Product Safety Assessment

**DOW™ Triethylenetetramine**

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**Names**

**Triethylenetetramine (TETA)**

- CAS No. 112-24-3
- GNS GS-TETA aliphatic amine
- N,N’-bis(2-aminoethyl)-1,2-ethylenediamine
- N,N’-bis(2-aminoethyl)-1,2-ethanediame
- N,N’-bis(2-aminoethyl) ethane 1,2-diamine
- DAEP
- CAS No. 6531-38-0
- N,N’-bis(2-aminoethyl)-piperazine
- PEEDA
- CAS No. 24028-46-4
- N[(2-aminoethyl)2-aminoethyl]piperazine
- TAEA
- CAS No. 4097-89-6
- tris(2-aminoethyl)amine

**Product Overview**

- DOW™ triethylenetetramine (TETA) is a mixture of four ethyleneamine compounds. It also contains minor amounts of other amines as impurities. At room temperature it is an oily, yellow liquid with an ammonia-like odor. It is readily soluble in both water and organic solvents.¹ See Product Description.
- DOW triethylenetetramine is used in asphalt additives, corrosion inhibitors, epoxy curing agents, fabric softeners, fuel additives, hydrocarbon purification processes, ion-exchange resins, lubrication-oil additives, mineral-processing aids, paper wet-strength resins, oil-field chemicals, polyamide resins, and surfactants.¹ For further details, see Product Uses.
- DOW triethylenetetramine is used and stored in closed systems. However, workplace exposure is possible during maintenance, transfer, or sampling operations. Although DOW triethylenetetramine is not sold for direct consumer use, it can be a component of products used by the public.² ³ For further details, see Exposure Potential.
- Triethylenetetramine 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 respiratory...
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reactions. Dietary feeding studies in animals have reported effects on the lung. For further details, see Health Information.

- DOW™ triethylenetetramine is slightly toxic to aquatic organisms. Its bioconcentration potential is low and mobility in soil is very high. Since it will biodegrade slowly, it would not persist in the environment and would be removed by normal wastewater-treatment processes. For further details, see Environmental Information.

- DOW triethylenetetramine is is stable under normal conditions of storage and use, but can decompose at higher temperatures. Ethyleneamines react with a variety of other chemicals and require substantial care in handling. For further details, see Physical Hazard Information.

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Manufacture of Product

- **Capacity** – Global annual production of ethyleneamines was estimated at 468,100 metric tons (approximately 1 billion pounds) in 2009. Dow produces ethyleneamines in the following locations: Freeport, Texas; Hahnville, Louisiana (St. Charles Operations); and Terneuzen, The Netherlands.

- **Process** – DOW™ triethylenetetramine is produced by reacting ethylene dichloride with an excess of ammonia under high pressure and moderate temperature. The resultant ethyleneamine hydrochloride solution is neutralized with caustic soda to form triethylenetetramine and other ethyleneamines, which are then separated and purified by distillation. Sodium chloride is formed as a by-product. The material sold as triethylenetetramine is a mixture of the four compounds shown below.

\[
\text{Ethylene dichloride} \rightarrow \text{TETA} + \text{DAEP} + \text{PEEDA} + \text{TAEA} + \text{NaCl} + \text{H}_2\text{O}
\]

<table>
<thead>
<tr>
<th>Compound</th>
<th>CAS Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>TETA</td>
<td>122-24-3</td>
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<tr>
<td>DAEP</td>
<td>6531-38-0</td>
</tr>
<tr>
<td>PEEDA</td>
<td>24028-46-4</td>
</tr>
<tr>
<td>TAEA</td>
<td>4097-89-6</td>
</tr>
</tbody>
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Product Description

DOW™ triethylenetetramine is marketed as a mixture of four compounds that are all members of the ethyleneamines family, but with different structures as shown and listed above. Linear triethylenetetramine makes up about 60% of the mixture. At room temperature the mixture is an oily yellowish liquid with an ammonia-like odor and an alkaline pH. It is readily soluble in both water and organic solvents. Triethylenetetramine contains more than 98% of the four compounds noted, but can also have aminoethylethanolamine (CAS No. 111-41-1), aminoethylpiperazine (CAS No. 140-31-8), and tetraethylenepentamine (CAS No. 112-57-2) present as impurities.
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Product Uses

DOW™ triethylenetetramine is used to produce:

- **Epoxy hardeners and 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
- **Marine protective coatings**
- **Paper wet-strength resins** – to promote wet-strength properties in towels and tissues
- **Polyamide resins** – for use in coatings, varnishes, adhesives, and binders for printing inks
- **Other miscellaneous products** – as asphalt additives, corrosion inhibitors, epoxy curing agents, fuel additives and surfactants

Exposure Potential

DOW™ triethylenetetramine is used in the production of a variety of industrial products. Based on the uses for this material, the public could be exposed through:

- **Workplace exposure** – Exposure can occur either in a triethylenetetramine manufacturing facility or in the various industrial or manufacturing facilities that use this material. It is produced, distributed, stored, and consumed in closed systems. Those working with this material 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 exposure. See Health Information.

- **Consumer exposure to products containing DOW triethylenetetramine** – Dow does not sell triethylenetetramine for direct consumer use. It is possible that small, residual amounts of the material can remain in materials made from these products. Always read the product information before use and follow the label/use instructions. See Health Information.

- **Environmental releases** – In the event of a spill, the focus is on containing the spill to prevent contamination of soil and surface or ground water. Eliminate all sources of ignition and ground and bond all containers and handling equipment. For small spills, triethylenetetramine should be absorbed with inert materials such as sand, clay, or dirt. Do not absorb spills with organic absorbents such as peat moss, ground corn cobs, cellulose, or sawdust. Triethylenetetramine is considered slightly toxic to aquatic organisms on an acute basis. It would not persist in the environment and would be removed by normal wastewater-treatment processes. See Environmental, Health, and Physical Hazard Information.

- **Large release** – Industrial spills or releases are infrequent and generally contained. If a large spill does occur, the material should be captured, collected, and reprocessed or disposed of according to applicable governmental requirements. 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. See Environmental, Health, and Physical Hazard Information.

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**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 water fog or fine spray, dry-chemical or carbon-dioxide extinguishers, or foam. Alcohol-resistant foams are preferred. Firefighters should wear positive-pressure, self-contained breathing apparatus (SCBA) and protective firefighting clothing and avoid contact with triethylenetetramine. If contact is likely, firefighters should wear full chemical-resistant clothing in addition to SCBA gear. Follow emergency procedures carefully. See Health and Physical Hazard Information.

For more information, see the relevant Safety Data Sheet.

**Health Information**

**Eye contact** – Contact with triethylenetetramine may cause severe irritation or chemical burns with corneal injury, which could result in permanent vision impairment. Vapor may cause eye irritation with mild discomfort and redness.

**Skin contact** – Brief contact with triethylenetetramine may result in severe burns. Symptoms may include pain, severe local redness, and tissue damage. Prolonged contact may result in absorption of harmful amounts. Skin contact may cause an allergic reaction, particularly for people who have had allergic reactions to similar materials in the past.

**Inhalation** – Vapor inhalation may cause severe irritation to the upper respiratory tract (nose and throat) and lungs. Excessive exposure could aggravate preexisting asthma.

**Ingestion** – Swallowing triethylenetetramine may result in burns to the mouth and throat, as well as gastrointestinal irritation and ulceration. Do not induce vomiting, which could result in aspiration of material into the lungs and consequent lung and tissue damage. Animal dietary feeding studies have reported effects on the liver.

**Other** – Triethylenetetramine has not caused cancer in laboratory animals. In animal feeding studies, high doses showed adverse fetal effects that were believed to be associated with an observed copper deficiency. Exposures having no effect on the mother should have no effect on the fetus. In vivo genetic toxicity studies have been negative.

For more information, see the relevant Safety Data Sheet.

**Environmental Information**

DOW™ triethylenetetramine is slightly toxic to aquatic organisms. Its bioconcentration potential is low and soil mobility is very high. Although DOW triethylenetetramine is not considered readily biodegradable according to Organisation for Economic Co-operation and Development (OECD) guidelines, it does biodegrade slowly in the environment. Therefore it would not persist in the environment and would be removed by normal wastewater-treatment processes.

For more information, see the relevant Safety Data Sheet.
Physical Hazard Information\textsuperscript{4,5,13}

DOW™ triethylenetetramine is stable under normal conditions of storage and use. Elevated temperatures can cause triethylenetetramine to decompose, with the possible release of ammonia, ethylenediamine, or other volatile amines. It can also 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.

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 DOW™ triethylenetetramine. These regulations may vary by city, state, country, or geographic region. Information may be found by consulting the relevant Safety Data Sheet, Technical Data Sheet, or Contact Us.

Additional Information

- Safety Data Sheet (www.dow.com/webapps/msds/msdssearch.aspx)
- Contact Us (www.dow.com/amines/contact/index.htm)
- Ethyleneamines: Storage and Handling, The Dow Chemical Company, Form No. 108-01350, November 2001

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

1 Triethylenetetramine Technical Data Sheet, The Dow Chemical Company, Form No. 108-01353-1001 AMS
4 Triethylenetetramine Material Safety Data Sheet, The Dow Chemical Company

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