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# 2008 Minerals Yearbook

## FLUORSPAR

U.S. Department of the Interior
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# Fluorspar

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**Domestic survey data and tables were prepared by Martha L. Jackson, statistical assistant, and the world production table was prepared by Linder Roberts, international data coordinator.**

In 2008, there was no primary fluorspar production in the United States, although a small amount of fluorspar was recovered as a byproduct of limestone quarrying in Illinois and was screened and sold as metallurgical grade. The bulk of U.S. consumption was supplied by imports and by small amounts of byproduct synthetic fluorspar produced from industrial waste streams. Byproduct fluorosilicic acid (FSA) production from some phosphoric acid producers supplemented fluorspar as a domestic source of fluorine but was not included in fluorspar production or consumption calculations. According to the U.S. Census Bureau, U.S. imports of fluorspar decreased by about 8%, imports of hydrofluoric acid (HF) decreased by about 13%, and exports of fluorspar increased by 39% compared with those in 2007 (tables 1, 4–6).

Fluorspar is used directly or indirectly to manufacture such products as aluminum, gasoline, insulating foams, plastics, refrigerants, steel, and uranium fuel. Most fluorspar consumption and trade involve either acid grade (also called acidspar), which is greater than 97% calcium fluoride ($CaF_2$), or subacid grade, which is 97% or less $CaF_2$. Subacid grade includes metallurgical and ceramic grades and is commonly called metallurgical grade or metspar.

### Production

In 2008, small amounts of byproduct fluorspar were produced in Illinois. There is no U.S. Geological Survey (USGS) data survey for synthetic fluorspar. FSA is produced as a byproduct from the processing of phosphate rock into phosphoric acid. Domestic production data for FSA were developed by the USGS from a voluntary canvass of U.S. phosphoric acid operations known to recover FSA. Of the five FSA operations surveyed, responses were received from four plants, representing 94% of the total sold or used by producers. Production and sales data for the one nonrespondent were estimated based on prior year company data.

In 2008, there were three companies producing marketable byproduct FSA at phosphoric acid plants (part of a phosphate fertilizer operation). J.R. Simplot Co., Mosaic Fertilizer (a subsidiary of The Mosaic Co.), and PCS Phosphate Co. Inc. operated five plants in Florida, Louisiana, North Carolina, and Wyoming that produced marketable FSA. Production of byproduct FSA was 62,300 metric tons (t) (100% basis), and quantities sold or used totaled 62,900 t (equivalent to approximately 111,000 t of fluorspar grading 92% CaF2) valued at about $14.2 million.

Some synthetic fluorspar was recovered as a byproduct of petroleum alkylation, stainless steel pickling, and uranium processing. The majority of the marketable product was estimated to come from uranium processing, but the actual amount of synthetic fluorspar recovered is unknown.

Hastie Mining and Trucking Co. (Cave-In-Rock, IL), Oxbow Carbon and Minerals LLC (Aurora, IN), and Seaforth Mineral & Ore Co. Inc. (East Liverpool, OH) marketed screened and dried imported acid- and metallurgical-grade fluorspar. Hastie Mining also screened and sold small amounts of byproduct fluorspar from the company's limestone quarry operation.

Hastie Mining and Moodie Mineral Co. completed an exploration program on the Klondike II fluorspar project in Livingston County, KY. The company drilled 25 holes identifying fluorspar reserves in excess of 1 million metric tons (Mt) with an average grade of 52% CaF2. Plans to restart an idle flotation mill at Salem, KY, were delayed because the plant was vandalized while it sat idle. It will require a significant outlay of time and money to bring the mill back into operating condition. It was originally anticipated that mine development could begin in 2008, but the project experienced further delays caused by bad weather and last minute State permitting requirements (Boyce Moody, III, Moody Minerals Co., oral commun., September 3, 2008; March 12, 2009).

### Consumption

Domestic consumption data were developed by the USGS from a quarterly consumption survey of three large consumers that provide data on HF and aluminum fluoride ($AlF_3$) consumption and four distributors that provide data on the merchant market (metallurgical and other uses). Quarterly data were received from all seven respondents, and these responses accounted for 100% of the reported consumption in table 2.

Industry practice has established three grades of fluorspar—acid grade, containing more than 97% $CaF_2$; ceramic grade, containing 85% to 95% $CaF_2$; and metallurgical grade, normally containing 60% to 85% $CaF_2$. Fluorspar grades are defined by the intended use, but these grades are essentially just ranges derived from customer and supplier specifications. During the past several decades, there has been a general movement in the United States toward the use of higher quality fluorspar by many of the consuming industries. For example, welding rod manufacturers may use acid-grade fluorspar rather than ceramic grade, and some steel mills use ceramic or acid grade rather than metallurgical grade.

Total reported U.S. fluorspar consumption decreased by 6% in 2008 compared with that of 2007. Consumption of acid grade for HF and $AlF_3$ decreased by about 8% to 429,000 t, while consumption of fluorspar for metallurgical and other uses increased by 2% (table 2).

Acid-grade fluorspar, which accounted for 93% of the total U.S. fluorspar consumption, was used primarily as a feedstock in the manufacture of HF. Two companies reported fluorspar consumption for the production of HF in 2008, E.I. du Pont de Nemours & Co. Inc. (DuPont) and Honeywell International

Inc. Fluorspar consumption for HF production decreased by 4% compared with that of 2007. Since most acid-grade fluorspar is converted to HF before consumption, it is necessary to discuss HF uses and markets in order to properly analyze fluorspar consumption.

The leading use of HF was for the production of a wide range of fluorocarbon chemicals, including hydrofluorocarbons (HFCs) and hydrochlorofluorocarbons (HCFCs), fluoroelastomers, and fluoropolymers. Production of these compounds accounted for an estimated 55% of domestic HF consumption. They were produced in the United States by Arkema Inc., DuPont, Great Lakes Chemical Corp., Honeywell, INEOS Fluor Americas LLC, MDA Manufacturing Ltd., and Solvay Solexis Inc.

Acid-grade fluorspar was used in the production of $AlF_3$ and cryolite ($Na_3AlF_6$), which are the main fluorine compounds used in aluminum smelting. Alumina is dissolved in a bath that consists primarily of molten $Na_3AlF_6$, $AlF_3$, and fluorspar to allow electrolytic recovery of aluminum. Fluorine losses are made up entirely by the addition of $AlF_3$, the majority of which will react with excess sodium from the alumina to form $Na_3AlF_6$.

Most $AlF_3$ is produced directly from acid-grade fluorspar or from byproduct FSA. In 2008, Alcoa World Alumina LLC (a business unit of Alcoa Inc.) produced $AlF_3$ from fluorspar at its plant at Point Comfort, TX. Alcoa shut down this plant in fall 2008 deciding to rely on imports for its $AlF_3$ needs. The plant, which was built in the early 1960s, had a capacity of 60,000 metric tons per year (t/yr) of $AlF_3$ and was the third leading consumer of fluorspar in the United States (David Cahill, Alcoa World Alumina LLC, written commun., January 9, 2009). As a result of the closure of the Point Comfort $AlF_3$ plant, Alcoa's consumption of fluorspar decreased by about 29% compared with that of 2007.

The merchant fluorspar market in the United States included sales of metallurgical- and acid-grade material mainly to steel mills, where it was used primarily 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 rail car, truckload, and less-than-truckload quantities. In 2008, this merchant market totaled 77,400 t, which included sales of 43,600 t of acid grade (56% of the merchant market) and sales of 33,800 t of metallurgical grade (44% of the merchant market). During the past 20 to 30 years, fluorspar usage in such industries as steel and glass has declined because of product substitutions or changes in industry practices.

In the United States, consumption of fluorspar in metallurgical markets (mainly steel) increased by 25% compared with that of 2007. Metallurgical-grade consumption accounted for nearly all of the overall increase in metallurgical consumption. Consumption in this sector was 69% metallurgical grade and 31% acid grade.

In 2008, byproduct FSA sold for water fluoridation was about 53,500 t valued at $7.07 million, and about 9,300 t valued at $7.1 million was sold or used for $AlF_3$ or other uses.

### Stocks

Data for stocks were available from some fluorspar distributors and HF and $AlF_3$ producers. Known consumer and distributor stocks at the end of 2008 totaled about 115,000 t. This represented a 27% increase in known consumer and distributor stocks from the end of the previous year. The last sales from the National Defense Stockpile were made in 2006, and Government stocks of fluorspar were zero.

### Transportation

The United States depends on imports for the majority of its fluorspar supply. Fluorspar is transported to customers by truck, rail, barge, and ship. Metallurgical grade 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 is shipped routinely 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 treating with sulfuric acid to produce HF. Acid-grade imports from China and South Africa 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 acid grade and ceramic grade is marketed in bags for small users and shipped by truck.

Ocean freight rates remained high during the first half of 2008, but declined sharply in the second half of the year. The Baltic dry index (BDI) fell from a peak of around 11,000 in May to 2,000 by yearend (Hayley-Bell, 2008). The BDI tracks worldwide international shipping prices of handymax, panamax, and capesize dry bulk carriers.

### Prices

In recent years, the import values [cost, insurance, and freight (c.i.f.)] for some acidspar imports have been underreported. As a result, average import values for acidspar are no longer listed in table 1.

In 2008, acid-grade fluorspar prices increased rather dramatically, almost doubling in some cases when compared with those of 2007 (table 3). At yearend, according to published prices, the average price range, U.S. Gulf of Mexico port, c.i.f., dry basis, for Chinese acid grade increased by a minimum of $225 per metric ton. The average range of prices for Mexican acid grade, free on board (f.o.b.) Tampico, increased by a minimum of $70 per ton and by a minimum of $190 per ton for low-arsenic acid grade. The South African price range for acid grade, f.o.b. Durban, increased by a minimum of $46 per ton (Industrial Minerals, 2008c). Prices for metallurgical-grade fluorspar listed in table 3 were calculated from fourth-quarter statistics from the U.S. Census Bureau.

### Foreign Trade

In 2008, U.S. exports of fluorspar increased by 39% to 18,800 t (table 4). With the disposal of all fluorspar stocks in the National Defense Stockpile and only a small amount of mined fluorspar, exports are likely reexports of imported material. About 47% (8,780 t) of exported fluorspar went to Taiwan, with an additional 4,280 t listed as exported to China. This additional material likely was shipped to Taiwan also, so Taiwan's percentage of U.S. exports may actually be 69%.

In 2008, imports for consumption of fluorspar decreased by about 8% compared with those of 2007 (table 5). The leading suppliers of fluorspar to the United States were Mexico (57%), China (32%), and South Africa (10%).

In 2008, owing to elevated Chinese acidspar prices coupled with high ocean freight rates, U.S. fluorspar consumers reduced purchases from China and replaced them with increased purchases from Mexico. This continued a trend that began in 2007. Mexico accounted for 50% of acidspar imports (41% in 2007); China, 37% (48% in 2007); and South Africa, 11% (7% in 2007).

In recent years, the c.i.f. import values for some acid-grade fluorspar imports have been underreported. Quantities as reported in table 5 are thought to be reasonably accurate, but the accompanying values reported for acid-grade imports at some customs districts appear to be low.

Imports of HF decreased by about 13% to 133,000 t (table 6). Imports of synthetic and natural $Na_3AlF_6$ increased by 71% to 7,650 t (table 7). Imports of $AlF_3$ increased by 73% to 47,600 t; China (61%) and Canada (32%) accounted for the bulk of imports (table 8). The increase in $AlF_3$ imports was necessitated by closure of Alcoa World Alumina's $AlF_3$ plant in fall 2008. $AlF_3$ import levels have increased by 500% since 2006.

## World Review

World fluorspar production increased by 5% compared with that of 2007. Increased production in Kenya, Mexico, and South Africa and an estimated increase in China accounted for the bulk of the increase.

***Canada.***—Burin Fluorspar Ltd. (Alberta) signed an agreement in principle with British Columbia-based Rivera Capital Corp. proposing to merge the two companies with the goal of restarting fluorspar mining near St. Lawrence, on the Burin Peninsula of Newfoundland. The net result of a merger would be the public listing of Burin Fluorspar on the Toronto [Ontario] Stock Exchange Venture Exchange. Before the merger takes place, shareholders of both companies must approve the transaction. Prior to signing the agreement, Burin Fluorspar raised more than $6 million to fund a drilling program, prepare a bankable feasibility study, and complete other necessary work to determine whether the project is viable (Herridge, 2008).

As part of the project to restart fluorspar mining, Burin Fluorspar's subsidiary Burin Minerals Ltd. (Newfoundland and Labrador) hired Cabo Drilling Corp. (North Vancouver, British Columbia) to drill 15,000 meters (m) on Burin's St. Lawrence fluorspar property. Drilling commenced on June 11 and was completed in November (Cabo Drilling Corp., 2008). In December, work began on the design of the mine, mill, and wharf and on the project's feasibility study (scheduled for completion in September 2009). The projected mill capacity was 120,000 to 180,000 t/yr of acid-grade fluorspar, and the proposed schedule called for mine and mill production to begin in mid-2011 (Canada Fluorspar, Inc., 2009).

The Burin Peninsula area has a long mining history; the St. Lawrence fluorspar mines operated from 1933 to 1977 and from 1984 to 1990. Burin Fluorspar, which was issued mining leases in 1996 by the Provincial government, has performed exploratory drilling and prepared prefeasibility studies but has heretofore been unsuccessful in raising sufficient financing to restart mine production.

***Kenya.***—Kenya Fluorspar Co. Ltd. (Nairobi), which operates a fluorspar mine in the Kerio Valley in northwestern Kenya, reported that its export operations were disrupted in January and February by postelection violence resulting from the disputed national election. Mine production was unaffected, but Kenya Fluorspar's road and rail logistics linking the mine to the Port of Mombasa were adversely affected. Export activities had returned to normal by April (Industrial Minerals, 2008b).

Kenya Fluorspar announced that it had expanded its markets by securing orders from two European fluorochemical manufacturers. Kenya Fluorspar previously shipped most of its product to India. The company invested $1.8 million in port and mine improvements that included an upgrade to the crushing equipment, a new laboratory, and improved environmental compliance (allAfrica.com, 2008).

***Mexico.***—Mexichem S.A.B. de C.V., which is Mexico's primary producer of fluorspar and HF through its Mexichem Fluor division, announced the acquisition of Mexican fluorspar producer Fluorita de Rio Verde S.A. de C.V. The acquisition included mining concessions Lilia II and La Esperanza and production plants in the municipalities of Rio Verde, State of San Luis Potosi, and Alamos de Martinez, State of Guanajuato. Mexichem planned to begin production in the second unit at the Alamos de Martinez plant, which would increase Fluorita de Rio Verde's fluorspar production to 80,000 t/yr from 40,000 t/yr. Longer term plans call for reactivating the Rio Verde fluorspar mine (Mexichem S.A.B. de C.V., 2008).

***South Africa.***—Sallies Ltd. (Pretoria) reported that it was mothballing its Buffalo Fluorspar Mine, which was treating tailings from fluorspar mining performed between 1974 and 1994. Fluorspar produced from the tailings was high in phosphorus—1,200 parts per million (ppm) compared with 400 ppm for the company's Witkop Fluorspar Mine—and Sallies found it difficult to market the high-phosphorus product at a reasonable price. Phosphorus is an undesirable contaminant in acidspar, and most HF producers have upper limits of 500 ppm in their purchase specifications. The Buffalo property contains substantial in-ground fluorspar reserves with similar $CaF_2$ content to Sallies' Witkop Mine, but the operation lacked mining infrastructure and would require the allocation of more power from Eskom Holdings Ltd., South Africa's public electricity utility, to exploit the reserves (Mathews, 2008). With the closure of Sallies' Buffalo fluorspar operation, the average quality of South African acidspar has improved, which may result in higher overall prices for South African acidspar.

Sephaku Holdings Ltd. (Centurion) announced results of fluorspar exploration work on two projects in South Africa. The Naauwpoort/Kromdraai project is adjacent to South Africa's leading fluorspar producer, Vergenoeg Mining Co. (Pty) Ltd., and reported a measured resource in excess of 8 Mt of ore grading 24.6% $CaF_2$. Sephaku identified the second project as the Plattekop deposit, which, according to company resource totals, contained an additional resource of 4 Mt. The Plattekop deposit is about 800 m south of the Vergenoeg deposit and is described as a relatively flat-lying cap to a hill. This cap comprises a body of fluorspar/iron mineralization 400 m by 200 m in area, averaging 18 m thick, and grading approximately 40% $CaF_2$. The company proposed construction of a 130,000-t/yr flotation plant that would be fed by a blend of ore from both deposits at 32% $CaF_2$ average feed grade. Determination of capital budget requirements was to begin shortly after the announcement and was expected to be completed by the end of the first quarter of 2009 (Mineweb, 2008).

Spain's Minerales y Productos Derivados S.A. (Minersa) was expected to replace Industries Chimiques du Fluor (Tunisia) as the major shareholder and technology partner in Alfluorco (Pty) Ltd. (South Africa). Minersa would own a 50% stake in Alfluorco, which continued to study the feasibility of constructing an HF and $AlF_3$ plant at Richards Bay, KwaZulu Natal Province. Vergenoeg and the state-owned Industrial Development Corp. each hold a 25% stake in the company. Minersa (a 30% shareholder in Vergenoeg) operates one of the leading HF and $AlF_3$ facilities in Europe. Completion of the bankable feasibility study was expected by the end of the year (van der Merwe, 2008). Construction of this facility is part of South Africa's plan to expand into the production of value-added fluorochemicals for domestic use and export, instead of simply being an exporter of fluorspar.

***Sweden.***—Tertiary Minerals plc (Macclesfield, United Kingdom) awarded a contract to a Canadian mining services company to complete an extensive program of mineral processing tests to evaluate the production of acid-grade fluorspar concentrates from Tertiary's Storuman fluorspar project in Sweden. The test work is a major component of an economic and technical scoping study that was scheduled for completion by yearend (Tertiary Minerals plc, 2008a). Tertiary completed a drilling program in spring 2008 designed to reinvestigate the deposit originally discovered in the 1970s by Gränges Aluminium AB (Sweden). The first round of assay results from 10 drill holes were received, and results were positive enough to warrant submission of an additional 138 samples for assay. According to the company, step-out holes suggested the potential for large extensions of the ore deposit in previously untested areas (Tertiary Minerals plc, 2008b).

***United Kingdom.***—In early 2008, Glebe Mines Ltd. (Stoney Middleton) submitted a planning application to the Peak District National Park Authority for the extraction of fluorspar. This would extend the existing Tearsall open pit on Bonsall Moor in Derbyshire, England. The proposal called for the extraction of approximately 660,000 t of fluorspar ore during a 6-year period and would include progressive restoration of the mined out area. On completion of mining, the site would be fully restored to agricultural use during the following year. The application received support from the local town council, but the company was still waiting for a decision from the Park Authority (Glebe Mines Ltd., 2008; Industrial Minerals, 2008a).

The Glebe Mines application received valuable support in the form of British Geological Survey Open Report OR/08/027, which was part of a larger project analyzing the need for nonenergy indigenous mineral production in England. The report described the uses of fluorspar and its importance to the British economy and downstream industries that it supports. The principal aims were to provide background information on fluorspar and its downstream industries, review their economic benefits, determine the need for indigenous production and the impacts of ceasing production, and consider environmental impacts of fluorspar mining (Lusty and others, 2008).

## Outlook

Long-term demand for fluorspar will depend to a large degree on the competition for the future refrigeration market between fluorochemical and not-in-kind systems (ammonia, carbon dioxide, hydrocarbons, and so forth). Current fluorocarbons have high global warming potential (GWP) and are being targeted for phase out as part of an international response to climate change. Fluorochemical producers, such as Arkema, Du Pont, and Honeywell, are attempting to develop new compounds with low GWP that could replace existing fluorocarbons or fluorocarbon blends. Candidates include hydrofluoroolefin HFO-1234yf as a replacement for HFC-134a in automotive air conditioning, and HFO-1234ze as a replacement in aerosols, foam blowing, and refrigeration. These two compounds each have low GWP and rapidly break down in the atmosphere. Regardless of the effectiveness of compounds such as these, fluorochemicals are already losing some of their markets to not-in-kind replacements. The aluminum fluoride market and smaller niche markets for fluoroelastomers and fluoropolymers are likely to be more resilient once the global economy recovers.

China maintained its 2009 fluorspar export quota at 550,000 t, which was the same as that in 2008. Significant capacity expansions in other countries are not expected until at least 2010, and as a result, international fluorspar supplies are expected to remain tight. The worldwide recession has reduced demand for fluorspar, but because fluorspar was in short supply, the effect on prices has been small. Market conditions in 2009 may cause a reduction in acid-grade fluorspar prices compared with peak prices at the end of 2008. The price of Chinese acidspar may decrease further as a result of a possible elimination of the current 15% export tax on fluorspar. The Chinese Government announced that it would reduce export taxes to zero and give more financial support to exporters as it tries to increase its share of global trade in the current economic downturn (Gil, 2009).

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TABLE 1

SALIENT FLUORSPAR STATISTICS[1, 2]

| | | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|
| United States: | | | | | | |
| Exports:[3] | | | | | | |
| Quantity | metric tons | 20,600 | 36,100 | 13,000 | 13,600 | 18,800 |
| Value[4] | thousands | $3,200 | $7,840 | $2,430 | $2,650 | $3,340 |
| Imports:[3] | | | | | | |
| Quantity | metric tons | 599,000 | 629,000 | 553,000 | 620,000 | 572,000 |
| Value[5] | thousands | $95,300 | $122,000 | $112,000 | $111,000 | $133,000 |
| Average value:[5] | | | | | | |
| Acid grade | dollars per metric ton | 167 | 202 | 217 | (6) | (6) |
| Metallurgical grade | do. | 83 | 93 | 101 | 111 | 107 |
| Consumption: | | | | | | |
| Reported | metric tons | 618,000 | 582,000 | 523,000 | 539,000 | 506,000 |
| Apparent[7] | do. | 691,000 | 616,000 | 608,000 | 613,000 | 529,000 |
| Stocks, December 31: | | | | | | |
| Consumer and distributor | do. | 105,000 [8] | 131,000 [8] | 89,900 [8] | 90,100 | 115,000 |
| Government stockpile | do. | 83,400 | 35,200 | 8,110 | 1,450 | -- |
| World, production | do. | 5,220,000 r | 5,410,000 r | 5,730,000 r | 5,750,000 r | 6,040,000 |

[r]Revised. do. Ditto. -- Zero.
[1]Data are rounded to no more than three significant digits.
[2]Does not include fluorosilicic acid production or imports of hydrofluoric acid and cryolite.
[3]Source: U.S. Census Bureau; may be adjusted by the U.S. Geological Survey.
[4]Free alongside ship values at U.S. ports.
[5]Average unit value for the year, includes cost, insurance, and freight values at U.S. ports.
[6]Value data for acid-grade fluorspar imports appear to be underreported; accurate average value calculations cannot be made.
[7]Imports minus exports plus adjustments for changes in stocks held by Government and three leading consumers.
[8]Includes fluorspar purchased from the National Defense Stockpile (NDS) but still located at NDS depots.

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 | 2007 | 2008 | 2007 | 2008 | 2007 | 2008 |
| Hydrofluoric acid and aluminum fluoride | 464,000 | 429,000 | -- | -- | 464,000 | 429,000 |
| Metallurgical | 14,800 | 14,900 | 24,300 | 33,800 | 39,000 | 48,700 |
| Other[2] | 28,400 | 28,700 | 8,270 | -- | 36,600 | 28,700 |
| Total | 507,000 | 472,000 | 32,500 | 33,800 | 539,000 | 506,000 |
| Stocks, consumer, December 31[3] | 78,200 | 94,300 | 11,900 | 20,500 | 90,100 | 115,000 |

-- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]May include acid grade or metallurgical grade used in enamel, glass and fiberglass, steel castings, and welding rod coatings.

[3]Stocks are from hydrofluoric acid and aluminum fluoride producers and major distributors.

TABLE 3
PRICES OF IMPORTED FLUORSPAR

(Dollars per metric ton)

| Source and grade | 2007 | 2008 |
|---|---|---|
| Acidspar: | | |
| Chinese, dry basis, cost, insurance, and freight (c.i.f.) Gulf port, filtercake | 305–310 | 530–550 |
| Mexican, free on board (f.o.b.) Tampico, filtercake | 180–200 | 250–325 |
| Mexican, f.o.b. Tampico, arsenic <5 parts per million | 210–220 | 400–420 |
| South African, f.o.b. Durban, filtercake | 175–204 | 250 |
| Metspar, Mexican, c.i.f. port of U.S. entry, metspar[1] | 110 | 108 |

[1]Metspar prices are the average value per metric ton of imported Mexican metspar for the fourth quarter calculated from the U.S. Census Bureau statistics.

Sources: Industrial Minerals, no. 483, December 2007, p. 76; no. 495, December 2008, p. 88.

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

| | 2007 | | 2008 | |
|---|---|---|---|---|
| Country | Quantity (metric tons) | Value[2] | Quantity (metric tons) | Value[2] |
| Australia | 5 | $3,060 | 15 | $7,200 |
| Brazil | -- | -- | 22 | 3,120 |
| Canada | 6,000 | 1,470,000 | 4,870 | 1,270,000 |
| China | -- | -- | 4,280 | 621,000 |
| Dominican Republic | 558 | 113,000 | 524 | 95,000 |
| India | 34 | 10,000 | 24 | 7,000 |
| Indonesia | -- | -- | 5 | 2,860 |
| Israel | -- | -- | 15 | 4,500 |
| Korea, Republic of | -- | -- | 72 | 18,000 |
| Malaysia | -- | -- | 15 | 9,630 |
| Mexico | -- | -- | 29 | 3,200 |
| Netherlands | 3 | 2,910 | 30 | 4,400 |
| Philippines | 23 | 2,590 | 161 | 18,000 |
| Taiwan | 6,930 | 1,040,000 | 8,780 | 1,280,000 |
| Total | 13,600 | 2,650,000 | 18,800 | 3,340,000 |

-- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]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]

| Country and customs district | 2007 Quantity (metric tons) | 2007 Value[2] (thousands) | 2008 Quantity (metric tons) | 2008 Value[2] (thousands) |
|---|---|---|---|---|
| Containing more than 97% calcium fluoride ($CaF_2$): | | | | |
| China: | | | | |
| Anchorage, AK | 41 | $8 | -- | -- |
| Cleveland, OH | -- | -- | 3,720 | $1,540 |
| Great Falls, MT | -- | -- | 6 | 15 |
| Houston, TX | 193,000 | 37,600 | 117,000 | 39,100 |
| New Orleans, LA | 83,900 | 18,900 | 63,200 | 26,400 |
| Total | 277,000 | 56,500 | 184,000 | 67,100 |
| Germany, Savannah, GA | -- | -- | 133 | 17 |
| Mexico: | | | | |
| Laredo, TX | 61,000 | 13,800 | 74,100 | 18,600 |
| New Orleans, LA | 174,000 | 23,600 | 175,000 | 23,400 |
| Total | 235,000 | 37,300 | 249,000 | 42,000 |
| Mongolia: | | | | |
| Houston, TX | 23,800 | 4,450 | -- | -- |
| New Orleans, LA | -- | -- | 5,500 | 2,100 |
| Total | 23,800 | 4,450 | 5,500 | 2,100 |
| Russia, Philadelphia, PA | -- | -- | 1 | 7 |
| South Africa: | | | | |
| Great Falls, MT | -- | -- | 258 | 106 |
| Houston, TX | 30,800 | 5,150 | 51,100 | 12,000 |
| New Orleans, LA | 10,600 | 2,840 | 5,360 | 1,960 |
| Total | 41,400 | 7,990 | 56,700 | 14,100 |
| United Kingdom: | | | | |
| Houston, TX | 31 | 37 | 55 | 51 |
| Los Angeles, CA | 345 | 42 | 588 | 69 |
| Total | 376 | 79 | 643 | 120 |
| Grand total | 577,000 | 106,000 | 496,000 | 125,000 |
| Containing not more than 97% $CaF_2$: | | | | |
| Mexico: | | | | |
| Charleston, SC | 3,030 | 345 | -- | -- |
| Laredo, TX | 2,440 | 232 | 5,100 | 522 |
| New Orleans, LA | 36,700 | 4,090 | 70,100 | 7,510 |
| Total | 42,100 | 4,670 | 75,200 | 8,040 |
| Namibia: | | | | |
| Charleston, SC | 191 | 17 | 283 | 26 |
| Houston, TX | 278 | 24 | 519 | 45 |
| Total | 469 | 41 | 802 | 71 |
| South Africa, New York, NY | 37 | 8 | -- | -- |
| Grand total | 42,600 | 4,720 | 76,000 | 8,110 |
| Grand total, all grades | 620,000 | 111,000 | 572,000 | 133,000 |

-- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

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

Source: U.S. Census Bureau; may be adjusted by the U.S. Geological Survey.

TABLE 6

U.S. IMPORTS FOR CONSUMPTION OF HYDROFLUORIC ACID, BY COUNTRY[1]

| Country | 2007 Quantity (metric tons) | 2007 Value[2] (thousands) | 2008 Quantity (metric tons) | 2008 Value[2] (thousands) |
|---|---|---|---|---|
| Canada | 31,500 | $49,500 | 23,900 | $48,400 |
| China | 2,120 | 1,970 | 1,690 | 2,430 |
| France | -- | -- | (3) | 2 |
| Germany | 427 | 1,010 | 562 | 1,420 |
| India | 177 | 192 | 71 | 142 |
| Japan | 1,080 | 2,340 | 1,240 | 2,520 |
| Liechtenstein | (3) | 6 | 1 | 90 |
| Mexico | 116,000 | 121,000 | 105,000 | 117,000 |
| Peru | 61 | 31 | -- | -- |
| Singapore | 48 | 97 | 79 | 209 |
| Taiwan | -- | -- | 34 | 133 |
| United Kingdom | 3 | 11 | (3) | 5 |
| Total | 152,000 | 176,000 | 133,000 | 172,000 |

-- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

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

[3]Less than ½ unit.

Source: U.S. Census Bureau.

TABLE 7

U.S. IMPORTS FOR CONSUMPTION OF CRYOLITE, BY COUNTRY[1]

| Country | 2007 Quantity (metric tons) | 2007 Value[2] (thousands) | 2008 Quantity (metric tons) | 2008 Value[2] (thousands) |
|---|---|---|---|---|
| Belgium | 36 | $37 | -- | -- |
| Canada | 2 | 7 | 398 | $118 |
| China | 1,060 | 960 | 1,590 | 1,460 |
| Denmark | 709 | 532 | 450 | 416 |
| Germany | 2,210 | 2,140 | 2,280 | 2,440 |
| Hungary | 265 | 256 | 345 | 382 |
| Japan | 149 | 205 | 2,450 | 3,200 |
| Turkey | -- | -- | 20 | 4 |
| United Kingdom | 19 | 26 | 120 | 160 |
| Other[3] | 25 r | 44 r | 1 | 9 |
| Total | 4,470 | 4,200 | 7,650 | 8,180 |

[r]Revised. -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

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

[3]Includes Bulgaria (2007), India, and Italy (2007).

Source: U.S. Census Bureau.

TABLE 8

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

| Country | 2007 Quantity (metric tons) | 2007 Value[2] (thousands) | 2008 Quantity (metric tons) | 2008 Value[2] (thousands) |
|---|---|---|---|---|
| Canada | 10,800 | $12,900 | 15,400 | $21,100 |
| China | 8,650 | 11,800 | 28,900 | 44,500 |
| Italy | 266 | 410 | 102 | 149 |
| Japan | 9 | 23 | 65 | 201 |
| Mexico | 4,130 | 4,220 | 1 | 9 |
| Other[3] | 3,750 | 3,950 | 3,100 | 3,400 |
| Total | 27,600 | 33,300 | 47,600 | 69,400 |

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

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

[3]Includes Brazil, Germany, Sweden, Switzerland, and the United Kingdom.

Source: U.S. Census Bureau.

TABLE 9

FLUORSPAR: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons)

| Country and grade[3, 4] | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|
| Argentina | 6,437 | 7,502 | 8,278 | 9,735 r | 9,500 e |
| Brazil, marketable: | | | | | |
| Acid grade | 40,948 | 42,043 r | 41,373 r | 44,869 r | 45,000 p |
| Metallurgical grade | 16,824 | 24,469 r | 22,231 r | 20,657 r | 20,700 p |
| Total | 57,772 | 66,512 | 63,604 | 65,526 r | 65,700 p |
| China:e | | | | | |
| Acid grade | 1,600,000 | 1,650,000 | 1,800,000 | 1,850,000 | 1,900,000 |
| Metallurgical grade[5] | 1,100,000 | 1,150,000 | 1,300,000 | 1,350,000 | 1,350,000 |
| Total | 2,700,000 | 2,800,000 | 3,100,000 | 3,200,000 | 3,250,000 |
| Egypt | 891 r | 549 r | 550 r, e | 550 r, e | 550 e |
| France:e, 6 | | | | | |
| Acid and ceramic grades | 80,000 | 80,000 | 35,000 | -- | -- |
| Metallurgical grade | 10,000 | 10,000 | 5,000 | -- | -- |
| Total | 90,000 | 90,000 | 40,000 | -- | -- |
| Germany, acid grade | 33,203 | 35,364 | 53,009 | 54,359 r | 51,200 e |
| India:e, 7 | | | | | |
| Acid grade | 4,300 | 4,400 | 500 | 1,000 | 1,500 |
| Metallurgical grade | 6,400 | 6,500 | 5,800 r | 5,000 | 5,500 |
| Total | 10,700 | 10,900 | 6,300 r | 6,000 | 7,000 |
| Iran[8] | 54,052 | 64,601 | 65,000 e | 65,000 e | 65,000 e |
| Italy[6] | 17,915 | 15,000 e | 8,000 e | -- | -- |
| Kazakhstan | 4,000 | 4,750 | 30,000 r, e | 64,000 r | 66,300 |
| Kenya, acid grade | 108,000 | 97,261 | 83,428 | 82,000 | 98,248 |
| Korea, North, metallurgical gradee | 12,000 | 12,500 | 12,500 | 12,500 | 12,500 |
| Kyrgyzstane | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 |
| Mexico:[9] | | | | | |
| Acid grade | 401,753 | 324,568 | 466,000 | 513,000 e | 630,000 e |
| Metallurgical grade | 440,945 | 550,882 | 470,000 | 420,000 e | 428,000 e |
| Total | 842,698 | 875,450 | 936,000 | 933,000 e | 1,058,000 |
| Mongolia: | | | | | |
| Acid grade | 148,200 | 134,100 | 137,600 | 131,000 r | 130,000 e |
| Other grades[10] | 206,700 | 233,400 | 255,000 | 250,000 | 250,000 e |
| Total | 354,900 | 367,500 | 392,600 | 381,000 r | 380,000 e |
| Morocco, acid grade | 112,100 | 114,740 | 94,254 | 78,900 | 60,700 |
| Namibia, acid grade[11] | 96,400 | 105,700 | 121,700 | 109,300 | 108,800 |
| Pakistan, metallurgical gradee | 1,026 [12] | 1,040 | 2,839 r, 12 | 1,500 r | 1,400 |
| Romania, metallurgical gradee | 15,000 | 15,000 r | 15,000 r | 15,000 r | 15,000 |

See footnotes at end of table.

TABLE 9—Continued

FLUORSPAR: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons)

| Country and grade[3, 4] | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|
| Russia | 226,400 | 245,500 | 210,000 e | 180,000 e | 269,000 e |
| South Africa:[e, 13] | | | | | |
| Acid grade | 250,000 | 250,000 r | 240,000 | 268,000 r | 301,000 |
| Metallurgical grade | 15,000 | 16,000 r | 16,000 | 17,000 r | 15,000 |
| Total | 265,000 | 266,000 | 256,000 | 285,000 | 316,000 |
| Spain: | | | | | |
| Acid grade | 135,505 | 133,495 | 135,864 r | 132,753 r | 133,000 p |
| Metallurgical grade | 10,186 | 10,500 | 17,241 r | 16,279 r | 16,300 p |
| Total | 145,691 | 143,995 | 153,105 r | 149,032 r | 149,300 p |
| Tajikistan[e] | 9,000 | 8,500 | 8,500 | 8,500 | 8,500 |
| Thailand, metallurgical grade | 2,375 | 295 | 3,240 | 1,820 | 1,800 e |
| Turkey, metallurgical grade | -- r | -- r | -- | -- r | -- |
| United Kingdom[e] | 50,080 12 | 60,980 12 | 60,000 | 40,000 | 45,000 |
| Grand total | 5,220,000 r | 5,410,000 r | 5,730,000 r | 5,750,000 r | 6,040,000 |

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

[1]World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Table includes data available through May 26, 2009.

[3]In addition to the countries listed, Bulgaria is thought to have produced fluorspar in the past, but production is not officially reported, and available information is inadequate for the formulation of reliable estimates of output levels.

[4]An effort has been made to subdivide production of all countries by grade (acid, ceramic, and metallurgical). Where this information is not available in official reports of the subject country, the data have been entered without qualifying notes.

[5]Includes submetallurgical-grade fluorspar used primarily in cement that may account for 33% to 50% of the quantity.

[6]Mine closed in 2006.

[7]Year beginning April 1 of that stated.

[8]Year beginning March 21 of that stated. Data for 2004 and 2005 are reported by Iranian Mines and Mining Development and Renovation Organization.

[9]Data are reported by Servicio Geológico Mexicano, quantities by grade may be estimated.

[10]Principally submetallurgical-grade material.

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

[12]Reported figure.

[13]Based on data from the South African Minerals Bureau; data show estimated proportions of acid-, ceramic-, and metallurgical-grade fluorspar within the reported totals.