HUNTSMAN

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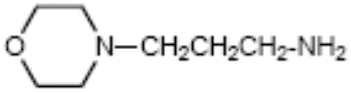
Technical Bulletin

N-AMINOPROPYLMORPHOLINE (APM)

4-Morpholinepropanamine

4-(3-Aminopropyl)morpholine

N-AMINOPROPYLMORPHOLINE (APM) is a clear, essentially colorless, low viscosity amine that is highly reactive with glycidyl ether type resins such as bisphenol A based epoxies.



APPLICATIONS

Due to its low viscosity, APM has found use as reactive diluent in some epoxy formulations. APM contains two amine hydrogen atoms per molecule, thus when used with difunctional resins, such as liquid DGEBA type resins, it will serve as a chain extender. In resin systems of higher functionality it can serve as a crosslinking agent. Because APM reacts quickly with epoxy resins, it may be used to accelerate curing of formulations containing slower amine curatives such as JEFFAMINE® T-403 or JEFFAMINE® D-230 amines.

SALES SPECIFICATIONS

Property	Specifications	Test Method*
APM, wt%	98.5 min.	ST-5.5
Appearance	Clear liquid, substantially free of foreign matter	ST-30.1
Color, Pt-Co	30 max.	ST-30.12
Water, wt%	0.5 max.	ST-31.53, 6

*Methods of Test are available from Huntsman Corporation upon request.

ADDITIONAL INFORMATION

Regulatory Information

DOT/TDG Classification	Amines, liquid, corrosive, n.o.s. (4-morpholinepropanamine)
HMIS Code	3-1-0
WHMIS Classification	E
CAS Number	123-00-2

Chemical Control Laws

Australia, AICS	Listed
Canada, DSL	Listed
Europe, EINECS/ELINCS	Listed
Japan, METI	Listed
United States, TSCA	Listed

Typical Properties

Boiling point, °C (°F)	224 (436)
Flash point, PMCC, °C (°F)	100 (212)
Freezing point, °C (°F)	-15 (5)
Molecular weight	144
Odor	Ammonia-like
pH	12
Refractive index, 25°C	1.4747
Specific gravity, 20/20°C	0.99
Vapor pressure, mm Hg, 20°C (68°F)	.06
Viscosity, cSt, 20°C	6
Water solubility (%)	> 10

TOXICITY AND SAFETY

Acute Toxicity

The results of acute toxicity testing using aminopropylmorpholine (APM) indicate that this product is considered to be slightly toxic by single oral and single dermal exposures. The oral LD_{50} in rats and the dermal LD_{50} in rabbits are 1.79 g/kg and 2.3 g/kg, respectively.

Acute irritation studies have shown this product to be extremely irritating/corrosive to the skin of rabbits, with a Draize normal irritation score of 8.0 (maximum score 8.0). An abbreviated rabbit eye irritation study (single animal screening study) using APM has shown that this product is extremely irritating and corrosive to the eyes, with a Draize ocular irritation score of 70 (maximum score 110).

Genetic Toxicity

A battery of genetic toxicity studies, employing an Ames Assay, a Micronucleus Test, and an Unscheduled DNA Synthesis (UDS) Assay were 3 conducted using aminopropylmorpholine. These studies were negative (non-genotoxic) in their responses to APM.

Human Health Effects and First Aid

On the basis of the above animal toxicity studies, the principal health hazard from accidental exposure to aminopropylmorpholine is a moderate to severe irritation/corrosion of the eyes, skin, and mucous membranes. Chemical-type goggles with face shield must be worn during handling or use of the undiluted product or concentrated solutions. Contact lenses should not be worn. Protective clothing and gloves resistant to chemicals and petroleum distillates must be worn. Should accidental eye and skin contact occur, flush eyes with large amounts of water for at least 15 minutes, after which a physician should be consulted. During flushing of the eyes, eyelids should be held apart to permit rinsing of entire surface of eye and lids.
For skin contact, immediately flush skin with large amounts of water for at least 15 minutes. Clothing wet with the product must be removed immediately and laundered before reuse.

If aminopropylmorpholine is accidentally ingested and the individual is conscious and can swallow, they should be given two large glasses of water, after which a physician should be consulted. Since this product is expected to produce severe irritation/corrosion of mucous membranes, vomiting should **not** be induced due to the possibility of lung damage from aspiration of the product into the lungs during vomiting.

Under usual circumstances of handling and use, exposure to harmful quantities of vapor should not occur. However, certain conditions such as poorly ventilated work areas or heating of the product may result in exposure to appreciable concentrations of aminopropylmorpholine vapors, resulting in irritation of the eyes, nose, and throat, and producing temporary and reversible hazy or blurred vision. These symptoms disappear when exposure to APM is terminated. Adequate ventilation should be provided where a large quantity of product is exposed or where mists or vapors are generated. Spills in confined areas should be cleaned up promptly using appropriate personal protective equipment.

HANDLING AND STORAGE

Carbon steel is a satisfactory material for storing and handling aminopropylmorpholine. Avoid the use of lined tanks or drums, since the product will attack them.

Copper, zinc, lead, or alloys containing any of these materials should not be used, since they will also be attacked by the product.

The freezing point of aminopropylmorpholine is below -45°C and the viscosity is low; therefore, heating the storage tank will not normally be necessary.

Aminopropylmorpholine may discolor when exposed to air. It is also hygroscopic and will pick up moisture. If either of these two characteristics is not acceptable in the intended use of the product, it will be necessary to pad the storage tank. We recommend a dry nitrogen which is also low in carbon dioxide content.

Carbon steel is acceptable for transfer lines. They should be blown or drained clear after each use. Otherwise, the product may discolor when it is left in the lines for an extended period. In cases where it is impossible to drain the

lines, stainless steel will be required. Since the product will leach conventional pipe dopes from threaded connections, the lines should be welded or flanged. Satisfactory gasketing materials are Garlock 7021, U.S. Rubber 899, John Crane 333, Johns-Manville 70, or equivalent.

Carbon steel, centrifugal pumps are satisfactory. Either pump packing or a mechanical seal may be used. Braided Teflon or asbestos are satisfactory packing materials. Seals may be John Crane Type 9, Durametallic Type RO-TT, or equivalent, with either stellite and carbon, or tungsten, faces and Teflon V-rings.

ADDITIONAL INFORMATION

Aminopropylmorpholine and its derivatives are useful as corrosion inhibitors. The reaction of Aminopropylmorpholine with d-butyrolactone gives an amber liquid useful as a corrosion inhibitor in lubricating oils and hydraulic fluids (Ref.1). Organic salts of aminopropylmorpholine are good corrosion inhibitors, sludge preventers, and color stabilizers in fuel oil (Ref. 2). Aminopropylmorpholine itself is an effective corrosion inhibitor for steel in both synthetic and petroleum oil lubricants (Ref. 3).

A copolymer of acrylic acid and methyl acrylate, reacted with aminopropylmorpholine and the successive reaction products converted to the amide and quaternized with allyl r-toluene-sulfonate, produces a durable antistatic agent for textile finishes (Ref. 4). Melt-spun filamentary material, especially nylon yarn, with improved dyeability and adhesion properties is prepared by treatment in the undrawn state with aminopropylmorpholine (Ref. 5).

Nonionic surface-active agents are prepared by reacting fatty acids, naphthenic acids, or rosin acids with aminopropylmorpholine, then adding alkylene oxides (Ref. 6).

Soil conditioners can be prepared from aminopropylmorpholine by conversion to substituted ammonium ions. Treatment of clay soils with such compounds renders them permeable to fluids and makes them stable toward disruption by either mechanical or chemical forces (Ref. 7).

A cross-linked, weakly basic, anion-exchange resin can be made by reaction of aminopropylmorphçline with a polymer made from an acrylic or methacrylic ester (Ref. 8).

Reaction products of disubstituted aminopropylmorpholine with an alkylene oxide are used as catalysts in the manufacture of polyurethanes which have no amine odor, even immediately after formation of the urethane (Ref. 9). Tertiary amine derivatives prepared by cyclocondensation of aminopropylmorpholine with formaldehyde catalyzed the polymerization of toluene diisocyanate isomer mixtures to give an isocyanurate polymer and diol-toluene diisocyanate mixtures to give polyurethanes (Ref. 10).

Pharmaceuticals useful as antiamebic agents (Ref. 11, 12), antihypertensives (Ref. 13, 14, 15, 16), inflammation inhibitors (Ref. 17, 18), tranquilizers (Ref. 18), and antithrombics (Ref. 19) are prepared from aminopropylmorpholine.

Products prepared by reacting aminopropylmorpholine with polyisobutenyl chloride are useful as detergents (Ref. 20), anti-icing additives (Ref. 21), and dispersant additives (Ref. 22) for liquid fuels and lubricating oils.

Motor fuel detergents with a high nitrogen content are prepared by reaction of alkenylsuccinic acid or anhydride with aminopropylmorpholine. The product has improved detergent and rust inhibition in motor fuels (Ref. 23).

Compositions useful as additives for lubricating oils and liquid fuels are prepared by treating a polyisobutene-substituted metal phenoxide with a chlorine-substituted metal carboxylate and then reacting with aminopropylmorpholine (Ref. 24).

Compositions that are useful as antirust, anticorrosion, antisludge, and varnish-inhibiting additives for lubricating oils and liquid fuels are prepared by reacting aminopropylmorpholine with carboxymeth-ylated polyisobutenylphenol-formaldehyde polymers (Ref. 25).

AVAILABILITY

Aminopropylmorpholine is available for shipment in tank cars, tank wagons and drums. Samples are available by contacting our sample department at 1-800-662-0924.

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