

1,2-Propylene glycol USP

Water-miscible, low -volatile, odourless solvent and humectant of very high purity.

For applications named below we recommend 1,2-Propylene Glycols supplied by our Fine Chemicals Division:

- 1,2-Propylene glycol Care for use in cosmetics and toiletries
- 1,2-Propylene glycol Pharma for use in pharmaceutical applications
- 1,2-Propanediol USP for pet food

Chemical nature

1,2-Propanediol	CH ₃ -CHOH-CH ₂ OH
Molecular formula:	C ₃ H ₈ O ₂
CAS Reg. No.:	57-55-6

Delivery specifications

Specified Characteristic	Test method	Specification
Identity	IR	fulfilled
Purity	Capillary GC	min. 99,5 Area-%
Specific gravity, 25/25 °C		1,035 – 1,037
Refractive index, 20 °C		1,431 – 1,433
Acid value		max. 0,019 mg KOH/ml
Water	KF-Titration	max. 0,2 %
Sulphated ash		max. 70 mg/kg
Chloride		max. 70 mg/kg
Sulfate		max. 60 mg/kg
Oxidizing substances		fulfilled
Reducing substances		fulfilled
Dimers and polymers	Capillary GC	max. 0,1 g/100 g
1,3-Propanediol		max. 100 mg/kg
Organic chloride compounds as Cl		max. 1 mg/kg
Arsenic		max. 3 mg/kg
Heavy metals		max. 5 mg/kg

Properties

1,2-Propylene glycol USP is a clear, colourless, odourless, viscous and hygroscopic liquid with low volatility and a neutral reaction. It is freely miscible with water, lower alcohols, esters and ketones, but mixes poorly or not at all with ethers, higher alcohols, hydrocarbons and chlorinated hydrocarbons.

1,2-Propylene glycol USP is a germicide of approximately equal strength to ethanol. In solutions it suppresses the growth of microorganisms, the concentration required depending on the type of microorganism, though generally 15 - 30 % Propylene Glycol USP in the solution achieves the desired effect.

1,2-Propylene glycol USP behaves as a typical bivalent alcohol in reactions leading to the formation of esters and ethers. The primary hydroxyl group reacts somewhat more readily than the secondary.

1,2-Propylene glycol USP meets the USP and European Pharmacopoeia [1] purity requirements.

Physical data

The physical data presented below pertain to the pure solvent and are not binding for our sales product.

There is not much agreement on the data given in the literature [2-8] on this solvent. For this reason, we have adopted recognized mathematical methods to derive any missing figures, particularly those relating the properties to temperature. The calculations were based on literature data that we have carefully assessed, or on our own measurements. The only figures listed below are those for which the value given in the literature agreed satisfactorily with that obtained by calculation.

Molar mass	76,096 g/mol
Boiling point at 1013 mbar	187,6 °C
Solidification point at 1013 mbar	-60 °C (glass transition temperature)

Vapour pressure [3]	T (°C)	P (mbar)
	0	0,031
	20	0,186
	40	0,873
	50	1,75
	60	3,36
	80	11,0
	100	31,5
	120	80,3
	140	186
	160	398
	180	793
	187,6	1013

Antoine constants $\ln P = A - B/(C+T)$
(P in mbar; T in °C)

$$A = 20,8200$$

$$B = 6091,95$$

$$C = 250,700$$

Critical data [2]

Critical temperature (T_c)	352 °C
Critical pressure (p_c)	61,0 bar
Critical density (ρ_c)	0,321 g/cm ³
Critical compressibility (Z_c)	0,278

Dielectric constant (ϵ) at 20 °C	32,0
Dipole moment (μ)	3,63 D
Solubility in water	Miscible with water in all proportions.
Evaporation rate	approx. 1000

Information on the infrared, NMR and mass spectra has been compiled by Grasselli [9].

Binary azeotropes

1,2-Propylene glycol USP forms azeotropic mixtures with a number of solvents, some of which are listed below. A detailed list, which includes mixtures that do not form azeotropes, has been compiled by Horsley [10].

1,2-Propylene glycol (mass fraction in %)	Azeotrope with	Mass fraction in %	bp (°C) at 1013 mbar
43	Aniline	57	179,4
1,5	Toluene	98,5	110,5
40,38	Dipropylene glycol monomethyl ether	59,62	183,7
10	o-Xylene	90	135,8
67	Dodecane	33	175

Examples of solvents with which 1,2-Propylene glycol USP does not form azeotropes are 1-methoxy-2-propanol, p-chlorophenol, n-butyl acetate, dipropylene glycol and benzene.

Solvent power

At room temperature, 1,2-Propylene glycol USP is miscible in all proportions with

- water,
- methanol, ethanol, propanols, butanols and other alcohols,
- phenols,
- 2-phenylethanol,
- formates and acetates,
- acetone,
- benzaldehyde,
- dimethylformamide,
- methylene chloride,
- chloroform,
- and numerous ethereal oils and fragrances.

The product mixes poorly or not at all with

- carbon tetrachloride,
- benzene,
- toluene,
- and other non-polar solvents.

Analytical method

Gas chromatography

Reliable results for the gas chromatographic assay can be obtained in practice under the following conditions.

Column:	CP Sil 5 CB
Length:	50 m
Diameter:	0,53 mm
Film thickness:	5,0 µm

Chromatographic conditions:

a) Temperatures	
Injection port:	250 °C
Detektor:	250 °C
Column oven:	90 °C – 200 °C, 10 °C/min
b) Detector:	FID (optimized carburation)
c) Injection:	Split injection
d) Carrier gas:	Nitrogen
e) Sample injection:	0,2 µl
f) Evaluation:	Percentage areas

Applications

1,2-Propylene glycol USP is a high-purity odourless grade that has been specially developed to meet the requirements of the tobacco industries. Some of its applications are listed below.

- Solvent for printing and ink -pad inks intended for food-contact applications
- Component in adhesives, e.g. for food packaging
- Humectant for corks, cellophane and tobacco
- For cleaning food packaging machinery
- Lubricant for machines in the food, pharmaceuticals and cosmetics industries
- Component in coolants in the drinks industry, e.g. in breweries

Storage

When stored properly and in the original sealed containers, the product can be kept for one year. The product must be protected from the action of light. The storage temperature should be below 40 °C.

Containers made of stainless steel, aluminium or high density polyethylene (HDPE) should be used for storing 1,2-Propylene glycol USP. We advise against galvanized tanks. [11]

It is important to prevent contact with air, e.g. by storing under a blanket of dry nitrogen. If atmospheric oxygen is not excluded, peroxides may be formed, which, in turn, may decompose into aldehydes and acids. The action of light and temperatures higher than 40 °C can also cause decomposition reactions. Typical decomposition products are carbonyl compounds and dioxolane derivatives.

Smaller containers should be kept tightly closed and stored in a well ventilated place.

Safety

A safety data sheet conforming to 91/155/EWG is available for 1,2-Propylene glycol USP.

Note

The information submitted in this publication is based on our current knowledge and experience. In view of the many factors that may affect processing and application, these data do not relieve processors of the responsibility of carrying out their own tests and experiments; neither do they imply any legally binding assurance of certain properties or of suitability for a specific purpose. It is the responsibility of those to whom we supply our products to ensure that any proprietary rights and existing laws and legislation are observed.

Literature

- [1] Current United States Pharmacopoeia and European Pharmacopoeia
- [2] Kirk-Othmer, "Encyclopedia of Chemical Technology", Vol. 10, 3rd Edn., 1966, Interscience Publ. Inc., New York, p. 649 ff
- [3] Gallant, R. W.; Hydrocarb. Process 46 (5), 201 (1967)
- [4] Spencer, C.F. and Danner, R.P.; J. Eng. Chem. Data 17 (2), 236 (1972)
- [5] Thomas, L.H. and Meatyard, R.; J. Chem. Soc. (A), 1966, 92
- [6] Thomas, L.H.; Meatyard, R.; Smith H. and Davis, G.H.; J. Chem. Eng. Data 24, 161 (1979)
- [7] Mallan, G.M.; Michaelian, M.S. and Lockhardt, F.; J. Chem. Eng. Data 17, 412 (1972)
- [8] Jamieson, D.T.; Irving, J.B. and Tudhope, J.S. "Liquid Thermal Conductivity: a data survey to 1973", Edinburgh 1975
- [9] Grasselli, J.G. "Atlas of Spectral Data and Physical Constants for Organic Compounds", CRC Press, Cleveland/Ohio, 1973, Atlas No. p 712
- [10] Horsley, L. H. "Azeotropic Data III", Advances in Chemistry Series No. 116, ACS, Washington, D.C., 1973
- [11] Guidelines for Handling and Distribution of Propylene Glycol USP/EP, 1999; published by the Propylene Oxide/Propylene Glycols sector group of CEFIC.