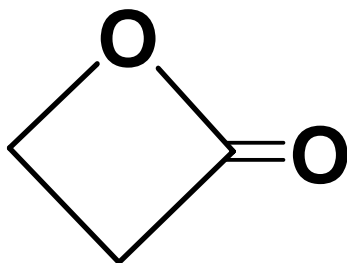


β -Propiolactone



Syn: 3-Hydroxypropionic Acid Lactone; 2-Oxetanone; Hydroacrylic Acid

β -Propiolactone is used for vaccines, tissue grafts, surgical instruments, and enzymes, as a sterilant of blood plasma, water, milk, and nutrient broth, and as a vapor-phase disinfectant in enclosed spaces. Its sporicidal action is used against vegetative bacteria, pathologic fungi, and viruses. (1,2,7)

β -Propiolactone is also used as a chemical intermediate. (1,2,12)

The vapor of β -Propiolactone is an irritant, mutagenic, possibly carcinogenic disinfectant which is very active against most micro-organisms, including viruses. It is rather less effective against bacterial spores. Propiolactone vapor has been used for the gaseous sterilization of pharmaceutical and surgical material and for disinfecting large enclosed areas. It has low penetrating power. Propiolactone liquid has also been

used.² The compound has been recommended as a substitute for formaldehyde in the disinfection of rooms and buildings, presumably 4000 times more active than ethylene oxide and 25 times more effective than formaldehyde. It is not recommended as a substitute for ethylene oxide because of a) a lack of "penetrating power" and b) its carcinogenicity in mice. Its activity is primarily due to alkylation of DNA.⁴

Guidelines have been published for use of β -Propiolactone in work with HIV.⁴ The combined use of BPL with UV radiation has been used for inactivation of the 1-lutchison strain of non-A, non-B hepatitis virus.⁵

Precautions and Disclaimer

Consult the Material Safety Data Sheet for handling recommendations before working

with this material.

Storage/Stability

β -propiolactone, BPL, has shown less than 1% loss in purity (by titration) after two years when kept sealed under dry inert gas at 2-8°C. Storage in glass under inert gas at -20°C is recommended.

If exposed to moisture, BPL, has a tendency to hydrolyze to Hydracrylic Acid, which then polymerizes to form an insoluble polymer.

The purity of the remaining material is not affected if the liquid is decanted from the solid polymer. Filtration is effective, but must be conducted in anhydrous atmosphere.

Hazard Summary

Acute (short-term) inhalation exposure to β -propiolactone causes severe irritation of the eyes, nose, throat, and respiratory tract in humans. Acute dermal exposure may cause irritation of the skin, blistering, or burns in humans. Contact with the eyes may cause permanent corneal opacification. Burns of the mouth and stomach may occur in humans following acute exposure via ingestion. No information is available on the chronic (long-term), reproductive, developmental, or carcinogenic effects of β -Propi-

olactone in humans. Squamous cell carcinomas of the forestomach have been reported in orally exposed rats. In dermally exposed rodents, skin tumors have been observed. The International Agency for Research on Cancer (IARC) has classified β -propiolactone as a Group 2B, possible human carcinogen.

Health Hazard Information

Acute Effects:

- Acute inhalation exposure β -Propiolactone causes severe irritation of the eyes, nose, throat, and respiratory tract in humans. Acute dermal exposure may cause irritation of the skin, blistering, or burns in humans. Contact with the eyes may cause permanent corneal opacification. Burns of the mouth and stomach may occur in humans following acute exposure via ingestion. (6,7)
- Acute oral exposure has been observed to result in muscular spasms, respiratory difficulty, and convulsions at high levels in rats. In rats acutely exposed intravenously, liver and kidney tubular damage has been reported. (6,13)
- Acute animal exposure tests in rats have demonstrated β -Propiolactone to have extreme acute toxicity by inhalation. (9)

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Chronic Effects (Noncancer):

- No information is available on the chronic health effects of β -Propiolactone in humans.
- Chronic dermal exposure has resulted in skin irritation, scarring, and hair loss in mice. (6,8)
- EPA has not established a Reference Concentration (RfC) or a Reference Dose (RfD) for β -Propiolactone. (7)

Reproductive/Developmental Effects:

- No information is available on the reproductive or developmental effects of β -Propiolactone in humans or animals.

Cancer Risk:

- No information is available on the carcinogenic effects of β -Propiolactone in humans.

- Squamous cell carcinomas of the forestomach have been reported in orally exposed rats. (6,7,11)
- In several studies of rats and mice exposed to β -Propiolactone via subcutaneous injection, local tumors have been observed at the site of injection. Lymphomas and hepatomas have been reported in mice following intra-peritoneal injection. (6,7,11)
- In mice, hamsters, and guinea pigs dermally exposed, skin tumors have been observed. (6,7,11)
- EPA has not classified β -Propiolactone for carcinogenicity. (7)
- IARC has classified β -Propiolactone as a Group 2B, possible human carcinogen. (11)

References:

1. Merck Index, 12th ed., #8005 (1996).
2. Martindale: The Extra Pharmacopoeia, 30th ed., (Pharmaceutical Press, 1993), p. 803.
3. Block, S., *Disinfection, Sterilization and Preservation*, 4th ed., p. 583 (Chapter 33, dedicated to gaseous sterilization agents).
4. Anonymous, *Lancet*, ii, 174-175 (1986).
5. Prince, et al., *J. Med. Virol*, **16**,119-125 (1985)
6. U.S. Department of Health and Human Services. Hazardous Substances Databank ([HSDB, online database](#)). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
7. U.S. Environmental Protection Agency. [Integrated Risk Information System \(IRIS\) on beta-Propiolactone](#). National Center for Environmental Assessment, Office of Research and Development, Washington, DC. 1999.
8. M. Sittig. *Handbook of Toxic and Hazardous Chemicals and Carcinogens*. 2nd ed. Noyes Publications, Park Ridge, NJ. 1985.
9. U.S. Department of Health and Human Services. Registry of Toxic Effects of Chemical Substances (RTECS, online database). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.

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10. American Conference of Governmental Industrial Hygienists (ACGIH). *1999 TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents. Biological Exposure Indices*. Cincinnati, OH. 1999.
11. International Agency for Research on Cancer (IARC). *IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man: Some Aromatic Amines, Hydrazine and Related Substances, N-Nitroso Compounds and Miscellaneous Alkylating Agents*. Volume 4. World Health Organization, Lyon. 1974.
12. *The Merck Index. An Encyclopedia of Chemicals, Drugs, and Biologicals*. 11th ed. Ed. S. Budavari. Merck and Co. Inc., Rahway, NJ. 1989
13. U.S. Department of Health and Human Services (DHHS). [*The 8th Report on Carcinogens. 1998 Summary*](#). Public Health Service, National Toxicology Program. Research Triangle Park, NC. 1998.

Product Specifications

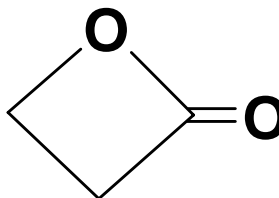
Product Name

β -Propiolactone, BPL

Syn:

3-Hydroxypropionic Acid Lactone; 2-Oxetanone; Hydroacrylic Acid

Structure



CAS No.

57-57-8

Empirical Formula

C₃H₄O₂

Mol. Weight

72.06

Appearance

Clear, colorless liquid ‡

Vapor pressure

3.4 mm Hg @ 25°C

Assay

≥ 90 %

Odor

Pungent, slightly sweet smell

‡ If exposed to moisture, β -Propiolactone, has a tendency to hydrolyze to Hydroacrylic Acid, which then polymerizes to form an insoluble polymer. The purity of the remaining material is not affected if the liquid is decanted from the solid polymer. Filtration is effective, but must be conducted in anhydrous atmosphere.