



Product Safety Assessment

DOW™ Anhydrous Hydrogen Chloride

DOW™ Aqueous Hydrochloric Acid

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Names

- CAS No. 7647-01-0
- DOW™ anhydrous hydrogen chloride
- AHCl
- Hydrogen chloride (HCl)
- Hydrogen chloride gas
- Hydrogen chloride, anhydrous
- EC No. 231-595-7
- DOW™ aqueous hydrochloric acid
- AqHCl
- Muriatic acid
- Aqueous HCl

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Product Overview

- Anhydrous hydrogen chloride, also referred to as hydrogen chloride gas, is a clear, colorless gas with an extremely sharp odor. “Anhydrous” means dry or without water. Anhydrous hydrogen chloride is extremely attracted to water and when exposed to air, quickly reacts with the moisture in the air forming white fumes, which are a mist of hydrochloric acid. DOW™ anhydrous hydrogen chloride is sold as liquefied gas. Aqueous hydrochloric acid is a highly corrosive liquid that is formed upon mixing anhydrous hydrogen chloride with water or moisture in the air. It emits a pungent odor and strong fumes in moist air. The color ranges from clear to slightly yellow.^{1,2} For further details, see [Product Description](#).
- DOW anhydrous hydrogen chloride (AHCl) is used as a raw material for the manufacture of other chemicals used in industrial, electronic, pharmaceutical, and consumer applications.³ DOW aqueous hydrochloric acid is produced and sold as an industrial product. It is used in applications such as steel pickling (surface removal of oxide and scale), chemical manufacturing, oil-field acidizing, industrial cleaning, and mining and metal production. Although some aqueous hydrochloric acid is used in food processing applications, Dow does not sell its products for use in those applications.⁴ For further details, see [Product Uses](#).
- Worker exposure to aqueous hydrochloric acid or anhydrous hydrogen chloride is possible during manufacturing. Exposure is also possible during industrial use. Direct consumer contact is unlikely.⁵ For further details, see [Exposure Potential](#).
- Because anhydrous hydrogen chloride gas reacts with moisture to become hydrochloric acid when exposed to air, its health hazards are very similar to aqueous hydrochloric acid. Eye or skin contact

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with these products causes severe burns. Inhalation of fumes may be fatal. Ingestion may cause fluid to form in the lungs and burns of the mouth and throat. Workers that use these materials must wear personal protective equipment and be familiar with the guidelines provided in the product [Safety Data Sheet](#).^{6,7} For further details, see [Health Information](#).

- If released to the environment, anhydrous hydrogen chloride will react with atmospheric moisture (humidity) and standing water to form hydrochloric acid. Hydrochloric acid is not expected to accumulate in the food chain. Hydrogen chloride gas released to the environment will distribute into the air and water. Hydrochloric acid released into water may be toxic to aquatic organisms due to the resulting decrease in pH.^{8,9,10} For further details, see [Environmental Information](#).
- Anhydrous hydrogen chloride is only handled by experienced, thoroughly trained individuals. It is thermally stable. Contact with moisture should be avoided. Anhydrous hydrogen chloride is corrosive to some metals.¹¹ For further details, see [Physical Hazard Information](#).
- Aqueous hydrochloric acid is stable at typical use temperatures. Exposure to elevated temperatures can cause this material to decompose. Heat is generated when hydrochloric acid is mixed with water, and spattering and boiling can result. Avoid contact with sulfuric acid, amines, bases, carbonates, and oxidizers. Aqueous hydrochloric acid is corrosive to most metals. Contact with common metals (i.e. zinc, magnesium, copper) generates extremely flammable hydrogen gas.¹² For further details, see [Physical Hazard Information](#).

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Manufacture of Product^{13,14}

- **Capacity** – Dow produces hydrogen chloride at the following sites in North America: Freeport, La Porte, Oyster Creek, Texas; Plaquemine, Louisiana; and Midland, Michigan. Additionally, Dow produces hydrogen chloride at facilities in Aratu, Brazil; Stade and Schkopau Germany; and Estarreja, Portugal. Global hydrogen chloride production capacity was estimated to be 36,000 metric kilotonnes (79 billion pounds) in 2005.
- **Process** – Anhydrous hydrogen chloride is a co-product of numerous chemical manufacturing operations, including organic synthesis of: isocyanates, fluorocarbons, chlorinated methanes and ethanes, and vinyl chloride monomer. Hydrogen chloride is also formed from inorganic manufacturing of magnesium, fumed silica, titanium dioxide, and sodium bisulfate and potassium bisulfate. DOW™ aqueous hydrochloric acid is produced by mixing anhydrous hydrogen chloride with water.

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Product Description^{15,16}

Anhydrous hydrogen chloride, also referred to as hydrogen chloride gas, is a clear, colorless, nonflammable gas that is heavier than air and has a strong, irritating odor. “Anhydrous” means dry or without water. DOW™ anhydrous hydrogen chloride is sold as liquefied gas.¹⁷

Anhydrous hydrogen chloride is extremely attracted to water and when exposed to air, quickly reacts with the moisture in the air to form dense, white, corrosive fumes, which are a mist of hydrochloric acid. Aqueous hydrochloric acid products are made up of hydrogen chloride gas that is dissolved in water to form a highly corrosive liquid, which also has a pungent odor and emits fumes in moist air. The color ranges from clear to slightly yellow. Aqueous hydrochloric acid chemically dissociates into protons (H⁺) and chloride ions (Cl⁻), similar to table salt (sodium chloride), which dissociates into sodium (Na⁺) and chloride ions.

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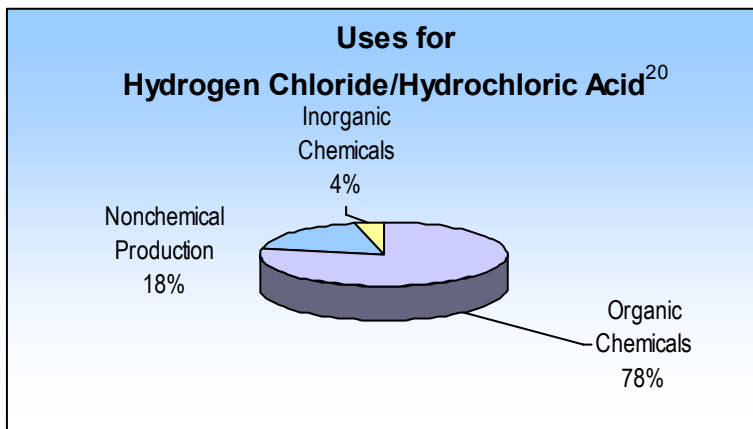
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Product Uses^{18,19,20}

DOW™ anhydrous hydrogen chloride is used as a raw material for the manufacture of other chemicals used in industrial, electronic, pharmaceutical, and consumer applications.

DOW aqueous hydrochloric acid is produced and sold as an industrial product. Industrial uses for this material include:

- **Steel pickling** – to remove oxide (rust) and scale
- **Chemical manufacturing** – for compounds and reactions such as:
 - Inorganic salts
 - Catalyst and/or solvent in organic synthesis
 - Phosphoric acid and ammonium chloride
 - Nitration reactions
 - Neutralization of basic systems
- **Oil-field acidizing** – to increase production of oil and gas wells by acidizing, formation fracturing, cleaning and descaling equipment, and formation cleaning
- **Industrial cleaning**
- **Mining and metal production** – for refining ore, etc.



Some aqueous hydrochloric acid is used in food processing applications; however, Dow does not currently market its products for use in those applications.²¹ Strict guidelines are in place and should be followed for materials that may be ingested as a result of direct or indirect food, feed or pharmaceutical contact applications.

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Exposure Potential^{22,23,24}

Based on the uses for anhydrous hydrogen chloride and aqueous hydrochloric acid, the public could be exposed through:

- **Workplace exposure** – Exposure can occur either in a hydrogen chloride or hydrochloric acid manufacturing facility or in the various industrial or manufacturing facilities that use these materials. Hydrogen chloride and hydrochloric acid are produced, distributed, and stored in closed systems. Those working with these materials 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 hydrogen chloride and aqueous hydrochloric acid** – DOW™ anhydrous hydrogen chloride and DOW aqueous hydrochloric acid are manufactured for industrial use only. Consumer exposure to these materials is unlikely. Gaseous hydrogen chloride occurs naturally in the environment as a result of volcanic eruptions. Small amounts of hydrogen chloride are released into the air by trash incineration. Hydrogen chloride in air is removed by rainfall. Humans produce hydrochloric acid in their stomach to aid in the breakdown of food and kill harmful microorganisms. Although Dow does not sell aqueous hydrochloric acid for consumer use, some household cleaning products such as toilet bowl cleaners, tile and grout cleaners, and rust stain removers contain it.²⁵
- **Environmental releases** – All spills and leaks should be immediately contained to prevent contamination of soil and surface or ground water. Hydrochloric acid released into water may be toxic

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to aquatic organisms due to decreased pH. For small spills, dilute with large quantities of water. Collect in suitable and properly labeled containers. See [Environmental](#) and [Physical Hazard Information](#).

- **Large release** –Industrial spills or releases are infrequent and generally contained. Liquefied anhydrous hydrogen chloride will vaporize into a gas when spilled or released. If this material is released, stop the flow and contain spilled material if possible. Apply vapor suppression foams until spill can be cleaned up. In the event of a large aqueous hydrochloric acid spill, ventilate the area and contain the spilled material if possible. Evacuate personnel upwind of the spill. Only trained and properly protected personnel should be involved in clean-up operations. A positive-pressure, self-contained breathing apparatus (SCBA) is recommended for emergency work. Attempt to neutralize the spill by adding materials such as limestone, lime, or soda ash. Pump recovered material into suitable and properly labeled containers. Contact Dow for clean-up assistance. See [Environmental](#), [Health](#) and [Physical Hazard Information](#).
- **In case of fire** – These materials do not burn. Fight the fire in a manner appropriate for the material that is burning. Keep people away. Stay upwind keeping out of low areas where fumes can accumulate. Isolate the fire and deny unnecessary entry. The application of water is not recommended, but may be applied as a fine spray when other extinguishing agents are not available. Warning! For liquefied gas, carefully consider the effects of adding water. Contact with water results in immediate and violent boiling and frothing. Contain fire water run-off if possible. Uncontained fire water run-off may cause environmental damage. Firefighters should wear positive-pressure, self-contained breathing apparatus (SCBA) and protective firefighting clothing. Follow emergency procedures carefully. See [Environmental](#), [Health](#) and [Physical Hazard Information](#).

For more information about protective equipment and procedures, see the relevant [Safety Data Sheet](#).

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Health Information^{26,27}

Because anhydrous hydrogen chloride gas reacts with moisture to become hydrochloric acid when exposed to air, its health hazards are very similar to aqueous hydrochloric acid.

Eye contact – Eye contact with hydrochloric acid may cause pain disproportionate to the level of irritation to eye tissues. Contact may cause severe irritation with corneal injury, which may result in permanent impairment of vision, even blindness. Chemical burns may occur. Hydrochloric acid vapor may cause lacrimation (tears).

Skin Contact – Brief skin contact may cause severe burns. Symptoms may include pain, severe local redness, and tissue damage. Prolonged skin contact is unlikely to result in absorption of harmful amounts. Skin contact with liquid anhydrous hydrogen chloride may cause frostbite.

Inhalation – Easily attainable vapor concentrations may cause serious adverse effects, even death. Excessive inhalation may cause severe irritation to the upper respiratory tract (nose and throat) and lungs. Inhalation may cause severe pulmonary edema (fluid in the lungs). Excessive exposure may injure the lungs.

Ingestion – Swallowing hydrochloric acid may result in burns of the mouth and throat as well as gastrointestinal irritation or ulceration. Aspiration into the lungs may occur during ingestion or vomiting causing tissue damage or lung injury.

Repeated exposure – Repeated excessive exposure may cause erosion of the teeth and bleeding and ulceration of the nose, mouth, and gums.

Cancer Information – This material did not cause cancer in laboratory animals. An epidemiology study of workers did not show any association between hydrogen chloride exposure and lung cancer.

For more information, see the relevant [Safety Data Sheet](#).

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Environmental Information^{28,29,30,31}

Anhydrous hydrogen chloride released into the environment will distribute in the air and water. Once released to the environment, anhydrous hydrogen chloride will react with atmospheric moisture (humidity) and standing water to form hydrochloric acid. Hydrogen chloride does not accumulate in the food chain because of its high water solubility. Hydrogen chloride in air will be removed by rainfall. In water, hydrogen chloride dissociates (breaks up) into hydronium ions (H⁺) and chloride ions (Cl⁻). The dissociation of hydrogen chloride in water lowers the pH of the water, making it more acidic. pH Levels below 5 could be toxic to fish and other aquatic organisms. If released to soil, hydrogen chloride will evaporate from dry soil, and dissociate into hydrochloric acid (form H⁺ and Cl⁻ ions) in moist soil.

The [Organisation for Economic Co-operation and Development \(OECD\) SIDS Initial Assessment Profile for Hydrogen Chloride](#) concluded that, although this chemical possesses corrosive properties indicating a hazard for human health and the environment, based on its use pattern, the chemical is currently of low priority for further work provided sufficient control measures are in place to avoid human exposure and environmental impact. The report may be reviewed at the link: (<http://www.inchem.org/documents/sids/sids/7647010.pdf>).

For more information, see the relevant [Safety Data Sheet](#).

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Physical Hazard Information^{32,33}

Anhydrous hydrogen chloride is thermally stable. It is corrosive to some metals. Avoid contact with metals. Anhydrous hydrogen chloride should only be handled by trained professionals.

Aqueous hydrochloric acid is thermally stable at typical use temperatures. Exposure to elevated temperatures can cause this material to decompose. Heat is generated when this material is mixed with water, and pattering and boiling can result. Avoid contact with sulfuric acid, amines, bases, carbonates, and oxidizers. Aqueous hydrochloric acid is corrosive to most metals. Contact with common metals can generate hydrogen gas, which is flammable.

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 aqueous hydrogen chloride. These regulations may vary by city, state, country, or geographic region. Information may be found by consulting the relevant [Safety Data Sheet](#) or [Contact Us](#).

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Additional Information

- Safety Data Sheets (<http://www.dow.com/webapps/msds/msdssearch.aspx>)
- [Contact Us](#) (Dow Customer Information Group (<http://www.dow.com/assistance/dowcig.htm>))
- *Aqueous Hydrochloric Acid*, Technical Data Sheet, The Dow Chemical Company, Form No. 102-00513-0306QRP, March 2006
- The Chlorine Institute (www.cl2.com) has the following resources detailing the safe use and handling of aqueous hydrochloric acid:
 - Pamphlet 65: "Protective Equipment for Chlor-Alkali Chemicals"
 - Pamphlet 98: "Recommended Practices for Handling Hydrochloric Acid in Tank Cars"
 - Pamphlet 150: "Recommendations and Practices for Handling HCl in Cargo Tanks"
 - Pamphlet 163: "Hydrochloric Acid Storage and Piping Systems"
 - HCl Video: "Handling Hydrochloric Acid Safely"
 - *Anhydrous Hydrogen Chloride Release Fact Sheet*

- *Screening Information Data Set (SIDS) Initial Assessment Report for SIAM 15 – Hydrogen Chloride: CAS No. 7647-01-0*, Organisation for Economic Co-operation and Development (OECD) United Nations Environment Programme (UNEP): Boston, Massachusetts, USA, 22-25 October, 2002 (<http://www.inchem.org/documents/sids/sids/7647010.pdf>)
- “ToxFAQs for Hydrogen Chloride,” Agency for Toxic Substances and Disease Registry (ATSDR), April 2002, webpage: (<http://www.atsdr.cdc.gov/tfacts173.html>)
- U.S. Department of Health and Human Services Household Products Database – Search hydrochloric acid (<http://www.google.com/search?hl=en&source=hp&q=nih+household+products+database&aq=0&oq=NIH+house&aqi=g2>)

For more business information about DOW™ anhydrous hydrogen chloride and DOW™ aqueous hydrochloric acid, contact Dow’s Customer Information Group at www.dow.com/assistance/dowcig.htm.

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References

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- ⁵ *HCl, aqueous 31.5% Technical Grade (20 degrees Baumé) Material Safety Data Sheet*, The Dow Chemical Company, February 12, 2008, pages 3–4.
- ⁶ *HCl, aqueous 31.5% Technical Grade (20 degrees Baumé) Material Safety Data Sheet*, The Dow Chemical Company, February 12, 2008, pages 1–2 and 5.
- ⁷ *HCl, anhydrous gas – High Purity Material Safety Data Sheet*, The Dow Chemical Company, January 15, 2007, pages 1–2 and 5.
- ⁸ *Aqueous HCl 31.5% Material Safety Data Sheet*, The Dow Chemical Company, February 12, 2008, page 5.
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- ¹³ Lacson, Jamie, Schlag, Stefan, Sakuma, Yas, “Marketing Research Report: Hydrochloric Acid,” *Chemical Economics Handbook*, SRI Consulting, February 2006, pages 8-11 and 15-19.
- ¹⁴ *SIAR for SIAM 15 – Hydrogen Chloride: CAS No. 7647-01-0*, OECD, UNEP, Boston, MA, 22-25 October, 2002, pages 5 and 8.
- ¹⁵ “ToxFAQs for Hydrogen Chloride,” Agency for Toxic Substances and Disease Registry (ATSDR), April 2002, page 1.
- ¹⁶ *HCl, aqueous 31.5% Technical Grade (20 degrees Baumé) Material Safety Data Sheet*, The Dow Chemical Company, February 12, 2008, pages 1, 2, and 4.
- ¹⁷ *Anhydrous Hydrogen Chloride Release Fact Sheet*, The Chlorine Institute, Inc., page 1.
- ¹⁸ *Aqueous Hydrochloric Acid*, Technical Data Sheet, The Dow Chemical Company, Form No. 102-00513-0306QRP, March 2006, page 1.

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- ²⁴ *HCl, anhydrous gas – High Purity Material Safety Data Sheet*, The Dow Chemical Company, January 15, 2007, pages 2–4 and 5.
- ²⁵ U.S. Department of Health and Human Services Household Products Database.
- ²⁶ *HCl, aqueous 31.5% Technical Grade (20 degrees Baumé) Material Safety Data Sheet*, The Dow Chemical Company, February 12, 2008, pages 1–2 and 5.
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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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