

Propylene Carbonate

1 Nonproprietary Names

USPNF: Propylene carbonate

2 Synonyms

Carbonic acid, cyclic propylene ester; cyclic methylethylene carbonate; cyclic propylene carbonate; 4-methyl-2-oxo-1,3-dioxolane; 1,2-propanediol cyclic carbonate; 1,2-propylene carbonate.

3 Chemical Name and CAS Registry Number

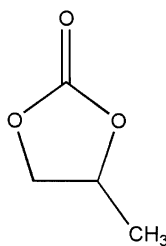
±-4-Methyl-1,3-dioxolan-2-one [108-32-7]

4 Empirical Formula Molecular Weight

C₄H₆O₃

102.09

5 Structural Formula



6 Functional Category

Gelling agent; solvent.

7 Applications in Pharmaceutical Formulation or Technology

Propylene carbonate is used mainly as a solvent in oral and topical pharmaceutical formulations.

In topical applications, propylene carbonate has been used in combination with propylene glycol as a solvent for corticosteroids. The corticosteroid is dissolved in the solvent mixture to yield microdroplets that can then be dispersed in petrolatum.⁽¹⁾

Propylene carbonate has also been used in hard gelatin capsules as a nonvolatile, stabilizing, liquid carrier. For formulations with a low dosage of active drug, a uniform drug content may be obtained by dissolving the drug in propylene carbonate then spraying this solution on to a solid carrier such as compressible sugar; the sugar may then be filled into hard gelatin capsules.⁽²⁾

Propylene carbonate may additionally be used as a solvent, at room and elevated temperatures, for many cellulose-based polymers and plasticizers. Propylene carbonate is also used in cosmetics.

8 Description

Propylene carbonate is a clear, colorless, mobile liquid, with a faint odor.

9 Pharmacopeial Specifications

See Table I.

Table I: Pharmacopeial specifications for propylene carbonate.

Test	USPNF 20
Identification	+
Specific gravity	1.203–1.210
pH (10% v/v aqueous solution)	6.0–7.5
Residue on ignition	≤0.01%
Organic volatile impurities	+
Assay	99.0–100.5%

10 Typical Properties

Boiling point: 242 °C

Flash point: 132 °C

Freezing point: –49.2 °C

Heat of combustion: 14.21 kJ/mol (3.40 kcal/mol)

Heat of vaporization: 55.2 kJ/mol (13.2 kcal/mol) at 150 °C

Refractive index: $n_D^{20} = 1.420$ –1.422

Solubility: practically insoluble in hexane; freely soluble in water. Miscible with acetone, benzene, chloroform, ethanol, ethanol (95%), and ether.

Specific heat: 2.57 J/g/°C (0.62 cal/g/°C) at 20 °C

Vapor pressure: 4 Pa (0.03 mmHg) at 20 °C.

Viscosity (dynamic): 2.5 mPa s (2.5 cP) at 25 °C.

11 Stability and Storage Conditions

Propylene carbonate and its aqueous solutions are stable but may degrade in the presence of acids or bases, or upon heating; see also Section 12.

Store in a well-closed container in a cool, dry place.

12 Incompatibilities

Propylene carbonate hydrolyzes rapidly in the presence of strong acids and bases, forming mainly propylene oxide and carbon dioxide. Propylene carbonate can also react with primary and secondary amines to yield carbamates.

13 Method of Manufacture

Propylene carbonate may be prepared by the reaction of sodium bicarbonate with propylene chlorohydrin.⁽³⁾

14 Safety

Propylene carbonate is used as a solvent in oral and topical pharmaceutical formulations and is generally regarded as an essentially nontoxic and nonirritant material.

In animal studies, propylene carbonate was found to cause tissue necrosis after parenteral administration.⁽⁴⁾

LD₅₀ (mouse, oral): 20.7 g/kg

LD₅₀ (mouse, SC): 15.8 g/kg

LD₅₀ (rat, oral): 29 g/kg

Observe normal precautions appropriate to the circumstances and quantity of material handled. Propylene carbonate may be irritant to the eyes and mucous membranes. Eye protection and gloves are recommended.

16 Regulatory Status

Included in the FDA Inactive Ingredients Guide (topical ointments).

17 Related Substances

(S)-Propylene carbonate.

(S)-Propylene carbonate

Empirical formula: C₄H₆O₃

Molecular weight: 102.09

CAS number: [51260-39-0]

Specific rotation: $[\alpha]_D^{25} = -1.7^\circ$ (0.92% v/v solution in ethanol)

Comments: the (S)-enantiomer of \pm -propylene carbonate.⁽⁵⁾

18 Comments

The EINECS number for propylene carbonate is 203-572-1.

19 Specific References

- 1 Burdick KH, Haleblan JK, Poulsen BJ, Cobner SE. Corticosteroid ointments: comparison by two human bioassays. *Curr Ther Res* 1973; 15: 233-242.
- 2 Dahl TC, Burke G. Feasibility of manufacturing a solid dosage form using a liquid nonvolatile drug carrier: a physicochemical characterization. *Drug Dev Ind Pharm* 1990; 16: 1881-1891.
- 3 Najer H, Chabrier P, Giudicelli R. Study of organic cyclic carbonates and their derivatives [in French]. *Bull Soc Chim Fr* 1954: 1142-1148.
- 4 Hem SL, Bright DR, Banker GS, Pogue JP. Tissue irritation evaluation of potential parenteral vehicles. *Drug Dev Commun* 1974-75 1: 471-477.
- 5 Usieli V, Pilersdorf A, Shor S, *et al.* Chiroptical properties of cyclic esters and ketals derived from (S)-1,2-propylene glycol and (S,S)- and (R,R)-2,3-butylene glycol. *J Org Chem* 1974; 39: 2073-2079.

20 General References

Cheng H, Gadde RR. Determination of propylene carbonate in pharmaceutical formulations using liquid chromatography. *J Pharm Sci* 1985; 74: 695-696.

Ursin C, Hansen CM, Van Dyk JW, Jensen PO, Christensen IJ, Ebbehøj J. Permeability of commercial solvents through living human skin. *Am Ind Hyg J* 1995; 56: 651-660.

21 Author

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22 Date of Revision

30 May 2002.