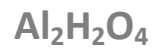








Bauxite



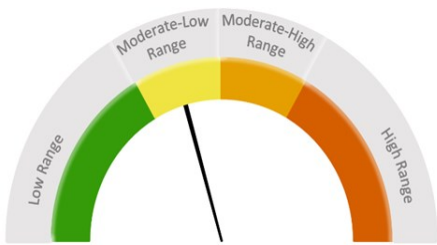
Raw Material

(solid) 

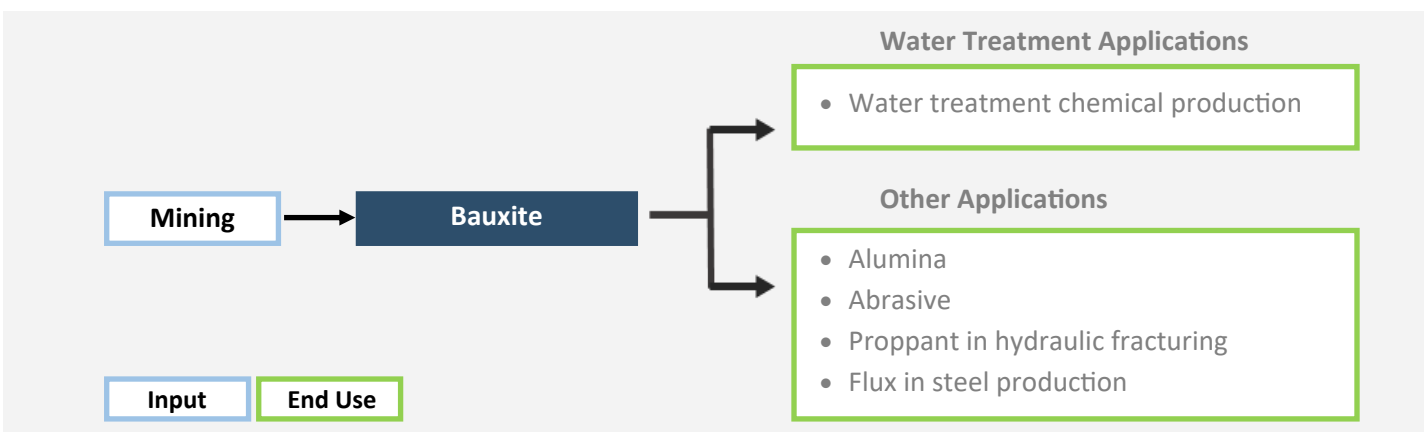
 Source of Raw Material: Naturally occurring ore	 % of Total Domestic Consumption Attributed to Water Sector: Less than 1%	 Product Family: Aluminum
 Derivative Water Treatment Chemicals: Aluminum-based coagulants	 Understanding Chemical Supply Chains	CAS No.: 1318-16-7
		 Shelf Life: 60+ Months

RISK OF SUPPLY DISRUPTION (Assessed in 2022)


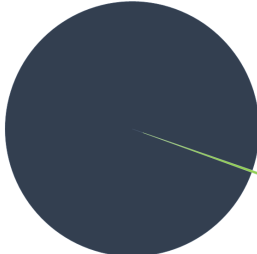
RISK RATING: Moderate-Low	RISK DRIVERS Alumina production is the leading domestic use of bauxite. Increases or decreases in demand for alumina derivatives; primarily aluminum, periodically impact the availability and price. Fluctuations in availability from leading worldwide producers also may impact availability.	RISK PARAMETERS Criticality: High. Essential for production of water treatment chemicals. Likelihood: Low. No history of a bauxite supply disruptions between 2000 and 2022. Vulnerability: Moderate-High. The U.S. is entirely reliant on imports of bauxite for alumina production. The U.S. has multiple sources of imports, which may provide some resilience to supply disruptions.
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PRODUCTION PROCESS



DOMESTIC PRODUCTION AND CONSUMPTION, AND INTERNATIONAL TRADE

Domestic Production Locations (2019):  5 mining locations for non-metallurgical (non-alumina) use.		Domestic Consumption (2019): 5,100 M kg
International Trade (2019) Primary Trading Partner (Imports): Jamaica Primary Trading Partner (Exports): Canada		■ Domestic Production (negligible; not reported) ■ Imports for Consumption (5,100 M kg) ■ Export of Domestic Production (15 M kg)

Product Description

Bauxite ($\text{Al}_2\text{H}_2\text{O}_4$), a widely occurring natural ore and primary source of alumina, is not used directly in water treatment. Alumina is the most significant raw material for manufacturing aluminum, and bauxite is a primary raw material in the production of aluminum hydroxide, which is used to produce most aluminum-based coagulants. The U.S. imports nearly all bauxite required for alumina manufacturing.

Use in Water Treatment

None.

Use as a Precursor to Other Water Treatment Chemicals

Bauxite is used to manufacture aluminum hydroxide, which in turn is used to make aluminum-based coagulants.

Other Applications

Bauxite is widely used in a range of applications. All applications of bauxite require processing and refining of the ore. The leading use of bauxite is to produce alumina, which accounts for nearly 90% of worldwide use. Bauxite is also used as an abrasive, as a proppant in hydraulic fracturing, and as a flux in steel production. Alumina is primarily used to manufacture aluminum, but may also be used in metallic paints, glass manufacturing, and metal refineries (NCBI, 2022; USGS, 2022).

Primary Industrial Consumers

In 2018, approximately 82% of bauxite consumed in the U.S. was used in the production of alumina. Of the alumina produced, 64% was consumed in metal production at aluminum smelters. The remaining bauxite was consumed in production of nonmetallurgical products including abrasives, ceramics, chemicals, and refractories (USGS 2022).

Manufacturing, Transport, & Storage

Manufacturing Process

Deposits of bauxite are found throughout the world, and are primarily extracted by surface mining techniques. Depending on the bauxite composition, mined bauxite may simply be crushed and dried before further processing or require beneficiation including removal of clay and silica, and drying in rotary kilns. Though aluminum can be extracted from clays and other minerals, bauxite is the most common and economical source (The Bauxite Index, n.d.; USGS, 2022).

Crushed and dried bauxite is predominantly further processed to extract alumina. The alumina may be used for chemical production as alumina hydrate or smelted to produce aluminum (The Bauxite Index, n.d.). In 2019, there were two operating domestic alumina refineries which produced alumina from imported bauxite, both located in Louisiana (USGS, 2022).

Product Transport

Bauxite, most commonly sold as a ground solid, is routinely transported by ship, rail, and truck (USGS, 2022).

Storage and Shelf Life

Bauxite is stable and non-reactive over a wide range of temperatures, though when exposed to intense moisture bauxite may be prone to liquefaction (Correia, 2018). When stored properly and kept dry, bauxite can have a shelf life in excess of 60 months.

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 bauxite.

Table 1. Bauxite Production and Trade Data Sources

Production and Trade Data			
Category	Data Source	Identifier	Description
Domestic Production	U.S. Geological Survey	CAS No.: 1318-16-7	Bauxite
Imports and Exports	U.S. International Trade Commission	HS Code: 2606.00	Bauxite (Aluminum ores and concentrates)

Total U.S. domestic production of bauxite is historically negligible, and on average accounts for less than 5% of U.S. consumption needs for bauxite exclusively for nonmetallurgical uses. Bauxite and bauxite clays are produced at five mining locations in Alabama, Arkansas, and Georgia. Production amounts at these locations are considered confidential business information and not reported by USGS. For all domestic production of alumina, the U.S. is entirely dependent on imported bauxite (USGS, 2020; USGS, 2022).

Domestic Consumption

U.S. consumption of bauxite in 2019 is estimated at 5,100 million kg (M kg). This estimate includes negligible production for nonmetallurgical uses (amount considered confidential business information and not reported), import of 5,100 M kg, and export of 15 M kg (USGS, 2020), as shown in Figure 1.

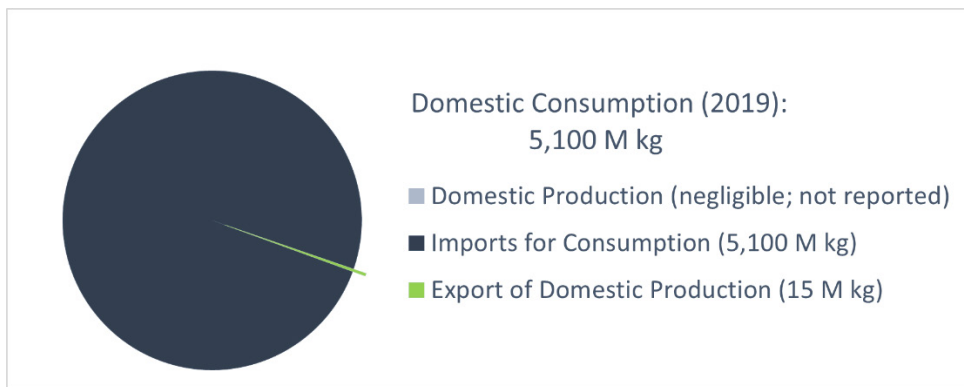


Figure 1. Domestic Production and Consumption of Bauxite in 2019

Trade & Tariffs

Worldwide Trade

Worldwide import and export data for bauxite are reported through the World Bank’s World Integrated Trade Solutions (WITS) software, as a category for aluminum ores and concentrates. In 2021, the U.S. ranked 19th worldwide in total exports and seventh in total imports of aluminum ores and concentrates. In 2021, Australia ranked first worldwide in total exports and China ranked first worldwide in total imports (WITS, 2022), as shown in Table 2. The quantity of aluminum ores and concentrates exported by Brazil and Guinea, countries with significant production, was not reported in 2021.

Table 2. WITS Worldwide Export and Import of Aluminum Ores and Concentrates in 2021

2021 Worldwide Trade Aluminum Ores and Concentrates (HS Code 2606.00)			
Top 5 Worldwide Exporters		Top 5 Worldwide Importers	
Australia	35,729 M kg	China	107,282 M kg
Indonesia	19,915 M kg	Ukraine	5,076 M kg
Turkey	1,844 M kg	United Arab Emirates	4,998 M kg
Guyana	518 M kg	Ireland	4,660 M kg
India	400 M kg	Spain	4,109 M kg

Domestic Imports and Exports

Domestic import and export data are reported by USITC in categories specific to bauxite. Figure 2 summarizes imports for consumption¹ and domestic exports² of bauxite ores and concentrates between 2015 and 2020. During this period, the overall quantity of imports diminished over the five-year period from a high in 2015. The volume of exports, considerably smaller than the volume of imports, remained relatively steady. Over this five-year period, Canada was the primary recipients of domestic exports while the primary source of imports were Jamaica and Brazil (USITC, 2021).

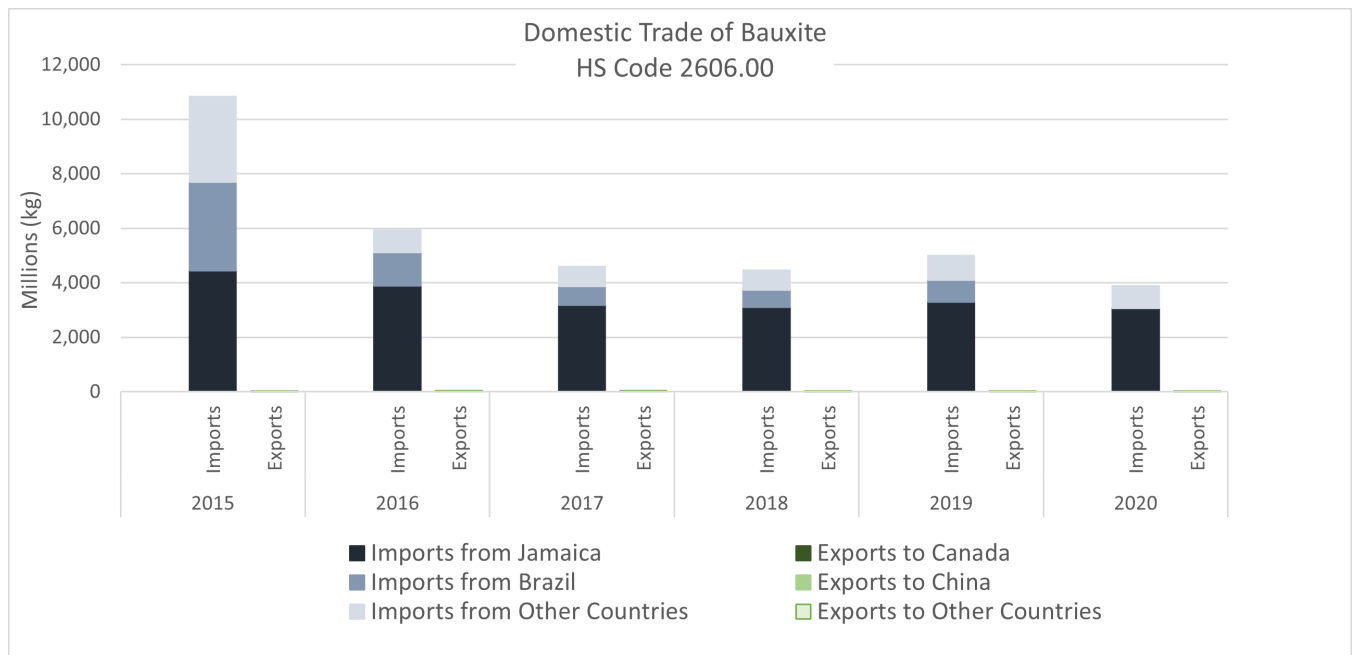


Figure 2. USITC Domestic Import and Export of Bauxite between 2015 and 2020

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 or special duty for import of bauxite (USITC, 2022), as summarized in Table 3.

Table 3. 2022 Domestic Tariff Schedule for Bauxite

HS Code	General Duty	Additional Duty – China (Section 301 Tariff List)	Special Duty
2606.00	None	None	None

Market History & Risk Evaluation

History of Shortages

The demand for bauxite is tightly tied to demand from downstream industries which utilize alumina and aluminum, such as the automotive industry, and production interruptions in countries which dominate global production: China, Guinea, and Indonesia. These factors have led to historic price spikes in the price for bauxite during periods of fluctuation in demand for derivative products and interruption to international trade. Though the U.S. is entirely dependent on bauxite imports for production of alumina and derivative chemicals, there were no identified 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, 2022). 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 Bauxite

Risk Parameter Ratings and Drivers					
Criticality	High	Likelihood	Low	Vulnerability	Moderate-High
Bauxite is essential to production of all aluminum-based water treatment chemicals.		There were no identified disruptions in the supply of bauxite between 2000 and 2022.		The U.S. is entirely reliant on imports of bauxite for production of alumina. However the U.S. has multiple sources of imports, which provides some resilience to supply disruptions.	
Risk Rating: Moderate-Low					

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World Integrated Trade Solutions (WITS), 2022. Trade Statistics by Product (HS 6-digit), retrieved from <https://wits.worldbank.org/trade/country-byhs6product.aspx?lang=en#void>