

Safety Data Sheet

p-Dioxane

Division of Safety
National Institutes
of Health



WARNING!

THIS COMPOUND IS ABSORBED THROUGH THE SKIN AND RESPIRATORY AND INTESTINAL TRACTS. IT IS TOXIC AND CARCINOGENIC. IT IS FLAMMABLE. AVOID FORMATION AND BREATHING OF AEROSOLS OR VAPORS.

LABORATORY OPERATIONS SHOULD BE CONDUCTED IN A FUME HOOD, GLOVE BOX, OR VENTILATED CABINET. PVA OR NITRILE GLOVES ARE RECOMMENDED.

AVOID SKIN CONTACT: IF EXPOSED, WASH WITH SOAP AND WATER.

FOR EYE EXPOSURE, IRRIGATE IMMEDIATELY WITH LARGE AMOUNTS OF WATER. FOR INGESTION, DRINK PLENTY OF WATER OR MILK. INDUCE VOMITING. FOR INHALATION, REMOVE VICTIM PROMPTLY TO CLEAN AIR. ADMINISTER RESCUE BREATHING IF NECESSARY. REFER TO PHYSICIAN.

IN CASE OF LABORATORY SPILL, WEAR PROTECTIVE CLOTHING DURING CLEANUP. AVOID SKIN CONTACT OR BREATHING OF AEROSOLS OR VAPORS. WASH DOWN AREA WITH SOAP AND WATER. DISPOSE OF WASTE SOLUTIONS BY INCINERATION.

A. Background

p-Dioxane is a flammable, volatile, reactive liquid. It may be absorbed through the skin and all other routes of entry. It irritates mucous membranes on inhalation or ingestion, and on prolonged or heavy exposure it is toxic to the liver and kidneys. It is carcinogenic in animals in high doses and is possibly mutagenic. p-Dioxane is commonly used as a solvent both commercially and in chemical and biological laboratories.

B. Chemical and Physical Data

1. Chemical Abstract No.: 123-91-1

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Synonyms:

Diethylene dioxide	Diethylene ether
1,4-Diethylene dioxide	Di(ethylene oxide)
1,4-Dioxacyclohexane	Dioxyethylene ether
Diokan	Glycol ethylene ether
Dioxan	NCI-C03689
Dioxane	Tetrahydro-1,4-dioxin
1,4-Dioxane (9CI)	Tetrahydro-p-dioxin

Molecular

formula:

$C_4H_8O_2$

structure:



weight:

88.1

Density: 1.0329 g/cm³.

Absorption spectroscopy: IR, Raman, UV, NMR, and MS are recorded (Grasselli and Ritchey, 1975).

Volatility: Vapor pressure = 37 mm Hg at 25°C.

Solubility: Miscible with water and many organic solvents.

Description, appearance: Colorless liquid with a faint sweet odor.

Boiling point: 101.1°C.

Melting point: 11.8°C.

Stability: Stable to light but unstable to heat, flame, and oxidizing materials. Absorbs atmospheric moisture readily; long-term stability requires a dry nitrogen atmosphere (Dow, 1971).

Chemical reactivity: Reacts with oxygen in air to form peroxides and acidic materials. Corrosive to zinc, copper, and copper alloys.

Flash point: 12.2°C.

Autoignition temperature: 180°C.

14. Explosive limits in air: 1.97-22.25 vol % (Weast, 1979).

Fire, Explosion, and Reactivity Hazard Data

1. Use dry chemical fire extinguisher. Fire-fighting personnel should wear air-supplied respirators with full-face mask.
2. p-Dioxane is flammable and its vapors in air can produce explosive mixtures. On prolonged standing in air, particularly in the anhydrous state, p-dioxane forms peroxides that can be explosive if the p-dioxane evaporates in a fire.
3. Conditions contributing to instability include exposure to oxygen and presence of oxidizing materials.
4. Incompatible with zinc, copper, and copper alloys.
5. No data on hazardous decomposition products.
6. Do not expose to spark or open flame. Store in a refrigerator designed to permit the safe storage of flammable solvents.

Operational Procedures

The NIH Guidelines for the Laboratory Use of Chemical Carcinogens describe operational practices to be followed when potentially carcinogenic chemicals are used in NIH laboratories. The Guidelines should be consulted to identify the proper use conditions required and specific controls to be implemented during normal and complex operations or manipulations involving p-dioxane.

PVA and nitrile gloves were superior to other gloves tested for permeability to p-dioxane (Sansone and Tewari, 1978). If p-dioxane is in solution, the solvent(s) present may have a substantial effect on glove performance.

Laboratory operations that involve distillation or evaporation of p-dioxane should be preceded by destruction of potentially explosive peroxide impurities.

1. Chemical inactivation: No validated method reported.
2. Decontamination: Turn off equipment that could be affected by p-dioxane or the materials used for cleanup. If more than 100 ml has been spilled or if there is any uncertainty regarding the procedures to be followed for decontamination, call the NIH Fire Department (dial 116) for assistance. Wash surfaces with copious quantities of water. Glassware should be rinsed (in a hood) with an organic solvent, followed by soap and water. Animal cages should be washed with water.

Disposal: No waste streams containing p-dioxane shall be disposed of in sinks or general refuse. Surplus quantities of p-dioxane or chemical waste streams contaminated with p-dioxane shall be handled as hazardous chemical waste and disposed of in accordance with the NIH chemical waste disposal system. Nonchemical waste (e.g., animal carcasses and bedding) containing p-dioxane shall be handled and packaged for incineration in accordance with the NIH medical-pathological waste disposal system. Potentially infectious waste (e.g., tissue cultures) containing p-dioxane shall be disinfected by heat using a standard autoclave treatment and packaged for incineration, as above. Burnable waste (e.g., absorbent bench top liners) minimally contaminated with p-dioxane shall be handled as potentially infectious waste and packaged for incineration, as above. Absorbent materials (e.g., associated with spill cleanup) grossly contaminated shall be handled in accordance with the chemical waste disposal system. Radioactive waste containing p-dioxane shall be handled in accordance with the NIH radioactive waste disposal system.

Storage: p-Dioxane should be stored in sealed containers under refrigeration (freezer preferred), with protection against moisture. Stock quantities must be brought to room temperature prior to sampling to avoid introducing moisture.

Monitoring and Measurement Procedures Including Direct Field Measurements and Sampling for Subsequent Laboratory Analysis

Sampling: The recommended procedure for air or water samples consists of adsorption on activated carbon and desorption with carbon disulfide. This procedure and others have been evaluated by NIOSH (1977).

Separation and analysis: The commonly used method is GC-MS. For low levels of p-dioxane in aqueous solutions this may be performed directly without previous extraction (Harris et al., 1974). An alternative procedure (for water and air samples concentrated as above) is GC with a flame ionization detector (NIOSH, 1977).

Biological Effects (Animal and Human)

Absorption: p-Dioxane is absorbed through the skin and the respiratory and intestinal tracts. Eye exposure results in irritation.

Distribution: No data.

Metabolism and excretion: After inhalation or ingestion in animals and humans, p-dioxane is excreted in the urine either unchanged or in the form of its metabolite (β -hydroxyethoxy) acetic acid (HEAA). The relative proportions are determined by the amount of p-dioxane administered since metabolism to HEAA appears to be slow (Braun and Yano, 1977).

4. Toxic effects: Oral LD50s in rodents are in the range of 2-6 g/kg. Target organs for toxic effects in animals and humans are the liver, kidney, and brain. In man, respiratory tract irritation occurs in 15 minutes at 300 ppm. Overexposure to p-dioxane results in hemorrhagic nephritis, liver necrosis, and, in some cases, brain and lung edema.
5. Carcinogenic effects: Ingestion of 1% p-dioxane in drinking water produces tumors in the liver, kidneys, and nasal cavity of rats (the latter might be the result of direct application during the drinking process).
6. Mutagenic and teratogenic effects: There is a questionable mutagenic effect reported on immersion of chick embryos in p-dioxane. An increase in in vitro mutagenicity is reported when p-dioxane is applied in conjunction with a known mutagen. There are no data on teratogenicity.

G. Emergency Treatment and Medical Surveillance

1. Skin and eye exposure: For skin exposure, remove contaminated clothing and wash skin with soap and water. For eye exposure, irrigate immediately with copious quantities of running water for at least 15 minutes.
2. Ingestion: Drink plenty of water or milk. Induce vomiting.
3. Inhalation: Remove victim promptly to clean air. Administer rescue breathing if necessary.
4. Refer to physician. Consider treatment for pulmonary irritation.

H. References

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NIOSH, National Institute for Occupational Safety and Health. 1
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