







Sodium Chlorate

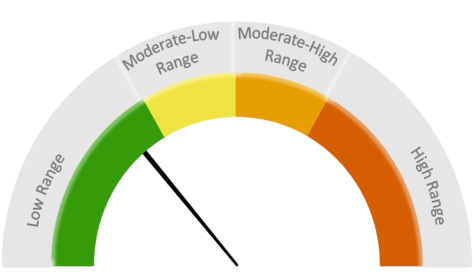


Direct Use Chemical **P** Precursor Chemical

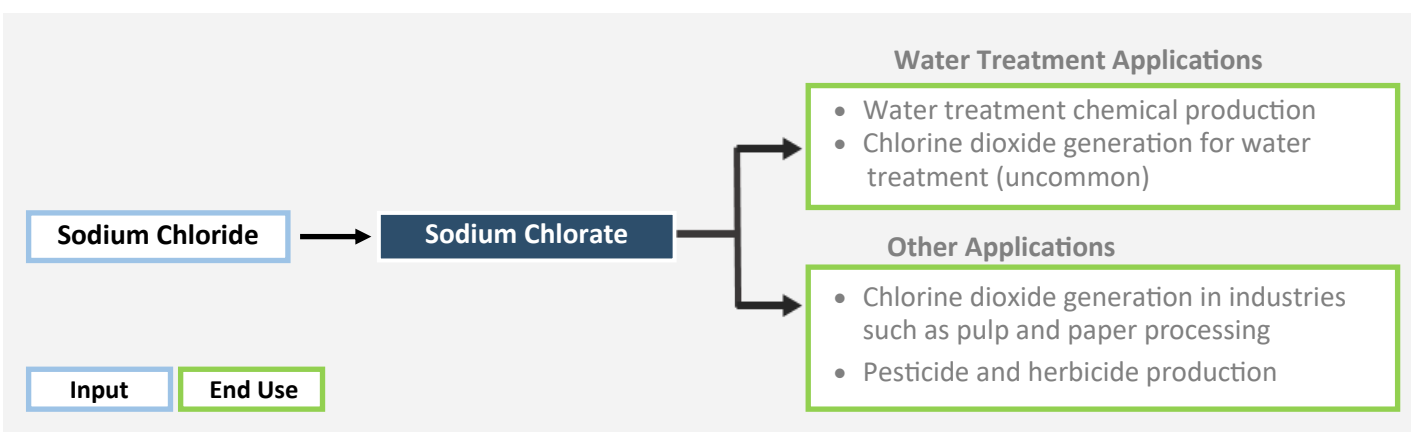
(solid) 

 Inputs to Manufacturing Process: Sodium Chloride	 % of Total Domestic Consumption Attributed to Water Sector: Less than 2%	 Product Family: Chlor-alkali CAS No.: 7775-09-9
 Derivative Water Treatment Chemicals: Sodium Chlorite	 Understanding Chemical Supply Chains	 Shelf Life: 12 Months


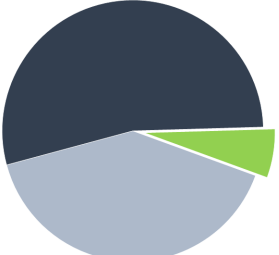
RISK OF SUPPLY DISRUPTION (Assessed in 2022)

<p>RISK RATING: Low</p> 	<p>RISK DRIVERS</p> <p>Production of sodium chlorate is concentrated at a limited number of domestic manufacturing facilities, and domestic consumption relies significantly on imports. The raw material, sodium chloride, is widely available.</p>	<p>RISK PARAMETERS</p> <p>Criticality: Moderate-High. Essential precursor for on-site generation of chlorine dioxide.</p> <p>Likelihood: Low. The water sector did not experience sodium chlorate supply chain disruptions between 2000 and 2022.</p> <p>Vulnerability: Moderate-High. Limited domestic manufacturing and reliance on imports to meet demand.</p>
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MANUFACTURING PROCESS



DOMESTIC PRODUCTION AND CONSUMPTION, AND INTERNATIONAL TRADE

<p>Domestic Manufacturing Locations (2019):</p>  5, in Georgia, Utah, South Carolina, and Washington		<p>Domestic Consumption (2019): 699 M kg</p> <ul style="list-style-type: none"> Domestic Production (320 M kg) Imports for Consumption (427 M kg) Export of Domestic Production (48 M kg)
<p>International Trade (2019)</p> <p>Primary Trading Partner (Imports): Canada</p> <p>Primary Trading Partner (Exports): Japan</p>		

Product Description

Sodium chlorate (NaClO₃) is an inorganic sodium salt that is used for production of sodium chlorite and generation of chlorine dioxide. It is primarily manufactured through electrolysis of a sodium chloride brine. The majority of sodium chlorate manufactured in the U.S. is used in chlorine dioxide generation for industries other than water treatment.

Use in Water Treatment

Sodium chlorate is not commonly used directly in water treatment but can occasionally be used for on-site generation of chlorine dioxide (AWWA, 2018).

Use as a Precursor to Other Water Treatment Chemicals

Sodium chlorate is used to manufacture sodium chlorite, the primary precursor to the on-site generation of chlorine dioxide for water treatment. Sodium chlorate is the primary chemical used in the manufacture of sodium chlorite.

Other Applications

Sodium chlorate is widely used for chlorine dioxide generation in paper and pulp processing, oil and gas well drilling, and disinfection in medical settings. It is also used in pesticide and herbicide formulations, manufacturing of explosives and matches, dyes, fabrics, toothpastes and mouthwashes, and ore processing. Sodium chlorate can also be used as a substitute for potassium chlorate. (ATSDR, 2004; FTC, 2016).

Primary Industrial Consumers

In North America, on-site generation of chlorine dioxide for bleaching of wood pulp in the paper industry accounts for more than 90% of sodium chlorate use. The second most common use of sodium chlorate is as a pesticide and herbicide formulation, accounting for only 2% of the total sodium chlorate used in the U.S. Because the North American market for sodium chlorate has long been dominated by paper product manufacturers, fluctuations for this end use drives demand in the market (FTC, 2016; Kemira, 2020; NCBI, 2020; Nouryon, 2020).

Manufacturing, Transport, & Storage

Manufacturing Process

Sodium chloride is the primary raw material used to produce sodium chlorate. The majority of sodium chlorate is produced by passing a direct electric current through a sodium chloride brine in an electrochemical cell, as shown in Figure 1. The resulting solution is crystalized, and pure sodium chlorate crystals are washed and dried (ERCO Worldwide, 2020).

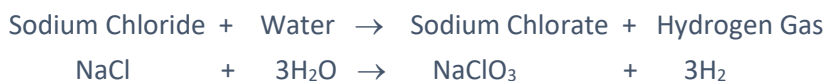


Figure 1. Chemical Equation for the Reaction to Manufacture Sodium Chlorate

Product Transport

Sodium chlorate is commonly transported in bulk by truck, rail, barge, and ship as a hazardous material (FTC, 2016).

Storage and Shelf Life

Sodium chlorate is a strong oxidizer. It is stable under normal conditions of use, storage, and transport. When stored properly, sodium chlorate can have a shelf life of 12 months (ERCO Worldwide, 2020).

Domestic Production & Consumption

Domestic Production

Production data was collected from the 2020 Toxic Substances Control Act (TSCA) Chemical Data Reporting (CDR) for the year 2019, while trade data was collected from the U.S. International Trade Commission (USITC) Dataweb, as characterized in Table 1. Both production data and trade data are specific to sodium chlorate.

Table 1. Sodium Chlorate Production and Trade Data Sources

Production and Trade Data			
Category	Data Source	Identifier	Description
Domestic Production	2020 TSCA Chemical Data Reporting	CAS No.: 7775-09-9	Sodium Chlorate
Imports and Exports	U.S. International Trade Commission	HS Code: 2829.11	Sodium Chlorate

Total U.S. domestic manufacturing of sodium chlorate was approximately 320 million kilograms (M kg) in 2019 (EPA, 2020). Domestic commercial manufacture of sodium chlorate takes place at a limited number of domestic facilities. In 2019, five manufacturing facilities reported domestic production in Georgia, South Carolina, Utah, and Washington. These facilities are owned by a relatively small number of companies including *Superior Plus* and *Kemira* (EPA, 2022a). U.S. customers account for roughly 75% of North American sodium chlorate sales, while 70% of North American production capacity is located in Canada (FTC, 2016).

Domestic Consumption

U.S. consumption of sodium chlorate in 2019 is estimated at 699 M kg. This includes production of 320 M kg, import of 427 M kg, minus export of 48 M kg (USITC, 2021), as shown in Figure 2.

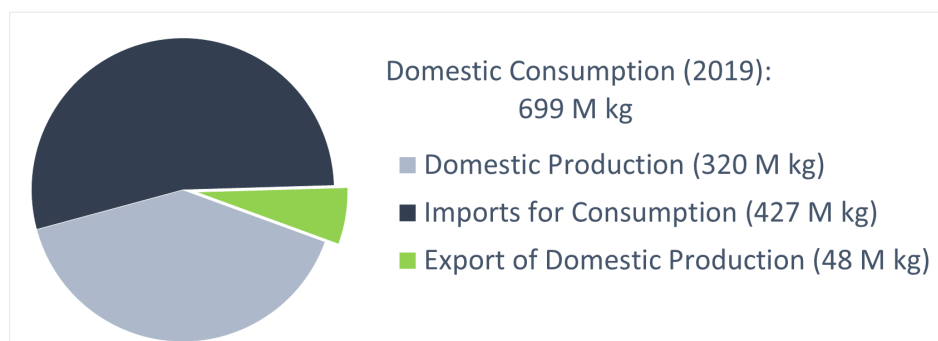


Figure 2. Domestic Production and Consumption of Sodium Chlorate in 2019

Trade & Tariffs

Worldwide Trade

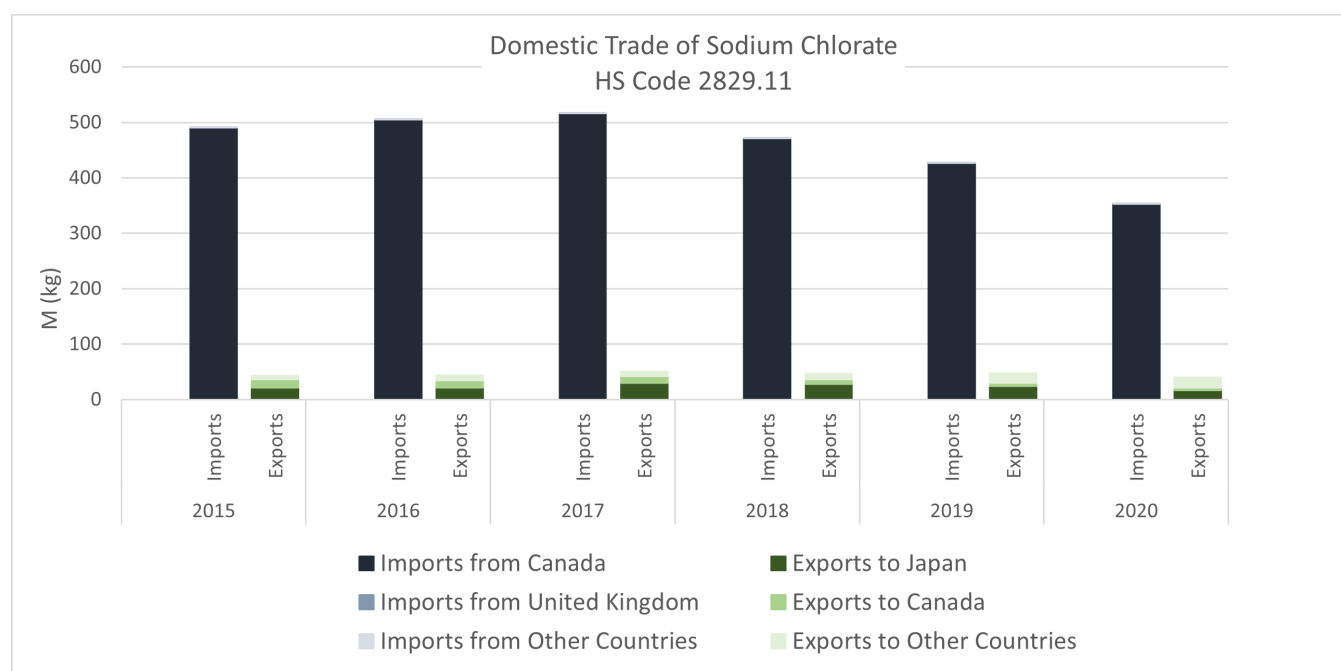
Worldwide import and export data for sodium chlorate are reported through the World Bank's World Integrated Trade Solutions (WITS) software, as a category specific to sodium chlorate. In 2021, U.S. ranked third worldwide in total exports and first in total imports of sodium chlorate, as shown in Table 2.

Table 2. WITS Worldwide Export and Import of Sodium Chlorate in 2021

2021 Worldwide Trade Sodium Chlorate (HS Code 2829.11)			
Top 5 Worldwide Exporters		Top 5 Worldwide Importers	
Canada	455 M kg	United States	339 M kg
France	93 M kg	Sweden	60 M kg
United States	48 M kg	Japan	47 M kg
Brazil	12 M kg	Thailand	19 M kg
China	8 M kg	India	16 M kg

Domestic Imports and Exports

Domestic import and export data are reported by USITC in categories specific to sodium chlorate. Figure 3 summarizes imports for consumption¹ and domestic exports² of sodium chlorate between 2015 and 2020. During this period, the overall quantity of exports and imports decreased slightly, with imports for consumption exceeding domestic exports. Over this five-year period, Japan was the primary recipient of domestic exports while Canada was the primary source of imports (USITC, 2021).

**Figure 3. USITC Domestic Import and Export of Sodium Chlorate between 2015 and 2020**

Tariffs

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

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.

Table 3. Domestic Tariff Schedule for Sodium Chlorate in 2022

HS Code	General Duty	Additional Duty – China (Section 301 Tariff List)	Special Duty
2829.11	None	25%	None

Market History & Risk Evaluation

History of Shortages

The North American market for sodium chlorate has long been dominated by the consumption for paper and pulp bleaching, and fluctuations for this end use drives demand in the market. Despite fluctuations in the paper industry, there were no notable shortages of sodium chlorate between 2000 and 2022.

Risk Evaluation

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

$$\text{Risk} = \text{Criticality} \times \text{Likelihood} \times \text{Vulnerability}$$

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 Sodium Chlorate

Risk Parameter Ratings and Drivers		
Criticality Moderate-High	Likelihood Low	Vulnerability Moderate-High
Sodium chlorate is essential to the water sector as a precursor in the production of sodium chlorite which is used in chlorine dioxide generation.	The water sector did not experience sodium chlorate supply disruptions between 2000 and 2022.	Limited domestic manufacturing capabilities and a significant reliance on imports to meet domestic demand could increase vulnerability.
Risk Rating: Low		

References

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