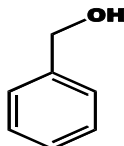


FlexiSolv™ Benzyl Alcohol (BA)



Product Description

INVISTA's FlexiSolv™ benzyl alcohol (BA) is a highly-refined, pure, aromatic, primary alcohol with a wide variety of applications as a solvent and chemical intermediate. Its physical, chemical, and regulatory advantages make FlexiSolv™ benzyl alcohol a preferred alternative to methylene chloride, isophorone, NMP, E-series glycol ethers, and other solvents targeted for replacement.

Because of its low vapor pressure, BA is treated favorably under certain VOC regulations in the USA and EU. In the USA, BA meets the consumer products LVP-VOC exemption criteria established by California Air Resources Board (CARB) for consumer and institutional products and the federal LVP-VOC exemption criteria for consumer products per 40 CFR 59.203(f)1. This means it is not considered a VOC when calculating VOC content in regulated consumer and institutional product categories. In EU, BA is not classified as a VOC as defined in the European Solvents Emissions Directive.¹

The physical and chemical properties of BA make it a desirable and versatile material for a wide variety of consumer and industrial applications. BA is a clear, colorless, low-viscosity, slow-evaporating liquid with a mild aromatic odor. It is non-flammable, non-combustible, and readily biodegradable by OECD 301D. BA is compatible with and readily soluble in a wide variety of common organic solvents. Although BA has limited solubility in water, it is water-stable over a wide pH range.

Performance Advantages

- Slow evaporating
- Low residue on evaporation
- Chemically compatible with wide range of other solvents
- Versatile blending ingredient for solvent replacement or formulation
- Water-stable

Environmental, Health, and Safety Advantages

- Non-flammable, non-combustible
- Non-carcinogen (IARC, NTP, OSHA, or ACGIH)
- Low dermal toxicity
- Readily biodegradable
- Non-ozone-depleting substance
- Not regulated as dangerous goods for transportation purposes (DOT, IMDG, or IATA)

¹ According to European Solvents Emissions Directive 1999/13/EC, BA is not a VOC when applied at 27°C or less at normal atmospheric pressure. However, BA is a VOC as defined in the European "Paint Directive" 2004/42/EC and the Swiss VOC Ordinance.

USA

Meets consumer products LVP-VOC exemption criteria established by EPA and CARB

Not a Hazardous Air Pollutant (HAP)

Not a RCRA-listed waste

EU

Not a VOC as defined by the European Solvents Emissions Directive¹

Not a Substance of Very High Concern based on criteria established by REACH

Japan

Not on Japan's Japanese Pollutant Release Transfer Regulation (PRTR)

Chemical Inventory Status

BA is listed on most chemical inventories around the world, as shown in the following table. Please contact INVISTA for status in countries not shown.

<u>Region</u>	<u>Listing</u>
Australia	AICS
Canada	DSL
China	IECSC
European Union	Eligible for pre-registration by importers and manufacturers
Japan	ENCS (MITI), ISHL
Korea	ECL (KECL)
New Zealand	HSNO
Philippines	PICCS
United States	TSCA

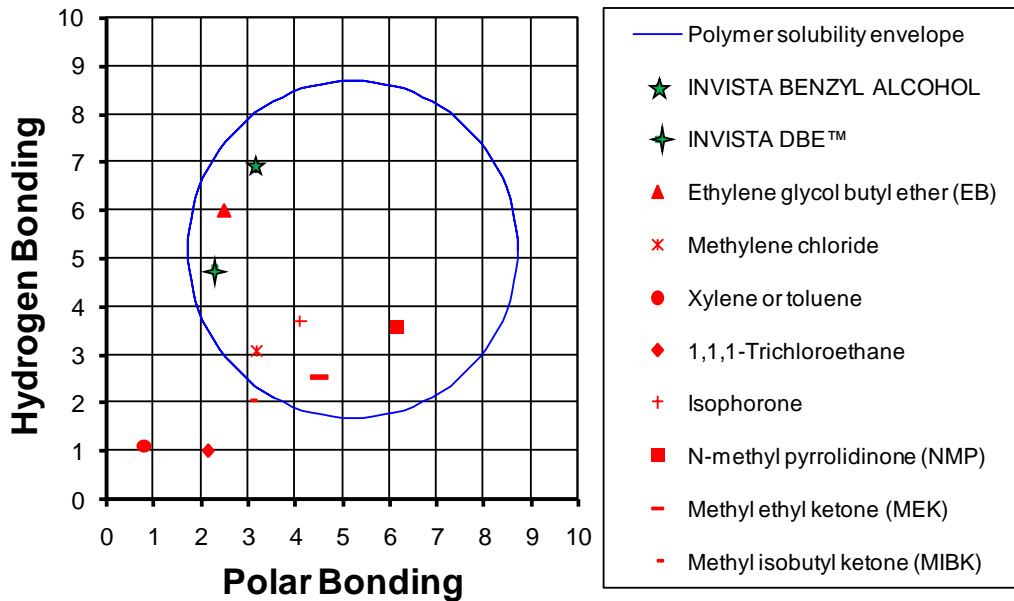
Applications

- Versatile solvent
 - Inks
 - Adhesives
 - Paints and coatings, especially epoxy
 - Paint and graffiti removers
 - Cleaning formulations (hand cleaners, industrial, electronic, hard surface, and general purpose cleaners)
- Photographic chemicals
- Chemical intermediate

FlexiSolv™ benzyl alcohol is a versatile solvent, alone or in combination with other materials such as FlexiSolv™ DBE® esters. Their desirable environmental, health and safety characteristics as noted above and in the DBE® esters literature make FlexiSolv™ benzyl alcohol and DBE® esters the preferred alternatives when reformulating. FlexiSolv™ benzyl alcohol and DBE® esters are both flexible solvents that can be used alone or in customized blends with other solvents to dissolve many polymers or resins useful in inks, coatings, adhesives, sealants, etc. They can be used for a wide variety of cleaning and degreasing tasks and in a multitude of products targeted at industrial, consumer, or institutional markets.

An approach based on Hansen Solubility Parameters⁴ is often useful when reformulating, replacing an undesirable solvent, or designing a solvent system for a particular product or task. The illustration below shows the location of BA and DBE® esters on a Hansen map.

Hansen Solubility Parameters



The versatility and compatibility of FlexiSolv™ benzyl alcohol and DBE® esters with other solvents enables customization of solvent blends to match Hansen solubility parameters of many solvents targeted for replacement.

Many applications for BA are illustrated by the following representative examples taken from the patent literature. Such examples are purely illustrative and their inclusion here does not constitute a representation or warranty regarding 3rd party patents nor does it imply any right to use or indemnification against infringement of 3rd party patents. It is the responsibility of the formulation manufacturer to comply with applicable law.

1. "Process for cleaning and defluxing parts, specifically electronic circuit assemblies." (US5431739, 1995)

"A printed circuit board was treated with a mildly activated rosin flux (RMA) and subsequently soldered. The board was then placed in a standard spray cleaning apparatus. ... After removal and rinsing, the board had no apparent flux residue on the surface. In addition, the solder was bright and clean ..."

<u>Ingredient</u>	<u>Parts by weight</u>
Benzyl alcohol	8
Water	92

2. "Paint stripper compositions having reduced toxicity" (US4732695, 1988)

"A paint stripper and coatings remover composition free of methylene chloride..."

<u>Ingredient</u>	<u>Parts by weight</u>
Benzyl alcohol	30
Klucel thickener	1
Aromatic naphtha	50
N-methyl pyrrolidone	17
Calsoft F-90	1
Monoethanolamine	1

3. "Methylbenzyl formate paint strippers." (US5405548, 1995)

"Aqueous paint stripper formulations..."

<u>Ingredient</u>	<u>Parts by weight</u>
Benzyl alcohol	35
Formic acid	11
Hydroxypropyl methylcellulose	0.8
Propylene glycol	3
2-mercaptobenzothiazole	0.7
Daxad 30 (sodium polymethacrylate)	2
Deionized Water	47.5

4. "Stain Remover." (US patent 3664962, 1972)

"The benzyl alcohol eradicates the stain by solvation. It is especially effective in removing ball-pen ink..."

<u>Ingredient</u>	<u>Parts by weight</u>
Sodium stearate	8.9
Benzyl alcohol	46.1
2-propanol	19.8
Propylene glycol	9.3
Diethylene glycol ethyl ether	10.7
Sodium dodecylbenzenesulfonate	1.3
Water	3.9

5. "Removal Composition and Process for Removing a Cured Epoxy Polymer from a Substrate" (EP32179B1, 1983)

"... remove the cured epoxy from the substrates without deleteriously affecting the other constituents of the electronic integrated circuit modules."

<u>Ingredient</u>	<u>Parts by weight</u>
Benzyl alcohol	85
Triethanolamine	14
FC-128 (fluorinated surfactant)	1

6. "Curing Agent for Epoxy Resins." (GB1344734A, 1974)

"... a curing agent which cures epoxy resins to provide products having very high resistance to solvent and chemical attack."

<u>Ingredient</u>	<u>Parts by weight</u>
Methylene dianiline	50
Benzyl alcohol	44
Salicylic acid	6
Epoxy novolac	10

7. "Multilayered Finish Having Good Stain Resistance" (US4844952, 1989)

"The clear coating composition had a total solids content of 30 percent."

The following ingredients are used as described in Example XXI:

<u>Ingredient</u>	<u>Parts by weight</u>
Water	284.79
NATROSOL 250 MR (thickener)	0.8
amino methyl propanol	0.15
Aerosol OT-75 (surfactant)	1.00

FOAMASTER R (defoamer)	1.50
triethyl phosphate	4.0
2,2,4-trimethyl-1,3-pentanediol monoisobutyrate	27.0
benzyl alcohol	80.0
PERGOPAK M3 (flattening agent)	32.0
RM 825 (thickener)	1.25
acrylic emulsion polymer (stain resistant)	450.0

8. "Cleaner/Degreaser Concentrate Compositions." (US6423677, 2002)

<u>Ingredient</u>	<u>Parts by weight</u>
Benzyl alcohol	68.0
Dodecylbenzenesulfonic acid	16.0
Ammonium hydroxide (28% NH3)	2.8
Biotege PAS-8S, 40% (sodium octanesulfonate)	12.6

"Upon a dilution of 1:12 with water, the concentrate rapidly and readily produced a clear, aqueous solution which was used to remove various markings from alkyd-enameled metal surfaces with the following results:"

<u>Marking (on alkyd enameled metal surface)</u>	<u>Percent removal</u>
Black felt tip Magic Marker	100
Black ballpoint pen	100
Blue ballpoint pen	100
Red (wax) china marker	100
#1 hardness pencil	100

"Upon a dilution of 1:50 with water, the concentrate very easily and very effectively removed fingerprints, smudges, and other surface soilants from painted walls, doors, moldings, and similar surfaces."

Availability, Shipment, Storage and Handling

FlexiSolv™ benzyl alcohol is immediately available in non-returnable drums (210 kg/463 lb net) and is available in bulk on request. BA should be stored in the original, tightly-sealed container in a dry, sheltered, well-ventilated area. Since BA freezes at -15°C (4°F), suitable precautions should be taken where exposure to temperatures below its freezing point is possible.

BA can be stored and handled in stainless steel or other compatible materials. However, BA is an excellent solvent and aggressive toward many polymers, plastics, and elastomers. BA users should consult with the material provider (e.g. manufacturer of the polymer or of specific polymer item) to determine compatibility with BA. When in doubt, compatibility should be tested before exposure to BA.

An approximate shelf life of BA is 2 years, if the product is stored in the original container, kept tightly closed and dry, in a well ventilated location. Because storage and local ambient conditions vary and INVISTA has no control over the practices, procedures and conditions at your or other locations, the shelf life estimate provided here should be used as guidance only. It is not provided as a guarantee of any shelf life.

BA is hygroscopic and will absorb water from exposure to humid air. BA is peroxidizable and exposure to oxygen (air) may form peroxides or other impurities (e.g. benzaldehyde) due to oxidation. BA should be stored in tightly-sealed containers to decrease the possibility of oxidation or water absorbance. Nitrogen or other inert gas padding can be used to reduce air and water exposure. To preserve quality and

minimize oxidation, opened or partially-consumed containers of BA should be re-padded with inert gas before being sealed for storage.

Consult the MSDS for additional information on properties and safe handling of BA.

Physical and Chemical Data

Composition

Benzyl alcohol (CAS number 100-51-6; EINECS number 202-859-9): >99.5%

Chemical formula: C₇H₈O

Molecular weight: 108.14

Specifications

Purity	99.5 min
Color (APHA)	10 max
Benzaldehyde, wt. %	0.1 max
Total Cl, wt. %	0.005 max
Water, wt. %	0.1 max
Acidity, wt. % as benzoic acid	0.1 max
Appearance	Free of particles or sediment

Physical-chemical properties

Viscosity: ³	5.474 cP (25°C)
Density: ³	1.0419 g/cm ³ at 24°C
Index of refraction ³ :	1.5396
Solubility of BA in water: ²	40 g/liter at 20°C
Solubility of water in BA:	~8 wt. %
Kauri Butanol value ⁵	>200
Thermal conductivity, ³	0.159 W m ⁻¹ K ⁻¹ (25°C)
Molar heat capacity: ³	217.9 J g-mol ⁻¹ K ⁻¹
Flash point: ²	101°C
Autoignition temperature: ³	436°C
Enthalpy of combustion: ³	34.56 kJ/g (14,872 BTU/lb)
Freezing / melting point ³ :	-15.4°C (4.3°F)
Enthalpy of fusion: ³	8.97 kJ/g-mol
Boiling point ³ :	205.31°C at 760 mm Hg
Latent heat of vaporization: ³	50.49 kJ/g-mol at 205°C
Surface tension: ³	27.89 mN/m (dyn/cm, at 75°C)
Dielectric constant: ³	11.916 (30°C)

Hansen Solubility Parameters,⁴ (cal/cm³)^{1/2}

non-polar	9.0
polar:	3.1
hydrogen bonding:	6.7

Vapor pressure

Vapor pressure at 20°C	0.03 mm Hg
Temperature where vapor pressure = 0.01 kPa	28°C

² IUCLID Dataset

³ CRC Handbook of Chemistry and Physics, 2008.

⁴ C. Hansen and A. Beerbower, "Solubility Parameters," in Kirk Othmer Encyclopedia of Chemical Technology, Supplemental volume to 2nd Edition, p 889-910.

⁵ ASTM Method D1133

For Samples and Information:
INVISTA Specialty Materials • (800) 231-0998 • Web address: www.FlexiSolv.com

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