Product Safety Assessment

DOW™ Triethanolamine


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Names
• CAS No. 102-71-6
• DOW™ triethanolamine
• TEA
• Triethylolamine
• 2,2′,2″-Trihydroxytriethylamine
• Trihydroxytriethylamine
• Trolamine
• Triethanolamin

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Product Overview
• DOW™ triethanolamine is a member of the ethanolamines family that combines the properties of amines and alcohols. Triethanolamine is typically supplied as a pale colorless to yellow liquid with an ammonia-like odor.¹² For further details, see Product Description.
• Triethanolamine is primarily used in detergents, personal-care products, and textile finishing. Triethanolamine may also be used as in other applications including adhesives, agricultural products, concrete additives, gas treating processes, rubber, surfactants, photographic chemicals, and urethane foams.³ For further details, see Product Uses.
• Triethanolamine is used in closed systems. Workplace exposure can occur either in facilities that manufacture triethanolamine or in the various industrial or manufacturing facilities that use this product. Triethanolamine is not sold directly to consumers, but it is used in very small amounts in personal-care products, soaps, and detergents with which consumers may come into contact. Always read the product label prior to use and carefully follow instructions.³ For further details, see Exposure Potential.
• Contact with triethanolamine may cause slight to severe eye irritation. Brief contact is essentially nonirritating to the skin, but repeated exposure may cause irritation and burns. Skin contact may cause an allergic skin reaction. At room temperature, exposure to vapor is minimal due to low volatility; single exposure is not likely to be hazardous. This product has very low toxicity if swallowed. Harmful effects are not anticipated from swallowing small amounts, but swallowing larger amounts may cause injury. This product has been toxic to the fetus in laboratory animals at doses toxic to the mother. Findings from a study by the National Toxicology

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Program suggest an increased incidence of liver tumors in mice, but their relevant to humans is not clear. Triethanolamine is not classified as a human carcinogen. For further details, see Health Information and the relevant Safety Data Sheet.

- Triethanolamine is water soluble and biodegradable according to the OECD 301A test for biodegradation. It is not expected to bioaccumulate or persist in the environment. Triethanolamine is practically non-toxic to aquatic organisms on an acute basis. However, large releases may increase the pH of aquatic systems to levels that may be toxic to aquatic organisms. For further details, see Environmental Information.
- Triethanolamine is stable under recommended storage and use conditions. Exposure to elevated temperatures can cause the product to decompose. This material is corrosive when wet. Avoid contact with moisture, nitrites, strong acids, strong oxidizers, organic solvents, and halogenated hydrocarbons. For further details, see Physical Hazard Information.

**Manufacture of Product**

- **Capacity** – Worldwide capacity for ethanolamines was 2.37 million metric tons (5.2 billion pounds) in 2011. Dow is the largest global supplier of ethanolamines, with production facilities in Seadrift, Texas, and Hahnville, Louisiana.
- **Process** – DOW™ triethanolamine is produced commercially by reacting three ethylene oxide molecules with each ammonia molecule, as shown below.

\[
\text{NH}_3 + 3\text{H}_2\text{C} = \text{O} \rightarrow \text{N}-(\text{CH}_2\text{-CH}_2\text{-OH})_3
\]

**Product Description**

DOW™ triethanolamine is a colorless to yellow liquid. It is completely soluble in water and has an ammonia-like smell. Triethanolamine is one of a class of organic compounds called ethanolamines, which combine the properties of amines and alcohols and can undergo reactions common to both groups. They can react with acids to form salts or soaps and can also form esters (sometimes used as artificial flavorings and fragrances).

DOW triethanolamine is available in four grades:

- TEA 99% is a tertiary amine used to react with acidic compounds to form salts.
- TEA Commercial Grade is a solution containing ≥85% triethanolamine and ≤15% diethanolamine.
- TEA 99% LFG is a low freeze grade variation of Commercial Grade for easier handling in colder ambient temperatures (freezing point: ~−42°C/−44°F). It is a solution of ~74% triethanolamine, ~15% water, and ~11% diethanolamine.
- TEA 99% is a tertiary amine used to react with acidic compounds to form salts.

**Product Uses**

DOW™ triethanolamine is commonly reacted with acids to form salts or soaps. Typical uses globally are shown in the chart. DOW triethanolamine is used in the following applications:

- **Adhesives** – as an intermediate for adhesive chemicals
- **Agricultural** – as an intermediate for herbicide, molluscide, fungicide, and algicide products
- **Cement** – in the formulation of cement-grinding media during the manufacture of cements
- **Detergents/cleaners/fabric softeners** – to provide efficient cleaning and prevent soil deposition
- **Gas treating** – for a variety of natural gas, petrochemical, and oil treatments

**U.S. Applications for Triethanolamine**

Herbicides 3%
Surfactants 42%
Metalworking Fluids 10%
Cement Grinding 30%
Other 14%
Textiles 1%

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Metalworking fluids – to neutralize acidic components in lubricants and prevent corrosion and rusting and for proprietary corrosion inhibitors and biocides

Personal-care products – to produce soaps for use in hand lotions, cosmetic creams, cleansing creams, shaving creams, and shampoos and for dry-cleaning solvents and heavy-duty liquid laundry detergents

Photographic chemicals – for use in complex modern developing systems used by the photographic chemical industry

Rubber – as an intermediate for chemicals used in the manufacture of rubber

Surfactants – to react with long-chain fatty acids to form surface-active soaps used in emulsifying additives in textile lubricants, polishes, detergents, pesticides, and personal-care products such as hand lotions, shaving creams, and shampoos

Textiles/textile additives – as aids to clean and scour textiles, facilitate wetting, and improve lather and ease of soap removal

Urethane foams – as a catalyst that promotes stability during the reaction process in the manufacture of flexible, rigid, and urethane foams

Exposure Potential

DOW™ triethanolamine is used in the production of industrial and consumer products. Based on the uses for triethanolamine, individuals could be exposed through:

Workplace exposure – Exposure could occur in a triethanolamine manufacturing facility or a facility that makes products using triethanolamine as a raw material. DOW triethanolamine is produced in a closed system to minimize emissions. Potential exposure may occur during process sampling, filter changes, and material loading. Exposure could also occur when working with gas treatments, cement components, metalworking fluids, photographic chemicals, or textile additives that contain triethanolamine. Each manufacturing or industrial facility should have appropriate work processes, ventilation, and safety equipment in place to minimize the risk of exposure. See Health Information.

Consumer exposure to products containing triethanolamine – Dow does not sell triethanolamine for consumer use. However, small amounts are formulated into products that consumers may use, such as soaps, shampoos, cosmetics, and detergents. Always review product labels and follow all instructions and guidelines for proper use. 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. Use dry absorbents (sand, clay) to soak up the spill and then wet down the area with water. Do not use cellulose or sawdust as absorbents. Dispose of contaminated absorbent in water-saturated containers in accordance with governmental requirements. Wear proper protective equipment. Triethanolamine is water soluble and degrades readily. If released to the environment, it will partition to water and degrade rapidly. Small releases will be removed by wastewater-treatment facilities. Triethanolamine is practically non-toxic to aquatic organisms on an acute basis. 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 product should be captured, collected, and reprocessed or disposed of according to applicable governmental requirements. Isolate the area. Keep unnecessary and unprotected personnel from entering the area. Use appropriate safety equipment. Prevent the spill from entering into soil, ditches, sewers, waterways, and/or groundwater. Dike the area to contain the spill. Pump into suitable and properly labeled containers. For small spills, dilute with water. Recover spilled material if possible. Absorb with non-combustible materials such as sand. Remove with a shovel and collect in suitable and properly labeled containers. See Environmental, Health, and Physical Hazard Information.

In case of fire – Keep people away. Isolate the fire and deny unnecessary entry. Use water spray to cool fire-exposed containers and the fire-affected zone until the fire is out and danger of reignition has passed. Fight the fire from a protected location or safe distance. Consider the use of unmanned hose holders or monitor nozzles. Immediately withdraw all personnel from the area in case of rising sound from a venting safety device or discoloration of the container. Burning liquids may be extinguished by dilution with water. Do not use a direct water stream, which may spread the fire. Move container from the fire area if this is possible without hazard. Burning liquids may be moved by flushing with water to protect personnel and minimize property damage. Keep fire water out of waterways and sewers to minimize the potential for environmental damage. Wear positive-pressure, self-contained breathing apparatus (SCBA) and protective firefighting clothing (includes firefighting helmet, coat, trousers, boots, and gloves). Avoid contact with this material during firefighting operations. If contact is likely, change to full chemical resistant firefighting clothing with self-contained breathing apparatus and fight fire from a remote location. Follow emergency procedures outlined in the Safety Data Sheet carefully. See Environmental, Health, and Physical Hazard Information.

For more information, see the relevant Safety Data Sheet.
Health Information
Health information for DOW™ triethanolamine product grades is summarized on the relevant Safety Data Sheets. Health risks associated with individual products vary based on their formulation. The Safety Data Sheet is the preferred source for specific health information. Health information for representative grades of DOW triethanolamine are provided below.

**Triethanolamine 99%**

**Eye contact** – May cause slight eye irritation. Corneal injury is unlikely.

**Skin contact** – Brief contact is essentially nonirritating to the skin. Repeated exposure may cause irritation, even burns. Prolonged skin contact is unlikely to result in absorption of harmful amounts. Skin contact may cause an allergic reaction in a small proportion of individuals.

**Inhalation** – At room temperature, exposure to vapor is minimal due to low volatility; single exposure is not likely to be hazardous. Based on the available data, respiratory irritation was not observed.

**Ingestion** – This material has very low toxicity if swallowed. Harmful effects are not anticipated from swallowing small amounts. Based on physical properties, this material is not likely to be an aspiration hazard.

**Cancer information** – Findings from a chronic skin painting study by the National Toxicology Program (NTP) include liver tumors in mice. Mechanistic studies indicate that tumor formation is of questionable relevance to humans. This material is not classified as a human carcinogen.

**Birth defects/developmental effects** – In animal studies, this material has been toxic to the fetus in laboratory animals at doses toxic to the mother. However, the relevance of this to humans is unknown. Dose levels producing these effects were many times higher than any dose levels expected from exposure due to use.

**Triethanolamine, Commercial Grade (contains 11 to 15% diethanolamine)**

**Eye contact** – May cause severe eye irritation and severe corneal injury.

**Skin contact** – Prolonged contact may cause skin irritation with local redness. Repeated contact may cause skin burns. Symptoms may include pain, severe local redness, swelling, and tissue damage. Prolonged skin contact is unlikely to result in absorption of harmful amounts. Skin contact may cause an allergic reaction in a small proportion of individuals.

**Inhalation** – At room temperature, exposure to vapor is minimal due to low volatility. Vapor from heated material may cause respiratory irritation and other effects.

**Ingestion** – This material has low toxicity if swallowed. Swallowing small amounts incidentally as a result of normal handling operations is not likely to cause injury; however, swallowing larger amounts may cause injury. Based on available information, aspiration hazard could not be determined.

**Repeated exposure** – Results from repeated exposure tests on diethanolamine in laboratory animals include anemia (rats) and kidney effects (rats and mice), and liver effects (mice). Heart and nervous system effects were also observed in animals given exaggerated doses of diethanolamine. Changes in other organs, causes of which are nonspecific, were judged to be secondary to the poor health of the animals due to the extremely high doses of diethanolamine given.

**Cancer information** – Findings from a chronic skin painting study by the NTP include liver tumors in mice. Mechanistic studies indicate that tumor formation is of questionable relevance to humans. Findings from a chronic diethanolamine skin painting study by the NTP include liver and kidney tumors in mice; no tumors were observed in rats. Mechanistic studies indicate that tumor formation is of questionable relevance to humans. A number of factors may have influenced the results and are being considered in their interpretation.
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**Birth defects/developmental effects** – In animal studies, this material has been toxic to the fetus of laboratory animals at doses toxic to the mother. However, the relevance of this to humans is unknown. Dose levels producing these effects were many times higher than any dose levels expected from exposure due to use.

**Reproductive effects** – In animal studies for diethanolamine, effects have been reported on the male reproductive organs. Repeated exposures to high amounts of diethanolamine may cause effects on testes and fertility in males. For more information, see the relevant Safety Data Sheet.

**Environmental Information**

Environmental information for DOW™ triethanolamine is summarized on the relevant Safety Data Sheets. Some grades of these materials may also contain minor components that have additional environmental impact. It is important to note that environmental impact associated with individual products may vary based on their formulation or intended use. The Safety Data Sheet is the preferred source for specific environmental information. An overview of environmental information for DOW triethanolamine appears below.

DOW triethanolamine is expected to partition (preferentially locate) in water when released to the environment. Triethanolamine is water soluble and readily biodegradable according to the OECD 301A Test for biodegradation. Triethanolamine is not likely to bioaccumulate in the food chain (bioconcentration potential is low), and is practically non-toxic (LC50 > 100 mg/L in the most sensitive species tested) to aquatic organisms on an acute basis. Large releases of triethanolamine can affect the pH of nearby water and wastewater-treatment facilities, resulting in possible toxic shock to biologically active species and poor treatment in wastewater-treatment facilities.

Commercial grades of DOW triethanolamine contain a minor component, diethanolamine (11-15%), which is moderately toxic (LC50 between 1 and 10 mg/L in the most sensitive species tested) to aquatic organisms on an acute basis. For more information, see the relevant Safety Data Sheet.

**Physical Hazard Information**

DOW™ triethanolamine is stable under recommended storage and use conditions. Exposure to elevated temperatures can cause this material to decompose. Generation of gas during decomposition can cause pressure in closed systems. Decomposition products depend on temperature, air supply, and the presence of other materials.

Avoid contact with moisture; this material is corrosive when wet. Avoid contact with nitrites, strong acids, and strong oxidizers. This product may potentially react with various halogenated organic solvents, resulting in temperature and/or pressure increases. Heating this material above 60°C (140°F) in the presence of aluminum can result in corrosion and generation of flammable hydrogen gas.

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™ triethanolamine. 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 (www.dow.com/webapps/msds/msdssearch.aspx)
- Contact Us (www.dow.com/amines/contact/index.htm)


References
1. Triethanolamine 99% Material Safety Data Sheet, The Dow Chemical Company
2. Ethanolamines Overview, The Dow Chemical Company, Form No. 111-01375-0103 AMS
4. Triethanolamine, Commercial Grade Material Safety Data Sheet, The Dow Chemical Company
6. Triethanolamine Technical Data Sheet, The Dow Chemical Company, Form No. 111-01412-1204 AMS
7. Ethanolamines Storage and Handling, The Dow Chemical Company, Form No. 111-01374-0103
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