Hydrochloric Acid

HCl

(liquid)

D Direct Use Chemical P Precursor Chemical

Inputs to Manufacturing Process:
Chlorine
Hydrogen
Organic Chemicals

% of Total Domestic Consumption Attributed to Water Sector:
Less than 1%

Product Family:
Chlor-alkali

CAS No.:
7647-01-0

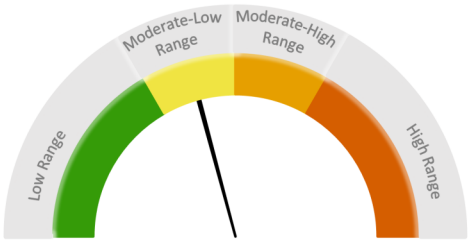
Derivative Water Treatment Chemicals:
Ferrous Chloride
Polyaluminum Chloride
Ferric Chloride
Zinc Orthophosphate

Understanding Chemical Supply Chains
Map of Suppliers & Manufacturers

Shelf Life:
12-24 Months

RISK OF SUPPLY DISRUPTION (Assessed in 2022)

RISK RATING: Moderate-Low



RISK DRIVERS

Hydrochloric acid production is directly dependent on chlorine. It is primarily produced as a co– or byproduct in the manufacturing of chlorinated derivative chemicals. Demand for chlorine and chlorine derivative products, as well as demand for end uses has resulted in supply disruptions.

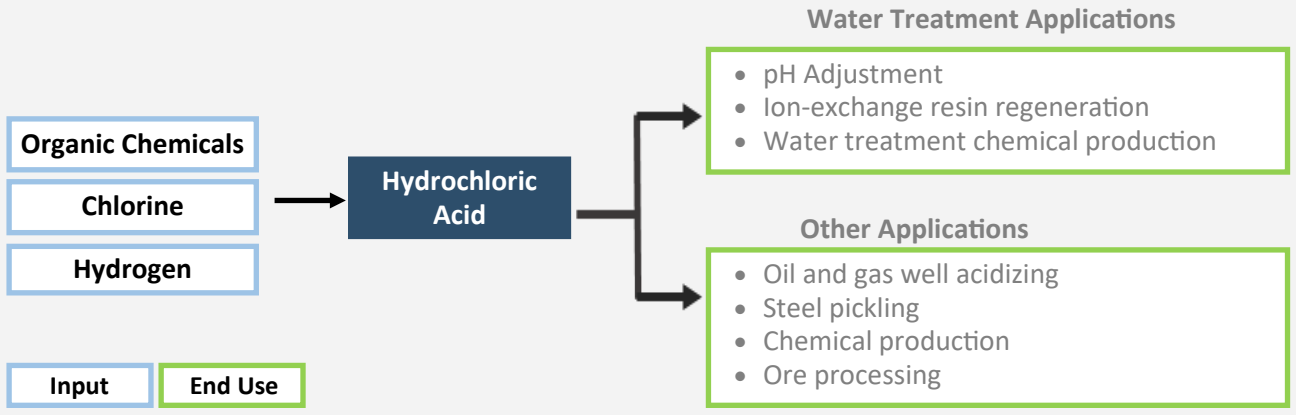
RISK PARAMETERS

Criticality: High. Essential for pH adjustment and production of water treatment chemicals.

Likelihood: High. Previous regional disruptions in supply that impacted the water sector.

Vulnerability: Low. Distributed domestic manufacturing and supply.

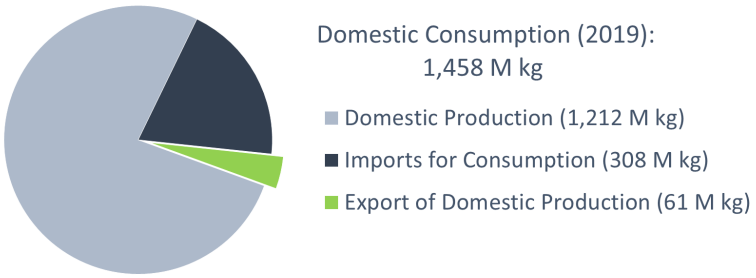
MANUFACTURING PROCESS



DOMESTIC PRODUCTION AND CONSUMPTION, AND INTERNATIONAL TRADE

Domestic Manufacturing Locations (2015):
94, distributed throughout the U.S.

International Trade (2019)
Primary Trading Partner (Imports): Canada
Primary Trading Partner (Exports): Canada



Product Description

Hydrochloric acid (HCl) is an inorganic, strong acid that is widely used for pH adjustment. It is a key input in the commercial manufacture of several other water treatment chemicals. Hydrochloric acid is primarily manufactured as a byproduct of manufacturing chlorinated organic chemicals or through combination of the chlor-alkali co-products chlorine and hydrogen. The majority of hydrochloric acid manufactured in the U.S. is used in oil and gas well acidification, steel pickling, and food manufacturing.

Use in Water Treatment

Hydrochloric acid is used in water treatment for pH adjustment and the regeneration of ion-exchange resins.

Use as a Precursor to Other Water Treatment Chemicals

Hydrochloric acid is used to manufacture ferrous chloride, ferric chloride, polyaluminum chloride, and zinc orthophosphate.

Other Applications

Hydrochloric acid has a wide range of applications. The leading uses of hydrochloric acid are steel pickling, oil well acidification, food manufacturing, ore processing, and organic and inorganic chemical production (OxyChem, 2018).

Primary Industrial Consumers

In 2011, the use of hydrochloric acid in oil and gas well acidification accounted for 30% of domestic consumption, followed by steel pickling and food processing, which each accounted for 19% of domestic consumption. A variety of other applications including organic chemical production, ore processing, and water treatment applications accounted for the remaining 32%. While the percentage of consumption accounted for by water treatment is unknown, it is believed to be less than 1% based on estimates of other uses (McCoy, 2012; NCBI, 2021).

Manufacturing, Transport, & Storage

Manufacturing Process

Over 90% of hydrochloric acid is produced as a byproduct from the production of chlorinated solvents, fluorocarbons, isocyanates, organics, magnesium, and vinyl chloride monomer. Hydrochloric acid is produced as a gas, generally referred to as hydrogen chloride, while the solution is more commonly referred to as hydrochloric acid, however the terms are often used interchangeably. Hydrogen chloride gas is readily absorbed by water. As chlorination of an organic compound takes place, the hydrogen chloride-containing gas stream goes to an absorption tower where concentrated hydrochloric acid is produced by absorption of hydrogen chloride gas into a weak solution of hydrochloric acid. Less than 10% of U.S. hydrochloric acid production is made by the direct reaction of hydrogen and chlorine, generally referred to as the thermal method (EPA, 2019; NCBI, 2021; OxyChem, 2018). Both manufacturing methods, depicted in Figure 1, depend on the chlor-alkali industry for inputs.

Hydrochloric Acid Produced as a Byproduct of Chlorination of Aliphatic Hydrocarbons

Chloromethane + Chlorine → Chloroform + Hydrochloric Acid

$CH_3Cl + 2Cl_2 \rightarrow CHCl_3 + 2HCl$

Hydrochloric Acid Produced from the Reaction of Hydrogen and Chlorine

Hydrogen + Chlorine → Hydrochloric Acid

$H_2 + Cl_2 \rightarrow 2HCl$

Figure 1. Chemical Equation for the Reaction to Manufacture Hydrochloric Acid

Product Transport

Hydrochloric acid can be transported in bulk or smaller containers by truck, rail, barge, and ship (OxyChem, 2018).

Storage and Shelf Life

Hydrochloric acid is a highly corrosive and hazardous chemical, and should be stored in non-reactive storage vessels at room temperature in a dry, cool place. When stored properly, hydrochloric acid can have a shelf life of 12 to 24 months, depending on concentration and size of storage container (NCBI, 2021).

Domestic Production & Consumption

Domestic Production

Production data was collected from 2020 EPA Chemical Data Reporting (CDR), while trade data was collected from the U.S. International Trade Commission (USITC) Dataweb, as shown in Table 1. Both production and trade data are specific to hydrochloric acid.

Table 1. Hydrochloric Acid Production and Trade Data Sources

Production and Trade Data			
Category	**Data Source**	**Identifier**	**Description**
Domestic Production	2020 TSCA Chemical Data Reporting	CAS No.: 7647-01-0	Hydrochloric acid
Imports and Exports	U.S. International Trade Commission	HS Code: 2806.10	Hydrochloric Acid

Total U.S. domestic production of hydrochloric acid was approximately 1,212 million kilograms (M kg) in 2019 (EPA, 2020). A substantial portion of domestic commercial manufacture of hydrochloric acid is integrated into production of other chemicals such as dichloroethane and vinyl chloride for polyvinyl chloride production (USITC, 1992). Many chemical manufacturers produce hydrochloric acid and subsequently use it as an intermediary in chemical production (EPA, 2003; McCoy, 2012). Some of the primary manufacturing locations in the U.S. are owned by *Shintech, Formosa Plastics Corporation,* and *Superior Plus US Holdings Inc.* The number of domestic manufacturing locations shown in Figure 2 represents operating facilities as of 2015 (EPA, 2016). Supply of NSF/ANSI Standard 60 certified hydrochloric acid for use in drinking water treatment is widely distributed throughout the U.S. (NSF International, 2021). For a more current listing of manufacturing locations and supplier locations, visit the U.S. Environmental Protection Agency's (EPA's) Chemical Locator Tool (EPA, 2022a).

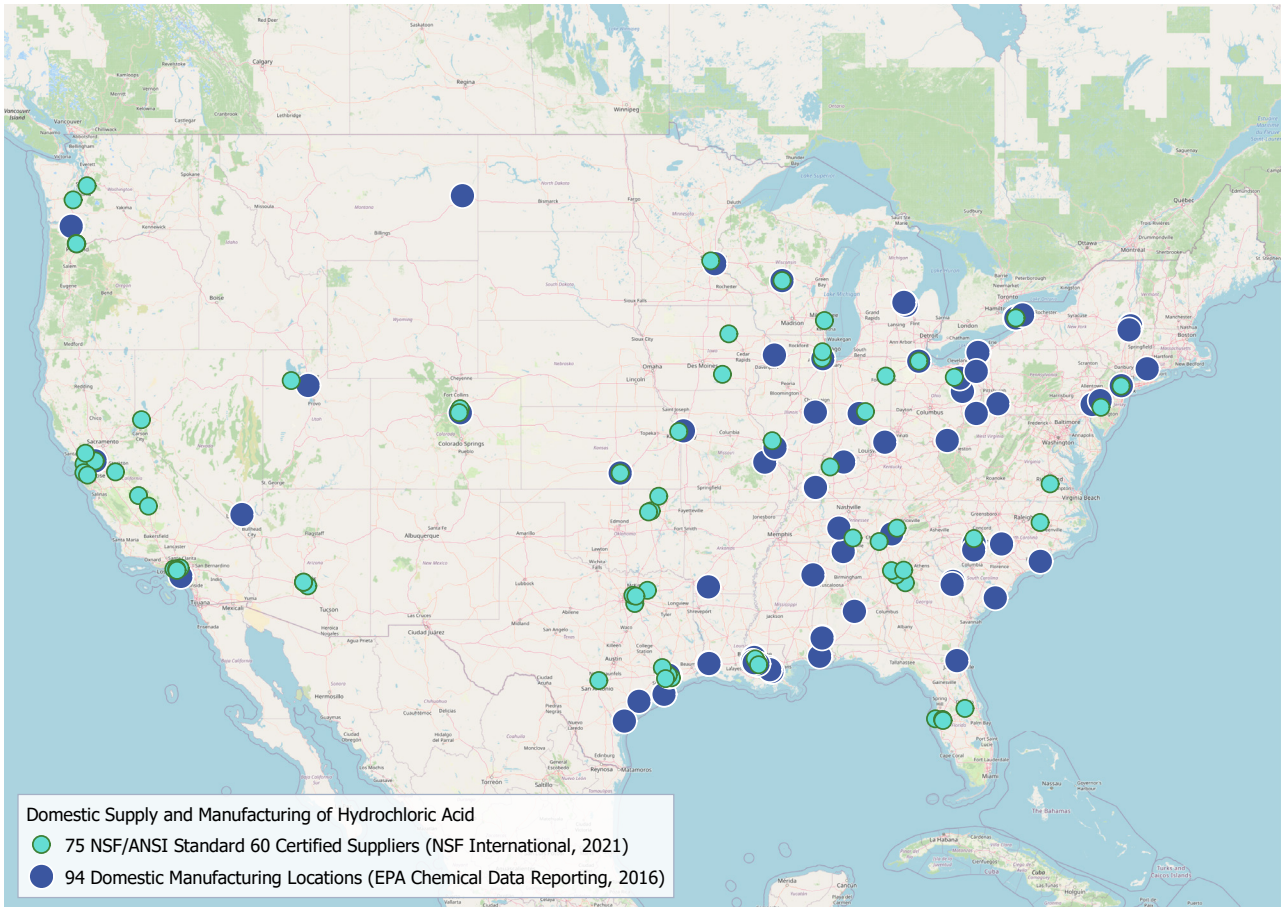


Figure 2. Domestic Supply and Manufacturing of Hydrochloric Acid

Domestic Consumption

U.S. consumption of hydrochloric acid in 2019 is estimated at 1,458 M kg. This estimate includes production of 1,212 M kg, import of 308 M kg, minus export of 61 M kg (EPA, 2020; USITC, 2021), as shown in Figure 3.

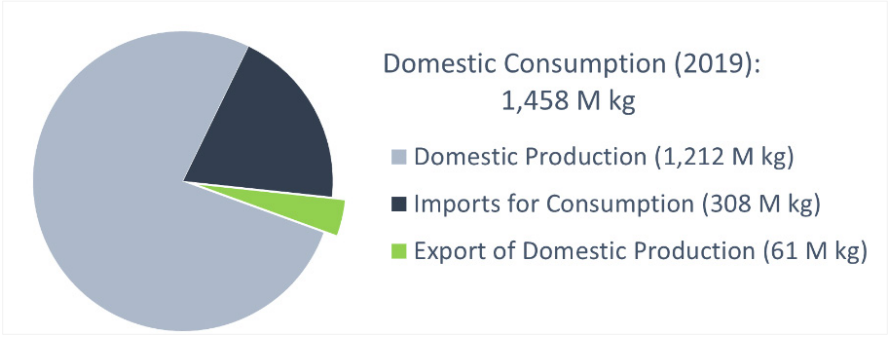


Figure 3. Domestic Production and Consumption of Hydrochloric Acid in 2019

Trade & Tariffs

Worldwide Trade

Worldwide import and export data for hydrochloric acid are reported through the World Bank's World Integrated Trade Solutions (WITS) software, as a category specific to hydrochloric acid. In 2021, the U.S. ranked tenth worldwide in total exports and first in total imports of hydrochloric acid. In 2021, Germany ranked first

worldwide in total exports (WITS, 2022), as shown in Table 2.

Table 2. WITS Worldwide Export and Import of Hydrochloric Acid in 2021

2021 Worldwide Trade Hydrochloric Acid (HS Code 2806.10)			
Top 5 Worldwide Exporters		Top 5 Worldwide Importers	
Germany	615 M kg	**United States**	**328 M kg**
Canada	317 M kg	Germany	250 M kg
Belgium	257 M kg	France	242 M kg
Netherlands	171 M kg	Netherlands	237 M kg
Hungary	138 M kg	Belgium	145 M kg

Domestic Imports and Exports

Domestic imports and export data are reported by USITC in categories specific to hydrochloric acid. Figure 4 summarizes imports for consumption[1] and domestic exports[2] of hydrochloric acid between 2015 and 2020. During this period, the overall quantity of exports and imports remained steady, with imports for consumption exceeding domestic exports. Over this five-year period, Canada was the primary recipient of domestic exports and the primary source of imports (USITC, 2021).

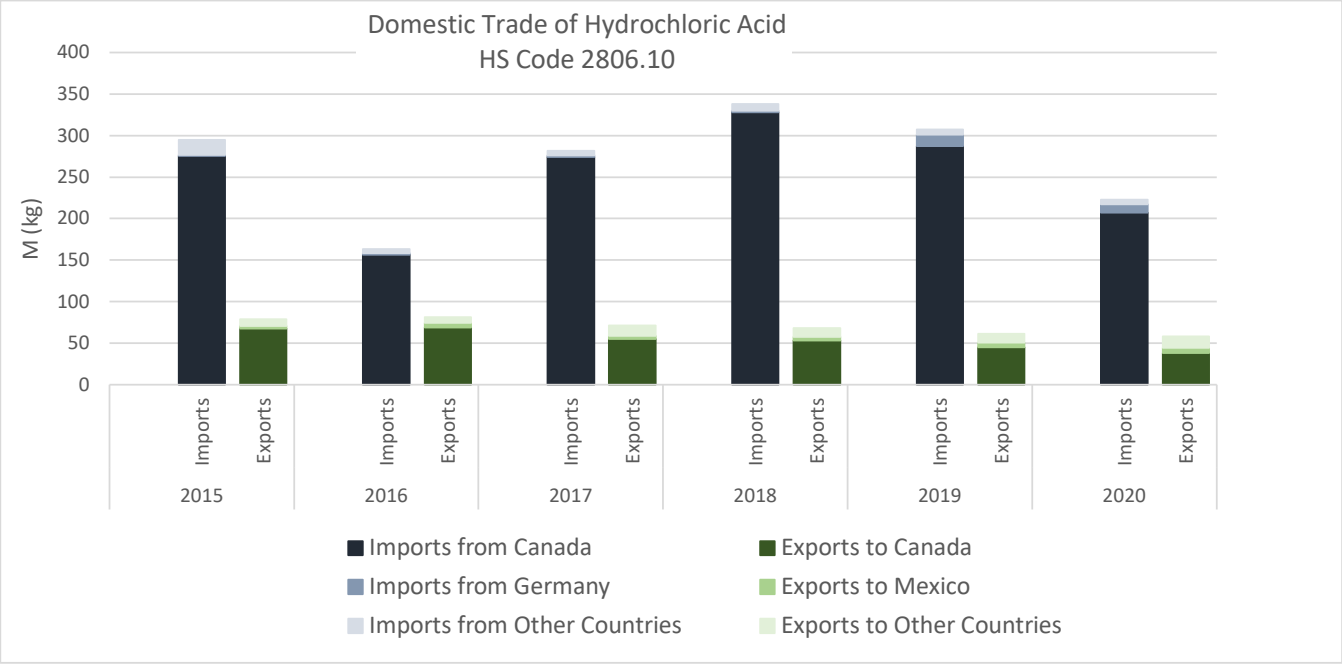


Figure 4. USITC Domestic Import and Export of Hydrochloric Acid between 2015 and 2020

[1] Imports for consumption are a subset of general imports, representing the total amount cleared through customs and entering consumption channels, not anticipated to be reshipped to foreign points, but may include some reexports.

[2] Domestic exports are a subset of total exports, representing export of domestic merchandise which are produced or manufactured in the U.S. and commodities of foreign origin which have been changed in the U.S.

Tariffs

There is no general duty for import of hydrochloric acid, however there is an additional 25% duty on imports from China (USITC, 2022), as summarized in Table 3.

Table 3. 2020 Domestic Tariff Schedule for Hydrochloric Acid

HS Code	General Duty	Additional Duty – China (Section 301 Tariff List)	Special Duty
2806.10	None	25%	None

Market History & Risk Evaluation

History of Shortages

Production of hydrochloric acid is highly dependent on demand for chemicals which produce hydrochloric acid as a co- or byproduct. Demand slowed considerably during the Great Recession of 2007-2009, which resulted in reduced production and a shortage of hydrochloric acid in 2011 (McCoy, 2012).

Historically the purchase price of hydrochloric acid has been impacted by fluctuations in the price of oil and growth or contraction of steel manufacturing activities, while availability has been tightly tied to availability of chlorine and demand for the other chemical products for which hydrochloric acid is an integrated co- or byproduct.

The COVID-19 pandemic also impacted the price and availability of hydrochloric acid. In 2020-2021, there was a sharp falloff in demand for hydrochloric acid in oilfields and steel manufacturing. As crude oil prices dropped in 2020, drilling activity decreases, which in turn reduced the demand for hydrochloric acid. Additionally, temporary shutdowns of factories for cleaning or reorganization to maintain social distancing led to a drop in demand for steel (Bowen, 2020). The tight market for chlorine during this period also played a role in the shortage of hydrochloric acid.

Risk Evaluation

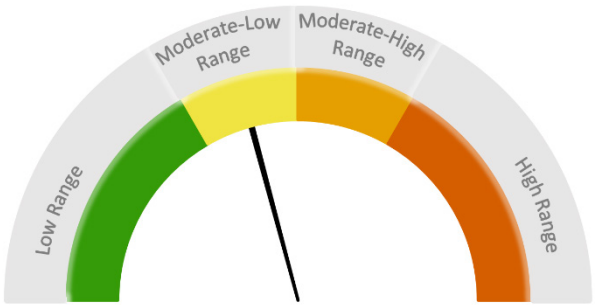
The complete risk evaluation methodology is described in *Understanding Water Treatment Chemical Supply Chains and the Risk of Disruptions* (EPA, 2022b). The risk rating is calculated as the product of the following three risk parameters:

Risk = Criticality x Likelihood x Vulnerability	
Criticality	Measure of the importance of a chemical to the water sector
Likelihood	Measure of the probability that the chemical will experience a supply disruption in the future, which is estimated based on past occurrence of supply disruptions
Vulnerability	Measure of the market dynamics that make a chemical market more or less resilient to supply disruptions

The individual parameter rating is based on evaluation of one or more attributes of the chemical or its supply chain. The ratings and drivers for these three risk parameters are shown below in Table 4.

Table 4. Supply Chain Risk Evaluation for Hydrochloric Acid

Risk Parameter Ratings and Drivers		
Criticality: High	**Likelihood: High**	**Vulnerability: Low**
Hydrochloric acid has widespread application for pH adjustment. It is a precursor in the production of several other critical water treatment chemicals.	The water sector has experienced regional hydrochloric acid supply disruptions in the past. In 2020 disruptions in the supply of hydrochloric acid occurred due to a decrease in demand for chemicals in industries that produce hydrochloric acid as a byproduct and disruptions in the supply of chlor-alkali chemicals needed to produce hydrochloric acid.	Strong domestic manufacturing capabilities and a distributed manufacturing base provide some resilience to supply disruptions.
Risk Rating: Moderate-Low		



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