

BORON

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: Two companies in southern California produced borates in 2022, and most of the boron products consumed in the United States were manufactured domestically. Estimated boron production increased in 2022 compared with 2021 production. U.S. boron production and consumption data were withheld to avoid disclosing company proprietary data. The leading boron producer mined borate ores, which contain the minerals kernite, tincal, and ulexite, by open pit methods and operated associated compound plants. Kernite was used to produce boric acid, tincal was used to produce sodium borate, and ulexite was used as a primary ingredient in the manufacture of a variety of specialty glasses and ceramics. A second company produced borates from brines extracted through solution-mining techniques. Boron minerals and chemicals were principally consumed in the north-central and eastern United States. In 2022, the glass and ceramics industries remained the leading domestic users of boron products, accounting for an estimated 65% of total borates consumption. Boron also was used as a component in abrasives, cleaning products, insecticides, and insulation and in the production of semiconductors.

Salient Statistics—United States:

	2018	2019	2020	2021	2022^e
Production	W	W	W	W	W
Imports for consumption:					
Refined borax	133	161	174	232	160
Boric acid	51	41	39	54	53
Colemanite (calcium borates)	73	42	18	3	1
Ulexite (sodium borates)	34	38	41	49	36
Exports:					
Boric acid	251	251	257	280	250
Refined borax	610	598	594	607	610
Consumption, apparent ¹	W	W	W	W	W
Price, average unit value of imports, cost, insurance, and freight, dollars per metric ton	404	373	380	394	430
Employment, number	1,350	1,370	1,330	1,330	1,370
Net import reliance ² as a percentage of apparent consumption	E	E	E	E	E

Recycling: Insignificant.

Import Sources (2018–21): All forms: Turkey, 90%; Bolivia, 5%; Chile, 2%; and other, 3%.

Tariff:	Item	Number	Normal Trade Relations 12–31–22
	Natural borates:		
	Sodium (ulexite)	2528.00.0005	Free.
	Calcium (colemanite)	2528.00.0010	Free.
	Boric acids	2810.00.0000	1.5% ad valorem.
	Borates, refined borax:		
	Anhydrous	2840.11.0000	0.3% ad valorem.
	Non-anhydrous	2840.19.0000	0.1% ad valorem.

Depletion Allowance: Borax, 14% (domestic and foreign).

Government Stockpile: None.

Events, Trends, and Issues: Elemental boron is a metalloid with limited commercial applications. Although the term “boron” is commonly referenced, it does not occur in nature in an elemental state. Boron combines with oxygen and other elements to form boric acid or inorganic salts called borates. Boron compounds, chiefly borates, are commercially important; therefore, boron products are priced and sold based on their boric oxide (B₂O₃) content, varying by ore and compound and by the absence or presence of calcium and sodium. Four borate minerals—colemanite, kernite, tincal, and ulexite—account for 90% of the borate minerals used by industry worldwide. Although borates were used in more than 300 applications, more than three-quarters of world consumption was used in ceramics, detergents, fertilizers, and glass.

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China, Malaysia, Canada, Mexico, India, and Indonesia, in decreasing order of tonnage, are the countries that imported the largest quantities of refined borates from the United States in 2022. Domestic shipments of boric acid were sent to China, the Netherlands, the Republic of Korea, Japan, and Malaysia, in decreasing order of tonnage. Because China has low-grade boron reserves and demand for boron is anticipated to rise in that country, imports from Chile, Russia, Turkey, and the United States were expected to remain steady during the next several years.

Continued investment in new borate refineries and the continued rise in demand were expected to fuel growth in world production for the next few years. An Australian-British multinational mining corporation completed and successfully produced battery-grade lithium from waste rock at its Boron Mine's lithium demonstration plant in 2021. The demonstration will be used as the basis for a feasibility assessment. The California mine site could help create an additional revenue stream from almost a century of waste rock once the project is completed. Initial capacity was expected to be 5,000 tons per year. Two Australian-based mine developers previously confirmed that production of high-quality boron products would be possible from their projects in California and Nevada, respectively. These companies continued to make progress on their respective projects by acquiring some of the permits and funding necessary to begin and continue construction. The project in California began construction in April and was expected to have a focus on specialty boron products for industries related to global decarbonization and food security once production starts. The Nevada project was expected to begin production by 2025. These companies have the potential to become substantial boron producers when their projects are fully developed.

World Production and Reserves: Reserves for China were revised based on Government reports.

	Production—All forms^e		Reserves³
	<u>2021</u>	<u>2022</u>	
United States	W	W	40,000
Argentina, crude ore	130	130	NA
Bolivia, ulexite	200	200	NA
Chile, ulexite	290	300	35,000
China, boric oxide equivalent	380	300	21,000
Germany, compounds	60	60	NA
Peru, crude borates	⁴ 246	250	4,000
Russia, datolite ore	80	80	40,000
Turkey, refined borates	<u>1,700</u>	<u>1,700</u>	<u>1,200,000</u>
World total ⁵	XX	XX	XX

World Resources:³ Deposits of borates are associated with volcanic activity and arid climates, with the largest economically viable deposits in the Mojave Desert of the United States, the Alpide belt along the southern margin of Eurasia, and the Andean belt of South America. U.S. deposits consist primarily of tincal, kernite, and borates contained in brines, and to a lesser extent, ulexite and colemanite. About 70% of all deposits in Turkey are colemanite, primarily used in the production of heat-resistant glass. At current levels of consumption, world resources are adequate for the foreseeable future.

Substitutes: The substitution of other materials for boron is possible in detergents, enamels, insulation, and soaps. Sodium percarbonate can replace borates in detergents and requires lower temperatures to undergo hydrolysis, which is an environmental consideration. Some enamels can use other glass-producing substances, such as phosphates. Insulation substitutes include cellulose, foams, and mineral wools. In soaps, sodium and potassium salts of fatty acids can act as cleaning and emulsifying agents.

^eEstimated. E Net exporter. NA Not available. W Withheld to avoid disclosing company proprietary data. XX Not applicable.

¹Defined as production + imports – exports.

²Defined as imports – exports.

³See Appendix C for resource and reserve definitions and information concerning data sources.

⁴Reported.

⁵World totals cannot be calculated because production and reserves are not reported in a consistent manner by all countries.