

# FLUORSPAR

(Data in thousand metric tons unless otherwise noted)

**Domestic Production and Use:** In 2022, minimal fluor spar (calcium fluoride, CaF<sub>2</sub>) was produced in the United States. One company sold fluor spar from stockpiles produced as a byproduct of its limestone quarrying operation in Cave-In-Rock, IL. A second company, which was developing a mine in Utah, received a \$5 million loan from the U.S. Department of Agriculture which it expected would be used to fund completion of a metallurgical-grade fluor spar-processing plant, rail spur, and tailings dam. An estimated 40,000 tons of fluorosilicic acid (FSA), equivalent to about 65,000 tons of fluor spar grading 100% CaF<sub>2</sub>, was recovered from three phosphoric acid plants processing phosphate rock. A company in Aurora, NC, continued construction on a plant to produce hydrofluoric acid (HF) from FSA. The U.S. Department of Energy continued to produce aqueous HF as a byproduct of the conversion of depleted uranium hexafluoride to depleted uranium oxide at plants in Paducah, KY, and Portsmouth, OH; the aqueous HF was sold into the commercial market.

U.S. fluor spar consumption was satisfied by imports. Domestically, production of HF in Louisiana and Texas was by far the leading use for acid-grade fluor spar. Hydrofluoric acid is the primary feedstock for the manufacture of virtually all fluorine-bearing chemicals, particularly refrigerants and fluoropolymers, and is also a key ingredient in the processing of aluminum and uranium. Fluor spar was also used in cement production, in enamels, as a flux in steelmaking, in glass manufacture, in iron and steel casting, and in welding rod coatings.

<b>Salient Statistics—United States:</b>	<b>2018</b>	<b>2019</b>	<b>2020</b>	<b>2021</b>	<b>2022<sup>e</sup></b>
Production:					
Finished, metallurgical grade	NA	NA	NA	NA	NA
Fluorosilicic acid from phosphate rock	33	29	22	40	40
Imports for consumption:					
Acid grade	381	346	427	391	450
Metallurgical grade	<u>78</u>	<u>59</u>	<u>65</u>	<u>59</u>	<u>80</u>
Total fluor spar imports	459	405	492	451	530
Hydrofluoric acid	122	124	103	103	110
Aluminum fluoride	25	38	21	28	22
Cryolite	17	21	26	42	29
Exports, fluor spar, all grades <sup>1</sup>	9	8	9	15	27
Consumption, apparent <sup>2</sup>	450	398	483	436	500
Price, average unit value of imports, cost, insurance, and freight, dollars per metric ton:					
Acid grade	276	304	309	322	360
Metallurgical grade	258	292	149	151	140
Employment, mine, number <sup>e</sup>	18	14	16	17	17
Net import reliance <sup>2</sup> as a percentage of apparent consumption	100	100	100	100	100

**Recycling:** Synthetic fluor spar may be produced from neutralization of waste in the enrichment of uranium, petroleum alkylation, and stainless-steel pickling; however, undesirable impurities constrain use. Primary aluminum producers recycle HF and fluorides from smelting operations.

**Import Sources (2018–21):**<sup>3</sup> Mexico, 66%; Vietnam, 16%; South Africa, 7%; Canada, 7%; and other, 4%.

<b>Tariff:</b>	<b>Item</b>	<b>Number</b>	<b>Normal Trade Relations</b>
			<b><u>12–31–22</u></b>
	Metallurgical grade (97% or less CaF <sub>2</sub> )	2529.21.0000	Free.
	Acid grade (more than 97% CaF <sub>2</sub> )	2529.22.0000	Free.
	Natural cryolite	2530.90.1000	Free.
	Hydrogen fluoride (hydrofluoric acid)	2811.11.0000	Free.
	Aluminum fluoride	2826.12.0000	Free.
	Sodium hexafluoroaluminate (synthetic cryolite)	2826.30.0000	Free.

**Depletion Allowance:** 22% (domestic), 14% (foreign).

**Government Stockpile:** None.

**Events, Trends, and Issues:** World production of fluor spar was estimated to have decreased in 2022. Global fluor spar supply, which is highly concentrated, was constrained by the bankruptcy and subsequent idling of a fluor spar mine in Canada and the declaration of force majeure for supply contracts by the world's leading exporting

## FLUORSPAR

mine in Mexico. Although prices from leading exporting countries such as Mexico, South Africa, and Vietnam reportedly increased, overall adverse impacts to supply appear to have been more than offset by decreased consumption in China. Overall, China decreased its fluor spar trade deficit. Chinese exports, including to the United States, increased. Chinese imports also decreased substantially, particularly from Mongolia, which likely contributed to a significant decrease in Mongolia's fluor spar production.

In September, the United States became the 137th country to ratify the Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer. The goal of the amendment is to reduce production and consumption of hydrofluorocarbon (HFC) gases, commonly used as aerosols, refrigerants, and solvents, by 80% over the next 30 years and which is expected to reduce projected global warming by as much as 0.5 degree Celsius by the end of the century. The American Innovation and Manufacturing Act of 2020 essentially established all of the HFC phasedown provisions and enforcement mechanisms needed to comply with the Kigali Amendment.

The U.S. Department of Energy awarded \$2.8 billion funding from the Bipartisan Infrastructure Law to stimulate domestic development of raw materials used in the production of electric-vehicle batteries. Nearly \$280 million in funding was awarded for the construction of a new facility in Louisiana to produce lithium hexafluorophosphate (LiPF<sub>6</sub>) and for the expansion of polyvinylidene difluoride (PVDF) production capacity in Georgia. LiPF<sub>6</sub> is the main salt used in lithium-ion battery electrolytes; PVDF is used as a binder and separator coating. Additionally, more than \$500 million was allocated to facilities that were likely to consume fluorochemicals in the processing of spherical graphite and the production of separator materials.

**World Mine Production and Reserves:** Reserves for China and Morocco were revised based on company and Government reports.

	Mine production		Reserves <sup>4</sup>
	2021	2022 <sup>e</sup>	
United States	NA	NA	4,000
Canada	140	18	NA
China	5,700	5,700	49,000
Germany	65	65	NA
Iran	50	50	3,400
Kazakhstan	67	67	NA
Mexico	1,000	970	68,000
Mongolia	650	350	22,000
Morocco	77	77	NA
Pakistan	65	65	NA
South Africa	403	420	41,000
Spain	155	160	10,000
Vietnam	215	220	5,000
Other countries	93	98	55,000
World total (rounded)	8,680	8,300	260,000

**World Resources:**<sup>4, 6</sup> Large quantities of fluorine are present in phosphate rock. Current U.S. reserves of phosphate rock are estimated to be 1 billion tons, containing about 72 million tons of 100% fluor spar equivalent assuming an average fluorine content of 3.5% in the phosphate rock. World reserves of phosphate rock are estimated to be 71 billion tons, containing about 5 billion tons of 100% fluor spar equivalent.

**Substitutes:** FSA has been used as an alternative to fluor spar in the production of aluminum fluoride (AlF<sub>3</sub>) and HF. Because of differing physical properties, AlF<sub>3</sub> produced from FSA is not readily substituted for AlF<sub>3</sub> produced from fluor spar. In 2022, a company in Australia was finalizing the design of a pilot plant to recover fluorine from aluminum smelter bath and then produce AlF<sub>3</sub> using either bauxite or aluminum smelting dross. Aluminum smelting dross, borax, calcium chloride, iron oxides, manganese ore, silica sand, and titanium dioxide have been used as substitutes for fluor spar fluxes.

<sup>e</sup>Estimated. NA Not available.

<sup>1</sup>Includes data for the following Schedule B codes: 2529.21.0000 and 2529.22.0000.

<sup>2</sup>Defined as total fluor spar imports – exports.

<sup>3</sup>Includes data for the following Harmonized Tariff Schedule of the United States codes: 2529.21.0000 and 2529.22.0000.

<sup>4</sup>See Appendix C for resource and reserve definitions and information concerning data sources.

<sup>6</sup>Measured as 100% CaF<sub>2</sub>.