

8.6 Hydrochloric Acid

8.6.1 General¹

Hydrochloric acid (HCl) is listed as a Title III Hazardous Air Pollutant. Hydrochloric acid is a versatile chemical used in a variety of chemical processes, including hydrometallurgical processing (e. g., production of alumina and/or titanium dioxide), chlorine dioxide synthesis, hydrogen production, activation of petroleum wells, and miscellaneous cleaning/etching operations including metal cleaning (e. g., steel pickling). Also known as muriatic acid, HCl is used by masons to clean finished brick work, is also a common ingredient in many reactions, and is the preferred acid for catalyzing organic processes. One example is a carbohydrate reaction promoted by hydrochloric acid, analogous to those in the digestive tracts of mammals.

Hydrochloric acid may be manufactured by several different processes, although over 90 percent of the HCl produced in the U. S. is a byproduct of the chlorination reaction. Currently, U. S. facilities produce approximately 2.3 million megagrams (Mg) (2.5 million tons) of HCl annually, a slight decrease from the 2.5 million Mg (2.8 million tons) produced in 1985.

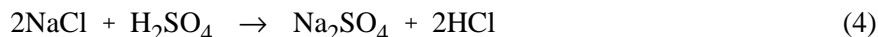
8.6.2 Process Description¹⁻⁴

Hydrochloric acid can be produced by 1 of the 5 following processes:

1. Synthesis from elements:



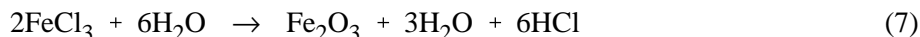
2. Reaction of metallic chlorides, particularly sodium chloride (NaCl), with sulfuric acid (H₂SO₄) or a hydrogen sulfate:



3. As a byproduct of chlorination, e. g., in the production of dichloromethane, trichloroethylene, perchloroethylene, or vinyl chloride:



4. By thermal decomposition of the hydrated heavy-metal chlorides from spent pickle liquor in metal treatment:



5. From incineration of chlorinated organic waste:

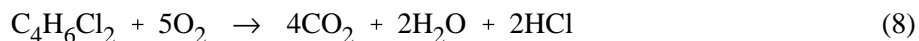


Figure 8.6-1 is a simplified diagram of the steps used for the production of byproduct HCl from the chlorination process.

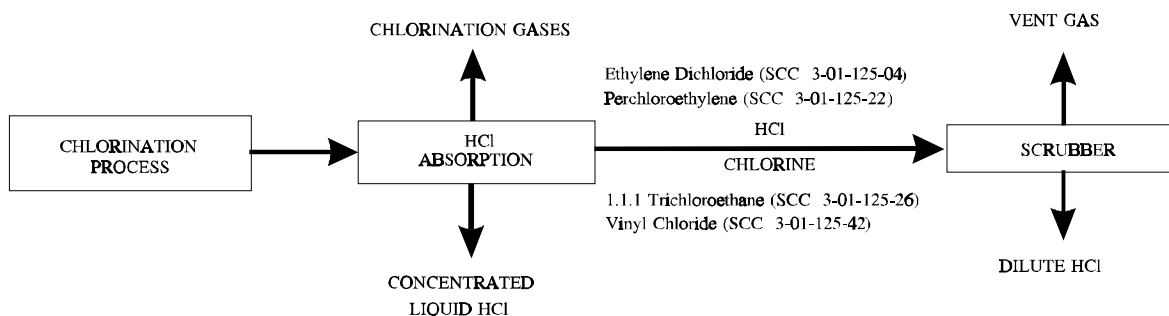


Figure 8.6-1. HCl production from chlorination process.
(SCC = Source Classification Code.)

After leaving the chlorination process, the HCl-containing gas stream proceeds to the absorption column, where concentrated liquid HCl is produced by absorption of HCl vapors into a weak solution of hydrochloric acid. The HCl-free chlorination gases are removed for further processing. The liquid acid is then either sold or used elsewhere in the plant. The final gas stream is sent to a scrubber to remove the remaining HCl prior to venting.

8.6.3 Emissions^{4,5}

According to a 1985 emission inventory, over 89 percent of all HCl emitted to the atmosphere resulted from the combustion of coal. Less than 1 percent of the HCl emissions came from the direct production of HCl. Emissions from HCl production result primarily from gas exiting the HCl purification system. The contaminants are HCl gas, chlorine, and chlorinated organic compounds. Emissions data are only available for HCl gas. Table 8.6-1 lists estimated emission factors for systems with and without final scrubbers. Units are expressed in terms of kilograms per megagram (kg/Mg) and pounds per ton.

Table 8.6-1 (Metric And English Units). EMISSION FACTORS FOR HYDROCHLORIC ACID MANUFACTURE^a

EMISSION FACTOR RATING: E

| Byproduct Hydrochloric Acid Process | HCl Emissions | |
|---|--------------------|---------------------|
| | kg/Mg HCl Produced | lb/ton HCl Produced |
| With final scrubber (SCC 3-01-011-99) ^b | 0.08 | 0.15 |
| Without final scrubber (SCC 3-01-011-99) ^b | 0.90 | 1.8 |

^a Reference 5. SCC = Source Classification Code.

^b This SCC is appropriate only when no other SCC is more appropriate. If HCl is produced as a byproduct of another process such as the production of dichloromethane, trichloroethane, perchloroethylene, or vinyl chloride then the emission factor and SCC appropriate for that process vent should be used.

References For Section 8.6

1. *Encyclopedia Of Chemical Technology, Third Edition*, Volume 12, John Wiley and Sons, New York, 1978.
2. *Ullmann's Encyclopedia Of Industrial Chemistry, Volume A*, VCH Publishers, New York, 1989.
3. *Encyclopedia Of Chemical Processing And Design*, Marcel Dekker, Inc., New York, 1987.
4. *Hydrogen Chloride And Hydrogen Fluoride Emission Factors For The NAPAP (National Acid Precipitation Assessment Program) Emission Inventory*, U. S. Environmental Protection Agency, Research Triangle Park, NC, October 1985.
5. *Atmospheric Emissions From Hydrochloric Acid Manufacturing Processes*, AP-54, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1969.