



Description

N,N-dimethylformamide, DMF, is a clear, colorless, hygroscopic liquid with a slight amine odor. The solvent properties of DMF are particularly attractive because of the high dielectric constant, the aprotic nature of the solvent, its wide liquid range and low volatility. It is frequently used for chemical reactions and other applications, which require a high solvency power. The product is known as a universal solvent.

Physical and chemical properties

Property	Value
Molecular formula	C ₃ H ₇ NO
CAS N°	68-12-2
EINECS N°	200-679-5
MITI (ENCS) listed	(2)-680
TOSCA listed	68-12-2
Molecular weight	73.09g/mol
Boiling point	153°C
Freezing point	-60.4°C
Density	
20°C	949 kg/m ³
40°C	931 kg/m ³
Vapor pressure	
20°C	0.38 kPa
40°C	1.3 kPa
60°C	3.9 kPa
Dielectric constant, 10kHz, 25°C	36.7
Vapor density	2.5

Property	Value
Critical values	
Temperature	374 °C
Pressure	4.42 Mpa
Volume	3.65 m ³ /kg
Surface tension, 25°C	36.42 mN/m (=dyn/cm)
Refractive index, 25°C	1.4278
Viscosity, 25°C,	0.802 mPa.s (=cP)
Dipole moment, C.m, 20°C	1.27 x 10 ⁻²⁹
Hansen solubility parameters at 25 °C:	$\delta_d = 17.4 \text{ (MPa)}^{1/2}$ $\delta_p = 13.7 \text{ (MPa)}^{1/2}$ $\delta_h = 11.3 \text{ (MPa)}^{1/2}$ $\delta_t = 24.8 \text{ (MPa)}^{1/2}$

The table below shows the thermal properties of DMF.

Flash point	
T closed cup	58 °C
T open cup	67 °C
Autoignition temperature	445 °C
Flammability limits in air	
Lower (100°C)	2.2 vol%
Upper (100°C)	16.0 vol%
Free energy of formation, 25°C	239 kJ/mol
Heat of vaporization	
25°C	47.6 kJ/mol
140°C	38.3 kJ/mol
Heat capacity,	
Liquid at 25°C	2.03 kJ/(kg.K)
Gas at 127°C, 101.3kPa	1.61 kJ/(kg.K)

Specifications

Property	Specification	Test method
DMF	≥ 99.8%	111.90/2
Colour	≤ 10 APHA	111.90/9
DMA	≤ 10 ppm	111.90/7
Formic acid	≤ 3 ppm	111.90/6
Methanol	≤ 100 ppm	111.90/2
Water	≤ 300 ppm	111.90/3
Conductivity at 20 °C	≤ 2.5 µS/cm	111.90/10
pH (20% aqueous solution at 25 °C ± 0.5)	6.5 - 8.5	111.90/5

Packaging

- Polyethylene drums : 200 kg net.
- Iron drums (on request): 195 kg net.
- IBC container : 945 kg
- Road tanker : stainless steel.
- Rail tank car : stainless steel.
- Barge - coaster - sea vessel.

Labeling

See Material Safety Data Sheet.

Transport regulations

See Material Safety Data Sheet.

Toxicology

See Material Safety Data Sheet.

Ecotoxicology

See Material Safety Data Sheet.

Storage and Handling

Dimethylformamide has practically no corrosive effect on ordinary metals with the exception of copper and its alloys.

Dimethylformamide may be stored in stainless steel or aluminum tanks.

Seals should preferably be made of polytetrafluoroethylene (PTFE), polyethylene, or high-density polypropylene.

Dimethylformamide is hygroscopic and it is advisable to store it under nitrogen. Additional technical information may be obtained on request.

As dimethylformamide is very easily absorbed through the skin, it is advisable for personnel to wear masks and polyethylene gloves. Independent breathing apparatus should be worn inside tanks that have contained dimethylformamide.

People susceptible to skin disease or liver and stomach disorders should not be exposed to dimethylformamide.

In the event of accidental spillage of a small amount of the substance, it may be diluted with water and removed without any danger to purification plants.

If the amount spilt is large, the product should be recovered by pumping and then destroyed by incineration or by absorption in a suitable substance for subsequent removal in compliance with current legislation.

First aid

In the event of contact with the skin, remove contaminated clothing under a shower. Wash skin with plenty of water and soap for at least 15 minutes. Wash contaminated clothing before re-use. In case more than half the body surface was covered by dimethylformamide or when the complaints persist, seek medical attention.

If there is contact with the eyes, rinse immediately with plenty of water for at least 15 minutes. Seek medical aid.

If the product has been inhaled, leave the contaminated area immediately. Bring patient in fresh air. In the event of coughing, breathing difficulties, or any other symptoms, seek medical aid even if these symptoms develop several hours after the exposure. Apply oxygen when breathing is difficult, and perform artificial respiration in case of respiratory arrest.

In case of ingestion and absence of convulsions, drink large amounts of water to dilute the substance, induce vomiting and seek medical aid.

Fire risk

With regard to transport regulations, dimethylformamide is classified as FLAMMABLE.

In the event of a fire, water in the form of mist of foam, CO₂, or powder should be used.

Warning: dimethylformamide releases carbon monoxide by decomposition on contact with heat. Fire fighters should therefore be equipped accordingly.

Principal chemical properties

Formation of complexes

Dimethylformamide complexes with a number of substances including the following: SO₃, P₂O₅, POCl₃, HCl, BF₃ metal salts: CoCl₂, NiCl₂, FeCl₃, SnCl₄

Stability

Decomposition reactions, which may be violent with metallic sodium, some halogenated hydrocarbons, inorganic nitrates (particularly magnesium nitrate), triethylaluminum, bromine, and potassium permanganate.

Decomposition into dimethylamine and formaldehyde may occur as a result of UV irradiation.

Hydrolysis

Slight tendency towards hydrolysis in aqueous solution and at elevated temperature. The rate of hydrolysis increases in the presence of acids or alkalis (formation of formic acid and dimethylamine).

Principal applications

The high solubility of polyacrylonitrile in DMF, together with the good miscibility of DMF in water makes DMF the preferred solvent for the production of acrylic fibers. Also the spinning of polyurethane based elastomers is performed from DMF based solutions.

Another significant application is the use of DMF as a solvent for polyurethane-based coatings on leather and artificial leather fabrics.

Polymers like polyvinylchloride, vinylchloride-vinylacetate copolymers and some polyamides are also readily dissolved in DMF. DMF is also used in epoxy based formulations.

The pharmaceutical industry uses DMF as a reaction and crystallization solvent because of its exceptional solvency parameters.

In the petrochemical industry DMF is used for the purification of acetylene from ethylene and butadiene from C₄ streams. Also for the separation of aromatics, which can be easily dissolved by DMF from aliphatic hydrocarbons. Those aliphatics are used in lube oils.

Due to the high solubility of SO₂ in DMF, exhaust combustion streams from high sulfur containing fuels can be purified with CO₂ being recovered.

Inorganic and organic based residual fluxes are highly soluble in DMF; therefore this solvent is used as a cleaner for instance hot-dip tinned parts. DMF is also used as industrial paint stripper.

This high solubility of inorganic substances also leads to the application of DMF in the production of high voltage capacitors.

DMF is also used as carrier for inks and dyes in various printing and fiber-dyeing applications.

DMF is widely used as a solvent, reagent and catalyst in the synthetic organic chemistry.

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