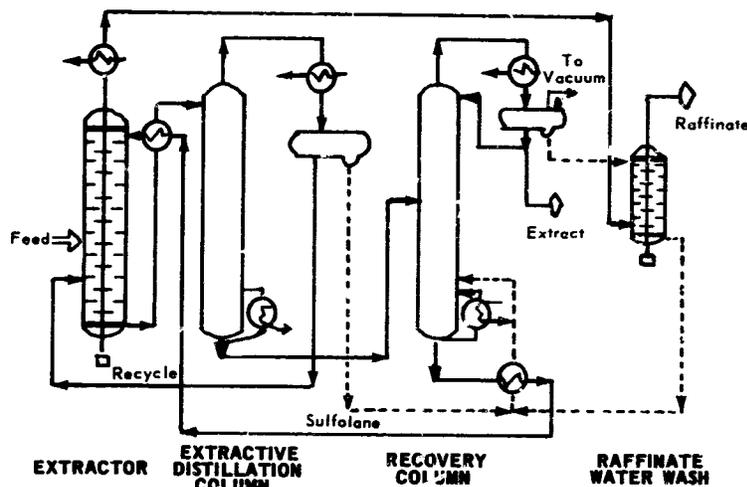
### Aromatic Hydrocarbon Extraction

Sulfolane is the preferred solvent in a number of liquid-liquid and liquid-vapor extraction applications. A major application of the SULFOLANE Extraction Process applies to the liquid-liquid extraction of BTX aromatics from reformat or hydrotreated pyrolysis naphtha feeds. It yields product purity over 99.9% with almost 100% recovery. Minimal utility consumption and capital investment costs may be realized because of the high solvency and selectivity of sulfolane for aromatics.

Detailed SULFOLANE Extraction Process studies have provided the basis for numerous aromatic extraction plants as well as for the conversion to sulfolane liquid-liquid extractions by plants which formerly utilized other less efficient solvents. Conversion to the SULFOLANE Extraction Process effectively increased plant capacity, reduced utility consumption and improved product purity.

In addition, the SULFOLANE Extraction Process is applicable for removal of aromatics from other refinery streams which include white spirit pyrolysis gasoline, coke oven gasoline, and catalytically cracked gasoline.<sup>51,61)</sup>

The SULFOLANE Extraction Process is illustrated below.



### **Extractive Distillation**

Sulfolane has been demonstrated to effectively separate n-propyl alcohol and sec-butanol. These alcohols are resistant to separation by fractional distillation as both their anhydrous and water binary azeotrope boiling points are within 1.7°C of each other. The separation is readily accomplished through extractive distillation with sulfolane as a reflux liquid. Since the sulfolane depresses the vapor pressure of the sec-butanol, n-propyl alcohol distills overhead and the sec-butanol plus sulfolane are recovered as a bottoms products. This procedure was stated to be of use in schemes for separation of mixtures of these and other close-boiling alcohols such as the water phase of process streams from the Fischer synthesis.<sup>17)</sup>

Similar systems have been studied and proposed for separation of other close low-boiling mixtures such as butane and 2-butene<sup>6)</sup> and close high-boiling materials such as  $\alpha$ -methylnaphthalene from kerosene streams. The relative volatilities of m- and p-xylene are insufficiently changed to allow practical use of sulfolane for extractive distillation.<sup>23)</sup> Unsaturated fatty acids have been separated by extractive distillation at reduced pressure.<sup>19)</sup> Also, isoprene has been separated from isoamylene mixtures.<sup>67)</sup>

### **Fractionation of Fatty Acids and Oils**

Preliminary liquid phase extraction with sulfolane permits fractionation of fatty acids into saturated and unsaturated components. In a single stage operation, a fatty acid mixture of oleic and linoleic acids of 131 iodine number was separated into fractions of 142 iodine value in the extract phase and 125 iodine value in the raffinate.<sup>20)</sup> Hence, multistage extraction should produce useful fractions from such mixtures as soya bean oil and glycerides.

### **Specialty Applications**

Low melting mixtures of sulfolane and other sulfones are indicated for use as dielectrics in high capacity electrical condensers to reduce size.<sup>44)</sup> The dielectric constant of sulfolane at 30°C is 44 which is high for an organic liquid.<sup>3)</sup>

Good thermal stability, low volatility, non-corrosivity and low toxicity of sulfolane make it an ideal candidate for hydraulic fluids when mixed with liquids such as glycol and castor oil.<sup>45)</sup>

Sulfolane has been suggested for fractionating and decolorizing non-cellulosic wood products such as pyroligneous liquids, tars and tall oil,<sup>22)</sup> as well as application in separating a wide variety of mixed coal and agricultural chemical products.<sup>18)</sup> It has been tested in a process for removing lignin from aspenwood.<sup>52)</sup>

Sulfolane (up to 30%) has been incorporated into water-soluble cellulose esters such as methylcellulose, hydroxyethylcellulose and carboxymethylcellulose to act as a flexibilizer. With 30% sulfolane in unmodified methylcellulose elongation was increased from 10 to 28%, with a retention of 22% after heating two weeks at 100°C. There was no serious loss in tensile strength.<sup>46)</sup>

In view of compatibility with other polymers, sulfolane should be of interest for plasticizing cellophane and other cellulosic films; proteins such as zein, casein and gelatin; and natural gums. The mild humectant property of the compound may be advantageous in such uses.

The compound has been attractive as a printing assistant in textile printing paste formulations. Use of some 18% sulfolane in gum-thickened aqueous dye pastes imparts greater depth and brightness of color as well as better leveling in the print dyeing of cotton, rayon, silk, wool, and nylon.<sup>47)</sup> It should further prove to have utility in a wide variety of fluids and pastes, such as metal cleaning solvents, paint removers, inks, surface coatings, penetrating liquids, humectants, etc.

In research studies sulfolane has proved useful as a solvent for phenyltri-methylammonium hydroxide for measuring pKa's of several neutral proton acids.<sup>48)</sup> It has been utilized as a solvent for fundamental studies of proteins such as casein, gluten, and insulin. Such studies included sedimentation, viscosity, osmotic pressure and enzymatic activity.<sup>49)</sup> It has also been employed as a non-aqueous solvent in studies of the behavior of electrolytes.<sup>3)</sup>

The compound has been used as a solvent for polyacrylonitrile fabrics to aid in stabilizing a chiseled pattern on synthetic stitched or woven fabric.<sup>53)</sup>

Sulfolane has been tested by the National Cotton Council for use in the durable cure process for production of permanent press fabrics.<sup>69)</sup>

Sulfolane has been used to extract dicyclopentadiene from aromatic olefins.<sup>70)</sup>

Sulfolane has been used as a plasticizer for cellulose acetate<sup>71)</sup> and as an emulsifier for photographic dispersions.<sup>72)</sup>

#### TOXICITY<sup>68)</sup>

On the basis of range-finding acute toxicity studies sulfolane is classified as a slightly toxic compound and is nonirritating to skin. Its LD<sub>50</sub> oral toxicity on rats is in the 500 to 5000 mg/kg range and on mice is 1900 to 2500 mg/kg. The LD<sub>50</sub> percutaneous toxicity on rabbits is greater than 2820 mg/kg (the highest dose applied to the skin). Sulfolane at 3800 mg/kg applied to the skin produced no apparent systematic effects in rats. Twenty-four hour exposure to the skin of rabbits produced no irritation. No vapor toxicity studies have been carried out on sulfolane in view of its low vapor pressure.

Sulfolane bioassays for two species of fish listed below.

<u>Fish</u>	<u>Milligram/Liter</u>	
	<u>48 Hour TLM</u>	<u>96 Hour TLM</u>
Sticklebacks	1,820	1,760
Gambusia	4,600	1,930

Use experience in dozens of plants has resulted in no adverse effects; however, reasonable precautions should be observed in handling the compound.

## HANDLING AND STORAGE

Sulfolane-W is relatively easy to handle and store.

Under most conditions mild steel is suitable for process equipment and storage tanks. Due to the presence of ppm sulfur dioxide a 1:1 dilution of Sulfolane-W and water will produce a solution with a pH in the range of 3 to 4. If it should be desirable to adjust the pH above 7, small amounts of alkanolamine may be added.

Sulfolane-W freezes at  $\sim 47^{\circ}\text{F}$ ; therefore, it is recommended that storage tanks and transfer lines be equipped with suitable heating facilities where temperatures are likely to fall below the freezing point.

Listed below are materials which have been successfully used with Sulfolane-W.

Hoses . . . . .	Flexible metal hose
Gaskets . . . . .	Teflon*, asbestos
Pipe thread joints . . . . .	Teflon

Sulfolane-W is a powerful solvent and if a polymer is considered for use with Sulfolane-W, it should be pretested.

For further information, contact Shell Chemical Company, Industrial Chemicals Division, One Shell Plaza, Houston, Texas 77001, (713-220-5524).

\*Registered DuPont Trademark.

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OCTOBER 1971

## REFERENCES

1. Shell Development Company, Unpublished.
2. C.H. Deal, et al. (Shell Development Co.), *Petrol. Refiner* 38, 185-82 (September 1952), I.A. 1959, 124E.
3. R.L. Burwell and C.H. Langford, *J. Am. Chem. Soc.* 81, 3799-800 (1959), C.A. 54, 4114 and I.A. 1959 124E.
4. E.E. Walker, *J. Appl. Chem. (London)* 2, 470-81 (1952), C.A. 47, 9253.
5. G.F. Longster and E.E. Walker, *Trans. Faraday Soc.* 49, 228-33 (1933), C.A. 47, 9697 and C.Z. 1955, 2385.
6. T.E. Jordan and F. Kipnis, *ind. Eng. Chem.* 41, 2635-7 (1949), C.A. 44, 2334 and C.Z. 1950, II 2534.
7. F.G. Bordwell and W.H. McKellin, *J. Am. Chem. Soc.* 73, 2351-3 (1951), C.A. 46, 1535 and B.A. 1952, AII, 273.
8. R.J. Moore and R.A. Trimble (Shell Development Co.), *Can.* 485,948 (1952), C.Z. 1954, 1953.
9. R.J. Moore and R.A. Trimble (Shell Development Co.), U.S. 2,471,077 (1949), C.A. 43, 7512 and B.A. 1951, BII, 35.
10. H.E. Faith (Allied Labs., Inc.), U.S. 2,656,362 (1953), C.A. 48, 10775 and C.Z. 1954, 4041.
11. W.E. Truce and K.R. Buser, *J. Am. Chem. Soc.* 76, 3577-9 (1954), C.A. 49, 12268 and C.Z. 1955, 1719.
12. G.J. Pierotti and C.L. Dunn (Bataafsche Pet. Mij.), *Ger.* 848,192 (1952), C.Z. 1953, 5394.
13. A.E. Handlos and G.J. Pierotti (Shell Development Co.), U.S. 2,496,207 (1950), C.A. 44, 4509 and B.A. 1951, BII, 555.
14. H.G. Staaterman, et al., *Chem. Eng. Progr.* 43, No. 4, 148-51 (1947), C.A. 41, 4142 and B.A. 1948, BII, 64.
15. H.G. Staaterman, et al., *Petrol. Processing* 1, 85-6 (October 1946), I.A. 1946, 1400.
16. E.L. Durrum (Shell Development Co.), U.S. 2,407,820 (1946), C.A. 41, 477 and C.Z. 1947, 1148.
17. C.S. Carlson and P.V. Smith (Standard Oil Development Co.), U.S. 2,570,205 (1951), C.A. 46, 5073 and C.Z. 1953, 7403.
18. T.W. Evans and R.C. Morris (Shell Development Co.), U.S. 2,360,859 (1944), C.A. 39, 2163.
19. R.C. Morris and A.V. Snider (Shell Development Co.), U.S. 2,368,597 (1945), C.A. 39, 5138.
20. R.C. Morris and E.C. Shokal (Shell Development Co.), U.S. 2,360,860 (1944), C.A. 39, 2164.
21. G.W. Hooker, et al. (Dow Chemical Co.), U.S. 2,385,704 (1945), C.A. 40, 185 and C.Z. 1945, I, 2292.
22. R.C. Morris and E.C. Shokal (Shell Development Co.), U.S. 2,360,862 (1944), C.A. 39, 2164.

23. J.C. Chu, et al., *Ind. Eng. Chem.* **46**, 754-61 (1954), *C.A.* **48**, 7867 and *C.Z.* **1955**, 5750.
24. B.D. Coleman and R.M. Fuoss, *J. Am. Chem. Soc.* **77**, 5472-6 (1955), *C.A.* **50**, 2257.
25. C.W. Tullock and D.D. Coffman, *J. Org. Chem.* **25**, 2016-2019 (1960).
26. J.W. Powell and M.C. Whiting, *Chemical Society (London) Proceedings*, 412 (1960).
27. P. Schleck, *Ger. (East)* **4496** (1954), *C.Z.* **1956**, 2313.
28. P.T. Mora and J.W. Wood, *J. Am. Chem. Soc.* **80**, 685 (1958).
29. H. Gilbert, et al., *J. Am. Chem. Soc.* **76**, 1074-6 (1954), *C.A.* **49**, 4499.
30. T.W. Campbell, *J. Polymer Sci.* **28**, 87-96 (1958), *C.A.* **52**, 12449.
31. H.F. Merk (Robert S. Aries), U.S. 2,895,944 (1959), *C.A.* **54**, 16029.
32. G.M. Rothrock (Du Pont), U.S. 2,706,674 (1955), *C.A.* **49**, 10636 and *C.Z.* **1956**, 12718.
33. Wuppertal-Eiberfeld, *Brit.* **698,174** (1953), *C.Z.* **1955**, 3525.
34. J.G. Calton and Q.J. O'Brien (Du Pont), U.S. 2,555,300 (1951), *C.A.* **45**, 8816 and *C.Z.* **1953**, 950.
35. J.G. Calton and Q.J. O'Brien, *French* **961,060** (1947), *C.Z.* **1951**, 278.
36. Du Pont, *Brit.* **579,887** (1946), *C.A.* **41**, 1882.
37. T.G. Finzel (Du Pont), U.S. 2,404,728 (1946), *C.Z.* **1947**, 546.
38. R.R. Merner (Du Pont), U.S. 2,404,723 (1946), *C.A.* **40**, 6887 and *C.A.* **1947**, 545.
39. R.C. Houtz (Du Pont), U.S. 2,404,722 (1946), *C.A.* **41**, 479, *C.Z.* **1947**, 544.
40. R.C. Houtz (Du Pont) U.S. 2,404,713 (1946), *C.A.* **41**, 150, *C.Z.* **1947**, 538.
41. E. Heisenberg and J. Kleine (Vereinigt Glanzstoff-Fabriken), U.S. 2,617,777 (1952), *C.A.* **47**, 4625 and *C.Z.* **1954**, 6624.
42. L.R. Barton (Du Pont), U.S. 2,953,818 (1960), *C.A.* **55**, 4052.
43. F.F. Miller (B.F. Goodrich Co.), U.S. 2,548,169 (1951), *C.A.* **45**, 5975 and *C.Z.* **1952**, 2088.
44. W.F. Buses and H.R. Davidson (General Aniline and Film Corp.), U.S. 2,628,265 (1953), *C.A.* **47**, 5827 and *C.Z.* **1956**, 4569.
45. R.C. Morris, et al. (Shell Development Co.), U.S. 2,394,251 (1946), *C.A.* **40**, 3843 and *C.Z.* **1946**, 1, 2435.
46. G.W. Hooker and N.R. Peterson (Dow Chemical Co.), U.S. 2,471,272 (1949).
47. W. Clarke, et al. (Imperial Chemical Industries, Ltd.) *Brit.* **708,248** (1954), *C.Z.* **1955**, 2783.
48. C.H. Langford and R.L. Burwell, *J. Am. Chem. Soc.* **82**, 1503-4 (1960), *I.A.* **1960**, 391.

49. E.D. Rees and S.J. Singer, *Arch. Biochem. Biophys.* 63, 144-50 (1956), C.Z. 1957, 13397.
50. C.H. Deal, Jr. et al. (Shell Development Co.) Section IV, Paper 32, Sixty WPC, June 1963.
51. H. Voett and W.C.G. Kusters Section III, Paper II, Sixth WPC, June 1963.
52. E.L. Springer and L.L. Zoch, C.A. 66, 3951 and *Svensk. Papperstidn* 69 (16), 513-16 (1966) (Eng.).
53. A. Rondea, et al. (Societe Industrielle der Etablissements B.V.R.) FR. 1, 461, 566 (1966), C.A. 67, 33780r.
54. C.L. Dunn, E.R. Freitas, J.W. Gootenbour, T.H. Henderson, M.N. Papadopoulos, *The Oil and Gas Journal*, 62, 95, (1964).
55. D.L. Little and G.R. Hettick (Phillips Petroleum Co.), U.S. 3,475,329 (1969) C.A. 72, 14446.
56. C.L. Dunn, et al., *Hydrocarbon Processing*, 43, (3), 150 (1964).
57. C.L. Dunn, et al., *Hydrocarbon Processing*, 44, (4), 137, (1965).
58. C.L. Dunn, et al., *The Oil and Gas Journal*, 63, (13), 87, (1965).
59. B.G. Goar, *The Oil and Gas Journal*, 67, (26), 117, (1969).
60. J. Frazier, *Hydrocarbon Processing*, 49, (4), 101, (1970).
61. G.H. Deal, Jr., et al., *Petr. Refiner*, 38, 185, (1959).
62. W.M. Hutchinson (Phillips Petroleum Company), U.S. 3,488,920 (1970), C.A. 72, 66796.
63. D.M. Little and G.R. Hettick (Phillips Petroleum Company), U.S. 3,477,945 (1969), C.A. 72, 68994.
64. F.B. Jones (Phillips Petroleum Company), U.S. 3,476,709 (1969), C.A. 72, 13514.
65. K. Kodama, et al., (Takeda Chemical Industries, Ltd.), Japan 7,006,553 (1970), C.A. 72, 122339.
66. J. Wisniak, et al., *Brit. Chem. Eng.*, 15, 76, (1970), C.A. 72, 125572.
67. G.C. Blytas (Shell Internationale Research Maatschappij N.V.), Ger. Offen. 1,941,946, C.A. 72, 99986.
68. V.K.H. Brown, et al., *Brit. J. Ind. Med.*, 23, 302 (1966), C.A. 66, 9577.
69. L. Smith, Paper (New Principles and Developments in Durable Press Cotton), National Cotton Council of America, March 1966.
70. F. Scardiglia and T. Hokama (Velsicol Chemical Corp.), U.S. 3,484,422 (1969), C.A. 72, 44475.
71. P.G. Schrader (Dow Chemical Co.), Ger. Offen. 1,925,430 (1970), C.A. 72, 102056.
72. K.I. Jacobson (Pavelle Ltd.) Brit. 1,038,029, C.A. 65, 13063.



SHELL CHEMICAL COMPANY

INDUSTRIAL CHEMICALS DIVISION

Shell Chemical Company is a Division of Shell Oil Company

0025

# MATERIAL SAFETY DATA SHEET

70-403

MSDS NUMBER ▶ 9,137

PAGE 1 OF 4

<b>PRODUCT</b> ▶ Isoprene <b>CHEMICAL SYNONYMS</b> ▶ 2-methyl-1,3-butadiene <b>CHEMICAL FAMILY</b> ▶ Diolefin <b>OSHA CODE</b> ▶ 85075 <b>CAS NUMBER</b> ▶ 78-79-5	<b>EMERGENCY ASSISTANCE</b> <b>OSHA</b> 718-475-8481 <b>CHEMTREC</b> 800-424-9300 <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">HAZARD RATING</td> <td style="width: 20px;"></td> <td style="text-align: center;">HEALTH</td> <td style="width: 20px;"></td> </tr> <tr> <td style="text-align: center;">LEAST 0</td> <td style="text-align: center;">▶</td> <td style="text-align: center;">BLIGHT 1</td> <td style="text-align: center;">▶</td> </tr> <tr> <td style="text-align: center;">MODERATE 2</td> <td style="text-align: center;">▶</td> <td style="text-align: center;">HIGH 3</td> <td style="text-align: center;">▶</td> </tr> <tr> <td></td> <td></td> <td style="text-align: center;">EXTREME 4</td> <td></td> </tr> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"> HEALTH</td> <td style="text-align: center;">2</td> </tr> <tr> <td style="text-align: center;"> FIRE</td> <td style="text-align: center;">4</td> </tr> <tr> <td style="text-align: center;"> REACTIVITY</td> <td style="text-align: center;">2</td> </tr> </table>	HAZARD RATING		HEALTH		LEAST 0	▶	BLIGHT 1	▶	MODERATE 2	▶	HIGH 3	▶			EXTREME 4		HEALTH	2	FIRE	4	REACTIVITY	2
HAZARD RATING		HEALTH																					
LEAST 0	▶	BLIGHT 1	▶																				
MODERATE 2	▶	HIGH 3	▶																				
		EXTREME 4																					
HEALTH	2																						
FIRE	4																						
REACTIVITY	2																						

COMPOSITION	%	TOXICITY DATA
Isoprene (Technical grade)	100	Inhalation (Rat) LD <sub>50</sub> = 64,600ppm (4 Hr)

**HEALTH HAZARD**

Prolonged or repeated exposure to high concentrations of liquid may cause irritation to skin and mucous membranes.

High concentrations of prolonged exposure to vapors may cause headache, dizziness, nausea, incoordination and loss of consciousness.

**SECTION IV OCCUPATIONAL EXPOSURE LIMITS**

No OSHA/PEL or ACGIH/TLV has been established.

0 0 2 8

# MATERIAL SAFETY DATA SHEET

MSDS NUMBER

9.137

PAGE 2 OF 4

**EYE CONTACT:** Flush with water for 15 minutes while holding eyelids open. Get medical attention.

**SKIN CONTACT:** Immediately deluge with water for 15 minutes while removing contaminated clothing and shoes. Follow by washing exposed area with soap and water. Do not reuse clothing or shoes until thoroughly cleaned. Get medical attention.

**INHALATION:** Remove victim to fresh air and provide oxygen if breathing is difficult. Give artificial respiration if not breathing. Get medical attention.

**INGESTION:** Do not induce vomiting. If vomiting occurs spontaneously, keep head below hips to prevent aspiration of liquid into the lungs. Get medical attention.\*

\*NOTE TO THE PHYSICIAN: If more than 2.0 ml per kg has been ingested and vomiting has not occurred, emesis should be induced with supervision. Keep victim's head below hips to prevent aspiration. If symptoms such as loss of gag reflex, convulsions or unconsciousness occur before emesis, gastric lavage using a cuffed endotracheal tube should be considered.

## SECTION VI PHYSICAL DATA

BOILING POINT (°F) ▶ 93	MELTING POINT (°F) ▶ -	VAPOR PRESSURE (mmHg) 400@60°F
SPECIFIC GRAVITY (H <sub>2</sub> O=1) ▶ 0.69	% VOLATILE BY VOLUME ▶ -	VAPOR DENSITY (AIR=1) ▶ 2.4
SOLUBILITY IN WATER ▶ insoluble	EVAPORATION RATE (BUTYL ACETATE=1) ▶ -	

### APPEARANCE AND ODOR

Colorless liquid, unpleasant irritating odor.

## SECTION VII FIRE AND EXPLOSION HAZARDS

FLASH POINT AND METHOD USED	FLAMMABLE LIMITS/% VOLUME IN AIR	LOWER	UPPER
-65°F TOC		1.6	12

### EXTINGUISHING MEDIA

Use foam or dry chemical

### SPECIAL FIRE FIGHTING PROCEDURES AND PRECAUTIONS

Evacuate hazard area of non-essential personnel. Notify fire department. Wear full protective clothing including NIOSH approved self-contained breathing apparatus to prevent any contact with vapor/gases. For massive cargo fires, apply deluge quantities of water from unmanned hose monitors to vapor space of container. If unavailable withdraw all personnel and let the fire burn. Stay away from ends of tanks. Cool fire exposed containers, with water from unmanned hose monitors.

### UNUSUAL FIRE AND EXPLOSION HAZARDS

Handle as an extremely flammable liquid.

STABILITY  UNSTABLE  STABLE      HAZARDOUS POLYMERIZATION  MAY OCCUR  WILL NOT OCCUR

## CONTAINERS AND MATERIALS TO AVOID

Avoid heat, sparks, open flames and oxidizing materials. Avoid vapor accumulation.

(Product being shipped or stored should contain inhibitor).

## HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide and unidentified organics may be formed during combustion.

## SECTION II

## EMPLOYEE PROTECTION

## RESPIRATORY PROTECTION

Use a NIOSH-approved respirator as required to prevent overexposure. In accord with 29 CFR 1910.134, use either a full-face, atmosphere-supplying respirator or an air-purifying respirator for organic vapors.

## PROTECTIVE CLOTHING

Wear gloves and other protective clothing as required to minimize skin contact. Wear safety glasses or goggles to avoid eye contact.

## ADDITIONAL PROTECTIVE MEASURES

Use explosion-proof ventilation as required to control vapor concentrations.

## SECTION III

## ENVIRONMENTAL PROTECTION

## FIRE AND LEAK RESPONSE

**EXTREMELY FLAMMABLE** - Eliminate all ignition sources. Wear a NIOSH-approved respirator. Evacuate unauthorized and/or unprotected personnel. Notify fire department.

Disperse vapor cloud with sustained flow of water fog. Shut off leak if safe to do so. Vapors are heavier than air and can travel long distances along ground to ignition source.

## WASTE DISPOSAL

Place in a disposal facility approved under RCRA regulations for hazardous waste (See Sec. XIII). Use non-leaking containers, seal tightly and label properly.

## ENVIRONMENTAL HAZARDS

This product is an "oil" under the Clean Water Act. **KEEP OUT OF SURFACE WATERS AND ANY WATER COURSES OR SEWERS ENTERING OR LEADING TO SURFACE WATERS.** See Section XII.

0028

# MATERIAL SAFETY DATA SHEET

PAGE 4 OF 4

## SECTION XI HAZARD IDENTIFICATION

**DANGER: Extremely Flammable.**  
Keep away from heat, sparks and open flames. Use adequate explosion-proof ventilation to prevent accumulation of vapor. All handling equipment must be grounded to prevent accumulation of static charge. When transferring, isoprene equipment must be electrically interconnected and grounded.

## SECTION XII

### TRANSPORTATION REQUIREMENTS

DEPARTMENT OF TRANSPORTATION CLASSIFICATION	<input checked="" type="checkbox"/> FLAMMABLE LIQUID	<input type="checkbox"/> COMBUSTIBLE LIQUID	<input type="checkbox"/> OXIDIZING MATERIAL	<input type="checkbox"/> NON-FLAMMABLE GAS
	<input type="checkbox"/> FLAMMABLE SOLID	<input type="checkbox"/> POISON, CLASS A	<input type="checkbox"/> CORROSIVE MATERIAL	<input type="checkbox"/> NOT HAZARDOUS BY D.O.T. REGULATIONS
	<input type="checkbox"/> FLAMMABLE GAS	<input type="checkbox"/> POISON, CLASS B	<input type="checkbox"/> IRRITATING MATERIAL	<input type="checkbox"/> OTHER—Specify below

D.O.T. PROPER SHIPPING NAME

Isoprene - Flammable liquid

OTHER REQUIREMENTS

D.O.T. I.D. Number UN 1218; Guide 27  
RQ - 1000 lbs. in one container

## SECTION XIII

### OTHER REGULATORY CONTROLS

EPA, FDA, OSHA, USDA, CPSC, etc.

#### EPA - Resource Conservation and Recovery Act (RCRA)

As produced, this material is a product and not a waste. If discarded or intended to be discarded as is, it is an ignitable hazardous waste as defined in 40 CFR 261.21. The EPA hazardous waste number is D001.

#### EPA - Clean Water Act (CWA)

This product is classified as an oil under Section 311 of the Act. Spills entering (a) surface waters or (b) any watercourses or sewers entering/ leading to surface waters that cause a sheen MUST be reported to the National Response Center, 800-424-8802.

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

**BE SAFE**

READ OUR PRODUCT  
SAFETY INFORMATION  
... AND  
PASS IT ON

(PRODUCT LIABILITY LAW  
REQUIRES IT)

*James J. Brown*  
Manager

SHELL OIL COMPANY  
PRODUCT SAFETY AND COMPLIANCE  
OIL AND CHEMICAL PRODUCTS  
P.O. BOX 4320  
HOUSTON, TEXAS 77210

DATE PREPARED

June 08, 1982

0029

1R-403

# MATERIAL SAFETY DATA SHEET

MSDS NUMBER ▶ 9,136

PAGE 1 OF 4

PRODUCT ▶ Isoprene Concentrate

CHEMICAL SYNONYMS ▶ --

CHEMICAL FAMILY ▶ Hydrocarbon

DELT CODE ▶ 85074 CAS NUMBER ▶ Mixture

SWELL 719-473-8461  
CHEMTREC 800-424-9300

HEALTH	2
FIRE	4
REACTIVITY	2

HAZARD RATING

LEAST 0 SLIGHT 1  
MODERATE 2 HIGH 3 EXTREME 4

COMPOSITION	%	TOXICITY DATA
Isoprene Concentrate	--	Not Determined
Isoprene	26	
Pentene-1	10	
2 methyl butene-1	10	
t-1, 3-pentadiene	10	
Other C <sub>5</sub> hydrocarbons	44	

**HEALTH INFORMATION**

**VAPORS MAY BE TOXIC!** Prolonged exposure to higher concentrations of vapor or repeated exposure to lower concentrations may cause headache, dizziness, nausea, incoordination and loss of consciousness.

No OSHA/PEL or ACGIH/TLV has been established.

0030

# MATERIAL SAFETY DATA SHEET

MSDS NUMBER ▶

9,136

PAGE 2 OF 4

**EYE CONTACT:** Flush with water for 15 minutes while holding eyelids open. Get medical attention.

**SKIN CONTACT:** Immediately deluge with water for 15 minutes while removing contaminated clothing and shoes. Follow by washing exposed area with soap and water. Do not reuse clothing or shoes until thoroughly cleaned. Get medical attention.

**INHALATION:** Remove victim to fresh air and provide oxygen if breathing is difficult. Give artificial respiration if not breathing. Get medical attention.

**INGESTION:** Do not induce vomiting. If vomiting occurs spontaneously, keep head below hips to prevent aspiration of liquid into the lungs. Get medical attention.\*

\*NOTE TO THE PHYSICIAN: If more than 2.0 ml per kg has been ingested and vomiting has not occurred, emesis should be induced with supervision. Keep victim's head below hips to prevent aspiration. If symptoms such as loss of gag reflex, convulsions or unconsciousness occur before emesis, gastric lavage using a cuffed endotracheal tube should be considered.

SECTION VI			PHYSICAL DATA		
<b>BOLING POINT</b> (°F) ▶ (Isoprene) 93°	<b>MELTING POINT</b> (°F) ▶ --	<b>VAPOR PRESSURE</b> (mmHg) (Isoprene) 493 @ 20°C			
<b>SPECIFIC GRAVITY</b> (H <sub>2</sub> O=1) ▶ (Isoprene) 0.7@20/4°C	<b>.% VOLATILE BY VOLUME</b> ▶ --	<b>VAPOR DENSITY</b> (AIR=1) ▶ (Isoprene) 2.3			
<b>SOLUBILITY IN WATER</b> ▶ Negligible	<b>EVAPORATION RATE</b> (BUTYL ACETATE=1) ▶ --				
<b>APPEARANCE AND ODOR</b> Volatile liquid, with disagreeable odor.					

SECTION VII			FIRE AND EXPLOSION HAZARDS		
<b>FLASH POINT AND METHOD USED</b> (Isoprene): 65°F estimated	<b>FLAMMABLE LIMITS/% VOLUME IN AIR</b>	LOWER 1.0	UPPER --		
<b>EXTINGUISHING MEDIA</b> Use dry chemical, foam or CO <sub>2</sub> .					
<b>SPECIAL FIRE FIGHTING PROCEDURES AND PRECAUTIONS</b> Evacuate hazard area of nonessential personnel. Wear full and appropriate protective clothing including a NIOSH approved self-contained breathing apparatus to prevent any contact with material or vapor/gases that are released. Cool fire-exposed containers, surrounding equipment and structures with water. For massive cargo fires, apply deluge quantities of water from unmanned hose monitors to vapor space of container. If water unavailable, <u>withdraw ALL personnel and let the fire burn. Stay away from ends of tanks.</u>					
<b>UNUSUAL FIRE AND EXPLOSION HAZARDS</b> Handle as an extremely flammable liquid.					

0 0 3 1

# NATIONAL SAFETY DATA SHEET

MSDS NUMBER ▶

9,136

PAGE 3 OF 4

STABILITY ▶  UNSTABLE  STABLE

HAZARDOUS POLYMERIZATION ▶  MAY OCCUR  WILL NOT OCCUR

## REACTIVE HAZARDOUS TO LIFE

Avoid heat, sparks, open flames and oxidizing materials. Avoid vapor accumulation.

## HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide and unidentified organics may be formed during combustion.

## RESPIRATORY PROTECTION

Use a NIOSH-approved respirator as required to prevent overexposure. In accord with 29 CFR 1910.134, use either a full-face, atmosphere-supplying respirator or an air-purifying respirator for organic vapors.

## PROTECTIVE CLOTHING

Wear gloves and other protective clothing as required to minimize skin contact. Wear safety glasses or goggles to avoid eye contact.

## ADDITIONAL PROTECTIVE MEASURES

Use explosion-proof ventilation as required to control vapor concentrations.

## SECTION 4

## EXPERIMENTAL PROCEDURES

### SPILL OR LEAK PROCEDURES

**DANGER!** Extremely Flammable.

Very high fire and explosion hazard when spilled. Do not use spark-generating equipment. Water fog may be used to suppress vapor cloud.

**Large spills:** Eliminate all sources of ignition. Evacuate the area of all nonessential personnel. Wear appropriate respirator and other protective clothing. Shut off source of leak only if safe to do so. Dike and contain. Remove with vacuum trucks or pump to storage/salvage vessels. Soak up residue with a noncombustible absorbent such as clay or vermiculite and place in containers for disposal. Flush area with water to remove trace residue and dispose of flush solutions in containers.

**Small spills:** Soak up with noncombustible absorbent and place in containers. Flush area with water, collect flush solutions for disposal.

### WASTE DISPOSAL

Dispose of in a facility approved under RCRA regulations for hazardous waste (See Sec. XIII). Containers must be tightly sealed.

## ENVIRONMENTAL HAZARDS

This product is an "oil" under the Clean Water Act. **KEEP OUT OF SURFACE WATERS AND ANY WATER COURSES OR SEWERS ENTERING OR LEADING TO SURFACE WATERS.** See Section XIII.



# MATERIAL SAFETY DATA SHEET

MSDS NUMBER

9,136

PAGE 4 OF 4

**DANGER! Extremely Flammable.**

Keep away from heat, sparks and open flames. Store away from other flammable materials in a cool, dry place. Containers must be tightly sealed. Use adequate explosion-proof ventilation to prevent accumulation of vapor. All handling equipment must be grounded to prevent accumulation of static charge. When pouring or transferring materials, containers must be electrically interconnected and grounded.

## SECTION XII

## TRANSPORTATION REQUIREMENTS

DEPARTMENT OF TRANSPORTATION CLASSIFICATION	<input checked="" type="checkbox"/> FLAMMABLE LIQUID	<input type="checkbox"/> COMBUSTIBLE LIQUID	<input type="checkbox"/> OXIDIZING MATERIAL	<input type="checkbox"/> NON-FLAMMABLE GAS
	<input type="checkbox"/> FLAMMABLE SOLID	<input type="checkbox"/> POISON, CLASS A	<input type="checkbox"/> CORROSIVE MATERIAL	<input type="checkbox"/> NOT HAZARDOUS BY D.O.T. REGULATIONS
	<input type="checkbox"/> FLAMMABLE GAS	<input type="checkbox"/> POISON, CLASS B	<input type="checkbox"/> IRRITATING MATERIAL	<input type="checkbox"/> OTHER—Specify below

D.O.T. PROPER SHIPPING NAME

Petroleum Naphtha

OTHER REQUIREMENTS

D.O.T. I.D. Number UN1255; Guide 27

RQ - Isoprene - 1000 lbs. in one containers

## SECTION XIII

## OTHER REGULATORY CONTROLS

EPA, FDA, OSHA, USDA, CPSC, etc.

### EPA - Clean Water Act (CWA)

This product is classified as an oil under Section 311 of the Clean Water Act. Spills entering (a) surface waters or (b) any watercourses or sewers entering/leading to surface waters that cause a sheen MUST be reported to the National Response Center, 800-424-8802.

### EPA - Resource Conservation and Recovery Act (RCRA)

As produced, this material is a product and not a waste. If discarded or intended to be discarded as is, it is an ignitable hazardous waste as defined in RCRA (40 CFR 261.21). The EPA hazardous waste number is D001.

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof.

Vendor assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vendor assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in use of the material.



*James J. Bowen*  
Manager

SHELL OIL COMPANY  
PRODUCT SAFETY AND COMPLIANCE  
OIL AND CHEMICAL PRODUCTS  
P.O. BOX 4320  
HOUSTON, TEXAS 77210

DATE PREPARED

April 12, 1982

# MATERIAL SAFETY DATA SHEET

1R-437

**Shell**

FORM NO. 1-82

MSDS NUMBER ▶ 5,620-4

PAGE 1 OF

<b>SECTION I</b>	<b>NAME</b>	<b>24 HOUR EMERGENCY ASSISTANCE</b>										
<b>PRODUCT</b> ▶	Sulfolane-V	<b>SHELL</b> 713-473-8481	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;"></td> <td style="text-align: center;">HEALTH</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;"></td> <td style="text-align: center;">FIRE</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;"></td> <td style="text-align: center;">REACTIVITY</td> <td style="text-align: center;">1</td> </tr> </table>		HEALTH	1		FIRE	1		REACTIVITY	1
	HEALTH	1										
	FIRE	1										
	REACTIVITY	1										
<b>CHEMICAL/SYNONYMS</b> ▶	Tetrahydrothiophene-1,1-Dioxide	<b>OWBENTEC</b> 800-424-9300										
<b>CHEMICAL FAMILY</b> ▶		<b>HAZARD RATING</b> LEAST 0 SLIGHT 1 MODERATE 2 HIGH 3 EXTREME 4										
<b>SHELL CODE</b> ▶	32366	<b>CAS NUMBER</b> ▶	126-33-0									

SECTION II		INGREDIENTS	TOXICITY DATA
	COMPOSITION	%	
Sulfolane-V		100	Not determined.
Sulfolane		97	Oral LD <sub>50</sub> : (rat)=1.5 g/kg Dermal LD <sub>50</sub> : (rabbit)= >2.8 g/kg
Water		3	

**SECTION III HEALTH INFORMATION**

**Acute Effects:** Overexposure may effect the central nervous system producing such effects as restlessness or hyperactivity, convulsions and vomiting.

**Eye Contact:** Liquid or vapor contact may cause mild irritation.

**Skin Contact:** Liquid or vapor can be absorbed through the skin. Skin contact should be considered in evaluating occupational exposure.

**Inhalation:** Very high vapor concentrations may cause lung inflammation and hemorrhage.

**SECTION IV OCCUPATIONAL EXPOSURE LIMITS**

None established.

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## SECTION V EMERGENCY AND FIRST AID PROCEDURES

**EYE CONTACT:** Flush with water for 15 minutes while holding eyelids open. Get medical attention.

**SKIN CONTACT:** Flush with water while removing contaminated clothing and shoes. Follow by washing with soap and water. Do not reuse clothing or shoes until cleaned. If irritation persists, get medical attention.

**INHALATION:** Remove victim to fresh air and provide oxygen if breathing is difficult. Give artificial respiration if not breathing. Get medical attention.

**INGESTION:** Do not give liquids if victim is unconscious or very drowsy. Otherwise, give no more than 2 glasses of water and induce vomiting by giving 30cc (2 tablespoons) Syrup of Ipecac.\* If Ipecac is unavailable, give 2 glasses of water and induce vomiting by touching finger to back of victim's throat. Keep victim's head below hips while vomiting. Get medical attention.

**\*NOTE TO THE PHYSICIAN:** If victim is a child, give no more than 1 glass of water and 15cc (1 tablespoon) Syrup of Ipecac. If symptoms such as loss of gag reflex, convulsions or unconsciousness occur before emesis, gastric lavage should be considered following intubation with a cuffed endotracheal tube.

## SECTION VI PHYSICAL DATA

BOILING POINT (°F) ▶ 550	MELTING POINT (°F) ▶ 47	VAPOR PRESSURE (mmHg) ▶ 0.01@68°F
SPECIFIC GRAVITY (H <sub>2</sub> O=1) ▶ 1.3	% VOLATILE BY VOLUME ▶ --	VAPOR DENSITY (AIR=1) ▶ 4.2
SOLUBILITY IN WATER ▶ Miscible	EVAPORATION RATE (BUTYL ACETATE=1) ▶ --	
APPEARANCE AND ODOR		
Slightly viscous liquid above 30°F. Sulfide odor.		

## SECTION VII FIRE AND EXPLOSION HAZARDS

FLASH POINT AND METHOD USED 320°F (PMCC)	FLAMMABLE LIMITS/% VOLUME IN AIR ▶ LOWER UPPER
EXTINGUISHING MEDIA Use water fog, "alcohol" foam, dry chemical or CO <sub>2</sub> .	
SPECIAL FIRE FIGHTING PROCEDURES AND PRECAUTIONS Do not enter confined fire space without proper protective equipment including a NIOSH approved self-contained breathing apparatus. Cool fire-exposed containers with water.  In the case of large fires, also cool surrounding equipment and structures with water.	
UNUSUAL FIRE AND EXPLOSION HAZARDS Sulfur oxides, which are corrosive and toxic, may be released upon combustion.	

STABILITY  UNSTABLE  STABLEHAZARDOUS POLYMERIZATION  MAY OCCUR  WILL NOT OCCUR

## PREVENTION AND AVOIDANCE

Avoid heat, open flames and contact with strong oxidizing agents.

## DECOMPOSITION PRODUCTS

Decomposes slowly above 420°F to release sulfur oxide. Carbon monoxide, sulfur dioxide and unidentified organics will be released with combustion.

## SECTION IX

## EMPLOYEE PROTECTION

## RESPIRATORY PROTECTION

Use a NIOSH-approved respirator as required to prevent overexposure. In accord with 29 CFR 1910.134, use either an atmosphere-supplying respirator or an air-purifying respirator for organic vapors.

## PROTECTIVE CLOTHING

Wear impervious gloves and other protective clothing as required to prevent skin contact. Wear chemical goggles to prevent splashing into the eyes.

## ADDITIONAL PROTECTIVE MEASURES

Use ventilation as required to control vapor concentrations.

## SECTION X

## ENVIRONMENTAL PROTECTION

May burn although not readily ignitable. Use cautious judgment when cleaning up large spills.

**Large spills:** Wear respirator and protective clothing as appropriate. Shut off source of leak if safe to do so. Dike and contain. Remove with vacuum trucks or pump to storage/salvage vessels. Soak up residue with an absorbent such as clay, sand or other suitable material; dispose of properly. Flush area with water to remove trace residue.  
**Small spills:** take up with an absorbent material and dispose of properly.

## WASTE DISPOSAL

Dispose of in an appropriate disposal facility in compliance with local regulations.

## ENVIRONMENTAL HAZARDS

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**SECTION XI SPECIAL PRECAUTIONS**

Store in a cool, dry place with adequate ventilation. Keep away from open flames and high temperatures.

Minimize skin contact. Wash with soap and water before eating, drinking, smoking or using toilet facilities. Launder contaminated clothing before reuse. Properly dispose of contaminated leather articles, including shoes, that cannot be decontaminated.

**SECTION XII TRANSPORTATION REQUIREMENTS**

DEPARTMENT OF TRANSPORTATION CLASSIFICATION	<input type="checkbox"/> FLAMMABLE LIQUID	<input type="checkbox"/> COMBUSTIBLE LIQUID	<input type="checkbox"/> OXIDIZING MATERIAL	<input type="checkbox"/> NON-FLAMMABLE GAS
	<input type="checkbox"/> FLAMMABLE SOLID	<input type="checkbox"/> POISON, CLASS A	<input type="checkbox"/> CORROSIVE MATERIAL	<input checked="" type="checkbox"/> NOT HAZARDOUS BY D.O.T. REGULATIONS
	<input type="checkbox"/> FLAMMABLE GAS	<input type="checkbox"/> POISON, CLASS B	<input type="checkbox"/> IRRITATING MATERIAL	<input type="checkbox"/> OTHER—Specify below

D.O.T. PROPER SHIPPING NAME  
--

OTHER REQUIREMENTS  
--

**SECTION XIII OTHER REGULATORY CONTROLS**  
EPA, FDA, OSHA, USDA, CPSC, etc.

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The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof.

Vender assumes no responsibility for injury to vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, vender assumes no responsibility for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.



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