2-Phosphono-1,2,4-butanetricarboxylic acid

Document History
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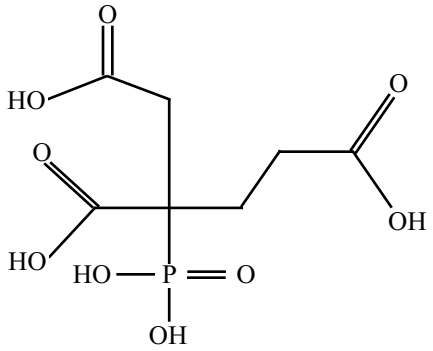
I. IDENTIFICATION[1]

Chemical Name: 2-Phosphono-1,2,4-butanetricarboxylic acid
Synonyms: PBTC, 1,2,4-Butanetricarboxylic acid 2-phosphono-, Bayhibit AM, Phosphono- butanetricarboxylic acid
CAS Number: 37971-36-1
Molecular Formula: C_7-H_{11}-O_9-P
Chemical Structure:



II. CHEMICAL AND PHYSICAL PROPERTIES[1]

Physical State: Solid
Molecular Weight: 270.13
Conversion Factors: 1 ppm = 11 mg/m^3; 1 mg/ m^3 = 0.09 ppm
Melting Point: -15°C (5°F) (aq. sol'n.)
Boiling Point: ~100°C (~212°F) for 50% aqueous solution
Vapor Pressure: 85.5 mm Hg at 50°C(122°F) for 50% aqueous solution
Saturated Vapor Concentration: 112000 ppm
Vapor Density: Not available
Odor Description and Threshold: Not available
Flammability Limits: LEL: not available UEL: not available
Flash Point: >100°C (~221°F)
Autoignition Temperature: Not available
Specific Gravity/Density: 1.3 g/cm^3 at 20°C (68°F)
Solubility: Soluble in water
Reactivity: Not available
Log K_{ow}: Not available

III. USES[1]

PBTC is used as an anti-scaling agent for cooling water systems, as an additive in industrial cleaning agents, and in the textile industry and as a cleaning/bleaching agent.

IV. TOXICOLOGY DATA

A. Acute Toxicity and Irritancy

1. Oral

LD_{50} = 8300 mg/kg, Wistar rat (Male, 14d post-exposure period, deaths occurred from 1 hr–6 days post-dosing)[2]

LD_{50} = 6770 mg/kg, CF-1 mouse (Male, 14d post-exposure period, deaths occurred from 1 hr–6 days post-dosing)[2]

2. Eye Irritation

The eyes of two albino rabbits were exposed to 0.1 mL PBTC (41.8% aqueous solution) and observed 24, 48, and 72 hours thereafter. Under the conditions of this study no significant irritation reactions were observed.[2]

3. Skin Absorption

LD_{50} > 4 g/kg, Wistar rat (M+F, GLP study, 14 day post-exposure period)[3]

4. Skin Irritation

The dermal irritancy of 0.5mL PBTC (41.8% aqueous solution) was tested on intact and abraded rabbit skin. Under the conditions of this study, no significant skin irritation reactions were observed.[2]

5. Skin Sensitization

PBTC was negative in a Magnusson and Kligman maximization test with guinea pigs.[4] Animals were given intradermal induction doses of 5% and topical induction doses of 100%, and were challenged with 100% PBTC. No skin sensitization reactions were observed.

6. Inhalation Toxicity

LC_{50} > 1780 mg/m^3, Wistar rat (M + F, 1-hour exposure period, 7 day post-exposure period).[5]

LC_{50} > 1979 mg/m^3, Wistar rat (M + F, 4-hour exposure period, 7 day post-exposure period).[5]

7. Other

No data found for PBTC

B. Subacute Toxicity

No data found for PBTC

C. Subchronic Toxicity

Groups of 15 rats of each sex per dose received 0, 50, 200, 1000, or 5000 ppm PBTC in feed for 90 days.[6] No adverse treatment-related effects were observed on survival, clinical chemistry, haematology, gross pathology, or histopathology in this study. The NOAEL for the study was set at 5000 ppm (approx. 375 mg/kg/day).

D. Chronic Toxicity/Carcinogenicity

No data found for PBTC

E. Developmental/Reproductive Toxicity

Groups of 25 pregnant Wistar rats were dosed orally with 0, 100, 300 or 1000 mg PBTC/kg/day from Gestation Day 6-15 in an OECD 414 study[7,1]. The test material was administered as a 49% solution in water. No adverse effects were observed in either dams or pups at any of the doses tested. The fetal and maternal NOAEL in this study was 1000 mg/kg/day.

F. Genotoxicity/Mutagenicity

PBTC was tested in *S. typhimurium* strains TA1535, TA1537, TA100, and TA98 with and without S-9. PBTC was negative in all strains with and without metabolic activation.[8,1]

PBTC was tested for cytogenetic effects in Chinese hamster lung (V79) cells in a GLP study conducted in accordance with OECD test guideline 473.[1] Test material concentrations of 125, 250 or 500 ug/mL were used without S-9 and 625, 1250 or 2500 ug/mL were used with S-9. PBTC was negative under the conditions of this study.

PBTC was tested in a GLP mouse micronucleus assay conducted in accordance with OECD guideline 474.[1] Male and female CFW1 mice were dosed once by gavage with an aqueous (50%) solution of 2000 mg/kg PBTC. PBTC was negative in this mouse micronucleus assay.

G. Metabolism and Pharmacokinetics

Although PBTC has some ability to chelate calcium, its activity (log K = 4.4) is substantially lower than that of EDTA (log K = 10.6) or DTPA (log K = 10.8). Calcium binding by PBTC at the recommended OEL would result in 15 mg/day loss (worst-case estimation), which would readily be recovered from average daily food intake of calcium (300 mg/day).[9]

V. HUMAN USE AND EXPERIENCE

The commercial product is sold and used as an aqueous solution of PBTC, although PBTC is produced as a solid.[1] The solid material has a very low vapor pressure and volatilization is not expected. When used as an anti-scaling agent in cooling water systems, PBTC-containing sprays/mists may be generated. Cleaning agents containing PBTC are usually product mixtures containing high alkali content and since they are corrosive to skin, are not sprayed. The daily dermal dose resulting from splashing in manufacture and shipment, considering twice daily use of a 50% PBTC solution was estimated to be 0.50 mg/kg/day for a 70-kg man.[1]

VI. RATIONALE

PBTC is sold as a liquid with a low vapor pressure at room temperature. It is normally used as an aqueous solution. Use as an antiscaling agent in water-cooling systems may sometimes result in spray/mist formation and potential inhalation exposure. As an aqueous solution, it is not irritating to skin and eyes. It has low acute toxicity via the oral, dermal and inhalation routes. It was negative for dermal sensitization reactions in a Magnusson and Kligman maximization guinea pig assay. PBTC was negative in Ames, cytogenetics and mouse micronucleus assays. No adverse effects were observed in a 90-day rat oral feeding study in which a dietary NOAEL of 5000 ppm (approx. 375 mg/kg/day) was established. No adverse developmental effects were noted in rats exposed to as much as 1000 mg/kg/day by gavage. Based on good industrial hygiene practice, a limit of 10 mg/m^3 (aerosol, as PBTC) is considered appropriate.

VII. RECOMMENDED OEL GUIDE

An OEL Guide of 10 mg/m^3 (aerosol) as PBTC is recommended.

VIII. REFERENCES

Databases consulted during this review include: IUCLID; TSCATS; RTECS; INCHEM

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