Product Safety Assessment

DOW™ Diethanolamine


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Names
- CAS No. 141-42-2
- DOW™ diethanolamine
- DOW DEA GT Grades
- DEA
- Diethanolamine
- 2,2′-Dihydroxydiethylamine
- Diolamine
- bis-2-Hydroxyethylamine
- 2,2′-Iminobisethanol
- Iminodiethanol
- 2,2′-Iminodiethanol
- Di(2-hydroxyethyl)amine

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Product Overview
- DOW™ diethanolamine (DEA) is a colorless, viscous liquid above its melting point of 28°C (82°F) and a white solid below this temperature. It is one of a class of organic compounds called ethanolamines that combine the properties of amines and alcohols. DOW diethanolamine is offered in commercial grades (>99% and 90%), gas treatment (GT) grades, and a low freezing grade (LFG, 85%). For further details, see Product Description.
- DOW diethanolamine is primarily used in the production of intermediates for herbicides and in personal-care products and gas-treating applications. Other applications include use as intermediates for photographic chemicals and as catalysts that promote stability during the reaction process in the manufacture of urethane foams. For further details, see Product Uses.
- Diethanolamine is used in closed systems. Workplace exposure can occur either in facilities that manufacture diethanolamine or in the various industrial or manufacturing facilities that use this product. Diethanolamine is not sold directly to consumers, but small amounts are formulated into personal care products and detergents used by consumers. Always read the product label prior to use and carefully follow instructions. For further details, see Exposure Potential.
- Diethanolamine can cause eye and skin irritation. It is harmful if swallowed or if mists are inhaled. Repeated exposure may cause liver and kidney damage. Findings from the National Toxicology Program (NTP) demonstrated an increased incidence of liver and kidney tumors in mice, but the relevance to humans is not clear. For further details, see Health Information and the relevant Safety Data Sheet.
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- **DOW™** diethanolamine is water soluble and biodegradable according to the OECD 301F test for biodegradation. This material is not expected to bioaccumulate or persist in the environment. Diethanolamine is moderately toxic to aquatic organisms on an acute basis. For further details, see [Environmental Information](#).
- Diethanolamine is stable under recommended storage and use conditions. Exposure to elevated temperatures can cause this product to decompose. Avoid contact with nitrites, strong acids, and strong oxidizers. For further details, see [Physical Hazard Information](#).

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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™ diethanolamine is produced commercially by reacting two ethylene oxide molecules with each ammonia molecule, as shown below.

\[
\text{NH}_3 + 2\text{H}_2\text{O} + 2\text{C}_2\text{H}_4\text{O} \rightarrow \text{NH}-(\text{CH}_2-\text{CH}_2-\text{OH})_2
\]

*ammonia*  
*ethylene oxide*  
*diethanolamine*

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Product Description

DOW™ diethanolamine is a thick, colorless liquid above its melting point of 82°F (28°C) and a white solid below this temperature. It is completely soluble in water and has an ammonia-like odor. Diethanolamine is one of a class of organic compounds called ethanolamines, which combine the properties of amines and alcohols and are capable of undergoing reactions common to both. Ethanolamines can react with acids to form salts or soaps and can also form esters (sometimes used as artificial flavorings and fragrances).

DOW diethanolamine is offered in the following grades:
- Two commercial grades (>99% and 90%)
- GT grades that are specially formulated for gas treatment
- A low freezing grade (LFG, 85%) with a freezing point of –2°C (28°F) because diethanolamine can become a solid at ambient temperatures

Diethanolamine is a secondary amine – it has two chemical groups and one hydrogen atom attached to the nitrogen. This affects its reactivity with other materials. See [Physical Hazard Information](#).

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Product Uses

DOW™ diethanolamine is used in a wide variety of applications, including:
- **Agricultural** – as chemical intermediates for herbicide, molluscide, fungicide, and algacide products
- **Detergents/cleaners/fabric softeners** – to provide efficient cleaning and prevent soil deposition
- **Cement** – to enhance strength, reduce drying time, and protect against the effects of freezing and thawing
- **Gas treating** – for a variety of natural-gas, petrochemical, and oil treatments
- **Metalworking fluids** – to neutralize acid components in lubricants, prevent corrosion and rusting, and for proprietary corrosion inhibitors and biocides

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Image: U.S. Applications for Diethanolamine

- **Herbicides** 77%  
- **Surfactants** 5%  
- **Gas Purification/Treatment** 14%  
- **Other** 1%  
- **Textiles** 2%  
- **Metalworking Fluids** 1%
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- **Personal-care products** – to make foam stabilizers, emulsifiers, and thickeners for personal-care products such as shampoos, cosmetics, and dishwashing liquids
- **Pharmaceuticals** – as raw materials in the production of antihistamines, antimalarials, antibiotics, local anesthetics, antidepressants, and muscle relaxants
- **Photographic chemicals** – for use in complex modern developing systems used by the photographic chemical industry
- **Textiles/textile additives** – as aids to clean and scour textiles, facilitate wetting, and improve lather and ease of soap removal
- **Urethane foams** – as catalysts that promote stability during the reaction process in the manufacture of flexible and rigid polyurethane foams

**Exposure Potential**

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

- **Workplace exposure** – Exposure could occur in a diethanolamine manufacturing facility or a facility that makes products using diethanolamine as a raw material. DOW diethanolamine 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, metalworking fluids (lubricating fluids), textile additives, or photographic chemicals that contain diethanolamine. Inhalation of diethanolamine could occur during the use of lubricating liquids in various machine building and metallurgy processes. Each manufacturing facility should have a thorough training program for employees and appropriate work processes, ventilation, and safety equipment in place to limit exposure. See Health Information.

- **Consumer exposure to products containing diethanolamine** – Dow does not sell diethanolamine for consumer use. However, it is used in the manufacture of other products that consumers may use, such as soaps, shampoos, cosmetics, and detergents that may contain small amounts of this material. 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. Diethanolamine is water soluble and readily biodegradable. If released to the environment, it will partition to water and degrade rapidly. Small releases will be removed by wastewater-treatment facilities. This product is considered moderately 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 material from entering into soil, ditches, sewers, waterways, and/or groundwater. For small spills, absorb with material such as sand, clay, vermiculite, or Zorb-all®. Collect in suitable and properly labeled containers. Do NOT use absorbent materials such as cellulose, or sawdust. For large spills, contain spilled material if possible. Pump into 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 venting safety device or discoloration of the container. Burning liquids may be extinguished by dilution with water. Do not use 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. Wear positive-pressure, self-contained breathing apparatus (SCBA) and protective firefighting clothing (includes firefighting helmet, coat, trousers, boots, and gloves). If protective equipment is not available or not used, fight the fire from a protected location or safe distance. 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.
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**Health Information**

**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. May cause more severe response if skin is abraded (scratched or cut). This material is not classified as corrosive to the skin according to DOT guidelines.

**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. Swallowing may result in gastrointestinal irritation or ulceration.

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

**Cancer information** – Findings from a chronic diethanolamine skin painting study by 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.

**Birth defects/developmental effects** – Has been toxic to the fetus in laboratory animals at doses toxic to the mother.

**Reproductive effects** – Repeated excessive exposures to high amounts may cause effects on testes and fertility in males.

For more information, see the relevant Safety Data Sheet.

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**Environmental Information**

Environmental information for DOW™ diethanolamine is summarized on the relevant Safety Data Sheets. Some product grades of this material 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 diethanolamine appears below.

Diethanolamine is expected to partition (preferentially locate) in water when released to the environment. This material is water soluble and readily biodegradable according to the OECD 301F Test for biodegradation. Diethanolamine is not likely bioaccumulate in the food chain (bioconcentration potential is low), and is moderately toxic (LC/EC$_{50}$ between 1 and 10 mg/L in the most sensitive species tested) to aquatic organisms on an acute basis. Large releases of diethanolamine can affect the pH of nearby water and wastewater-treatment facilities, resulting in possible toxic shock to biologically active species.

For more information, see the relevant Safety Data Sheet.

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**Physical Hazard Information**

DOW™ diethanolamine 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

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this material above 60°C (140°F) in the presence of aluminum can result in corrosion and generation of flammable hydrogen gas. Avoid unintended contact with halogenated hydrocarbons.

For more information, see the relevant Safety Data Sheet.

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Regulatory Information

Regulations may exist that govern the manufacture, sale, transportation, use, and/or disposal of DOW™ diethanolamine. 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)
- Ethanolamines Storage and Handling, The Dow Chemical Company, Form No. 111-01374-0103 (http://www.dow.com/amines/prod/ethano.htm)

For more business information about DOW™ diethanolamine, visit the Dow Specialty Amines web site at www.dow.com/amines/index.htm or the product webpage at www.dow.com/amines/prod/ethano-dea.htm.

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References

1 DOW™ Diethanolamine Technical Data Sheet, The Dow Chemical Company, Form No. 111-01411-1204 AMS
2 Ethanolamines Overview, The Dow Chemical Company, Form No. 111-01375-0103 AMS
3 Diethanolamine Material Safety Data Sheet, The Dow Chemical Company
5 Dow Amines website – www.dow.com/amines/
6 Ethanolamines Storage and Handling, The Dow Chemical Company, Form No. 111-01374-0103

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