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FLUORSPAR [ADVANCE RELEASE]

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Fluorspar

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In 2017, the bulk of fluorspar consumed in the United States was from imports. Although not included in fluorspar production or consumption calculations, byproduct fluorosilicic acid (FSA) from some phosphoric acid producers, byproduct hydrofluoric acid (HF) from the U.S. Department of Energy's (DOE's) conversion of depleted uranium hexafluoride (DUF_6), and small amounts of byproduct synthetic fluorspar produced from industrial waste streams supplemented fluorspar as a domestic source of fluorine. Apparent consumption was 390,000 metric tons (t), an increase of 5% from 371,000 t in 2016. World production decreased slightly to 5.88 million metric tons (Mt) (table 1).

Fluorspar is the commercial name that refers to crude or beneficiated material that is mined and (or) milled from the mineral fluorite (calcium fluoride, CaF_2). Most of the fluorspar consumed and traded is either acid grade (also called acidspar), which is more than 97% CaF_2, or subacid grade (including ceramic and metallurgical grade), which is less than or equal to 97% CaF_2 and is commonly called metspar.

Globally, there are three leading fluorspar-consuming industries. The manufacture of HF, the leading source of fluorine in industrial applications and a precursor in the production of most other fluorine-containing chemicals, accounts for approximately 40% of global annual fluorspar consumption. The manufacture of aluminum fluoride (AlF_3) and cryolite (Na_3AlF_6), which are essential for primary aluminum smelting, accounts for approximately 15% of global annual fluorspar consumption. Both of these applications typically require acid-grade fluorspar, although FSA can also be used to produce AlF_3. Fluorspar used as a steelmaking flux accounts for approximately 35% of global consumption. Metallurgical-grade fluorspar is primarily used in this application, although acid-grade material may also be used (Roskill Information Services Ltd., 2017, p. 20). Other applications of fluorspar include its use in the manufacture of cement, ceramics, enamel, glass, and welding rod coatings.

Legislation and Government Programs

On March 1, 2017, the U.S. Department of Commerce announced its final determination that 1,1,1,2 tetrafluoroethane (HFC–134a) from China was being sold in the United States at less than fair value and was causing or threatened to cause material injury to a United States industry. As a result of the determination, imports of the chemical from China would be subject to an antidumping duty rate ranging between 149% and 167% ad valorem. HFC–134a is a hydrofluorocarbon (HFC) refrigerant used in automotive and stationary air conditioning (Mexichem S.A.B. de C.V., 2017; U.S. Department of Commerce, International Trade Administration, 2017).

The U.S. Environmental Protection Agency's Significant New Alternatives Policy (SNAP) program was established under the Clean Air Act Amendments of 1990 Section 612 for the purpose of meeting the United States' obligations under the Montreal Protocol on Substances that Deplete the Ozone Layer. Because of the ozone-depleting potential of early generations of fluorocarbon gases (chlorofluorocarbons, or CFCs and, later, hydrochlorofluorocarbons, or HCFCs), many fluorinated substances used as foam-blowing agents, propellants, refrigerants, and solvents had been identified for reduction and eventual phase out under the SNAP program. In many cases, HFCs, which are not ozone depleting, had been approved as acceptable alternatives. In 2015, Mexichem Fluor, Inc. challenged a final rule under SNAP that restricted the use of certain HFCs because of their high global warming potential (GWP). On August 8, 2017, the D.C. Circuit Court of Appeals ruled that because HFCs are not ozone depleting, the EPA did not have the authority to regulate the use of HFCs under the SNAP program (U.S. Environmental Protection Agency, 2016, undated c; Mexichem Fluor, Inc. v. Environmental Protection Agency, 2017); however, Honeywell International, Inc. and The Chemours Co. filed an appeal arguing that the court ignored the EPA's original directive to replace ozone-depleting substances with safer alternatives (Chemours Co., The, 2017b; Honeywell International, Inc., 2017a).

Perfluoroalkyl substances (PFASs) are a class of fluorinated chemicals that have a wide range of uses. They are commonly used to make products that are resistant to grease, oil, and water. PFASs have also been used in firefighting foams and as a processing aid in the manufacture of fluoropolymers. These substances, particularly long-chain PFASs (PFAS molecules containing eight or more carbon atoms, which are sometimes referred to as C–8), have come under scrutiny in the past 10 to 15 years owing to their environmental persistence, prevalence in the bloodstream of 99% of the U.S. population, and widespread geographic distribution. PFASs may enter the environment directly or through the degradation of other fluorinated telomers.

Perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) are two long-chain PFASs that have received the most attention. Human studies have examined possible links between elevated blood levels of PFOA and PFOS and numerous adverse health conditions. Domestically, PFOS was voluntarily phased out of production by 2002, and the EPA's voluntary 2010/2015 PFOA Stewardship Program likely reduced or eliminated the manufacture and import of PFOA and other long-chain PFASs. Although the presence of PFOA and PFOS in blood levels remained widespread, the levels are thought to have decreased (U.S. Environmental Protection Agency, undated a, b). Numerous communities and States across the United States, however, have identified localized areas with PFOA and PFOS contamination, particularly areas near industrial sites where the chemicals were manufactured or used, or near airfields where the chemicals were used in firefighting foams (Morrison, 2016).

The U.S. Department of Defense continued its investigation of PFAS contamination in drinking water at 600 sites nationwide where the military had used aqueous film-forming foam in crash training and fire suppression (McDermott, 2016). As the investigation continued throughout 2017, the number of identified communities across the country affected by contamination increased, and an increasing number of congressional legislators called for further Federal action. The Fiscal Year 2018 National Defense Authorization Act, which was signed into law in December, included funding for a nationwide study of the impact of PFASs in drinking water. The study would be conducted by the Agency for Toxic Substances and Disease Registry (InDepthNH.org, 2017; Shaheen, 2017).

As of November 10, 2017, the State of California's Office of Environmental Health Hazard Assessment added PFOA and PFOS to the list of chemicals that cause reproductive toxicity under Proposition 65 (Office of Environmental Health Hazard Assessment, 2017). Several other States were considering further regulatory and legislative action on PFASs.

In February, Chemours and E.I. du Pont de Nemours and Co. each agreed to pay a $335 million settlement for a 2001 class action lawsuit involving more than 3,500 personal injury claims related to PFOA that was used in the production of its Teflon™ brand polytetrafluoroethylene fluoropolymer at the Washington Works plant in Wood County, OH. A science panel established as part of the settlement determined probable links between PFOA exposure and six health conditions, including high cholesterol, kidney and testicular cancers, pregnancy-induced hypertension and preeclampsia, thyroid disease, and ulcerative colitis (Mancini, 2017; C8 Science Panel, undated).

Production

In 2017, small amounts of fluorspar may have been produced in Illinois by Hastie Mining & Trucking as a byproduct of limestone mining operations, but no data were collected on quantities produced. Synthetic fluorspar may have been produced as a byproduct of petroleum alkylation, stainless-steel pickling, and uranium processing; however, the U.S. Geological Survey (USGS) does not conduct a data survey for synthetic fluorspar produced in the United States.

FSA was produced as a byproduct of the processing of phosphate rock into phosphoric acid. Domestic production data for FSA were collected by the USGS from a voluntary canvass of U.S. phosphoric acid operations known to recover FSA. Of the five active FSA operations surveyed, responses were received from three, representing 37% of the total sold or used by producers. In 2017, three companies—J.R. Simplot Co., Mosaic Fertilizer LLC (a subsidiary of The Mosaic Co.), and PCS Phosphate Co., Inc.—produced marketable byproduct FSA at five phosphoric acid plants (part of phosphate fertilizer operations) in Florida, Louisiana, North Carolina, and Wyoming. In 2017, production of FSA decreased by 11% to 39,500 t (equivalent to about 64,300 t of fluorspar grading 100% CaF_2) (table 1).

Ferroglobe plc (London, United Kingdom), Hastie Mining & Trucking (Cave-in-Rock, IL), and Seaforth Mineral & Ore Co., Inc. (East Liverpool, OH) marketed screened and dried imported acid- and metallurgical-grade fluorspar. Hastie Mining & Trucking also continued development of the Klondike II fluorspar mine in Livingston County, KY.

The DOE's DUF_6 conversion project operated two plants—one in Paducah, KY, and another, the Portsmouth facility, in Piketon, OH. The goal of the project, which started production in 2011, was to convert the Government's inventory of DUF_6 into more stable forms, including uranium oxide and aqueous HF. The HF was sold into the commercial market. Operations at both plants were suspended in early 2015 owing to the failure of HF condensers. By yearend 2017, all four conversion process lines at the Paducah plant were operating following the installation of new condensers. The DOE also intended to replace the HF condensers in all three of the conversion process lines at the Portsmouth facility, and in early 2018, one line resumed operation. Through January 2017 the combined HF production at the Paducah and Portsmouth facilities totaled 33.5 million liters (Edwards, 2017; U.S. Department of Energy, 2018).

Consumption

Domestic consumption data were collected by the USGS from a quarterly survey of two large consumers that provide data on HF consumption and four distributors that provide data on the merchant market (metallurgical and other uses). Owing to decreased survey participation, beginning in 2014, total reported U.S. fluorspar consumption and data on quarterly consumer stocks were withheld to avoid disclosing company proprietary data (table 2). Apparent consumption of fluorspar was 390,000 t, a 5% increase from 371,000 t in 2016 (table 1).

Approximately 40% of global annual fluorspar production is used to produce HF. Domestically, two companies used fluorspar for the production of HF in 2017—Chemours and Honeywell. HF may be used directly in a variety of industrial processes or as an intermediate in the production of organic and inorganic fluorine chemicals. In direct use, HF is crucial in many manufacturing processes, such as in the cleaning and etching of semiconductors and circuit boards, the enrichment of uranium, the production of low octane fuels (petroleum alkylation), and the removal of impurities from metals (pickling). As an intermediate, HF is primarily used to produce organic fluorocarbons, which were estimated to account for more than 30% of annual fluorspar production (Roskill Information Services Ltd., 2017, p. 20, 21). Fluorocarbon chemicals (HCFCs; HFCs; and hydrofluoroolefins, or HFOs) are used in a wide variety of applications, such as aerosols, refrigerants, and solvents and in the production of high-performance plastics and rubbers (fluoropolymers and fluoroelastomers). These substances are contained in dozens of familiar products used in daily life. Examples include antifingerprint coatings on touch-screen devices; nonstick coatings on cookware; refrigerant gases used in household and commercial refrigeration and automotive, home, and industrial air-conditioning systems; and water- and stain-resistant clothing and textiles. Major U.S. producers were Arkema SA; Chemours; Daikin America, Inc. (formerly MDA Manufacturing Ltd.); Honeywell; Mexichem; and Solvay Solexis Inc.

In February, Chemours began construction of a new HFO–1234yf manufacturing facility at its Corpus Christi site in Ingleside, TX. HFOs were designed as low-GWP replacements for HFCs. Because of increased global regulation of HFCs, Chemours expected strong demand for HFO refrigerants in the automotive and commercial cold storage sectors. According to the company, the new facility would triple its current capacity, making it the leading global manufacturing facility for HFOs. Refrigerants and refrigerant blends produced at the facility would be sold under the Opteon™ trade name (Chemours Co., The, 2017a).

In May, Honeywell opened a $300 million plant in Geismar, LA, for the production of Solstice®yf (HFO–1234yf). The refrigerant would expand Honeywell's production of Solstice® products in Louisiana, which also include aerosol propellants and foam insulation. Solstice®yf, which is a mobile air conditioning refrigerant with a GWP of less than 1, was designed as a replacement for HFC–134a, which has a GWP of 1,300. Honeywell projected that the refrigerant would be used in more than 40 million vehicles by 2018 (Griggs, 2017; Honeywell International, Inc., 2017b).

In September 2017, Arkema announced that it planned to expand the production capacity for its Kynar® brand polyvinylidene difluoride (PVDF) fluoropolymer by 20% at its plant in Calvert City, KY, beginning in mid-2018. In terms of quantity produced, PVDF was the second-ranked fluoropolymer, and most of the production capacity was located in China. Use of PVDF has been increasing because one of its many uses is as the standard binder in the production of lithium hexafluorophosphate composite electrodes in lithium-ion and lithium metal polymer batteries (Roskill Information Services Ltd., 2017, p. 197). Arkema expected increased demand for PVDF, particularly in new energy technology and water management markets (Arkema SA, 2017).

In November, Honeywell announced plans to temporarily idle production of uranium hexafluoride (UF_6) at its Metropolis processing facility in Illinois owing to decreased demand and global oversupply of UF_6. This idling would also result in the layoff of 170 of the facility's 200 employees. HF is required in the production of UF_6 (Honeywell International, Inc., 2017c).

Internationally, acid-grade fluorspar was used in the production of AlF_3 and Na_3AlF_6, which are essential in primary aluminum smelting. Alumina (Al_2O_3) is dissolved in a bath that consists primarily of molten cryolite and small amounts of aluminum fluoride and fluorspar to allow electrolytic recovery of aluminum. During the aluminum smelting process, the amount of excess sodium in the bath (a result of impurities in the alumina) is controlled by the addition of aluminum fluoride, which reacts with the sodium to form cryolite. This reaction results in excess bath material, which is drawn off in a liquid form, allowed to cool and solidify, and can then be crushed and reused to start up new pots or to compensate for electrolyte losses. This excess material is variously called crushed tapped bath, secondary cryolite, or bath cryolite, as well as other terms. In the aluminum smelting process, AlF_3 is also used to replace the fluorine lost either by being absorbed by the bath walls or captured as emissions. Most AlF_3 is produced directly from acid-grade fluorspar or from byproduct FSA. The AlF_3 requirements of the U.S. aluminum industry were met through imports in 2017 (table 8), as there are no active AlF_3 producers in the United States.

The merchant fluorspar market in the United States included sales of acid- and metallurgical-grade material mainly to steel mills, where it was used as a fluxing agent to increase the fluidity of the slag. Sales were also made to smaller markets, such as cement plants, foundries, glass and ceramics plants, and welding rod manufacturers, in railcar, truckload, and less-than-truckload quantities. (In table 2, data on merchant fluorspar sales are not shown to avoid disclosing company proprietary data.) In the late 1970s, the United States used upwards of 500,000 metric tons per year (t/yr) of fluorspar for these applications. During the past 20 to 30 years, however, fluorspar usage in such industries as steel and glass manufacturing has declined because of product substitutions or changes in industry practices.

In the United States, FSA is primarily used for water fluoridation, but it is also used as a metal surface treatment and cleaner and for pH adjustment in industrial textile processing or laundries. It also can be used in the processing of animal hides, for hardening masonry and ceramics, and in the manufacture of other chemicals. In 2017, the amount of FSA sold or used by producers was 39,000 t (table 1) (equivalent to about 63,400 t of fluorspar grading 100% CaF_2), an 8% decrease compared with that of 2016 (table 1).

Transportation

The United States depends on imports for most of its fluorspar supply. Metallurgical-grade fluorspar is shipped routinely as lump or gravel, with the gravel passing a 75-millimeter (mm) sieve and not more than 10% by weight passing a 9.5-mm sieve. Acid-grade fluorspar is shipped in the form of damp filtercake that contains 7% to 10% moisture to facilitate handling and to reduce dust. This moisture is removed by heating the filtercake in rotary kilns or other dryers before being treating with sulfuric acid to produce HF. Acid-grade imports are usually shipped by ocean freight using bulk carriers of 10,000- to 50,000-t deadweight capacity; ships in this size range are termed "handymax." Participants negotiate freight levels, terms, and conditions. Some of the acid- and ceramic-grade fluorspar is marketed in bags for small users and shipped by truck.

Prices

According to Industrial Minerals (2016, 2017), the yearend price of acid-grade fluorspar from China (free-on-board wet filtercake), which had decreased each year since 2011, increased by more than 50% in 2017 from that of 2016, to $400 to $420 per metric ton. The yearend price of acid-grade fluorspar from South Africa (free-on-board Durban, filtercake), which had decreased each year since 2013, increased slightly to $200 to $230 per metric ton. Prices for both high- and low-arsenic acid-grade fluorspar (free-on-board Tampico, filtercake and arsenic <5 parts per million, respectively) and metallurgical-grade fluorspar from Mexico remained unchanged. The price of acid-grade fluorspar at ports in the gulf coast, including cost, insurance, and freight, also remained unchanged at $260 to $270 per metric ton (table 3).

Foreign Trade

In 2017, U.S. exports of fluorspar were 10,900 t, an 8% decrease compared with those of 2016 (table 4). With the absence of fluorspar stocks in the National Defense Stockpile and only a small amount of mined or byproduct fluorspar, exports are likely reexports of imported material. In terms of quantity, approximately 76% of exports went to Canada.

In 2017, combined acid- and metallurgical-grade fluorspar imports for consumption were 401,000 t, a 5% increase compared with those of 2016 (table 5). Acid-grade imports were essentially unchanged from 2016. Metallurgical-grade imports increased by 27% to 70,400 t, and 99% of the imports were from Mexico. The leading suppliers of fluorspar to the United States were Mexico (68%), Vietnam (14%), South Africa (7%), China (6%), and Spain (5%).

Compared with those of 2016, imports of HF decreased slightly to 123,000 t (table 6); the majority of HF imports were from Mexico (89%), China (4%), and Japan (3%). Imports of cryolite decreased by 37% to 9,900 t (table 7). Aluminum fluoride imports remained essentially unchanged at 20,600 t (table 8); the leading suppliers of AlF_3 were China (40%), Mexico (30%), Norway (15%), and Canada (13%).

World Review

Canada.—Canada Fluorspar Inc. (CFI) (St. Lawrence, Newfoundland and Labrador) continued development of its project in Newfoundland and Labrador's Burin Peninsula. CFI's resource totaled 8.8 Mt of fluorspar from four vein deposits, including the AGS, Blue Beach North, Director, and Tarefare veins which together had an average grade of 39% CaF_2. The mine officially opened in August, and construction continued on the 200,000-metric-ton-per-year flotation mill. Ore from three open pits would be stockpiled until the mill is commissioned. First production of acid-grade concentrate was expected in early 2018 (Gorrill, 2016; VOCM, 2017; Canada Fluorspar Inc., written commun., 2017).

The Atlantic Canada Opportunities Agency (ACOA) provided Canada Fluorspar Inc. with $3.71 million (5 million Canadian dollars) as part of its business development program (CBC News, 2017). This was in addition to a $12.6 million (17 million Canadian dollars) loan that the provincial government of Newfoundland and Labrador had given the company (McLeod, 2017).

Morocco.—Groupe Managem (Casablanca) reported acid-grade concentrate production of 56,395 t from the El Hammam Mine operated by Samine, a 15% decrease from that of 2016. In response to the decrease in acid-grade concentrate production, the company increased production of metallurgical-grade fluorspar for use in the cement market by more than five times that of 2016 (Groupe Managem, 2018, p. 53).

South Africa.—In July, SepFluor Ltd. began construction on the Nokeng Mine and milling project in Rust de Winter, Gauteng Province. Nokeng is located in the Bushveld Complex directly south of the Minersa Group's Vergenoeg Mine, the country's only operational fluorspar mine. Open pits would be developed at two of three fluorspar-hematite deposits that make up the Nokeng Mine—the Outwash Fan, which has an average ore grade of 22.7% CaF_2, and Plattekop, which has an average ore grade of 38.2% CaF_2. A processing plant with a capacity of 180,000 t/yr of acid-grade fluorspar and 30,000 t/yr of metallurgical-grade fluorspar was designed to accommodate different types of ore. The estimated life of the mine was 19 years, and first production was expected in early 2019 (Wagner, 2017, p. 8, 9, 16; SepFluor Ltd., undated).

Vietnam.—Nui Phao Mining Co. Ltd. (Masan Resources Corp., Ho Chi Minh City) produced acid-grade fluorspar as well as bismuth, copper, and tungsten concentrates from its Nui Phao polymetallic mine in Thai Nguyen Province in northern Vietnam. The company had reported increased production of fluorspar each year since the mine went into operation in 2014; the production increases were attributed to the implementation of successive capital upgrades to increase ore throughput and enhance recovery rates, particularly in the tungsten and fluorspar processing circuits. Mill recovery rates of fluorspar increased to 57% in 2017 from 49% in 2016, which resulted in an 8% increase in fluorspar production (Masan Resources Corp., 2018, p. 18, 24, 26, 68–69).

Outlook

Because of fluorspar's role as the basic material for almost all other fluorochemicals, fluorspar consumption is primarily driven by factors affecting the downstream industries. Fluorochemicals, particularly those containing carbon, are very stable and versatile, and new applications continue to be developed. Numerous environmental, health, and safety issues constrain the use of fluorine, HF, and many other fluorinated substances, however. These conflicting factors complicate an assessment of the outlook for fluorspar. The following discussion examines fluorspar consumption within three leading industrial sectors.

Aluminum.—Because aluminum produced from scrap does not require either AlF_3 or cryolite, demand for fluorspar is expected to increase with primary aluminum production only. Aluminum fluoride produced from FSA may displace some AlF_3 produced from fluorspar; however, because of the differences in their physical properties, the two products are not readily interchangeable.

Chemicals.—Because of the ozone-depleting potential of early generations of fluorocarbon gases (CFCs and later HCFCs), many fluorinated substances used as foam-blowing agents, propellants, refrigerants, and solvents have been identified for reduction and eventual phase out under the Montreal Protocol, which was adopted in 1987. CFCs and HCFCs have been replaced by HFCs, which, although not ozone depleting, in many cases are potent greenhouse gases owing to high GWP and long atmospheric lifecycles. The adoption of the Kigali Amendment in 2016 effectively expanded the scope of the Montreal Protocol to phase down the use of many higher GWP HFCs as well.

Fluorinated foam-blowing agents and propellants are still in use but have been replaced in many applications by nonfluorinated alternatives. The use of fluorinated refrigerants has persisted, and increased global demand for refrigeration and air-conditioning, particularly in developing countries, had been expected to drive increased consumption of fluorspar. Furthermore, subsequent generations of fluorinated refrigerants often contained more fluorine than previous generations, which increased the amount of fluorspar required for their manufacture. Although low-GWP fluorinated refrigerants have been developed and are gaining acceptance, a portion of the refrigerant market is expected to transition to nonfluorinated alternatives, which could temper increased consumption of fluorspar in this sector.

The use of some fluorocarbons, particularly those used to manufacture fluoropolymers and fluoroelastomers, has not been restricted by the provisions of the Montreal Protocol because chemicals used entirely as feedstock in the manufacture of other chemicals are excluded from production and consumption calculations. In 2012, fluoropolymer industry revenue was estimated to be $5.8 billion with an estimated 6.5% compound annual growth rate (Boday, 2012).

Fluxes in Steelmaking.—Fluorspar's use as a flux in steelmaking varies significantly by geographic region. Metspar consumption in Europe and North America decreased dramatically in the 1990s with decreasing use of open-hearth steelmaking furnaces that used large quantities of fluorspar as a flux. Improvements in steelmaking technology have also reduced the unit consumption of fluorspar per unit ton of steel produced. In less developed countries, the quantity of fluorspar used as a flux in steelmaking continues to be much higher, but further efficiency improvements are expected to moderate growth.

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TABLE 1

SALIENT FLUORSPAR STATISTICS[1, 2]

		2013	2014	2015	2016	2017
United States:						
Fluorspar:						
Exports:[3]						
Quantity	metric tons	16,000	13,400	13,700	11,900	10,900
Value[4]	thousands	$2,520	$2,200	$2,210	$1,900	$1,950
Imports for consumption:[3]						
Quantity	metric tons	643,000	414,000	376,000	383,000	401,000
Value[5]	thousands	$147,000	$105,000	$107,000	$102,000	$105,000
Consumption:						
Reported	metric tons	441,000	W	W	W	W
Apparent[6]	do.	548,000	518,000	411,000	371,000	390,000
Fluorosilicic acid:						
Production	metric tons	74,300	70,100	64,500	44,400	39,500
Sold and used	do.	73,900	70,600	63,500	42,300	39,000
Value	thousands	$21,800	$19,800	$15,500	$14,100	$13,500
Stocks, consumer and distributor, December 31	metric tons	313,000	195,000	146,000 e	147,000 e	NA
World, production, fluorspar	do.	7,100,000 r	6,730,000 r	5,820,000 r	5,760,000 r	5,880,000

[e]Estimated. [r]Revised. do. Ditto. NA Not available. W Withheld to avoid disclosing company proprietary data.

[1]Table includes data available through March 31, 2020. Data are rounded to no more than three significant digits.

[2]Does not include byproduct or synthetic fluorspar production.

[3]Source: U.S. Census Bureau; data may be adjusted by the U.S. Geological Survey.

[4]Free alongside ship values at U.S. ports.

[5]Cost, insurance, and freight values at U.S. ports.

[6]Imports minus exports plus adjustments for changes in stocks.

TABLE 2

U.S. REPORTED CONSUMPTION OF FLUORSPAR, BY END USE[1]

(Metric tons)

	Containing more than 97% calcium fluoride		Containing not more than 97% calcium fluoride		Total	
End use or product	2016	2017	2016	2017	2016	2017
Hydrofluoric acid	W	W	--	--	W	W
Metallurgical	W	W	30,700	NA	W	NA
Other[2]	W	W	--	--	W	W
Total	W	W	30,700	NA	W	NA
Stocks, consumer and distributor, December 31	W	W	18,200	NA	147,000 e	NA

[e]Estimated. NA Not available. W Withheld to avoid disclosing company proprietary data; included in “Other.” -- Zero,

[1]Table includes data available through March 31, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]May include cement, enamel, glass and fiberglass, hydrofluoric acid, steel castings, and welding rod coatings.

TABLE 3

PRICES OF IMPORTED FLUORSPAR[1]

(Dollars per metric ton)

Source and grade	2016	2017
Acidspar:		
Chinese, dry basis, cost, insurance, and freight (c.i.f.) gulf port, filtercake	260–270	260–270
Chinese, free on board (f.o.b.) China, wet filtercake	250–270	400–420
Mexican, f.o.b. Tampico, filtercake	260–280	260–280
Mexican, f.o.b. Tampico, arsenic <5 parts per million	280–310	280–310
South African, f.o.b. Durban, filtercake	200–220	200–230
Metspar, Mexican, f.o.b. Tampico	230–250	230–250

[1]Table includes data available through March 31, 2020.

Source: Industrial Minerals magazine (London).

TABLE 4
U.S. EXPORTS OF FLUORSPAR, BY COUNTRY OR LOCALITY[1, 2]

Country or locality	2016 Quantity (metric tons)	2016 Value[3]	2017 Quantity (metric tons)	2017 Value[3]
Australia	--	--	87	$12,600
Canada	10,700	$1,730,000	8,290	1,590,000
Chile	214	28,300	194	28,600
China	--	--	65	9,480
Dominican Republic	199	28,800	--	--
El Salvador	--	--	36	4,050
France	5	3,820	143	23,800
Germany	--	--	8	4,400
Hong Kong	--	--	308	44,700
Indonesia	4	2,800	--	--
Italy	44	6,000	43	4,800
Japan	--	--	18	2,560
Korea, Republic of	--	--	80	22,700
Malaysia	10	9,930	185	26,800
Mexico	672	85,100	1,490	169,000
Nicaragua	30	4,350	--	--
Trinidad and Tobago	44	6,350	--	--
Total	11,900	1,900,000	10,900	1,940,000

-- Zero.

[1]Table includes data available through March 31, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Exports include domestic exports only for Schedule B numbers 2529.21.0000 and 2829.22.0000.

[3]Free alongside ship values at U.S. ports.

Source: U.S. Census Bureau.

TABLE 5

U.S. IMPORTS FOR CONSUMPTION OF FLUORSPAR, BY COUNTRY AND CUSTOMS DISTRICT[1, 2]

	2016		2017	
Country and customs district	Quantity (metric tons)	Value[3] (thousands)	Quantity (metric tons)	Value[3] (thousands)
Containing more than 97% calcium fluoride (CaF_2):				
China:				
Baltimore, MD	--	--	380	$209
Houston, TX	35,900	$11,000	17,200	4,810
New Orleans, LA	10,200	3,000	5,280	1,510
Total	46,100	14,000	22,900	6,530
France, Houston, TX	285	150	--	--
Germany:				
Houston, TX	270	150	510	217
New York City, NY	171	86	114	51
Total	441	235	624	268
Israel, New Orleans, LA	1	7	34	21
Japan, New York, NY	--	--	2	10
Mexico:				
Baltimore, MD	57	35	75	36
Laredo, TX	16,200	4,970	20,400	5,680
New Orleans, LA	197,000	53,400	182,000	47,600
Philadelphia, PA	19	8	19	9
Total	213,000	58,400	202,000	53,300
Mongolia, Baltimore, MD	247	129	152	80
Russia, Chicago, IL	1	6	--	--
South Africa, Houston, TX	31,300	6,260	27,900	5,990
Spain:				
Cleveland, OH	--	--	60	36
Houston, TX	10,900	2,680	20,100	4,630
Total	10,900	2,680	20,100	4,670
United Kingdom:				
Chicago, IL	--	--	177	115
Cleveland, OH	2,060	991	--	--
Houston, TX	25	24	6	17
Los Angeles, CA	146	75	--	--
Total	2,230	1,090	183	132
Vietnam:				
Houston, TX	17,700	5,360	52,500	16,400
New Orleans, LA	5,600	1,130	4,500	993
Total	23,300	6,490	57,000	17,400
Grand total	328,000	89,500	331,000	88,400
Containing not more than 97% CaF_2:				
China:				
Houston, TX	27	9	--	--
Los Angeles, CA	9	6	52	19
New Orleans, LA	--	--	300	174
New York City, NY	--	--	98	62
Seattle, WA	25	8	151	97
Total	61	23	601	352
Mexico:				
Laredo, TX	3,750	631	2,670	342
New Orleans, LA	50,700	11,800	67,100	16,000
Total	54,500	12,400	69,800	16,300
Mongolia, New Orleans, LA	700	406	--	--
Netherlands, Los Angeles, CA	--	--	1	8
Grand total	55,200	12,900	70,400	16,700
Grand total, all grades	383,000	102,000	401,000	105,000

-- Zero.

[1]Table includes data available through March 31, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Includes acid and metallurgical grade fluorspar as reported by Harmonized Tariff Schedule of the United States codes 2529.22.0000 and 2529.21.0000, respectively.

[3]Cost, insurance, and freight values at U.S. ports.

Source: U.S. Census Bureau.

TABLE 6
U.S. IMPORTS FOR CONSUMPTION OF HYDROFLUORIC ACID, BY COUNTRY OR LOCALITY[1, 2]

Country or locality	2016 Quantity (metric tons)	2016 Value[3] (thousands)	2017 Quantity (metric tons)	2017 Value[3] (thousands)
Belgium	1	$4	--	--
Canada	595 r	988 r	744	$1,200
China	7,550 r	6,900 r	5,320	5,450
Germany	1,100	2,260	1,360	2,620
India	72	75	88	87
Japan	1,560	2,020	3,900	5,030
Korea, Republic of	89	334	327	1,130
Mexico	114,000	175,000	110,000	159,000
Singapore	274	750	274	774
Spain	149	424	695	1,060
Taiwan	533 r	1,130 r	360	943
Total	126,000	190,000	123,000	177,000

[r]Revised. -- Zero.
[1]Table includes data available through March 31, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Import information for hydrofluoric acid is reported by Harmonized Tariff Schedule of the United States code 2811.11.0000.
[3]Cost, insurance, and freight values at U.S. ports.

Source: U.S. Census Bureau.

TABLE 7
U.S. IMPORTS FOR CONSUMPTION OF CRYOLITE, BY COUNTRY OR LOCALITY[1, 2]

Country or locality	2016 Quantity (metric tons)	2016 Value[3] (thousands)	2017 Quantity (metric tons)	2017 Value[3] (thousands)
Canada	7,830	$2,720	756	$217
China	261	178	180	199
Denmark	19	40	119	206
Germany	1,930	2,640	1,950	2,690
Hungary	228	348	254	403
Iceland	--	--	460	438
India	1	3	2	7
Italy	10	15	6	9
Japan	4,510	5,580	5,510	6,880
Mexico	1	4	20	8
Spain	236	72	64	55
Switzerland	--	--	43	20
United Arab Emirates	50	51	--	--
United Kingdom	628	1,100	537	975
Total	15,700	12,800	9,900	12,100

-- Zero.
[1]Table includes data available through March 31, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes natural and synthetic cryolite as reported by Harmonized Tariff Schedule of the United States codes 2530.90.1000 and 2826.30.0000, respectively.
[3]Cost, insurance, and freight values at U.S. ports.

Source: U.S. Census Bureau.

TABLE 8

U.S. IMPORTS FOR CONSUMPTION OF ALUMINUM FLUORIDE, BY COUNTRY OR LOCALITY[1, 2]

Country or locality	2016 Quantity (metric tons)	2016 Value[3] (thousands)	2017 Quantity (metric tons)	2017 Value[3] (thousands)
Canada	1,130	$1,540	2,760	$3,480
China	12,100	13,600	8,180	9,290
Italy	--	--	480	579
Mexico	7,200	7,880	6,160	7,160
Norway	--	--	3,000	3,140
Other[4]	43 r	56 r	24	47
Total	20,400 r	23,100	20,600	23,700

[r]Revised. -- Zero.

[1]Table includes data available through March 31, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Import information for aluminum fluoride is reported by Harmonized Tariff Schedule of the United States code 2826.12.0000.

[3]Cost, insurance, and freight values at U.S. ports.

[4]Includes all countries with quantities less than 100 metric tons.

Source: U.S. Census Bureau.

TABLE 9

FLUORSPAR: WORLD PRODUCTION, BY COUNTRY[1]

(Metric tons)

Country or locality and form	2013	2014	2015	2016	2017
Afghanistan	-- e	4,700 r	4,108 r	4,000 r, e	4,000 e
Argentina	38,601 r	39,433 r	65,282 r	14,222 r	14,000 e
Brazil:					
Acid grade	6,835	6,496	6,500 e	6,500 e	6,500 e
Metallurgical grade	20,886	17,353	17,000 e	17,000 e	17,000 e
Total	27,721 r	23,849 r	23,500 e	23,500 e	23,500 e
Bulgaria	12,000 e	20,000 e	20,000 e	2,000 e	--
China[2]	4,800,000	4,310,000	3,820,000	3,730,000 r, e	3,700,000 e
Egypt	850 e	900 e	1,105	1,000	1,000 e
Germany, acid grade	48,744	58,100	49,801	52,552 r	55,000 e
India, metallurgical grade	3,094	2,439	2,270	1,920	1,120
Iran	69,828	78,736	39,286	70,820 r	70,000 e
Kazakhstan	108,000	65,000 r, e	21,200 r, e	20,000 r, e	--
Kenya, acid grade	48,500	74,000	64,395	42,656	6,945
Mexico:					
Acid grade	707,514	631,590	623,740	649,361	692,125
Metallurgical grade	502,963	478,131	250,000 r, e	250,000 r, e	325,000 e
Total	1,210,477 r	1,109,721 r	874,000 r, e	899,000 r, e	1,020,000 e
Mongolia:					
Acid grade[3]	76,400	71,900	47,300	34,100	39,900
Metallurgical grade[4]	161,700	303,000	183,500	167,700	180,000
Total	238,100 r	374,900 r	230,800 r	201,800 r	219,900
Morocco	81,200	79,840	80,890	73,920 r	78,400 e
Namibia, acid grade, 97% CaF_2	60,774 [5]	65,485 [5]	--	1,495 [6]	--
Pakistan	11,292	8,961	7,692	6,625	2,300 e
Russia, unspecified, 55% to 96.4% CaF_2	56,200	8,200	2,000 r	1,000 r, e	1,000 e
South Africa:					
Acid grade[e]	137,000	150,000	106,000	143,000	240,000
Metallurgical grade[e]	21,000	14,000	14,000	34,000	17,000
Total	157,776	164,056	120,000 r, e	177,000 r, e	257,000 e
Spain:					
Acid grade	96,810 r	120,582 r	130,647 r	130,131 r	130,000 e
Metallurgical grade	5,400 r	5,800 r	24,635 r	11,997 r	12,000 e
Total	102,210 r	126,382 r	155,282 r	142,128 r	142,000 e
Thailand					
Acid grade	2,829	34,022	36,772	37,286	25,279
Metallurgical grade	2,432	4,590	15,095	20,100	5,500
Total	5,261 r	38,612 r	51,867 r	57,386 r	30,779
Turkey	3,874	4,271	6,238	10,339 r	10,000 e
United Kingdom, all grades	16,000	25,000	17,000	12,000 r	12,000 e
Vietnam	--	50,000 e	163,000 r, e	219,000 r, e	236,000 e
Grand total	7,100,000 r	6,730,000 r	5,820,000 r	5,760,000 r	5,880,000
Of which:					
Acid grade	1,270,000 r	1,290,000 r	1,150,000 r	1,170,000 r	1,270,000
Metallurgical grade	717,000 r	825,000 r	507,000 r	503,000 r	558,000
Other and unspecified	5,120,000 r	4,620,000 r	4,170,000 r	4,090,000 r	4,050,000

[e]Estimated. [r]Revised. -- Zero.

[1]Table includes data available through August 8, 2018. All data are reported unless otherwise noted. Grand totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]As reported by China's Ministry of Land and Resources. Production may include a significant amount of submetallurgical-grade material.

[3]Flotation concentrate, includes some material less than 97%.

[4]May include some submetallurgical-grade fluorspar.

[5]Data were in wet tons but have been converted to dry tons to agree with other data in the table.

[6]Likely metallurgical grade.