SAFETY DATA SHEET

Updated on 26/09/2024

1. Material Identification

Product Name : Hexamethylphosphoramide
Catalog Number : io-2491
CAS Number : 680-31-9
Identified uses : Laboratory chemicals, manufacture of chemical compounds
Company : Ionz

>> R&D Use only

2. Hazards Identification

GHS Classification:

Flammable liquid (category 2)
Acute toxicity, oral (Category 3)
Acute toxicity, dermal (Category 3)
Acute toxicity, inhalation (Category 3)
Specific target organ toxicity, single exposure (Category 1)

Pictogram(s)

GHS Hazard Statements

>> H340 (100%): May cause genetic defects [Danger Germ cell mutagenicity]

>> H350 (100%): May cause cancer [Danger Carcinogenicity]

Precautionary Statement Codes

>> P203, P280, P318, P405, and P501

Health Hazards:

>> Excerpt from NIOSH Pocket Guide for Hexamethyl phosphoramide:

>> Exposure Routes: Inhalation, skin absorption, ingestion, skin and/or eye contact

>> Symptoms: Irritation eyes, skin, respiratory system; dyspnea (breathing difficulty); abdominal pain; [potential occupational carcinogen]

>> Target Organs: Eyes, skin, respiratory system, central nervous system, gastrointestinal tract

>> Cancer Site: [in animals: cancer of the nasal cavity] (NIOSH, 2024)

>> This chemical is combustible. (NTP, 1992)

>> Combustible. Gives off irritating or toxic fumes (or gases) in a fire.

3. Composition/Information On Ingredients

Chemical name : Hexamethylphosphoramide
CAS Number : 680-31-9
Molecular Formula : C6H18N3OP
Molecular Weight : 179.2000 g/mol

4. First Aid Measures

First Aid:

>> EYES: First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. IMMEDIATELY transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop.

>> SKIN: IMMEDIATELY flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. IMMEDIATELY call a hospital or poison control center even if no symptoms (such as redness or irritation) develop. IMMEDIATELY transport the victim to a hospital for treatment after washing the affected areas.

>> INHALATION: IMMEDIATELY leave the contaminated area; take deep breaths of fresh air. IMMEDIATELY call a physician and be prepared to transport the victim to a hospital even if no symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, Self-Contained Breathing Apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Protective Clothing.

>> INGESTION: DO NOT INDUCE VOMITING. If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and IMMEDIATELY call a hospital or poison control center. Be prepared to transport the victim to a hospital if advised by a physician. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. DO NOT INDUCE VOMITING. IMMEDIATELY transport the victim to a hospital.

>> OTHER: Since this chemical is a known or suspected carcinogen you should contact a physician for advice regarding the possible long term health effects and potential recommendation for medical monitoring. Recommendations from the physician will depend upon the specific compound, its chemical, physical and toxicity properties, the exposure level, length of exposure, and the route of exposure. (NTP, 1992)

First Aid Measures

Inhalation First Aid

>> Refer for medical attention.

Skin First Aid

>> Wear protective gloves when administering first aid. Remove contaminated clothes. Rinse and then wash skin with water and soap. Refer for medical attention .

Eye First Aid

>> First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then refer for medical attention.

Ingestion First Aid

>> Rinse mouth. Refer for medical attention .

5. Fire Fighting Measures

>> Fires involving this compound should be controlled using a dry chemical, carbon dioxide or Halon extinguisher. (NTP, 1992)

>> Use water spray, powder, alcohol-resistant foam, carbon dioxide.

6. Accidental Release Measures

Isolation and Evacuation:

Isolation and evacuation measures to take when a large amount of this chemical is accidentally released in an emergency.

>> Excerpt from ERG Guide 153 [Substances - Toxic and/or Corrosive (Combustible)]:

>> IMMEDIATE PRECAUTIONARY MEASURE: Isolate spill or leak area in all directions for at least 50 meters (150 feet) for liquids and at least 25 meters (75 feet) for solids.

>> SPILL: Increase the immediate precautionary measure distance, in the downwind direction, as necessary.

>> FIRE: If tank, rail tank car or highway tank is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions. (ERG, 2024)

Spillage Disposal:

Methods for containment and safety measures to protect workers dealing with a spillage of this chemical.

>> Personal protection: filter respirator for organic gases and vapours adapted to the airborne concentration of the substance. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb liquid in sand or inert absorbent. Then store and dispose of according to local regulations.

7. Handling And Storage

Safe Storage:

>> Ventilation along the floor. Separated from acids and oxidants.

Storage Conditions:

>> PRECAUTIONS FOR "CARCINOGENS": Storage site should be as close as practical to lab in which carcinogens are to be used, so that only small quantities required for ... expt need to be carried. Carcinogens should be kept in only one section of cupboard, an explosion-proof refrigerator or freezer (depending on chemicophysical properties ...) that bears appropriate label. An inventory ... should be kept, showing quantity of carcinogen & date it was acquired ... Facilities for dispensing ... should be contiguous to storage area. /Chemical Carcinogens/

8. Exposure Control/ Personal Protection

>> Ca See Appendix A

>> none

>> Skin notation

>> (skin); A3 (confirmed animal carcinogen with unknown relevance to humans).

TLV-TWA (Time Weighted Average)

>> No TLV value [1990]

MAK (Maximale Arbeitsplatz Konzentration)

>> skin absorption (H); carcinogen category: 2; germ cell mutagen group: 2

Inhalation Risk:

>> No indication can be given about the rate at which a harmful concentration of this substance in the air is reached on evaporation at 20 °C.

Effects of Short Term Exposure:

>> Exposure to high concentrations could cause effects on the nervous system, kidneys and respiratory tract.

Effects of Long Term Exposure:

>> The substance may have effects on the respiratory tract, kidneys and testes. This substance is possibly carcinogenic to humans. May cause genetic damage in humans.

Fire Prevention

>> NO open flames.

Exposure Prevention

>> AVOID ALL CONTACT! IN ALL CASES CONSULT A DOCTOR!

Inhalation Prevention

>> Use ventilation, local exhaust or breathing protection.

Skin Prevention

>> Protective gloves. Protective clothing.

Eye Prevention

>> Wear safety spectacles or face shield.

Ingestion Prevention

>> Do not eat, drink, or smoke during work.

9. Physical And Chemical Properties

Molecular Weight:

>> 179.20

Exact Mass:

>> 179.11874920

Physical Description:

>> Hexamethylphosphoramide is a clear colorless to light amber liquid with a spicy odor. (NTP, 1992)

>> COLOURLESS MOBILE LIQUID.

Color/Form:

>> COLORLESS, MOBILE LIQUID

Odor:

>> AROMATIC ODOR

Boiling Point:

>> 451 °F at 760 mmHg (NTP, 1992)

>> 232 °C

Melting Point:

>> 41 to 45 °F (NTP, 1992)

>> 7.2 °C

Flash Point:

>> 222 °F (NTP, 1992)

>> 105 °C

Solubility:

>> greater than or equal to 100 mg/mL at 64 °F (NTP, 1992)

>> Solubility in water: very good

Density:

>> 1.024 at 77 °F (NTP, 1992) - Denser than water; will sink

>> Relative density (water = 1): 1.03

Vapor Density:

>> 6.18 (NTP, 1992) - Heavier than air; will sink (Relative to Air)

>> Relative vapor density (air = 1): 6.18

Vapor Pressure:

>> 0.07 mmHg at 77 °F (NTP, 1992)

>> Vapor pressure, Pa at 20 °C: 4

Stability/Shelf Life:

>> REACTS UPON HEATING WITH ORG ACIDS TO FORM THE DIMETHYLAMIDE OF THE ORG ACID

Decomposition:

>> When heated to decomposition it emits very toxic fume of /phosphine, phosphorus oxides and nitrogen oxides/.

Refractive Index:

>> INDEX OF REFRACTION: 1.4572 @ 21 °C/D

Dissociation Constants:

10. Stability And Reactivity

>> Water soluble.

11. Toxicological Information

EPA Provisional Peer-Reviewed Toxicity Values:

This section provides the EPA Provisional Peer-Reviewed Toxicity Values (PPRTVs) and links of related assessment documents.

Chemical Substance

>> Hexamethylphosphoramide

Reference Dose (RfD), Chronic

>> 4 x 10^-4 mg/kg-day

Reference Dose (RfD), Subchronic

>> 4 x 10^-3 mg/kg-day

PPRTV Assessment

>> PDF Document

Weight-Of-Evidence (WOE)

>> Suggestive evidence of carcinogenic potential

Last Revision

>> 2012

Evidence for Carcinogenicity:

Evidence that this chemical does or may cause cancer. The information here is collected from various sources by the Hazardous Substances Data Bank (HSDB).

>> Evaluation: No epidemiological data relevant to the carcinogeniciy of hexamethylphosphoramide were available. There is sufficient evidence in experimental animals for the carcinogenicity of hexamethylphosphoramide. Overall evaluation: Hexamethylphosphoramide is possibly carcinogenic to humans (Group 2B).

Carcinogen Classification:

This section provides the International Agency for Research on Cancer (IARC) Carcinogenic Classification and related monograph links. In the IARC Carcinogenic classification, chemicals are categorized into four groups: Group 1 (carcinogenic to humans), Group 2A (probably carcinogenic to humans), Group 2B (possibly carcinogenic to humans), and Group 3 (not classifiable as to its carcinogenicity to humans).

IARC Carcinogenic Agent

>> Hexamethylphosphoramide

IARC Carcinogenic Classes

>> Group 2B: Possibly carcinogenic to humans

IARC Monographs

>> Volume 15: (1977) Some Fumigants, the Herbicides 2,4-D and 2,4,5-T, Chlorinated Dibenzodioxins and Miscellaneous Industrial Chemicals

>> Volume Sup 7: Overall Evaluations of Carcinogenicity: An Updating of IARC Monographs Volumes 1 to 42, 1987; 440 pages; ISBN 92-832-1411-0 (out of print)

>> Volume 71: (1999) Re-evaluation of Some Organic Chemicals, Hydrazine and Hydrogen Peroxide (Part 1, Part 2, Part 3)

Exposure Routes:

>> The substance can be absorbed into the body by inhalation and through the skin.

>> inhalation, skin absorption, ingestion, skin and/or eye contact

Skin Exposure

>> MAY BE ABSORBED!

>> irritation eyes, skin, respiratory system; dyspnea (breathing difficulty); abdominal pain; [potential occupational carcinogen]

Target Organs:

Organs that are affected by exposure to this chemical. Information in this section reflects human data unless otherwise noted.

>> Eyes, skin, respiratory system, central nervous system, gastrointestinal tract

Cancer Sites:

The site in which cancer develops due to exposure to this compound. Cancers are casually referred to based on their primary sites (e.g., skin, lung, breasts, prostate, colon and rectum).

>> [in animals: cancer of the nasal cavity]

Adverse Effects:

An adverse effect is an undesired harmful effect resulting from a medical treatment or other intervention.

>> Nephrotoxin - The chemical is potentially toxic to the kidneys in the occupational setting.

>> IARC Carcinogen - Class 3: Chemicals are not classifiable by the International Agency for Research on Cancer.

>> NTP Carcinogen - Reasonably anticipated to be a human carcinogen.

>> ACGIH Carcinogen - Confirmed Animal.

Toxicity Data:

>> LCLo (rat) = 2,920 mg/m3/4h

Interactions:

>> A series of six alkyl-substituted dioxolanes were studied for their inhibitory effects on mono-oxygenase activities in vitro with nasal and hepatic microsomes from rats and rabbits. Carbon monoxide binding and hexamethylphosphoramide (HMPA) N-demethyase activity were most susceptible to inhibition by the test compounds. Inhibition of HMPA N-demethylase activity in both nasal and liver microsomes increased with lipophilicity of the inhibiting compound. In olfactory mucosa, the bulk of the substiturent at the 4-position also seemed to have an effect on inhibition. Mono-oxygenase activity in the nasal mucosa was inhibited more readily than that in the liver.

Human Toxicity Excerpts:

>> ... NO SIGNIFICANT INCR IN CHROMOSOME ABERRATIONS /WAS REPORTED/ WHEN CULTURED HUMAN LEUKOCYTES WERE TREATED WITH 5X10-3 MOLAR HEXAMETHYLPHOSPHORAMIDE.

Non-Human Toxicity Excerpts:

>> ... 120 MALE & 120 FEMALE CHARLES RIVER CD RATS WERE EXPOSED TO CONCN OF 0, 50, 400 OR 4000 PPB (0, 0.366, 2.93 OR 29.3 MG/CU M) HEXAMETHYLPHOSPHORAMIDE (BY VOL) IN AIR 6 HR/DAY FOR 5 DAYS EACH WK. AT THE TIME OF REPORTING (8 MO AFTER THE START OF THE EXPERIMENT), 7/8 RATS RECEIVING 400 PPB & 12/15 RECEIVING 4000 PPB THAT HAD DIED OR BEEN KILLED, HAD SQUAMOUS-CELL CARCINOMAS OF NASAL CAVITY. NO SUCH TUMORS WERE FOUND IN 6 RATS RANDOMLY SELECTED FROM THE GROUP RECEIVING 50 PPB. ... THE CAUSE OF DEATH OF ANIMALS EXPOSED TO ... LEVELS OF UP TO 4000 PPB (29.3 MG/CU M) WAS DEGENERATIVE CHANGES IN THE CONVOLUTED TUBULES OF THE KIDNEY.

TSCA Test Submissions:

Under the Toxic Substances Control Act (TSCA), EPA has broad authority to issue regulations designed to require manufacturers (including importers) or processors to test chemical substances and mixtures for health and environmental effects. This section provides information on test reports submitted for this chemical under TSCA.

>> Chronic toxicity and oncogenicity were evaluated in two separate experiments in male and female Charles River-CD rats exposed to hexamethylphosphoramide (HMPA) via inhalation. In experiment No. 1, 120 rats/sex/group were exposed to 0, 50, 400 or 4000 ppb HMPA for 9-24 months, and in experiment No. 2, 100 rats/sex/group were exposed to 0, 10, 50 or 100 ppb HMPA for 6-24 months. There were significant increases between treated and control animals in the following: rhinitis and squamous metaplasia in the nasal cavity with formation of excessive keratin material which occasionally almost occluded the entire nasal cavity (all treatment levels except 10 ppb), keratinized squamous metaplasia of the trachea (4000 ppb), dose-related increase in tracheitis and desquamation of the tracheal epithelium, and bronchitis, desquamation and regeneration of the bronchial epithelium (100, 400 and 4000 ppb), murine pneumonia (dose related pulmonary lesions at 100, 400 and 4000 ppb), bone marrow erythropoietic hyperplasia (males at 4000 ppb), and testicular atrophy (males at 4000 ppb). Exposures at 400 and 4000 ppb HMPA were stopped at 9 and 10 months, respectively, due to the high incidence of nasal tumors and mortality. HMPA lesions were confined to the bronchial air passages of the lungs and there were no changes in alveoli adjacent to respiratory bronchioles.

12. Ecological Information

Resident Soil (mg/kg)

>> 2.50e+01

Industrial Soil (mg/kg)

>> 3.30e+02

Tapwater (ug/L)

>> 8.00e+00

MCL (ug/L)

>> 5.00e+01

Risk-based SSL (mg/kg)

>> 1.80e-03

Chronic Oral Reference Dose (mg/kg-day)

>> 4.00e-04

Volatile

>> Volatile

Mutagen

>> Mutagen

Fraction of Contaminant Absorbed in Gastrointestinal Tract

>> 1

Fraction of Contaminant Absorbed Dermally from Soil

>> 0.1

13. Disposal Considerations

Spillage Disposal

>> Personal protection: filter respirator for organic gases and vapours adapted to the airborne concentration of the substance. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb liquid in sand or inert absorbent. Then store and dispose of according to local regulations.

Disposal Methods

>> PRECAUTIONS FOR "CARCINOGENS": There is no universal method of disposal that has been proved satisfactory for all carcinogenic compounds & specific methods of chem destruction ... published have not been tested on all kinds of carcinogen-containing waste. ... Summary of avail methods & recommendations ... /given/ must be treated as guide only. /Chemical Carcinogens/

>> PRECAUTIONS FOR "CARCINOGENS": ... Incineration may be only feasible method for disposal of contaminated laboratory waste from biological expt. However, not all incinerators are suitable for this purpose. The most efficient type ... is probably the gas-fired type, in which a first-stage combustion with a less than stoichiometric air:fuel ratio is followed by a second stage with excess air. Some ... are designed to accept ... aqueous & organic-solvent solutions, otherwise it is necessary ... to absorb soln onto suitable combustible material, such as sawdust. Alternatively, chem destruction may be used, esp when small quantities ... are to be destroyed in laboratory. /Chemical Carcinogens/

>> PRECAUTIONS FOR "CARCINOGENS": HEPA (high-efficiency particulate arrestor) filters ... can be disposed of by incineration. For spent charcoal filters, the adsorbed material can be stripped off at high temp & carcinogenic wastes generated by this treatment conducted to & burned in an incinerator. ... LIQUID WASTE: ... Disposal should be carried out by incineration at temp that ... ensure complete combustion. SOLID WASTE: Carcasses of lab animals, cage litter & misc solid wastes ... should be disposed of by incineration at temp high enough to ensure destruction of chem carcinogens or their metabolites. /Chemical Carcinogens/

>> PRECAUTIONS FOR "CARCINOGENS": ... Small quantities of ... some carcinogens can be destroyed using chem reactions ... but no general rules can be given. ... As a general technique ... treatment with sodium dichromate in strong sulfuric acid can be used. The time necessary for destruction ... is seldom known ... but 1-2 days is generally considered sufficient when freshly prepd reagent is used. ... Carcinogens that are easily oxidizable can be destroyed with milder oxidative agents, such as saturated soln of potassium permanganate in acetone, which appears to be a suitable agent for destruction of hydrazines or of compounds containing isolated carbon-carbon double bonds. Concn or 50% aqueous sodium hypochlorite can also be used as an oxidizing agent. /Chemical Carcinogens/

>> PRECAUTIONS FOR "CARCINOGENS": Carcinogens that are alkylating, arylating or acylating agents per se can be destroyed by reaction with appropriate nucleophiles, such as water, hydroxyl ions, ammonia, thiols & thiosulfate. The reactivity of various alkylating agents varies greatly ... & is also influenced by sol of agent in the reaction medium. To facilitate the complete reaction, it is suggested that the agents be dissolved in ethanol or similar solvents. ... No method should be applied ... until it has been thoroughly tested for its effectiveness & safety on material to be inactivated. For example, in case of destruction of alkylating agents, it is possible to detect residual compounds by reaction with 4(4-nitrobenzyl)-pyridine. /Chemical Carcinogens/

14. Transport Information

DOT

Hexamethylphosphoramide

IATA

Hexamethylphosphoramide

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15. Regulatory Information

Regulatory Information

The Australian Inventory of Industrial Chemicals

>> Chemical: Phosphoric triamide, hexamethyl-

New Zealand EPA Inventory of Chemical Status

>> Hexamethylphosphoramide: Does not have an individual approval but may be used under an appropriate group standard

16. Other Information

Other Safety Information

Chemical Assessment

>> IMAP assessments - CMR chemicals not registered under REACH: Human health tier II assessment

>> IMAP assessments - Phosphoric triamide, hexamethyl-: Environment tier I assessment

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