Product Safety Assessment

DOW™ Tetraethylenepentamine

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Names

Tetraethylenepentamine mixture (TEPA)
- CAS No. 112-57-2 / 90640-66-7 in Europe
- N-(2-aminoethyl)-N’-[2-[(2-aminoethyl)amino]ethyl]1,2-ethanediame
- 3,6,9,-triazaundecane-1,11-diamine
- 1,11-diamino-3,6,9-triazaundecane
- 3,6,9-triazaundecamethylenediamine
- 1,4,7,10,13-pentazatridecane
- 1,2-ethanediame,N-(2-aminoethyl)-N’-[2-[(2-aminoethyl)amino]ethyl]

Triethylenetetramine mixture (TETA)
- CAS No. 112-24-3 / 90640-67-8 in Europe
- N,N’-bis(2-aminoethyl)-1,2-ethanediame

Pentaethylenehexamine mixture (PEHA)
- CAS No. 4067-16-7
- 3,6,9,12-tetraazatetradecane-1,14-diamine

Product Overview

- DOW™ Tetraethylenepentamine (TEPA) is a mixture of linear, branched and cyclic pentamines (also referred to as ‘congeners’
- This product is a yellow liquid with an ammonia-like odor. It is readily soluble in both water and organic solvents. Dow manufactures a high-purity grade of TEPA containing > 92% of TEPA congeners (TEPA, UHP; TEPA-E). Impurities are triethylenetetramine (TETA) and pentaethylenehexamine (PEHA).
- TEPA is a chemical building block mainly used in the manufacture of epoxy curing agents, lubricating oils, fuels, and polyamide resins. Additional applications include asphalt additives, corrosion inhibitors, paper additives, hydrocarbon recovery and purification, mineral processing aids, surfactants, and textile adhesives.
- Ethyleneamines should be used and stored in closed systems. However, workplace exposure is possible during maintenance, transfer, or sampling operations. Dow is not aware of TEPA being present in consumer products.
- TEPA liquid can cause severe burns to the eyes and skin or to the mouth and throat if swallowed. Exposure to liquid or vapor may result in allergic skin or nose and throat

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*Congeners : related chemical substances "related to each other by origin, structure, or function"
responses. TEPA has low toxicity if ingested, but swallowing may result in gastrointestinal irritation, ulceration, or burns to the mouth and throat.\(^5\) See Health Information.

- Ethylenamines react with many chemicals and require substantial care in handling.\(^6\) TEPA is combustible. It is stable under normal conditions of storage and use.\(^5\) Organic absorbents should not be used to clean up spills. It can react with carbon dioxide in the air to form amine-carbamate salts, which can plug vent or relief lines.\(^2\) See Physical Hazard Information.

### Manufacture of Product\(^7\)

- **Capacity** – Global annual production of ethylenamines was estimated at 468,000 metric tons (1033 million pounds) in 2012. Dow produces ethylenamines in the following locations: Taft, Louisiana (St. Charles Operations) and Terneuzen, The Netherlands.

- **Process** – Tetrathylenepentamine (TEPA) is produced by reacting ethylene dichloride with an excess of ammonia under high pressure and moderate temperature. The resultant solution of various ethylenamines hydrochlorides is neutralized with caustic soda to form TEPA and other ethylenamines, which are separated and purified by distillation. Sodium chloride is formed as a by-product. The material sold as TEPA is a mixture of congeners as shown in the reaction sequence below.

\[
\begin{align*}
\text{EDC} & \xrightarrow{1) \text{NH}_3} \text{TEPA, AE-DAEP, AE-PEEDA, AE-TAEA} \\
& \xrightarrow{2) \text{NaOH}} + \text{NaCl, H}_2\text{O}
\end{align*}
\]

### Product Description\(^5\)

DOW™ Tetraethylenepentamine is a mixture consisting of > 92% of linear, branched and cyclic TEPA congeners (linear TEPA, AE-DAEP, AE-PEEDA and AE-TAEA). The product is a yellow liquid with an ammonia-like odor. It is readily soluble in both water and organic solvents.
Product Uses\(^1,2,8\)

TEPA is a highly reactive chemical used as a building block to produce a wide variety of products. It is used to produce:

- **Epoxy curing agents** – to enhance the performance and application of epoxy coatings, adhesives, laminates, castings, and grouts
- **Lubrication oil additives** – to reduce sludge and varnish build-up in engine oils
- **Polyamide resins** – for varnishes, adhesives, and binders for printing inks
- **Fuel additives** – to enhance detergents used to control fuel system deposits
- **Asphalt additives** – as an adhesion promoter between mineral aggregates and asphalt for paving material and to aid in the formation of asphalt-in-water emulsions
- **Corrosion inhibitors** – to slow corrosion in petroleum production operations
- **Paper additives** – to promote wet-strength properties in paper towels and tissues
- **Surfactants** – for mild soaps and detergents with good foaming characteristics
- **Hydrocarbon purification** – to remove small concentrations of sulfur compounds from hydrocarbons
- **Mineral processing aids** – to aid in the removal of silica impurities in certain ores by flotation techniques
- **Oil production chemicals** – for corrosion inhibitors, demulsifiers, and neutralizers, as well as functional additives that enhance certain separation techniques

Exposure Potential\(^4\)

Tetraethylenepentamine (TEPA) is used in the production of a variety of industrial products. Based on the uses for TEPA, the public could be exposed through:

- **Workplace exposure** – Exposure can occur either in a TEPA manufacturing facility or in the various industrial or manufacturing facilities that use TEPA. It is produced, distributed, stored, and consumed in closed systems. Those working with TEPA in manufacturing operations could be exposed during maintenance, sampling, testing, or other procedures. Each manufacturing facility should have a thorough training program for employees and appropriate work processes, ventilation, and safety equipment in place to limit unnecessary TEPA exposure. See [Health Information](#).
- **Consumer exposure to products containing TEPA** – Dow does not sell TEPA for direct consumer use. It is used to manufacture other products. Dow is not aware of TEPA being present in consumer products. See [Health Information](#).
- **Environmental releases\(^5\)** – In the event of a TEPA spill, the focus is on containing the spill to prevent contamination of soil or surface or ground water. For small spills, TEPA should be absorbed with materials such as sand, clay, or dirt. Do not absorb spills with materials such as organic absorbents, peat moss, ground corn cobs, cellulose, or sawdust. For cleaning up spills and leaks, use an approved air-purifying respirator with an organic vapor cartridge and a particulate prefilter or an air-supply full-face respirator. See [Environmental](#), [Health](#), and [Physical Hazard Information](#).
- **Large release** – Industrial spills or releases are infrequent and generally contained. If a large spill does occur, dike the area to contain the spill. Knockdown and dilute vapors with water

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spray or fog and collect diluted material with vacuum equipment. An approved air-purifying respirator with an organic vapor cartridge and a particulate prefilter is recommended for emergency work. Eliminate all sources of ignition immediately. Use only explosion-proof equipment. Ground and bond all containers and handling equipment. In case of fire, deny any unnecessary entry into the area. Burning liquids may be extinguished by diluting with water, but use of a direct water stream may spread the fire. Use a water fog or fine spray, dry-chemical or carbon-dioxide fire extinguisher, or foam. Alcohol-resistant foams are preferred. Fire fighters should wear positive-pressure, self-contained breathing apparatus (SCBA) and protective fire-fighting clothing and avoid contact with TEPA. If contact is likely, fire fighters should wear full chemical-resistant clothing in addition to SCBA gear. Follow emergency procedures carefully. See Environmental, Health, and Physical Hazard Information.

For more information, see the relevant Safety Data Sheet.

Health Information

Tetraethylenepentamine (TEPA) is a corrosive chemical and must be handled with care. Brief skin contact may cause burns with pain, severe local redness, tissue damage, or an allergic reaction. Prolonged or widespread skin contact may result in absorption of harmful amounts.

Eye contact with TEPA may cause severe irritation or chemical burns with corneal injury, which may result in permanent impairment of vision, even blindness.

Excessive inhalation may cause irritation to the nose and throat.

TEPA has a low toxicity if ingested. However, swallowing may result in gastrointestinal irritation, ulceration, or burns to the mouth and throat. This material can also cause tissue damage or lung injury if aspirated into the lungs.

For more information, see the relevant Safety Data Sheet.

Environmental Information

TEPA is moderately toxic to aquatic organisms. Its bioconcentration potential is low and soil mobility is very high, meaning TEPA is unlikely to accumulate in the food chain. Laboratory testing suggests TEPA will biodegrade very slowly in the environment.

For more information, see the relevant Safety Data Sheet.

Physical Hazard Information

TEPA is stable under normal conditions of storage and use. It can react with carbon dioxide in the air to form amine-carbamate salts, which tend to plug vent and relief lines, compromising pressure-relief systems and introducing solid contaminants into the storage system. Elevated temperatures can cause TEPA to decompose, with the possible release of ammonia, ethylenediamine, or other volatile amines.

Avoid contact with oxidizing materials, acids, acrylates, alcohols, aldehydes, halogenated hydrocarbons, ketones, nitrites, and metals such as brass, bronze, copper, and copper alloys. Avoid using organic absorbents such as ground corn cobs, sawdust, cellulose or peat moss.

For more information, see the relevant Safety Data Sheet.
Regulatory Information
Regulations may exist that govern the manufacture, sale, transportation, use, and/or disposal of TEPA. These regulations may vary by city, state, country, or geographic region. Information may be found by consulting the Safety Data Sheet, Technical Data Sheet, or Contact Us.

Additional Information
- Safety Data Sheet (http://www.dow.com/webapps/msds/msdssearch.aspx)
- Contact Us (http://www.dow.com/amines/contact/)
- Ethyleneamines: Storage and Handling, The Dow Chemical Company, Form No. 108-01350-1101 AMS

For more business information about DOW tetraethylenepentamine, visit the Dow Amines web site at www.dow.com/amines.

References
1 DOW™ Tetraethylenepentamine (TEPA) Technical Data Sheet, The Dow Chemical Company, Form No. 108-01354-1104 AMS
2 Ethyleneamines, The Dow Chemical Company, Form No. 108-01347-801 AMS
3 Ethyleneamines: Storage and Handling, The Dow Chemical Company, Form No. 108-01350-1101 AMS
5 Tetraethylenepentamine Material Safety Data Sheet, The Dow Chemical Company
8 Estimates by The Dow Chemical Company for 2006.
NOTICES:

As part of its 2015 Sustainability Goals, Dow has committed to make publicly available safety assessments for its products globally. This product safety assessment is intended to give general information about the chemical (or categories of chemicals) addressed. It is not intended to provide an in-depth discussion of health and safety information. Additional information is available through the relevant Safety Data Sheet, which should be consulted before use of the chemical. This product safety assessment does not replace required communication documents such as the Safety Data Sheet.

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Form No. 233-00345-MM-0914X