Calcium Oxide (Quicklime)

CaO (solid)

D Direct Use Chemical P Precursor Chemical

Source of Raw Material:
Calcium Carbonate (Limestone)

% of Total Domestic Consumption Attributed to Water Sector:
Less than 7%

Product Family
Calcium

CAS No.: 1305-78-8

Derivative Water Treatment Chemicals:
Calcium Hydroxide

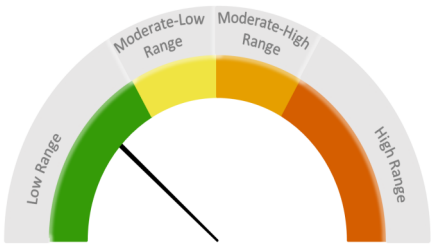
Understanding Chemical Supply Chains

Map of Suppliers & Manufacturers

Shelf Life:
3 Months

RISK OF SUPPLY DISRUPTION (Assessed in 2022)

RISK RATING: Low



RISK DRIVERS

Calcium oxide is used in a variety of industries and is widely manufactured and supplied. The key input (calcium carbonate) is currently abundant and supplied from domestic sources.

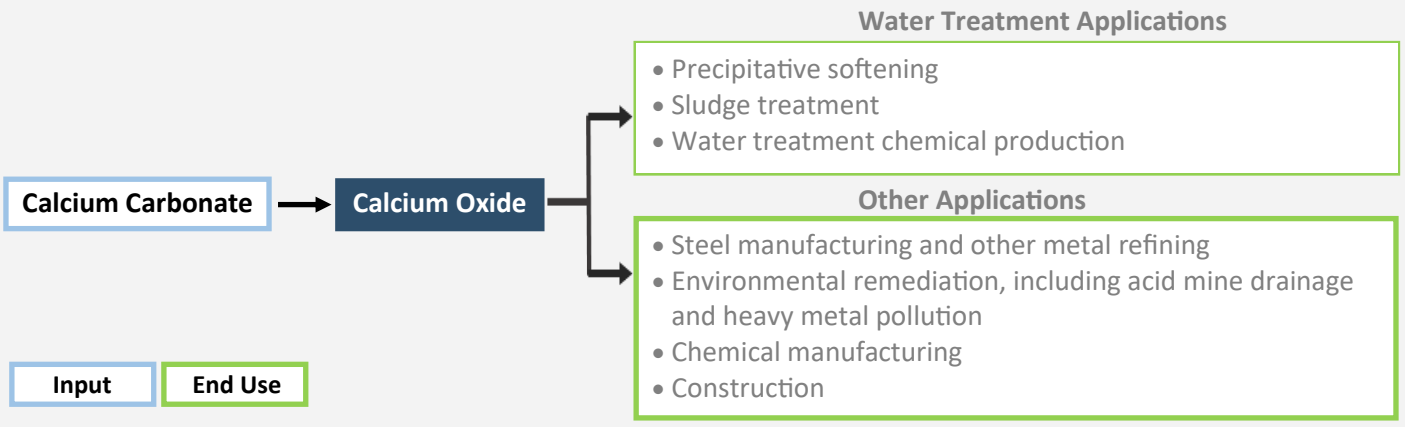
RISK PARAMETERS

Criticality: High. Essential for softening, sludge treatment, and production of water treatment chemicals.

Likelihood: Low. The water sector has not experienced calcium oxide supply disruptions between 2000 and 2022.

Vulnerability: Low. Manufacturing and supply is widely distributed. Key raw material (calcium carbonate) is abundant and widely available.

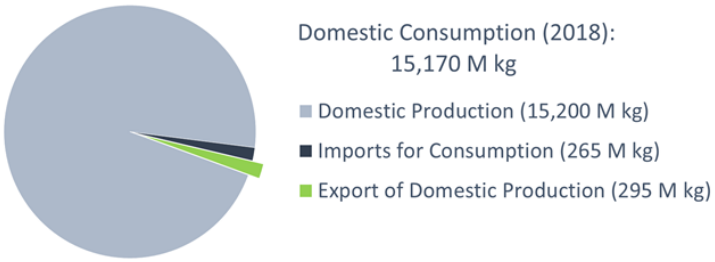
PRODUCTION PROCESS



DOMESTIC PRODUCTION AND CONSUMPTION, AND INTERNATIONAL TRADE

Domestic Production Locations (2018):
74, widely distributed across 28 states.

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



Product Description

Calcium oxide (CaO), also known as quicklime, is a widely used derivative of calcium carbonate (limestone). Calcium oxide is used directly in water treatment for precipitative softening and sludge treatment, and also as an input in the manufacturing of calcium hydroxide.

Use in Water Treatment

Calcium oxide is used directly in precipitative softening and sludge treatment.

Use as a Precursor to Other Water Treatment Chemicals

Calcium oxide is used to manufacture calcium hydroxide (slaked lime).

Other Applications

Lime, including both calcium oxide (quicklime) and calcium hydroxide (slaked lime), has a wide range of applications. The leading domestic use of lime is as a flux and slagging agent to remove impurities as part of steel manufacturing. Other metallurgical uses include beneficiation of copper and zinc ores, bauxite processing, and recovery of uranium and nickel. Lime also has environmental remediation applications including treatment of acid mine drainage and heavy metal contamination, as well as construction applications including soil stabilization, asphalt manufacturing, as a component of mortar and plaster, and alkali chemical manufacturing. (USGS, 2020; USGS 2021).

Primary Industrial Consumers

Domestic consumption information identifies consumers of lime, including both calcium oxide (quicklime) and calcium hydroxide (slaked lime). Calcium oxide is the predominant form of lime consumed. In 2018, approximately 35% of calcium oxide consumed in the U.S. was used for ferrous and nonferrous metallurgy. Additional applications include environmental uses (29%), chemical and industrial use (21%), construction use (10%), miscellaneous uses (3%), and use for refractories (1%) (USGS, 2021). Commercial sale of lime accounted for 94% of total domestic consumption in 2018, while captive consumption, including sugar refining and precipitated calcium carbonate manufacturing, accounted for the remaining 6%. Use of lime (calcium oxide and calcium hydroxide) in wastewater and drinking water accounted for approximately 7% of 2018 domestic consumption (USGS, 2021).

Manufacturing, Transport, & Storage

Manufacturing Process

The majority of calcium oxide produced in the U.S. starts with calcium carbonate (limestone) and utilizes a calcining process. Magnesium carbonate (dolomite) may also be used as a raw material.

Lime manufacturing begins with crushed calcium carbonate (limestone), which may vary considerably in composition and structure by source. Subsequent processing, including calcining, will include process variations according to the raw material characteristics. After beneficiation, calcium carbonate is calcined in a carbon dioxide-rich environment at a temperature high enough to promote thermal decomposition of the calcium carbonate to calcium oxide. The overall equation for this process is outlined in Figure 1.

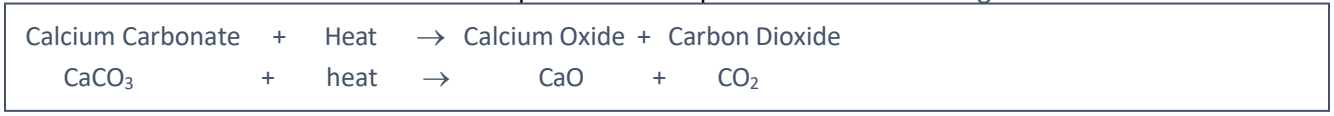


Figure 1. Chemical Equation for the Reaction to Manufacture Calcium Oxide

Product Transport

Calcium oxide is commonly transported by rail, truck, and waterway. Though widely manufactured throughout the U.S., there are areas without local access to calcium oxide plants, and transportation costs may significantly increase the cost of the delivered product (USGS, 2021).

Storage and Shelf Life

Calcium oxide is stable and non-combustible, though it reacts exothermically with water. When stored properly, calcium oxide can have a shelf life of approximately 3 months (Mississippi Lime, 2015).

Domestic Production & Consumption

Domestic Production

Production data was collected from USGS, 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 calcium oxide.

Table 1. Calcium Oxide Production and Trade Data Sources

Production and Trade Data			
Category	**Data Source**	**Identifier**	**Description**
Domestic Production	U.S. Geological Survey	CAS No.: 1305-78-8	Calcium Oxide
Imports and Exports	U.S. International Trade Commission	HS Code: 2522.10	Calcium Oxide (Quicklime)

Total U.S. domestic production of calcium oxide for commercial sale was approximately 15,200 million kilograms (M kg) in 2018 (USGS, 2021). In 2018, domestic commercial production of calcium oxide took place at 74 locations in 28 states. Production volume was highest in the Midwest, followed by the southern U.S., and Missouri, Alabama, Kentucky, Ohio, and Texas were the top producing states (USGS, 2021). The majority of quicklime produced is high-calcium quicklime. In 2018, ten companies with 45 locations accounted for 90% of calcium oxide production. The number of domestic manufacturing locations shown in Figure 2 represents operating facilities as of 2018 (USGS, 2021). Supply of NSF/ANSI Standard 60 certified calcium oxide for use in drinking water treatment is 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).

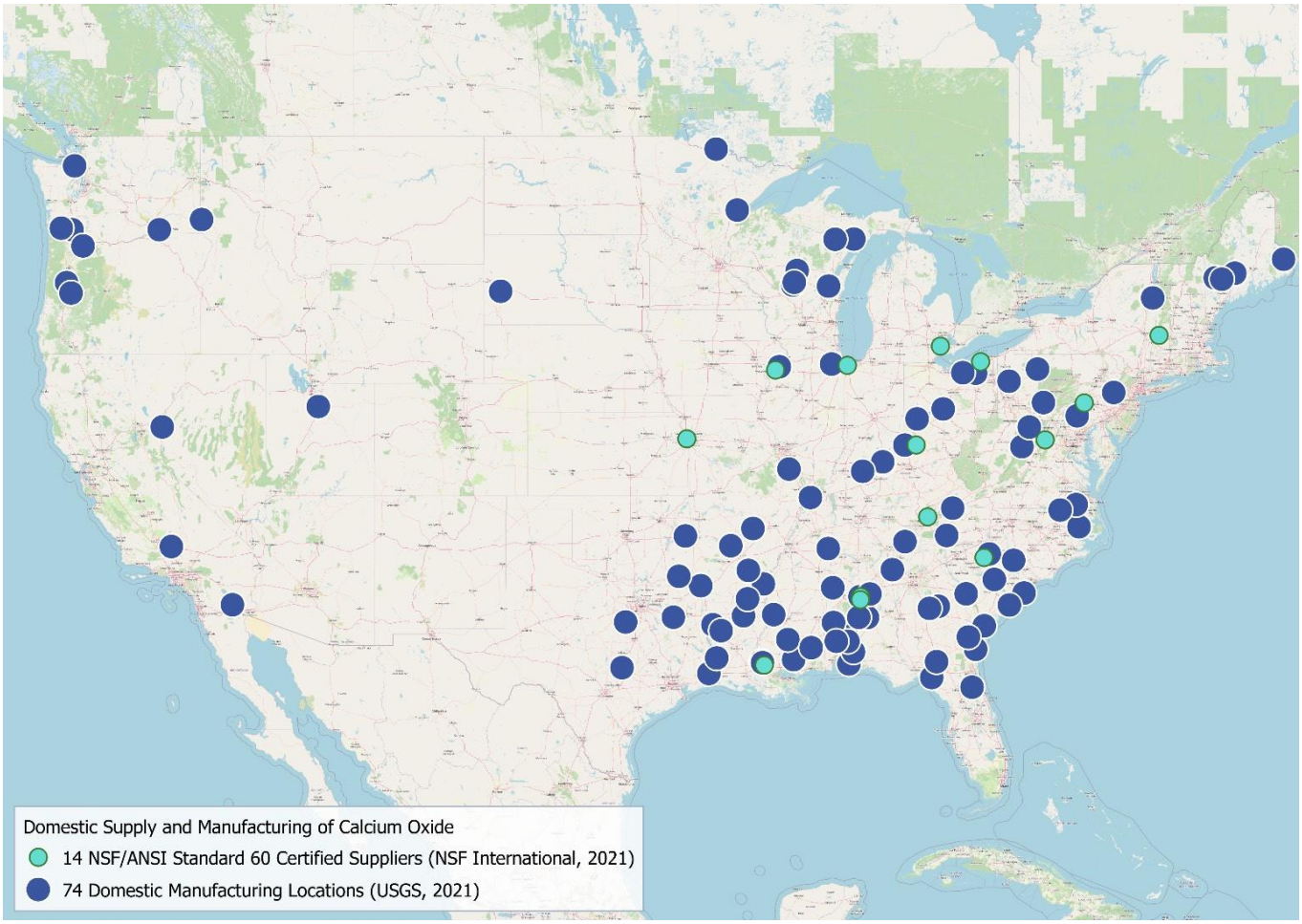


Figure 2. Domestic Supply and Manufacturing of Calcium Oxide

Domestic Consumption

U.S. consumption of calcium oxide in 2018 is estimated at 15,170 M kg. This estimate includes production of 15,202 M kg, import of 265 M kg, minus export of 295 M kg (USGS, 2021; USITC, 2021), as shown in Figure 3.

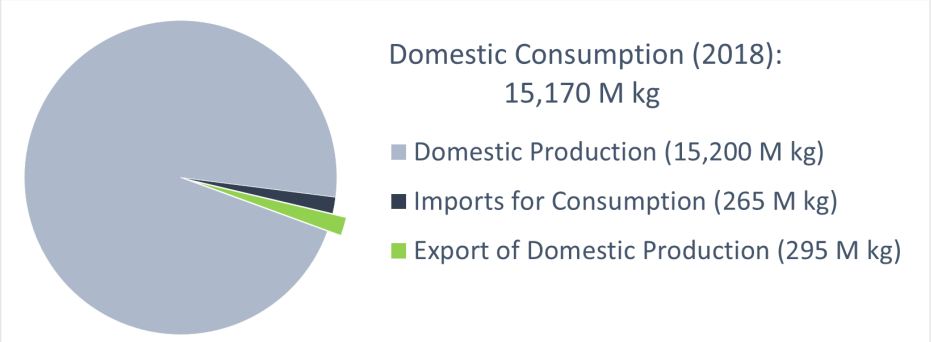


Figure 3. Domestic Production and Consumption of Calcium Oxide in 2018

Trade &Tariffs

Worldwide Trade

Worldwide import and export data for calcium oxide (quicklime) are reported through the World Bank's World

Integrated Trade Solutions (WITS) software, as a category specific to calcium oxide. In 2021, the U.S. ranked 12th worldwide in total exports and 9th in total imports of calcium oxide. In 2021, France ranked first worldwide in total exports and Zimbabwe ranked first worldwide in total imports (WITS, 2022) as shown in Table 2.

Table 2. WITS Worldwide Export and Import of Calcium Oxide in 2021

2021 Worldwide Trade Calcium Oxide (Quicklime) (HS Code 2522.10)			
Top 5 Worldwide Exporters		Top 5 Worldwide Importers	
France	786 M kg	Zimbabwe	1,707 M kg
Germany	749 M kg	Netherlands	537 M kg
Malaysia	506 M kg	Germany	430 M kg
Belgium	421 M kg	France	380 M kg
Vietnam	418 M kg	Australia	313 M kg

Domestic Imports and Exports

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

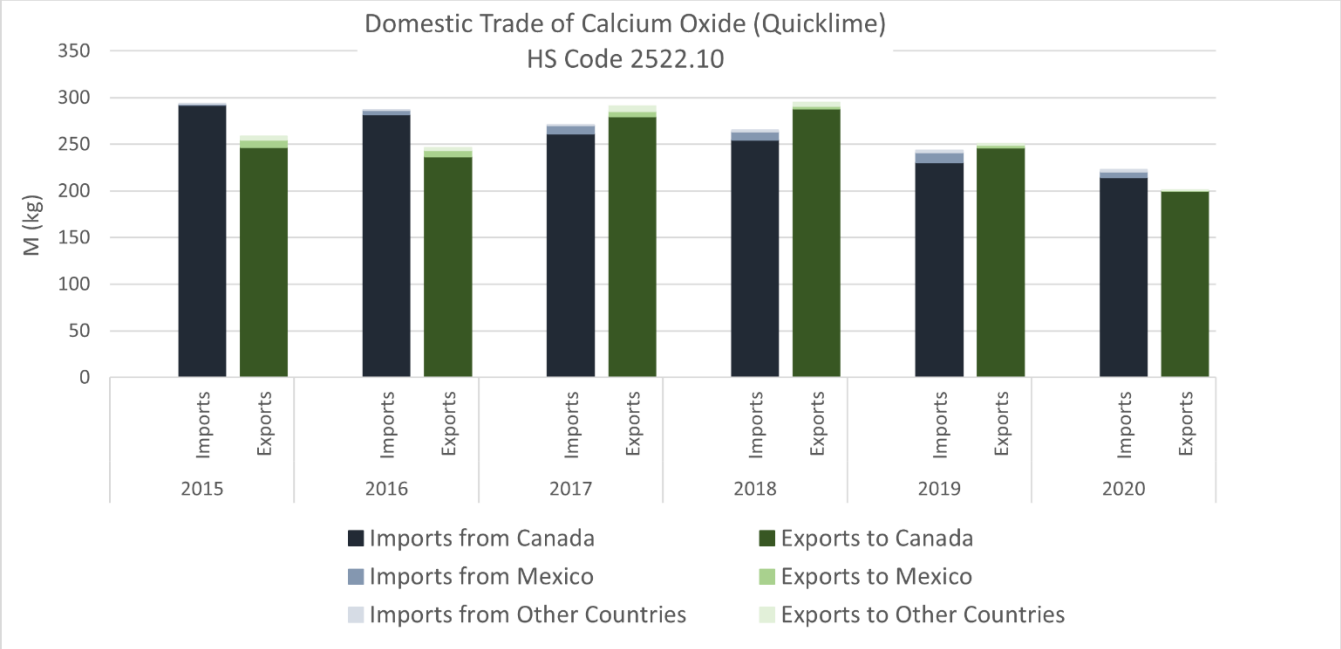


Figure 4. USITC Domestic Import and Export of Calcium Oxide between 2015 and 2020

[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

Imports of calcium oxide are primarily supplied from Canada. There is no general duty for import of calcium oxide, 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 Calcium Oxide

HS Code	General Duty	Additional Duty – China (Section 301 Tariff List)	Special Duty
2522.10	None	25%	None

Market History & Risk Evaluation

History of Shortages

Calcium oxide is widely manufactured and used in a variety of industries. There were no identified calcium oxide supply chain disruptions between 2000 and 2022.

Risk Evaluation

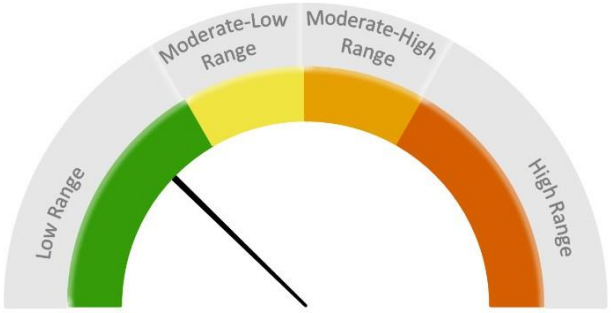
The complete risk assessment methodology is described in *Understanding Water Treatment Chemical Supply Chains and the Risk of Disruptions* (EPA, 2022b). The risk rating is calculated as the product of the following three risk parameters:

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 Calcium Oxide

Risk Parameter Ratings and Drivers		
Criticality: High	**Likelihood: Low**	**Vulnerability: Low**
Calcium oxide is widely used in water treatment for softening and sludge treatment. It is a precursor in the production of calcium hydroxide (slaked lime).	The water sector has not experienced calcium oxide supply disruptions between 2000 and 2022.	The U.S. is a leading producer of the key input of calcium oxide, calcium carbonate. Manufacturing and supply are widely distributed.
Risk Rating: Low		



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