Product Safety Assessment

*DOW™ Ethylenediamine*


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**Names**

- CAS No. 107-15-3
- *DOW™ ethylenediamine*
- 1,2-Ethylenediamine
- β-Aminoethylamine
- Diaminoethane
- Ethylenediamine
- 1,2-Diaminoethane
- Dimethylenediamine

**Product Overview**

- *DOW™ ethylenediamine (EDA)* is the lowest molecular weight member of the ethyleneamines family. At room temperature, it is a clear, colorless liquid with an ammonia-like odor.\(^1,2\) For further details, see Product Description.
- *DOW ethylenediamine* is used in chelating agents, corrosion inhibitors, epoxy curing agents, fungicides, fuels, and mineral-processing aids, and as an intermediate in the production of bleach activators, pharmaceuticals, plastic lubricants, polyamide resins, rubber-processing aids, textile additives, and certain polyurethane catalysts.\(^2\) For further details, see Product Uses.
- *DOW ethylenediamine* is used in closed systems. However, workplace exposure is possible during maintenance, transfer or sampling operations.\(^3,4\) Product safety labels should be followed carefully. For further details, see Exposure Potential.
- Ethylenediamine liquid can cause severe burns to the eyes and skin or burns to the mouth and throat if swallowed. Exposure to liquid or vapor may result in an allergic reaction. Ethylenediamine has been toxic to the fetus in lab animals at doses toxic to the mother.\(^5\) For further details, see Health Information.
- *DOW ethylenediamine* is slightly toxic to aquatic organisms. It biodegrades readily in the environment and would not persist. It would be removed by common wastewater-treatment processes. For further details, see Environmental Information.
- *DOW ethylenediamine* is a combustible liquid. It 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.\(^5,6\) 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 2012. Dow produces ethyleneamines in the following locations: Freeport, Texas; Hahnville, Louisiana (St. Charles Operations); and Terneuzen, The Netherlands.
- **Process** – DOW™ ethylenediamine 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 several ethyleneamine products, which are then separated and purified by distillation. Sodium chloride is formed as a by-product. The reaction sequence is shown below.

\[
\begin{align*}
\text{Cl} & \quad \text{CH}_2 \quad [\text{NH}_3^+] \\
\text{CH}_2 & \quad \text{Cl} \\
\end{align*}
\]

\[
\begin{align*}
\text{H}_2\text{C} & \quad \text{NH}_2\text{HCl} \\
\text{H}_2\text{C} & \quad \text{NH}_2\text{HCl} \\
\end{align*}
\]

\[
\begin{align*}
\text{H}_2\text{C} & \quad \text{NH}_2 \quad + \quad \text{NaCl} + \text{H}_2\text{O} \\
\text{H}_2\text{C} & \quad \text{NH}_2 \\
\end{align*}
\]

Dow also produces ethylenediamine using the reductive amination process in which monoethanolamine reacts with ammonia over a catalyst to produce several ethyleneamines, including ethylenediamine.

\[
\begin{align*}
\text{H}_2\text{C} & \quad \text{OH} \\
\text{H}_2\text{N} & \quad \text{CH}_2 \\
\end{align*}
\]

\[
\begin{align*}
\text{H}_2\text{C} & \quad \text{NH}_2 \quad + \quad \text{NH}_3 \quad \text{[catalyst]} \\
\text{H}_2\text{N} & \quad \text{CH}_2 \\
\end{align*}
\]

Product Description

DOW™ ethylenediamine (EDA) is the lowest molecular weight member of the ethyleneamines family. At room temperature, it is a clear, colorless liquid with an ammonia-like odor. DOW ethylenediamine is soluble in both water and alcohol, and dilute solutions have an alkaline pH.

Product Uses

- **Bleach activators** – such as tetraacetylethylenediamine, which is widely used as an activator for peroxygen bleach in home-laundry products
- **Chelating agents** – that form complexes with certain metal ions to prevent the ions from interfering with processing or to promote buffering, concentration, separation, or transport
- **Epoxy curing agents** – to enhance the performance and application of epoxy coatings, adhesives, laminates, castings, and grouts
- **Fuel additives** – to enhance the detergents used to control fuel-system deposits
- **Fungicides** – to prevent mildew, scab, rust, and blight
- **Miscellaneous materials** – for uses such as marine protective coatings, paint, surfactants, polyamide industrial coatings, pharmaceuticals, textile additives, among others

![U.S. Use of Ethylenediamine (2012)](image)
Exposure Potential

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

- **Workplace exposure** – Exposure can occur either in an ethylenediamine 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 ethylenediamine 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 ethylenediamine** – Dow does not sell ethylenediamine for direct consumer use. Based on information provided by Organisation for Economic Co-operation and Development, the concentration of unreacted or residual ethylenediamine in products sold to consumers is low, typically less than 0.5 percent. 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, ethylenediamine 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. This material is considered slightly toxic to aquatic organisms on an acute basis. It biodegrades readily in the environment and would not persist. It would be removed by common wastewater-treatment processes. See Environmental 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. Approved positive-pressure, self-contained breathing apparatus (SCBA) 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 Health and Physical Hazard Information.

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

**Inhalation** – Vapor exposure could cause irritation to the upper respiratory tract (nose and throat) and lungs. Excessive exposure could aggravate preexisting asthma. Ethylenediamine has good warning properties: it can be detected by most people at 2.1 parts per million, below the concentration at which significant adverse affects have been observed.11

**Ingestion** – If swallowed, ethylenediamine has moderate toxicity, but it can cause burns to the mouth and throat, as well as gastrointestinal irritation or ulceration. In animal feeding studies, repeated exposures resulted in observed effects on the liver and kidneys. Ingestion or nausea could result in aspiration of material into the lungs and consequent lung and tissue damage.

**Other** – Ethylenediamine has not caused birth defects or cancer in animal testing. Fetal death has been observed in laboratory animals, but only at doses toxic to the mother. Animal genetic toxicity studies were negative, and no effect on animal reproduction has been observed.

For more information, see the relevant Safety Data Sheet.

**Environmental Information**1,10

DOW™ ethylenediamine is slightly toxic to aquatic organisms. Its bioconcentration potential is low and potential for mobility in soil is very high. It biodegrades readily in the environment and would not persist. It would be removed by common wastewater-treatment processes.

For more information, see the relevant Safety Data Sheet.

**Physical Hazard Information**1, 6,12,13

DOW™ ethylenediamine is stable under normal conditions of storage and use. Elevated temperatures can cause ethylenediamine to decompose, with the possible release of ammonia, carbon dioxide, carbon monoxide, nitrogen oxides, or 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, carbon steel, copper, and copper alloys. Avoid using organic absorbents such as ground corn cobs, sawdust, cellulose or peat moss.

DOW ethylenediamine is often shipped in polyethylene drums, which must be handled properly.

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™ ethylenediamine. 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.

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Additional Information

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

For more business information about DOW™ ethylenediamine, visit the Dow Amines web site at www.dow.com/amines/prod/ethyl-eda.htm.

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References

1 Ethylenediamine Material Safety Data Sheet, The Dow Chemical Company
2 Ethylenediamine Technical Data Sheet, The Dow Chemical Company, Form No. 108-01352-0309

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