

## FLUORSPAR

(Data in thousand metric tons unless otherwise noted)

**Domestic Production and Use:** In 2019, 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. Synthetic fluor spar may have been recovered as a byproduct of petroleum alkylation, stainless steel pickling, or uranium processing, but no data were collected from any of these operations. An estimated 17,000 tons of fluorosilicic acid (FSA), equivalent to about 27,000 tons of fluor spar grading 100%, was recovered from four phosphoric acid plants processing phosphate rock. Fluorosilicic acid was used primarily in water fluoridation.

U.S. fluor spar consumption was satisfied by imports and small quantities of byproduct synthetic fluor spar. Domestically, production of hydrofluoric acid (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>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	<b>2019<sup>e</sup></b>
Production:					
Finished, metallurgical grade	NA	NA	NA	NA	NA
Fluor spar equivalent from phosphate rock	105	72	64	27	27
Imports for consumption:					
Acid grade	328	328	331	381	370
Metallurgical grade	48	55	70	78	70
Total fluor spar imports	376	383	401	459	440
Hydrofluoric acid	120	126	123	122	130
Aluminum fluoride	32	20	21	26	39
Cryolite	19	16	10	17	22
Exports, all grades	14	12	11	9	7
Consumption					
Apparent <sup>1</sup>	362	371	390	450	430
Reported	W	W	W	W	W
Price, average value of imports					
Cost, insurance, and freight, dollars per ton:					
Acid grade	289	273	267	276	300
Metallurgical grade	249	233	237	258	270
Stocks, yearend, consumer and dealer <sup>2</sup>	<sup>e</sup> 150	<sup>e</sup> 150	NA	NA	NA
Employment, mine, number <sup>e</sup>	5	4	4	3	3
Net import reliance <sup>3</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 (2015–18):** Mexico, 66%; Vietnam, 13%; South Africa, 8%; China, 6%; and other, 7%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations 12–31–19</b>
Metallurgical grade (less than 97% CaF <sub>2</sub> )	2529.21.0000	Free.
Acid grade (97% or more 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.
Synthetic cryolite	2826.30.0000	Free.

**Depletion Allowance:** 22% (Domestic), 14% (Foreign).

**Government Stockpile:** None.

## FLUORSPAR

**Events, Trends, and Issues:** In recent years, several of the world's leading mines have been operating at or near full capacity. Further, there have been increasing concerns about the possibility of China becoming a net fluorspar importer owing to increased environmental regulation of its mining industry. Although there is little reliable information on China's fluorspar production, China's reported imports of fluorspar increased by approximately 350,000 tons from 2017 to 2018, and by an estimated 100,000 tons in 2019; imports were primarily from Mongolia and new production in Burma. New producers in Canada, Morocco, and South Africa were also ramping up production in 2019.

A hydrofluoroolefin (HFO) plant in Corpus Christi, TX, went into operation in February. HFO manufacturers continued to introduce HFOs and blends as low global-warming-potential alternatives to hydrofluorocarbon-based foam-blowing agents, propellants, and refrigerants, which are subject to increased restrictions under the Montreal Protocol. Because refrigerant gases are a leading downstream use of HF, the HFO plant, along with a similar plant in Baton Rouge, LA, that went into operation in 2017, were expected to support strong demand for fluorspar in the United States.

**World Mine Production and Reserves:** Reserves for Brazil and Spain were revised based on updated data from Government sources, and reserves for Morocco were revised based on company-reported information.

	Mine production		Reserves <sup>4, 5</sup>
	2018	2019 <sup>e</sup>	
United States	NA	NA	4,000
Argentina	14	14	NA
Brazil	26	18	1,400
Burma	70	44	NA
Canada	20	110	NA
China	4,000	4,000	42,000
Germany	45	45	NA
Iran	70	55	3,400
Mexico	1,080	1,200	68,000
Mongolia	605	670	22,000
Morocco	65	100	320
South Africa	242	240	41,000
Spain	145	140	10,000
Thailand	48	50	3,600
United Kingdom	11	21	4,000
Vietnam	239	240	5,000
Other countries	40	41	110,000
World total (rounded)	6,720	7,000	310,000

**World Resources:** Enormous 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% fluorspar equivalent assuming an average fluorine content of 3.5% in the phosphate rock. World reserves of phosphate rock are estimated to be 70 billion tons, equivalent to about 5 billion tons of 100% fluorspar equivalent.

**Substitutes:** Fluorosilicic acid is used to produce aluminum fluoride (AlF<sub>3</sub>), but because of differing physical properties, AlF<sub>3</sub> produced from FSA is not readily substituted for AlF<sub>3</sub> produced from fluorspar. Fluorosilicic acid has been used to produce HF, but this practice has not been widely adopted. Synthetic fluorspar could potentially be recovered by the Department of Energy's two depleted uranium hexafluoride conversion plants in Paducah, KY, and Portsmouth, OH. However, the preferred product is currently aqueous HF rather than fluorspar. Aluminum smelting dross, borax, calcium chloride, iron oxides, manganese ore, silica sand, and titanium dioxide have been used as substitutes for fluorspar fluxes.

<sup>e</sup>Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data.

<sup>1</sup>Defined as total fluorspar imports – exports.

<sup>2</sup>Industry stocks for leading consumers and fluorspar distributors.

<sup>3</sup>Defined as imports – exports.

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

<sup>5</sup>Measured as 100% calcium fluoride.