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CODING FORM FOR GLOBAL INDEXING

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Chemical Division



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December 22, 1988

FEDERAL EXPRESS



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Robert Brink
ITC Executive Secretary (TS 792)
U.S. Environmental Protection Agency
401 M Street, SW
Washington, D.C. 20460

Contains No CBI

Dear Mr. Brink:

Enclosed, please find Material Safety Data Sheets (MSDS) for three chloro-alkyl phosphates listed in the Twenty-Third Report of the Interagency Testing Committee. Included are MSDS on the following:

<u>Trade Name</u>	<u>CAS No.</u>	<u>Chemical Name</u>
Fyrol CEF	115-96-8	Tris(2-chloroethyl)phosphate
Fyrol PCF	13674-84-5	Tris(1-chloro-2-propyl)phosphate
Fyrol FR-2	13674-87-8	Tris(1,3-dichloro-2-propyl)phosphate

I hope this information is useful. Please do not hesitate to call if you have any questions.

Sincerely,

Louette Paul

Louette Paul
Toxicologist

LP/ej

cc: E. Bisinger
R. Buff
R. Freudenthal

REC'D

DEC 23 1988

RH Brink

94 JUL 26 PM 3:51

RECEIVED
OPPT. DIV.

Akzo Chemicals Inc.
300 South Riverside Plaza
Chicago, Illinois 60606
Tel. (312) 905 7500
Fax (312) 906 7680



Material Safety Data Sheet*

Chemical Division

FYROL[®] PCF Flame Retardant

This Product Safety Information Sheet is principally directed to managerial, safety, hygiene and medical personnel. The description of physical, chemical and toxicological properties and handling advice is based on experimental results and past experience. It is intended as a starting point for the development of health and safety procedures.

This Product Safety Information Sheet meets the material safety data sheet (MSDS) requirements of the federal OSHA Hazard Communication standard (29 CFR 1910.1200).

New Issue 4/86
Supersedes Issue Dated 4/80
FYR.189.S

SYNONYMS:

Tri(i-chloromethyl ethyl) phosphate;
Tri(2-chloroisopropyl) phosphate

CAS REGISTRY NUMBER:

13674-84-5

CAS INDEX NAME:

2-propanol, 1-chloro-, phosphate (3:1) (8CI 9CI)

I. PHYSICAL/CHEMICAL PROPERTIES

COMPOSITION:

Tri(beta-chloropropyl) phosphate

FORMULA:



MOLECULAR WEIGHT:

328 (approx)

PHYSICAL STATE/DESCRIPTION:

Clear colorless liquid

SPECIFIC GRAVITY:

1.290 at 77°F/77°F (25°C/25°C)

VAPOR PRESSURE:

40 mm Hg at 230°F (110°C); Less
than 2 mm Hg at 77°F (25°C)

**IN CASE OF SUSPECTED POISONING,
REFER TO THE INFORMATION IN
SECTION VII:HUMAN HEALTH AND
THE PROCEDURE AND EMERGENCY
CONTACTS IN SECTION VIII:FIRST AID.**

**IN CASE OF SPILLAGE, REFER TO
THE PROCEDURE AND EMERGENCY
CONTACTS IN SECTION X:SPILL
HANDLING OR CALL CHEMTREC
800-424-9300.**

*Registered trademark of Stauffer Chemical Company

*Also referred to as a Product Safety Information Sheet

All information concerning this product and/or all suggestions for handling and use contained herein are offered in good faith and are believed to be reliable. Akzo Chemicals Inc., however, makes no warranty as to the accuracy and/or sufficiency of such information and/or suggestions, as to the product's merchantability or fitness for any particular purpose, or that any suggested use will not infringe any patent. Nothing contained herein shall be construed as granting or extending any license under any patent. Buyer must determine for himself, by preliminary tests or otherwise, the suitability of this product for his purposes. The information contained herein supersedes all previously issued bulletins on the subject matter covered.

Akzo Chemicals Inc.
300 S. Riverside Plaza
Chicago, Illinois 60606
(312) 906-7500

FLASH POINT:

425°F (218°C) Cleveland Open Cup

WATER SOLUBILITY:

Less than 1% at 77°F (25°C)

VISCOSITY:

57 cp at 77°F (25°C)

II. CHEMICAL REACTIVITY

Relatively nonreactive. Hydrolyzes slowly and nonviolently under wet alkaline or acidic conditions.

III. STABILITY

Thermally stable to temperatures of 302°F (150°C). Above this temperature toxic hydrogen chloride, chlorinated hydrocarbons and ester acids may form.

IV. FIRE HAZARD

Not defined as combustible. However, supports combustion under fire conditions and decomposes to give off irritating phosphorus oxides and corrosive hydrogen chloride. The product is self-extinguishing once the source of ignition is removed.

V. FIREFIGHTING TECHNIQUE

Products of combustion are irritating to the respiratory tract and may cause breathing difficulty and pulmonary edema. Symptoms may be delayed several hours or longer depending upon the extent of exposure.

As in any fire, prevent human exposure to fire, smoke, fumes or products of combustion. Evacuate nonessential personnel from the fire area. Firefighters should wear full-face, self-contained breathing apparatus and impervious protective clothing.

Use standard firefighting techniques to extinguish fires involving this material -- use water spray, dry chemicals or carbon dioxide.

Keep fire-exposed containers cool with a water spray to prevent rupture due to excessive heat. High pressure water hose may spread product from broken containers increasing contamination or fire hazard.

Contaminated buildings, areas and equipment must not be used until they are properly decontaminated.

VI. TOXICOLOGY

INGESTION

The acute oral LD50 is 2800 mg/kg in female rats. The acute oral LD50 is 4200 mg/kg in male rats. A single oral dose of 794 mg/kg did not produce signs of toxicity in female rats. Toxic signs in female rats at higher doses included convulsions, decreased physical activity, hyperactivity, lacrimation, salivation, stained fur, tremors, and bloated cecums and/or stomachs. A single oral dose of 2000 mg/kg produced alopecia and decreased physical activity in 10 percent of the male rats. Toxic signs in male rats at higher doses also included lacrimation, salivation, stained fur, and tremors. No observable abnormalities were noted at necropsy.

Daily dietary ingestion of 800, 2500, 7500 or 20000 ppm by rats for three months produced body weight depression in males and females at 20000 ppm, increased absolute and relative liver weights in males at all levels and in females at 7500 and 20000 ppm, increased relative kidney weights in males at 2500, 7500 and 20000 ppm, no changes in cholinesterase activity, and histopathological changes in the liver (mild peri portal swelling at 20000 ppm), kidney (mild cortical tubular degenerative changes in males at 7500 and 20000 ppm and females at 20000 ppm), dose-related very mild thyroid follicular hyperplasia and/or thyroid follicular epithelial cell vacuolation, and very mild hypoplasia of the sternal bone marrow in females at 20000 ppm.

SKIN CONTACT

The acute dermal LD50 is greater than 5000 mg/kg in rabbits. A single dermal application of 5000 mg/kg produced mild diarrhea and no mortality in rabbits.

Mild irritant to rabbit skin following a 24-hour exposure.

EYE CONTACT

Nonirritant to rabbit eyes.

INHALATION

The acute inhalation LC50 is greater than 4.6 mg/l in both male and female rats. A single 4-hour inhalation exposure of 4.6 mg/l (greater than 90 percent respirable) produced mild lethargy and matted fur during the first 24 hours and a 3 to 7 percent decrease in body weights in male and female rats. No mortality was observed.

MUTAGENICITY/CARCINOGENICITY

The product was examined for mutagenic activity in a series of in vitro microbial assays employing Salmonella and Saccharomyces indicator organisms with and without metabolic activation. Four different activation systems were obtained from livers of Aroclor⁺1254 pretreated rats and mice and or phenobarbital pretreated rats and mice. The product did not demonstrate mutagenic activity in these assays.

The product was examined in a Mouse Lymphoma Forward Mutation Assay using the mouse lymphoma cell line L5178Y with and without metabolic activation. The activation system was obtained from livers of mice. The product did not demonstrate mutagenic activity in these assays.

The product was examined in an Un-scheduled DNA Synthesis in Human WI-38 Cells Assay with and without metabolic activation. The activation system was obtained from livers of Aroclor⁺1254 pretreated mice. The product was found to be weakly active

in this assay.

The product was examined in the Rat Bone Marrow Cytogenetic Assay. Rats received one dose of the product in dimethyl sulfoxide by the oral route at dose levels of 0.011, 0.04, and 0.11 ml/kg. The product in dimethyl sulfoxide was administered to additional groups of rats for five consecutive days at dose levels of 0.011, 0.04, and 0.11 ml/kg/day. The product did not induce chromosomal change in these assays.

Three lots of the product were examined in an in vitro malignant transformation test utilizing BALB/3T3 cells. One lot did induce a significant incidence of morphologic transformations with doses ranging from 0.039 ul/ml to 0.312 ul/ml. The media was the solvent. Another lot did not induce a significant incidence of morphologic transformations with doses ranging from 0.00125 ul/ml to 0.02 ul/ml. Dimethyl sulfoxide was the solvent. Higher doses resulted in less than 50 percent survival relative to control. A third lot did not induce a significant incidence of morphologic transformation with doses ranging from 0.0025 ul/ml to 0.04 ul/ml with dimethyl sulfoxide as the solvent. Therefore, the product does not possess transforming potential.

NEUROTOXICITY

The product was examined for acute delayed neurotoxic potential in hens orally administered two doses (10 ml/kg) 21 days apart. Toxic effects included severe feather loss, cessation of egg production, reduced food consumption, loss of body weight, and one mortality in 18 hens. One hen exhibited mild spinal cord lesions and impaired walking behavior. Lesions in this hen were located in the spino-cerebellar tracts of the cervical and thoracic cord. Plasma cholinesterase and brain neurotoxic esterase activities were not significantly inhibited in a biochemical neurotoxicity study in hens dosed at 10 ml/kg. These tests indicate that the product did not produce TOCP-like delayed neurotoxicity in hens (Sprague et al. 1981).

FYROL[®] PCF

T-5957, T-6343A, T-6357, T-6361, T-6539,
T-6556, T-10118, T-10182

*A registered trademark of Monsanto
Chemical Company

VII. HUMAN HEALTH

The principal routes of exposure are skin contact and inhalation. Skin contact may result in irritation.

In some laboratory cell studies the product was weakly mutagenic, but in animals did not show this effect. It would not, therefore, be expected to be mutagenic in man.

There are no data available which address medical conditions that are generally recognized as being aggravated by exposure to this product. (Reader should consult SECTION VI: TOXICOLOGY for effects observed in experimental animals under controlled laboratory conditions using this product.)

VIII. FIRST AID

CALL A POISON CENTER OR A PHYSICIAN IMMEDIATELY

If a known exposure occurs or is suspected, immediately start the recommended procedures below. Simultaneously contact a Poison Center, a physician or the nearest hospital. Inform the person contacted of the type and extent of exposure, describe the victim's symptoms, and follow the advice given.

FOR ADDITIONAL MEDICAL OR
TOXICOLOGICAL INFORMATION,
CALL COLLECT, DAY OR NIGHT,
STAUFFER CHEMICAL COMPANY,
(203) 226-6602 OR CHEMTREC
800-424-9300

INGESTION

If swallowed, immediately give several glasses of water and induce vomiting by gagging the victim with a finger placed on the back of the victim's tongue. Give fluids until vomitus is clear. If victim is unconscious or convulsing, do not induce vomiting or give anything by mouth.

SKIN CONTACT

Flush all affected areas with plenty of water for several minutes. Remove and clean any contaminated clothing and shoes. Seek medical attention if skin irritation occurs.

EYE CONTACT

Flush the eyes with plenty of running water for several minutes. Seek medical attention if eye irritation occurs.

INHALATION

If inhaled, remove to fresh air. If breathing becomes difficult, oxygen may be given, preferably with a physician's advice. If not breathing, give artificial respiration, preferably mouth-to-mouth. Get medical attention.

IX. INDUSTRIAL HYGIENE

The recommendations described in this section are provided as general guidance for minimizing exposure when handling this product. Because use conditions will vary depending upon customer applications, specific safe handling procedures should be developed by a person knowledgeable of the intended use conditions and equipment. During the development of safe handling procedures, consideration should be given to the need for cleaning of equipment and piping systems to render them nonhazardous before maintenance and repair activities are performed.

FYROL[®] PCF

ENGINEERING CONTROLS

In those cases where engineering controls are indicated by the use conditions, the following traditional exposure control techniques may be used to effectively minimize employee exposure: local exhaust ventilation, enclosed system design or process isolation and remote control in combination with appropriate use of personal protective equipment.

INGESTION

All food must be kept in a separate area away from the storage/use location. Eating, drinking, smoking and carrying of tobacco products must be prevented in areas where there is a potential for exposure to this material. Before eating, drinking or smoking, hands and face must be thoroughly washed.

SKIN CONTACT

Skin contact with liquid or its aerosol should be minimized through the use of gloves and suitable long-sleeved clothing selected with regard for use condition exposure potential.

EYE CONTACT

Eye contact with liquid or its aerosol should be avoided through the use of chemical safety glasses, goggles or a face shield selected with regard for use condition exposure potential.

INHALATION

If use conditions generate airborne mist or vapor, the material should be handled in an open (e.g. outdoor) or well ventilated area. Where adequate ventilation is not available, use NIOSH-approved organic vapor respirators with dust and fume filters to reduce exposure. Where exposure potential under the use conditions necessitates a higher level of protection, use a positive-pressure, air-supplied respirator.

EXPOSURE LIMITS

No exposure limits have been established for this product.

X. SPILL HANDLING

Make sure all personnel involved in the spill cleanup follow good industrial hygiene practices (refer to SECTION IX: INDUSTRIAL HYGIENE).

Any person, entering either a significant spill area or an unknown concentration of a gas, vapor, or mist, should use a positive-pressure self-contained breathing apparatus or a positive-pressure air-supplied respirator with escape pack.

Small spills can be handled routinely. Use adequate ventilation and/or wear a NIOSH-approved respirator to prevent inhalation exposure. Wear protective clothing to prevent skin and eye contact. Use the following procedures:

Soak up pooled liquid with a suitable absorbent such as clay, sawdust or kitty litter. Sweep up absorbed material and place in a chemical waste container for disposal (refer to SECTION XIII: DISPOSAL OF MATERIAL). Generously cover contaminated area with a slurry of common household powdered laundry detergent and water. Using a stiff brush, work the slurry into cracks and crevices. Allow to stand for 2-3 minutes then flush with water. Repeat if necessary.

Large spills should be diked and pumped to salvage according to a predetermined plan. For assistance in developing a plan, contact the Specialty Chemicals Group, Stauffer Chemical Company, Westport, CT 06881.

**IN CASE OF SPILL EMERGENCY,
DAY OR NIGHT, CALL CHEMTREC
800-424-9300.**

FYROL[®] PCF

XI. CORROSIVITY TO MATERIALS OF CONSTRUCTION

Not corrosive to glass or metals. However, the product may soften or deteriorate certain plastics and elastomers (particularly vinyl-based resins and natural rubbers). Contact the Specialty Chemicals Group, Stauffer Chemical Company, Westport, CT, 06881 for specific recommendations.

XII. STORAGE REQUIREMENTS

Containers should be stored in a cool, dry, well ventilated area away from flammable materials and sources of heat or flame. Store away from foodstuffs or animal feed. Exercise due caution to prevent damage to or leakage from the container. The product may undergo degradation upon storage for extended periods at temperatures of 122°F (50°C) or greater.

XIII. DISPOSAL OF MATERIAL

Material that cannot be used as directed on the product label must be disposed of according to any applicable regulations under the Resource Conservation and Recovery Act. **NOTE:** State and local regulations may be more stringent than federal.

XIV. DISPOSAL OF CONTAINER

Dispose of empty containers according to any applicable regulations under the Resource Conservation and Recovery Act. **NOTE:** State and local regulations may be more stringent than federal.

FOR NONEMERGENCY HANDLING
INFORMATION, CONTACT THE
SPECIALTY CHEMICALS GROUP,
STAUFFER CHEMICAL COMPANY,
WESTPORT, CT 06881 OR PHONE
(203) 222-3000.

REFERENCE CITED

G.L. Sprague, L.L. Sandvik, M.J. Brookins-Hendricks, A.A. Bickford
"Neurotoxicity of Two Organophosphorus Ester Flame Retardants in Hens." Tox. Envir. Health 8:507-512, 1981.



Material Safety Data Sheet*

Chemical Division

FYROL® CEF (Flame Retardant)

This Product Safety Information Sheet is principally directed to managerial, safety, hygiene and medical personnel. The description of physical, chemical and toxicological properties and handling advice is based on experimental results and past experience. It is intended as a starting point for the development of health and safety procedures.

I. PHYSICAL AND CHEMICAL PROPERTIES

Chemical Composition:

Tri (B-chloroethyl) phosphate; CAS #115-96-8

Physical State: Clear, colorless liquid

Specific Gravity: 1.42 at 77° F/25° C

Density: 11.0 lbs./gal.

Flash Point: 485° F/252° C (Cleveland Open Cup)

Fire Point: 545° F/285° C (Cleveland Open Cup)

Boiling Point: 0.5 mmHg at 293° F/145° C

Pour Point: -80° F/-51° C

Vapor Pressure: Less than 10 torr at 77° F/25° C

Viscosity: 38 cps at 77° F/25° C

Water Solubility: Less than 1% at 77° F/25° C

II. CHEMICAL REACTIVITY

This material will hydrolyze slowly under wet alkaline or acidic conditions.

III. STABILITY

This material is thermally stable at temperatures below 302° F/150° C. Above this temperature, acids will form.

IV. FIRE HAZARD

The material has an open cup flash point of 485° F/252° C. Under fire conditions, it may support combustion and may decompose to give off phosphorus oxides and hydrogen chloride. It is self-extinguishing once the source of ignition is removed.

V. FIREFIGHTING TECHNIQUE

Vapors may be irritating to the respiratory tract and may cause breathing difficulty and pulmonary edema.

Symptoms may be delayed several hours or longer depending upon exposure.

As in any fire, prevent human exposure to fire, smoke, fumes or products of combustion. Evacuate nonessential personnel from the fire area.

When there is a potential for exposure to smoke, fumes or products of combustion, firefighters should wear full-face, self-contained breathing apparatus and impervious clothing such as gloves, hoods, suits and rubber boots.

Use standard firefighting techniques in extinguishing fires involving this material—use water, dry chemicals, foam, carbon dioxide or other suitable suffocation agents. Use of contaminated buildings, areas and equipment must be prevented until they are properly decontaminated.

VI. TOXICOLOGY

WARNING: Harmful if swallowed. May cause irritation. Do not take internally. Avoid prolonged contact with skin and eyes.

Ingestion

The acute oral LD50 is 390 mg/kg in female rats. The acute oral LD50 is 710 mg/kg in male rats. A single oral dose of 125 mg/kg produced decreased physical activity, tremors, and no mortality in female rats. Other toxic signs in female rats included convulsions, lacrimation, hyperactivity, and stained fur. A single oral dose of 316 mg/kg produced convulsions, decreased physical activity, tremors, and 10 percent mortality in male rats. Other toxic signs in male rats included stained fur. Necropsy findings in both male and female rats included apparent hemorrhages in the stomach and intestines.

Skin Contact

The acute dermal LD50 is greater than 5000 mg/kg in rabbits. A single dermal application of 5000 mg/kg did not produce signs of toxicity in rabbits. Local effects included mild edema and erythema.

Mild irritant to rabbit skin following a 24-hour exposure.

In case of suspected exposure, refer to the procedure and emergency contacts in Section VII—FIRST AID.

In case of spillage, refer to the procedures and emergency contacts in Section IX—SPILL HANDLING.

In case of suspected animal poisoning, call a veterinarian or call collect, day or night (203) 226-8802 (Stauffer Chemical Company) or (800) 424-9300 (CHEMTREC).

In case of contamination with other materials, call (800) 424-9300 (CHEMTREC).

*Also referred to as a Product Safety Information Sheet

All information concerning this product and/or all suggestions for handling and use contained herein are offered in good faith and are believed to be reliable. Akzo Chemicals Inc., however, makes no warranty as to the accuracy and/or sufficiency of such information and/or suggestions, as to the product's merchantability or fitness for any particular purpose, or that any suggested use will not infringe any patent. Nothing contained herein shall be construed as granting or extending any license under any patent. Buyer must determine for himself, by preliminary tests or otherwise, the suitability of this product for his purposes. The information contained herein supersedes all previously issued bulletins on the subject matter covered.

Akzo Chemicals Inc.
300 S. Riverside Plaza
Chicago, Illinois 60606
(312) 906-7500

Eye Contact

Irritant to rabbit eyes.

Inhalation

The acute inhalation LC50 is greater than 5.0 mg/l in both male and female rats. A single 4-hour inhalation exposure of 5.0 mg/l (greater than 94 percent respirable) produced decreased physical activity, bloodlike flecks about the face, matted fur, and no mortality in male and female rats.

Mutagenicity/Carcinogenicity

The product was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Salmonella* and *Saccharomyces* indicator organisms with and without metabolic activation. Four different activation systems were obtained from livers of Aroclor[®]1254 pretreated rats and mice and of phenobarbital pretreated rats and mice. The product did not demonstrate mutagenic activity in these assays.

The product was examined in a Mouse Lymphoma Forward Mutation Assay using the mouse lymphoma cell line L5178Y with and without metabolic activation. The activation system was obtained from livers of mice. The product did not demonstrate mutagenic activity in these assays.

The product was examined in the Sister Chromatid Exchange Assay using mouse lymphoma cell line L5178Y with and without metabolic activation. The activation system was obtained from livers of rats. The product did induce small increases in the rate of sister chromatid exchange with metabolic activation, but the product did not induce increases in the rate of sister chromatid exchange without metabolic activation.

The product was examined in an Unscheduled DNA Synthesis in Human WI-38 Cells Assay with and without metabolic activation. The activation systems were obtained from livers of mice and Aroclor[®]1254 pretreated rats. The product did not consistently demonstrate activity in this assay.

The product was examined for mutagenic activity in the Rat Bone Marrow Cytogenetic Assay. Rats received one dose of Fyrol CEF in dimethyl sulfoxide by the oral route at dose levels of 0.062, 0.021, and 0.0062 ml/kg. Additional groups of rats were orally administered Fyrol CEF in dimethyl sulfoxide for five consecutive days at dose levels of 0.062, 0.021, and 0.0062 ml/kg/day. The product did not induce chromosomal change in these assays.

Two lots of the product were examined in an *in vitro* malignant transformation test utilizing BALB/3T3 cells. One lot did induce a significant incidence of morphologic transformations with doses ranging from 0.078 μ l/ml to 0.0625 μ l/ml. Another lot did not induce a significant incidence of morphologic transformations with doses ranging from 0.039 to 0.025 μ l/ml. Further studies are under way to resolve this difference in test results.

Neurotoxicity

The product was examined for acute delayed neurotoxic potential in hens orally administered two doses (10 ml/kg) 21 days apart. Toxic effects included diarrhea, severe feather loss, cessation of egg production, reduced food consumption, loss of body weight, and 22 percent mortality. The product did not produce acute delayed neurotoxicity.

Threshold Limit Value (TLV)

The American Conference of Governmental Industrial Hygienists has not established a TLV

T-5958, T-6346, T-6360, T-6364, T-6438, T-6540

VII. FIRST AID

CALL A PHYSICIAN IMMEDIATELY

If a known exposure occurs or is suspected, immediately initiate the recommended procedures below. Simultaneously contact a physician, or the nearest hospital, or the nearest Poison Control Center. Inform the person contacted of the type and extent of exposure, describe the victim's symptoms, and follow the advice given. For additional information call collect, day or night, Stauffer Chemical Company (203) 226-6602 or Chemtrec (800) 424-9300.

Ingestion

If swallowed—Immediately dilute the swallowed material by giving large quantities of water. Induce vomiting by gagging the victim with a blunt object placed on the back of the victim's tongue. Continue fluid administration until vomitus is clear. Never give anything by mouth to an unconscious person. Call a physician or the nearest Poison Control Center immediately.

Skin Contact

Immediately flush all affected areas with water for at least 15 minutes while removing any contaminated clothing. Seek medical attention if irritation occurs.

Eye Contact

Flush the eyes with running water for 15 minutes. Hold the eyelids apart during the rinsing to ensure flushing of the entire surface of the eye and lids with water. Obtain medical attention if eye irritation occurs.

Inhalation

Remove from contaminated atmosphere. Seek medical attention if respiratory irritation or breathing difficulty occurs. If the victim is having difficulty breathing, oxygen may be administered, preferably with a physician's advice.

VIII. INDUSTRIAL HYGIENE

Ingestion

All food must be kept in a separate area away from the storage/use location. Eating, drinking, smoking and carrying of tobacco products must be prevented in areas where there is a potential for exposure to this material. Before eating, drinking, or smoking hands and face must be thoroughly washed.

Skin Contact

Skin contact with liquid or its aerosol should be minimized through the use of gloves and suitable long-sleeved clothing, selected with regard for use condition exposure potential.

Eye Contact

Eye contact with liquid or its aerosol should be avoided through the use of chemical safety glasses, goggles or a face shield, selected with regard for use condition exposure potential.

Inhalation

If use conditions generate airborne aerosol, liquid or vapor, handle this material only in an open (e.g. out-

or well-ventilated area. Where adequate ventilation is not available, NIOSH-approved respirators should be employed to reduce exposure. Respirator selection must address the potential for exposure under the use conditions.

IX. SPILL HANDLING

Make sure all personnel involved in the spill cleanup follow good industrial hygiene practices (refer to Section VIII).

Small spills can be handled routinely. Use adequate ventilation and wear a respirator to prevent inhalation. Wear suitable protective clothing to prevent skin and eye contact. Use the following procedures:

Soak up pooled liquid with a suitable absorbent such as clay, sawdust, kitty litter or fuller's earth. Sweep up the absorbed material and place in an appropriate chemical waste container. Seal container and dispose of in an approved landfill. Flush the spill area with detergent and water to remove any residue.

Large spills should be diked and pumped to salvage according to a predetermined plan. For assistance in developing a plan, contact the Specialty Chemicals Division, Stauffer Chemical Company, Westport, CT 06880.

**IN CASE OF EMERGENCY, CALL, DAY OR NIGHT
(800) 424-9300 (CHEMTREC)**

X. CORROSIVITY TO MATERIALS OF CONSTRUCTION

This material is not corrosive to glass or metals, but as it has plasticizing properties, it may soften or deteriorate some plastics and elastomers (particularly vinyl-based resins and natural rubbers)

XI. STORAGE REQUIREMENTS

Carbon steel is the preferred material of construction for storage equipment. The material is commonly shipped in unlined tank cars, tank trucks or drums. Containers should be stored in a cool, dry, well-ventilated area. Exercise due caution to prevent damage to or leakage from the container.

The material will undergo degradation when stored for extended periods at temperatures above 122° F/50° C depending upon the conditions and environment

XII. DISPOSAL OF UNUSED MATERIAL

Material that cannot be used or chemically reprocessed should be disposed of in an approved landfill or in a manner that will not adversely affect the environment. Unused material can be incinerated by means which provide appropriate environmental pollution controls

XIII. DISPOSAL OF CONTAINER

Rinse and offer empty container for recycling, reconditioning or disposal in an approved landfill. Empty containers can be incinerated by means which provide appropriate environmental pollution controls.



Material Safety Data Sheet*

Chemical Division

FYROL® FR-2

Chemical Flame Retardant

This Product Safety Information Sheet is principally directed to managerial, safety, hygiene and medical personnel. The description of physical, chemical and toxicological properties and handling advice is based on experimental results and past experience. It is intended as a starting point for the development of health and safety procedures.

This Product Safety Information Sheet meets the material safety information sheet (MSDS) requirements of the federal OSHA Hazard Communication standard (29 CFR 1910.1200).

New Issue 11/86
Supersedes Issue Dated 11/83
FYR.043.S

SYNONYMS

Tris (1,3-dichloro-isopropyl) phosphate
Tri (B,B'-dichloro-isopropyl) phosphate

CAS REGISTRY NUMBER: 13674-87-8

CAS INDEX NAME (8CI9CI):

1,3-Dichloro-2-propanol phosphate (3:1)

I. PHYSICAL/CHEMICAL PROPERTIES

FORMULA: $C_9H_{15}Cl_6O_4P$

FORMULA WEIGHT: 431

COMPOSITION: Tris (1,3-dichloro-isopropyl) phosphate (95%)

PHYSICAL STATE/DESCRIPTION:

Clear liquid

SPECIFIC GRAVITY:

1.52 at 77°F (25°C)

FREEZING POINT: 80°F (27°C)

BOILING POINT:

392°F (200°C) at 4 mm Hg

FLASH POINT:

485°F (252°C) Cleveland Open Cup

IN CASE OF SUSPECTED POISONING,
REFER TO THE INFORMATION IN
SECTION VII:HUMAN HEALTH AND
THE PROCEDURE AND EMERGENCY
CONTACTS IN SECTION VIII:FIRST AID.

IN CASE OF SPILLAGE, REFER TO
THE PROCEDURE AND EMERGENCY
CONTACTS IN SECTION X:SPILL
HANDLING OR CALL CHEMTREC
800-424-9300.

*Registered trademark of Stauffer
Chemical Company

* Also referred to as a Product Safety Information Sheet

All information concerning this product and all suggestions for handling and use contained herein are offered in good faith and are believed to be reliable. Akzo Chemicals, Inc. however, makes no warranty as to the accuracy and/or sufficiency of such information and/or suggestions, as to the product's merchantability or fitness for any particular purpose, or that any suggested use will not infringe any patent. Nothing contained herein shall be construed as granting or extending any license under any patent. Buyer must determine for himself, by preliminary tests or otherwise, the suitability of this product for his purposes. The information contained herein supersedes all previously issued bulletins in the subject matter covered.

Akzo Chemicals Inc
300 S. Riverside Plaza
Chicago, Illinois 60606
(312) 906-7500

AUTOIGNITION TEMPERATURE:

955°F (515°C)

SOLUBILITY:

0.01% in water at 86°F (30°C). Soluble in alcohols, ketones and chlorinated hydrocarbons. Insoluble in aliphatic hydrocarbons.

VISCOSITY:

22,000 cp at 32°F (0°C)
1,800 cp at 77°F (25°C)
540 cp at 104°F (40°C)

II. CHEMICAL REACTIVITY

Relatively nonreactive. Hydrolyzes slowly when refluxed with an aqueous acid. Under alkaline conditions, exhibits a slow cleavage.

III. STABILITY

Stable at ambient temperature and pressure. Acidity may change at temperatures above 130°F (54°C).

The product generally exists as a super-cooled liquid at room temperature. It can, however, occasionally solidify when exposed to low temperatures for prolonged periods.

IV. FIRE HAZARD

Not defined as flammable or combustible. However, the product may support combustion and decompose under fire conditions to give off toxic materials such as phosphorus oxides and hydrogen chloride. The product is self-extinguishing once the source of ignition is removed.

V. FIREFIGHTING TECHNIQUE

Products of combustion are irritating to the respiratory tract and may cause breathing difficulty and pulmonary edema. Symptoms may be delayed several hours or longer depending upon the extent of exposure.

As in any fire, prevent human exposure to fire, smoke, fumes or products of combustion. Evacuate nonessential personnel from the fire area. Firefighters should wear full-face, self-contained breathing apparatus and impervious protective clothing.

Use standard firefighting techniques to extinguish fires involving this material -- use water spray, dry chemicals or carbon dioxide.

Keep fire-exposed containers cool with a water spray to prevent rupture due to excessive heat. High pressure water hose may spread product from broken containers increasing contamination.

Contaminated buildings, areas and equipment must not be used until they are properly decontaminated.

VI. TOXICOLOGY

INGESTION

The acute oral LD50 is 2830 to 3160 mg/kg in male rats. A single oral dose of 2000 mg/kg or above produced decreased physical activity, ataxia, increased irritability, and tetany in male rats.

The acute oral LD50 is 7500 mg/kg (4.99 ml/kg) in mice.

The acute oral LD50 is 6800 mg/kg in rabbits. A single oral dose of 5000 mg/kg produced ataxia, head nodding, prostration, labored respiration and 20 percent mortality in rabbits. Other signs of toxicity observed at higher doses included decreased physical activity, teeth grinding, salivation and diarrhea.

Daily oral administration of 25 or 250 mg/kg to rats for 90 days produced mortality and increased organ weights and organ to body weight ratios for liver and kidney (Ulsamer, et al., 1980). Histopathological evaluations were not different in any tissue.

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Daily oral administration of 2, 20 or 200 mg/kg to male rabbits for 12 weeks did not affect male rabbit fertility or sperm quantity or quality. At 200 mg/kg there was an increase in liver and kidney weight but no histological changes were observed.

Daily oral administration of 25, 100 or 400 mg/kg to pregnant rats during days 6 through 15 of gestation resulted in no indications of teratogenicity. The high-dose level produced maternal toxicity which included reduced food consumption and body weight gain, mortality (15%), an increased incidence of resorptions, lowered fetal viability, decreased fetal size and delayed fetal ossification. The mid-dose produced maternal toxicity which included reduced food consumption and body weight gain. Embryotoxicity and fetotoxicity were not observed at the mid-dose. No adverse effects were observed in the animals which received the low dose.

Daily ingestion of 20 mg/kg or 80 mg/kg for two years was oncogenic to rats. No significant effects were observed at 5 mg/kg/day. Microscopic examination revealed statistically significant increases in the incidences of: liver neoplastic nodules in high dose males and females, renal cortical tumors in mid and high dose males and female, interstitial cell tumors of the testis in mid and high dose males and adrenal cortical adenomas in high dose females. Other effects included: decreased body weights for high dose males and females, 25 to 30 percent depression of plasma cholinesterase in the high dose females, and increased mean absolute and mean relative liver, kidney and thyroid weights for the high dose groups.

SKIN CONTACT

The acute dermal LD50 is greater than 23900 mg/kg (15.8 ml/kg) in rabbits. A single dermal application of 12000 mg/kg resulted in irritability while a similar exposure to 23900 mg/kg resulted in increased muscle tonus, irritability,

diarrhea, pupillary constriction, and 40 percent depression of RBC cholinesterase.

Mild irritant to rabbit skin following a 24-hour exposure.

Dermal application of 1450 mg/kg to rabbits for 30 days produced an increase in kidney weight but no histological changes were observed in any tissue (Ulsamer, et al., 1980).

EYE CONTACT

Nonirritant to rabbit eyes.

MUTAGENICITY/CARCINOGENICITY

The product was examined for mutagenic activity in a series of *in vitro* microbial assays employing *Salmonella* and *Saccharomyces* indicator organisms with and without metabolic activation. The activation systems were obtained from Aroclor[®] 1254 pretreated rats and phenobarbital pretreated rats and mice. The product did demonstrate mutagenic activity at toxic doses in an assay conducted with metabolic activation using the tester strain TA-100.

The product was examined in an *in vitro* malignant-transformation test with BALB/3T3 cells. The product did not induce a significant increase in morphological transformations and thus did not exhibit tumorigenic potential under the conditions of this assay.

The product was examined in a Sex-Linked Recessive Lethal Test in *Drosophila melanogaster*. The product did not induce mutagenic activity in this assay.

In a Mouse Lymphoma Multiple Endpoint Test for point mutations, sister chromatid exchanges and chromosome aberrations using the L5178Y Mouse Lymphoma cell line with and without metabolic activation, the product did not induce point mutations or increase the incidence of sister chromatid exchanges. A significant number of chromosome aberrations were

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observed using two activation systems obtained from livers of Aroclor 1254 and of phenobarbital pretreated mice, indicating weak clastogenic activity.

The mutagenic activity of urine from mice treated orally with the product was evaluated in an *in vitro* microbial assay employing *Salmonella* indicator organisms. The product did not produce urineborne mutagens.

The product was evaluated for its mutagenic potential in the mouse bone marrow cytogenetic analysis. The product was administered orally, either as a single dose or as five consecutive daily doses, to mice at dose levels of 0.5, 0.17, and 0.05 ml/kg. Mice were sacrificed at various intervals after the last dose (6-48 hours), and cells from the bone marrow of the tibia were examined for chromosomal aberrations. The product did not produce a significant increase in the frequency of chromosomal aberrations when the results were compared to concurrent negative controls and to historical controls.

The product was evaluated in the Hepatocyte Primary Culture/DNA Repair Assay. The product did not induce DNA damage under the condition of this assay.

*Registered trademark of Monsanto Company for a series of polychlorinated polyphenols.

NEUROTOXICITY

In an initial study, daily oral administration of 600, 1200, 2400 or 4800 mg/kg to hens for five days resulted in leg and wing weakness at 1200 mg/kg and above and 100 percent mortality at 4800 mg/kg.

More recently, the daily oral administration of 4, 20 or 100 mg/kg to hens for 90 days produced no evidence of delayed neurotoxicity by clinical observation or microscopic evaluation. Fifty percent mortality was observed in

hens receiving 200 mg/kg/day for 21 days.

The product when administered orally in a single dose (10 g/kg) to hens, did not significantly inhibit hen brain neurotoxic esterase and produced no mortality.

T-4055, T-4100, T-4287, T-5960, T-6254, T-6255, T-6300, T-6301, T-6303, T-6324, T-6326, T-6331, T-6354, T-6355, T-6385, T-6406, T-6507, T-6773, T-10554, T-10727, T-10863, T-10867

VII. HUMAN HEALTH

The principal routes of exposure are skin contact and inhalation. Repeated or prolonged skin contact may produce irritation. Although some tests for mutagenicity in cell systems were positive, tests in living animals showed no evidence of mutagenicity. Therefore, the product is not considered a potential human mutagen. The product is not classified as a carcinogen (reference: IARC, 1982; NTP, 1985; or OSHA (29 CFR 1910.1000)). In a lifetime feeding study in rats, however, the product, at high doses, produced tumors of the liver and kidneys. FYROL FR-2 chemical flame retardant must, therefore, be considered an animal carcinogen.

There are no data available which address medical conditions that are generally recognized as being aggravated by exposure to this product. (Reader should consult SECTION VI: TOXICOLOGY for effects observed in experimental animals under controlled laboratory conditions using this product.)

VIII. FIRST AID

CALL A POISON CENTER OR A PHYSICIAN IMMEDIATELY

If a known exposure occurs or is suspected, immediately start the recommended procedures below. Simultaneously contact a Poison Center, a physician or the nearest hospital. Inform the person

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contacted of—the type and extent of exposure, describe the victim's symptoms, and follow the advice given.

FOR ADDITIONAL MEDICAL OR TOXICOLOGICAL INFORMATION, CALL COLLECT, DAY OR NIGHT, STAUFFER EMERGENCY MEDICAL ASSISTANCE (203) 226-6602 OR CHEMTREC 800-424-9300

INGESTION

If swallowed, immediately give several glasses of water and induce vomiting by gagging the victim with a finger placed on the back of the victim's tongue. Give fluids until vomitus is clear. If victim is unconscious or convulsing, do not induce vomiting or give anything by mouth.

SKIN CONTACT

Flush all affected areas with plenty of water for several minutes. Remove and clean any contaminated clothing and shoes. Seek medical attention if skin irritation occurs.

EYE CONTACT

Flush the eyes with plenty of running water for several minutes. Seek medical attention if eye irritation occurs.

INHALATION

If inhaled, remove to fresh air. Seek medical attention if respiratory irritation occurs or if breathing becomes difficult.

IX. INDUSTRIAL HYGIENE

The recommendations described in this section are provided as general guidance for minimizing exposure when handling this product. Because use conditions will vary depending upon customer applications, specific safe handling procedures should be developed by a person knowledgeable of the intended use

conditions and equipment. During the development of safe handling procedures, consideration should be given to the need for cleaning of equipment and piping systems to render them nonhazardous before maintenance and repair activities are performed. Waste resulting from these procedures should be handled in accordance with SECTION XIII: DISPOSAL OF MATERIAL.

ENGINEERING CONTROLS

In those cases where engineering controls are indicated by the use conditions, the following traditional exposure control techniques may be used to effectively minimize employee exposure: local exhaust ventilation, enclosed system design, or process isolation and remote control, in combination with appropriate use of personal protective equipment.

INGESTION

All food must be kept in a separate area away from the storage/use location. Eating, drinking, smoking and carrying of tobacco products must be prevented in areas where there is a potential for exposure to this material. Before eating, drinking or smoking, hands and face must be thoroughly washed.

SKIN CONTACT

Skin contact with liquid or its aerosol should be minimized through the use of suitable protective clothing, gloves and footwear selected with regard for use condition exposure potential. Unprotected skin exposed to vapors, aerosol or mist should be thoroughly washed at the end of the work shift.

EYE CONTACT

Eye contact with liquid or its aerosol should be avoided through the use of chemical safety glasses, goggles or a face shield selected with regard for use condition exposure potential.

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INHALATION

This product must be handled in an open (e.g., outdoor) or well ventilated area. Where adequate ventilation is not available and use conditions could generate aerosol or vapor, inhalation must be prevented through the use of NIOSH-approved organic vapor respirators with dust, mist and fume filters to reduce potential for exposure under the use conditions. Where exposure potential under the use conditions necessitates a higher level of protection, use a positive-pressure, air-supplied respirator.

EXPOSURE LIMITS

No exposure limits have been established for this product.

X. SPILL HANDLING

Make sure all personnel involved in the spill cleanup follow good industrial hygiene practices (refer to SECTION IX: INDUSTRIAL HYGIENE).

Any person entering either a significant spill area or an unknown concentration of a vapor or aerosol, should use a positive-pressure self-contained breathing apparatus or a positive-pressure supplied-air respirator with escape pack.

Soak up pooled liquid with a suitable absorbent such as clay, sawdust or kitty litter. Sweep up absorbed material and place in a chemical waste container for disposal (refer to SECTION XIII: DISPOSAL OF MATERIAL). Generously cover contaminated area with a slurry of common household powdered laundry detergent and water. Using a stiff brush, work the slurry into cracks and crevices. Allow to stand for 2-3 minutes then flush with water. Repeat if necessary. Do not contaminate waters by disposal of flushings.

Large spills should be diked and pumped to salvage according to a predetermined plan. For assistance in developing a plan, contact the Specialty Chemical

Group, Stauffer Chemical Company, Westport, CT 06881.

**IN CASE OF SPILL EMERGENCY,
DAY OR NIGHT, CALL CHEMTREC
800-424-9300.**

XI. CORROSIVITY TO MATERIALS OF CONSTRUCTION

Not corrosive to glass or metals. The product has plasticizing properties and, as such, may soften or deteriorate certain plastics and elastomers (particularly vinyl-based resin, neoprene and natural rubbers).

XII. STORAGE REQUIREMENTS

Containers should be stored in a cool, dry, well ventilated area away from flammable materials and sources of heat or flame. Store away from foodstuffs or animal feed. Exercise due caution to prevent damage to or leakage from the container.

The product may begin to crystallize at temperatures below 80°F (27°C). Maximum storage temperatures should not exceed 130°F (54°C).

Carbon steel is the preferred material of construction for storage containers.

XIII. DISPOSAL OF MATERIAL

Material that cannot be used or chemically reprocessed should be disposed of at an approved facility in accordance with any applicable regulations under the Resource Conservation and Recovery Act. **NOTE:** State and local regulations may be more stringent than federal.

XIV. DISPOSAL OF CONTAINER

Dispose of empty containers according to any applicable regulations under the Resource Conservation and Recovery Act. **NOTE:** State and local regulations may be

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more stringent than federal.

**FOR NONEMERGENCY HANDLING
INFORMATION, CONTACT THE
SPECIALTY CHEMICAL GROUP,
STAUFFER CHEMICAL COMPANY,
WESTPORT, CT 06881 OR PHONE
(203) 222-3000.**

REFERENCES CITED

Ulsamer, A. G., R. E. Osterberg and J. McLaughlin, Flame Retardant Chemicals in Textiles, 17 (1): 101-131, 1980.

U.S. Department of Health and Human Services, National Toxicology Program (NTP), Fourth Annual Report on Carcinogens, Summary September, 1985, Research Triangle Park, NC, 1985.

World Health Organization, International Agency for Research on Cancer (IARC), IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans, Supplement 4, IARC: Lyon, France, 1982.