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# 2006 Minerals Yearbook

## FLUORSPAR

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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 2006, 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 stockpiled for future processing. The bulk of U.S. consumption was supplied by imports, although imports were supplemented by sales of material from the National Defense Stockpile (NDS) 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 12%, imports of hydrofluoric acid (HF) increased by nearly 14%, and exports of fluorspar decreased by 64% compared with those in 2005 (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.

## Legislation and Government Programs

During calendar year 2006, the Defense National Stockpile Center (DNSC) sold about 4,420 metric tons (t) of acid-grade fluorspar (4,867 short dry tons) and about 15,100 t of metallurgical-grade fluorspar (16,686 short dry tons). Unsold quantities that remain in the NDS are discussed in the "Stocks" section of this report.

## Production

In 2006, there was no reported mine production of fluorspar in the United States. 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 seven FSA operations surveyed, responses were received from four plants representing 90% of the total sold or used by producers. Production and sales data for the three nonrespondents were estimated based on company information or prior year data.

In 2006, 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 seven plants in Florida, Louisiana, North Carolina, and Wyoming. Mosaic shut down its Green Bay and South Pierce plants in Florida at the end of May, reducing supplies to water fluoridation and other markets, although some of the shortfall was made up by the decision of J.R. Simplot to begin production and marketing of FSA at its Rock Springs, WY, fertilizer plant. Production of byproduct FSA was 46,200 t (100% basis $H_2SiF_6$), and quantities sold or used totaled 45,200 t (equivalent to approximately 79,600 t of fluorspar grading 92% $CaF_2$). This material was valued at about $9.55 million.

Some synthetic fluorspar was recovered as a byproduct of uranium processing, petroleum alkylation, and stainless steel pickling. 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. in Cave-In-Rock, IL, Oxbow Carbon and Minerals LLC in Aurora, IN, and Seaforth Mineral & Ore Co. Inc. in East Liverpool, OH, screened and dried acid-grade and metallurgical-grade fluorspar. These materials were either purchased from the NDS or imported from Mexico.

Hastie Mining and Moodie Mineral Co. conducted a drilling program for fluorspar in Livingston County, KY, northeast of the former Klondike Fluorspar Mine. The partners are exploring a previously unmined vein deposit that runs parallel to the one mined by Klondike Fluorspar. Drilling completed through the end of 2006 had located a fluorspar vein with an average width of about 9 meters (m) extending to a depth of 60 m. Drilling identified nearly 1.6 million metric tons (Mt) of reserves with an average ore grade of 60% $CaF_2$, with additional drilling scheduled to begin in the spring of 2007. Hastie Mining, a supplier of fluorspar to assorted U.S. markets, has sourced the majority of its supply from NDS purchases since the mid-1990s. With the NDS material almost exhausted and import sources uncertain, the company decided to explore the idea of restarting fluorspar production from the Illinois-Kentucky Fluorspar Mining District. Hastie Mining had hoped to begin mine production from the deposit by late 2007, but weather-related delays in the drilling program may push this back into 2008. Hastie also has been stockpiling fluorspar ore produced as a byproduct from its limestone quarry in Hardin County, IL, and owns the mineral rights to several former fluorspar properties in Illinois. The company purchased an idle flotation plant near Salem, KY, and was in the process of installing a heavy-media separation plant and a briqueting plant at its quarry. Ultimately, the company hopes to produce about 20,000 metric tons per year (t/yr) of acid-grade fluorspar and 30,000 t/yr of metallurgical-grade fluorspar from its mine and quarry operations (Jimmy Watson, Hastie Mining and Trucking Co., oral commun., March 13, 2007).

## 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 10% in 2006 compared with that of 2005. Consumption of acid grade for HF and $AlF_3$ decreased by nearly 13% to 444,000 t, while consumption of fluorspar for metallurgical and other uses increased by more than 8% (table 2).

Acid-grade fluorspar, which accounted for nearly 94% 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—E.I. du Pont de Nemours & Co. Inc. (DuPont) and Honeywell International Inc. Fluorspar consumption for HF production decreased by about 12% compared with that of 2005, although some of the decrease was compensated for by increased HF imports. 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. In 2006, the United States consumed about 680,000 t of HF, a decrease of about 5% compared with that of 2005. This included primary HF production, the HF produced in the $AlF_3$ production process, and HF imports of 156,000 t.

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 2006, Alcoa World Alumina LLC (a business unit of Alcoa Inc.) produced $AlF_3$ from fluorspar at Point Comfort, TX. Alcoa's consumption of fluorspar decreased by nearly 9% compared with that of 2005.

The merchant fluorspar market in the United States includes sales of metallurgical and acid grade 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 2006, this merchant market totaled 79,700 t, which included sales of 44,800 t of acid grade (56% of the merchant market) and sales of 34,900 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) decreased by about 8% compared with that of 2005. Acid-grade consumption accounted for the entire decrease; metallurgical-grade consumption was essentially unchanged. Consumption in this sector was 65% metallurgical grade and 35% acid grade.

In 2006, byproduct FSA sold for water fluoridation was about 36,200 t valued at $7 million, and about 9,030 t valued at $2.54 million was sold or used for other uses. There were no sales for $AlF_3$ production in 2006. Water fluoridation sales were essentially unchanged compared with those of 2005 as shortages resulting from the closure of the two Mosaic plants were covered by diverting FSA from other markets to the fluoridation market and by the startup of marketable FSA production at the J.R. Simplot plant in Wyoming.

## Stocks

Data for stocks were available from fluorspar distributors and HF and $AlF_3$ producers. Known consumer and distributor stocks totaled about 89,900 t, which included 79,400 t at consumer or distributor facilities and 10,500 t purchased from the NDS but still located at NDS depots. At yearend 2006, unsold NDS material consisted of about 8,110 t of metallurgical-grade fluorspar.

## Transportation

Ocean freight rates remained high in 2006. The various ocean shipping indices that track freight rates all increased during the course of 2006. An explanation of fluorspar shipping practices may be found in the fluorspar chapter of the 2005 U.S. Geological Survey Minerals Yearbook, volume I, Metals and minerals, or on the Minerals Information Web site at http://minerals.usgs.gov/minerals.

## Prices

The average import price of acid-grade fluorspar (including the cost of insurance and freight) increased by $15 per metric ton compared with that of 2005 (table 1). High ocean freight

rates, tight supplies, and price increases by some fluorspar producers were some of the causes.

At yearend, according to published prices, the average U.S. Gulf port price, cost, insurance, and freight (c.i.f.), dry basis, for Chinese acid grade was unchanged (table 3). The South African average price for acid grade [free on board (f.o.b.) Durban] increased by about $20 per metric ton. The average price of standard Mexican acid-grade fluorspar (f.o.b. Tampico) increased by $50 per ton, and the price of low-arsenic acid grade increased by about $35 per ton (Industrial Minerals, 2006b). Prices for metallurgical-grade fluorspar listed in table 3 were calculated from fourth-quarter statistics from the U.S. Census Bureau.

## Foreign Trade

U.S. exports of fluorspar decreased by 64% to 13,000 t from those of 2005 (table 4). The decrease in available material from the NDS likely contributed to the decrease in exports. All U.S. exports were exports of material purchased from the NDS or reexports of material imported into the United States.

In 2006, imports for consumption of fluorspar decreased by 12% compared with those of 2005 (table 5). The leading suppliers of fluorspar to the United States were China (65%), Mexico (21%), South Africa (8%), and Mongolia (6%).

Some of the c.i.f. values reported by the U.S. Census Bureau for imports of acid-grade fluorspar were missing freight costs. For the specific shipments that were missing freight costs, adjustments were made by incorporating estimated freight costs derived from industry sources. These adjustments resulted in a significantly higher average value per metric ton for acid-grade imports than that derived from the unadjusted U.S. Census Bureau data. The average c.i.f. unit value, including c.i.f., was $217 per metric ton for acid grade and $101 per ton for metallurgical grade (table 1).

Compensating, in part, for reduced imports of acid-grade fluorspar, imports of HF increased by nearly 14% to 156,000 t (table 6). Imports of synthetic and natural $Na_3AlF_6$ increased by 27% to 3,960 t and imports of $AlF_3$ increased by 87% to 7,950 t (tables 7, 8).

## World Review

Estimated world production increased only slightly compared with that of 2005. The leading producers were, in descending order, China, Mexico, Mongolia, and South Africa.

***Australia.***—Minemakers Ltd.,West Perth, Australia, announced that it was reexamining a polymetallic prospect in Tasmania known as the Moina skarn. Based on higher grade and relatively shallow fluorspar intersections, a previous exploration company had made a preliminary resource estimate of 26.5 Mt grading 18% $CaF_2$. The deposit was originally identified in the 1970s, and is the largest identified fluorspar resource in Australia (Minemakers Ltd., 2006).

***China.***—According to the United Nations Commodity Trade Statistics Database, China exported 643,000 t of fluorspar that included 584,000 t of acid grade and 59,000 t of metallurgical grade. Import statistics from major fluorspar importing countries, however, indicate that Chinese exports have likely been underreported in recent years.

China reduced its 2007 total export quota for fluorspar to about 685,000 t from 710,000 t in 2006. The first public bidding for export quotas on 342,500 t of fluorspar for 2007 was held on December 15, 2006. The export license fees averaged RMB220 or about $28 per metric ton.

China's Ministry of Finance announced that effective November 1 a 10% export tariff would be levied on a number of industrial minerals including acid-grade and metallurgical-grade fluorspar. The duties were part of a policy shift intended to reduce China's trade surplus, protect resources, lower energy consumption, and reduce environmental pollution (O'Driscoll, 2006). This follows the May 2005 elimination of the 5% value-added tax rebate paid to fluorspar exporters.

***France.***—Société Générale de Recherches et d'Exploitations Minières (Sogerem) ceased fluorspar production in 2006. Sogerem operated three mines (Burg, Montroc, and Moulinal) in the Tarn region of the Midi-Pyrenees in southern France, but the mines contained insufficient reserves for further production, and an exploration plan in the area failed to discover significant new reserves.

***Italy.***—Italy's sole fluorspar producer, Nuova Mineraria Silius SpA, ceased operations in 2006 as a result of the European Commission's insistence that subsidies provided by the Sardinian regional government were illegal under European Union law. The company operated a fluorspar mine in the municipality of Silius and a flotation mill near Cagliari (Industrial Minerals, 2007).

***Mexico.***—In late March, Mexican HF producer Química Flúor S.A. de C.V. changed its name to Mexichem Flúor S.A. de C.V. Subsequently, Mexichem Flúor merged with fluorspar mining company Cia. Minera Las Cuevas S.A. de C.V. to form the fluorine arm of its parent company the Mexichem Group. The Mexichem Group was formed in 2005 when its predecessor, Camesa Group, sold its steel division to focus on its chemicals businesses and changed its name to Mexichem to give it a clearer identification with the new focus (Industrial Minerals, 2006a).

***Namibia.***—Okorusu Fluorspar (Pty.) Ltd. of Namibia announced that it expected 2006 production to increase by about 10%, which would allow exports to Europe totaling 127,000 wet metric tons (about 116,000 dry metric tons). Okorusu Fluorspar is a subsidiary of Solvay S.A. and almost all of its acid-grade fluorspar is shipped to Solvay's HF plants in Bad Wimpfen, Germany, and Porta Marghera, Italy (Mining Engineering, 2006).

***South Africa.***—Central African Mining & Exploration Co. Plc (CAMEC) purchased a 51% stake in South African company Nelesco 346 (Pty.) Ltd. Nelesco controls a large undeveloped fluorspar deposit in North West Province about 10 kilometers from the Witkop Fluorspar Mine of Sallies Ltd. Under the terms of the purchase agreement, CAMEC will pay one-half upon completion of the deal and one-half at bankable feasibility or upon Nelesco being granted full mining rights on the deposit. Exploration drilling on the ore body was done between 1978 and 1982, the results of which were acquired by Nelesco. Three ore zones of algal dolomites (characteristic

of the district) have been identified at depths of about 40 m, 50 m, and 90 m. About 30 to 50 holes were to be drilled to provide additional data to quantify indicated and measured reserves. Acquisition of the fluorspar rights was made possible by an amendment to the minerals and mining legislation of South Africa, which resulted in the abolishment of a complex mineral rights holding in the area (Central African Mining & Exploration Co. Plc, 2006a). According to CAMEC, the properties were explored in detail in the late 1970s and early 1980s by Armco Bronne and Esso Minerals. Setting a 10% $CaF_2$ cutoff grade, and using a minimum 2 m mining width, Esso calculated a total resource of 48.2 Mt at an average grade of about 18% $CaF_2$ (Central African Mining & Exploration Co. Plc, undated).

CAMEC hired mineral and mining consulting group RSG Global Consulting Pty. Ltd. to perform resource evaluation work on CAMEC's 51%-owned fluorspar property (now called the Doornhoek fluorite project) in South Africa. The work involved resurveying all the original drill holes and twinning of about 10% of these holes to verify the results of the earlier drilling program. RSG Global was expected to complete the study by August 2006, after which feasibility studies and permitting could be started (Central African Mining & Exploration Co. Plc, 2006b).

Sallies Ltd. had a difficult year that included a delayed decision from the Department of Water Affairs and Forestry on its application for an integrated water usage license and to build a new tailings dam at its Witkop Mine, which would enable it to process tailings. The company also experienced problems with recovery grades from its Buffelshoek area, lowered production levels owing to equipment breakdowns and heavy rains, and inadequate working capital that made it difficult to replace equipment and pay operating expenses (Mathews, 2007; Times, The, 2007).

After some initial delays, Sallies proceeded with the acquisition of Buffalo Fluorspar from Transvaal Mining and Finance Company Ltd. The assets acquired were the fluorspar properties (a portion of the overall 717.5 hectares owned by Transvaal Mining), all the slimes and/or tailings on the fluorspar properties, and all plant and other production equipment on the fluorspar properties associated with fluorspar recovery (Ernst & Young Sponsors Pty. Ltd., 2006). Sallies planned to reprocess the tailings (initially by trucking them to the mill and then by hydromining) to recover fluorspar and possibly rare earths since the tailings also include 2% to 4% magnetic materials mostly in the form of monazite.

In early 2006, Honeywell appealed the 2005 decision of Sallies to terminate its supply contract to the International Chamber of Commerce in Switzerland. The arbitrators still had not made a decision by yearend 2006.

Work continued by the Nuclear Energy Corporation of South Africa on the prefeasibility study to construct a 30,000-metric-ton-per-year HF plant at Richards Bay. The project is being undertaken by Alfuorco, which is 50% owned by Tunisia's $AlF_3$ producer Industries Chimiques du Fluor (more commonly known by its initials, ICF), Metorex Ltd. (25%), and South Africa's Industrial Development Corp. (25%). Construction could be completed sometime between August 2009 and August 2010, and the plant would consume about 70,000 t/yr of acid-grade fluorspar (Kruger, 2007).

***Vietnam.***—Tiberon Minerals Ltd., on behalf of the Nui Phao Mining Joint Venture Co. Ltd. (Nuiphaovica), hired the Australian firm Ausenco Ltd. to undertake the detailed engineering, procurement, and construction management for the Nui Phao fluorspar project. In addition, Tiberon announced it had signed an offtake agreement for fluorspar with CMC Cometals (a division of Commercial Metals Co.). Cometals agreed to purchase 100% of Nuiphaovica's projected acid-grade fluorspar output from the Nui Phao deposit in Vietnam for the first 3 years of production, followed by a 3-year renewal at Cometals' option and successive 1-year mutual extension options thereafter (Tiberon Minerals Ltd., 2006c, d). Cometals has been a major force in the worldwide marketing of Chinese fluorspar and is very well known in the fluorspar business.

A project update prepared by Ausenco and Nuiphaovica reported that, through optimization of the mining plan, production of fluorspar would increase to 222,000 t/yr of acid-grade fluorspar from 214,000 t/yr. Owing to unexpected delays, mine production was expected to begin in early 2009, reaching full production in the second half of 2009 (Tiberon Minerals Ltd., 2006b).

Tiberon Minerals announced that it had received a takeover offer (valued at about $217 million) from Dragon Capital Management Ltd. and that Tiberon's board of directors determined the offer was fair and recommended that Tiberon shareholders accept the offer. Dragon Capital is a Vietnamese investment bank that manages several Vietnam-focused investment funds. At the time of the offer, Dragon Capital already owned about 12% of Tiberon's shares (Tiberon Minerals Ltd., 2006a). In a subsequent announcement, Dragon Capital reported that a majority of Tiberon's shareholders had accepted the offer by its expiration date of February 9, 2007 (Tiberon Minerals Ltd., 2007).

## Outlook

Fluorspar supplies will remain tight as a result of reduced exports from China coupled with rapidly increasing Chinese consumption. Fluorocarbon and fluoropolymer markets remain strong, although owing to global warming concerns, the demand for fluorocarbons in Europe and Japan is forecast to decline. Short supplies, high ocean freight rates, and Chinese export fees and tariffs are expected to keep acid-grade fluorspar prices high. Additional production may be available from South Africa in the near term, if Sallies has surmounted the various problems that have plagued the company in the last couple of years and can produce at capacity. Mexico, Mongolia, and South Africa all have large reserves and are the most likely to increase production and help replace supplies lost because of decreasing Chinese exports. As an example, South Africa's Vergenoeg Mining Co. (Pty.) Ltd., which has nearly 20 Mt of proven and probable reserves and a total resource in excess of 200 Mt, has stated that it could quadruple its current production of 180,000 t/yr, if markets warranted it (Kruger, 2007). In addition, the successful scheduled launch of Vietnam's Nui Phao project in 2009 would increase available supplies.

The trade in fluorspar may be replaced, in part, by trade in HF and downstream fluorochemicals as countries like China, Mexico, and South Africa switch to producing and exporting higher-value downstream products such as HF or fluorocarbons. This has already happened in the United States as increasing demand for fluorocarbons and fluoropolymers has been met by increased imports of HF rather than by increasing domestic HF capacity and consuming more fluorspar.

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TABLE 1
SALIENT FLUORSPAR STATISTICS[1, 2]

| | | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|
| United States: | | | | | | |
| Exports:[3] | | | | | | |
| Quantity | metric tons | 24,300 | 30,700 | 20,600 | 36,100 | 13,000 |
| Value[4] | thousands | $3,540 | $4,610 | $3,200 | $7,840 | $2,430 |
| Imports:[3] | | | | | | |
| Quantity | metric tons | 494,000 | 567,000 | 599,000 | 629,000 | 553,000 |
| Value[5] | thousands | $62,000 | $76,300 | $95,300 | $122,000 | $112,000 |
| Average value:[5] | | | | | | |
| Acid grade | dollars per metric ton | 128 | 138 | 167 | 202 | 217 |
| Metallurgical grade | do. | 89 | 85 | 83 | 93 | 101 |
| Consumption: | | | | | | |
| Reported | metric tons | 588,000 | 616,000 | 618,000 | 582,000 | 523,000 |
| Apparent | do. | 477,000 [6] | 589,000 [7] | 691,000 [7] | 616,000 [7] | 608,000 [7] |
| Stocks, December 31: | | | | | | |
| Consumer and distributor[8] | do. | 245,000 | 206,000 | 105,000 | 131,000 | 89,900 |
| Government stockpile | do. | 109,000 | 95,000 | 83,400 | 35,200 | 8,110 |
| World, production | do. | 4,450,000 [r] | 4,850,000 [r] | 5,240,000 [r] | 5,300,000 [r] | 5,320,000 [e] |

[e]Estimated. [r]Revised

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

[6]Imports minus exports plus adjustments for Government and industry stock changes.

[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 | 2005 | 2006 | 2005 | 2006 | 2005 | 2006 |
| Hydrofluoric acid and aluminum fluoride | 508,000 | 444,000 | -- | -- | 508,000 | 444,000 |
| Metallurgical | 19,600 | 15,600 | 29,000 | 29,100 | 48,600 | 44,800 |
| Other[2] | 24,900 | 31,100 | -- | 3,750 | 24,900 | 34,900 |
| Total | 553,000 | 490,000 | 29,000 | 32,900 | 582,000 | 523,000 |
| Stocks, consumer, December 31[3] | 69,600 | 56,900 | 11,200 | 22,400 | 80,800 | 79,400 |

-- 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 | 2005 | 2006 |
|---|---|---|
| Chinese, dry basis, cost, insurance, and freight (c.i.f.) Gulf port, acidspar filtercake | 230-240 | 230-240 |
| South African, f.o.b. Durban, acidspar | 157-167 | 160-204 |
| Mexican, free on board (f.o.b.) Tampico, acidspar filtercake | 130-150 | 180-200 |
| Mexican, f.o.b. U.S. Gulf port, arsenic <5 parts per million | 175-186 | 210-220 |
| Mexican, c.i.f. port of U.S. entry, metspar[1] | 93 | 111 |

[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. 459, p. 70, December 2005; no. 471, p. 74, December 2006.

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

| | 2005 | | 2006 | |
|---|---|---|---|---|
| Country | Quantity (metric tons) | Value[2] | Quantity (metric tons) | Value[2] |
| Canada | 28,300 | $6,580,000 | 7,400 | $1,570,000 |
| China | 232 | 38,500 | -- | -- |
| Dominican Republic | 758 | 138,000 | 466 | 86,900 |
| Germany | 1 | 5,000 | -- | -- |
| Korea, Republic of | 9 | 9,140 | -- | -- |
| Mexico | -- | -- | 757 | 111,000 |
| Netherlands | -- | -- | 6 | 5,820 |
| Taiwan | 6,680 | 1,040,000 | 4,380 | 655,000 |
| Venezuela | 120 | 30,200 | -- | -- |
| Total | 36,100 | 7,840,000 | 13,000 | 2,430,000 |

-- 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 | 2005 | | 2006 | |
|---|---|---|---|---|
| | Quantity (metric tons) | Value[2] (thousands) | Quantity (metric tons) | Value[2] (thousands) |
| Containing more than 97% calcium fluoride ($CaF_2$): | | | | |
| China: | | | | |
| Baltimore | -- | -- | 6 | $4 |
| Houston, TX | 229,000 | $48,600 | 161,000 | 35,400 |
| Laredo, TX | 2,670 | 601 | -- | -- |
| New Orleans, LA | 188,000 | 39,900 | 199,000 | 44,500 |
| Total | 420,000 | 89,200 | 359,000 | 79,900 |
| France, Philadelphia, PA | 39 | 21 | -- | -- |
| Germany, Savannah, GA | 19 | 9 | 17 | 13 |
| Japan, Los Angeles, CA | 1 | 5 | 61 | 10 |
| Mexico: | | | | |
| Laredo, TX | 40,000 | 7,060 | 39,600 | 8,300 |
| New Orleans, LA | 6,540 | 730 | 15,300 | 2,160 |
| Total | 46,500 | 7,790 | 54,900 | 10,500 |
| Mongolia: | | | | |
| Houston, TX | 22,400 | 4,050 | 27,600 | 5,600 |
| New Orleans, LA | 20,200 | 3,200 | 4,940 | 988 |
| Total | 42,600 | 7,250 | 32,500 | 6,590 |
| South Africa: | | | | |
| Houston, TX | 15,000 | 3,270 | 23,500 | 4,910 |
| New Orleans, LA | 62,000 | 10,800 | 19,800 | 4,180 |
| Total | 77,000 | 14,100 | 43,300 | 9,090 |
| United Kingdom: | | | | |
| Houston, TX | 2 | 8 | 6 | 25 |
| Los Angeles, CA | 147 | 18 | 345 | 41 |
| Total | 149 | 26 | 351 | 66 |
| Grand total | 586,000 | 118,000 | 490,000 | 106,000 |
| Containing not more than 97% $CaF_2$: | | | | |
| Canada, Buffalo, NY | 75 | 29 | -- | -- |
| Mexico: | | | | |
| Charleston | -- | -- | 3,100 | 306 |
| Laredo, TX | 931 | 99 | 1,640 | 175 |
| New Orleans, LA | 42,500 | 3,920 | 57,500 | 5,810 |
| Total | 43,400 | 4,020 | 62,200 | 6,290 |
| Grand total | 43,500 | 4,050 | 62,200 | 6,290 |
| Grand total, all grades | 629,000 | 122,000 | 553,000 | 112,000 |

-- 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 | 2005 Quantity (metric tons) | 2005 Value[2] (thousands) | 2006 Quantity (metric tons) | 2006 Value[2] (thousands) |
|---|---|---|---|---|
| Canada | 44,100 | $46,100 | 42,600 | $52,300 |
| China | 895 | 599 | 2,080 | 1,470 |
| Germany | 355 | 704 | 294 | 653 |
| India | 84 | 75 | -- | -- |
| Italy | 188 | 28 | 38 | 51 |
| Japan | 1,300 | 3,100 | 1,390 | 3,010 |
| Korea, Republic of | 172 | 582 | 106 | 343 |
| Mexico | 89,900 | 86,700 | 109,000 | 109,000 |
| Netherlands | 85 | 310 | 300 | 467 |
| Peru | -- | -- | 40 | 21 |
| Singapore | 32 | 62 | 238 | 524 |
| Switzerland | 1 | 17 | -- | 5 |
| Taiwan | 78 | 110 | 32 | 84 |
| Total | 137,000 | 138,000 | 156,000 | 168,000 |

-- 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; adjusted by the U.S. Geological Survey.

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

| Country | 2005 Quantity (metric tons) | 2005 Value[2] (thousands) | 2006 Quantity (metric tons) | 2006 Value[2] (thousands) |
|---|---|---|---|---|
| Belgium | 150 | $137 | 19 | $16 |
| China | 735 | 576 | 936 | 782 |
| Denmark | 99 | 189 | 346 | 578 |
| Germany | 1,570 | 1,720 | 1,970 | 1,790 |
| Hong Kong | 30 | 18 | -- | -- |
| Hungary | 379 | 380 | 371 | 357 |
| Japan | -- | -- | 255 | 278 |
| United Kingdom | 119 | 215 | 2 | 4 |
| Other[3] | 24 | 26 | 57 | 66 |
| Total | 3,110 | 3,260 | 3,960 | 3,870 |

-- 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 Canada, France, Russia, Republic of South Africa, and Spain.

Source: U.S. Census Bureau.

TABLE 8
U.S. IMPORTS FOR CONSUMPTION OF ALUMINUM FLUORIDE, BY COUNTRY[1]

| Country | 2005 Quantity (metric tons) | 2005 Value[2] (thousands) | 2006 Quantity (metric tons) | 2006 Value[2] (thousands) |
|---|---|---|---|---|
| Brazil | 93 | $59 | 11 | $8 |
| Canada | 2,240 | 2,340 | 1,970 | 2,150 |
| China | 169 | 120 | 389 | 390 |
| Germany | 1 | 16 | 1 | 19 |
| Italy | 6 | 18 | -- | -- |
| Japan | -- | -- | (3) | 4 |
| Mexico | 1,660 | 1,500 | 4,600 | 4,510 |
| Spain | 39 | 41 | -- | -- |
| Sweden | 36 | 63 | 977 | 1,020 |
| United Kingdom | 11 | 8 | -- | -- |
| Total | 4,250 | 4,170 | 7,950 | 8,090 |

-- 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 9
FLUORSPAR: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons)

| Country and grade[3, 4] | 2002 | 2003 | 2004 | 2005 | 2006[e] |
|---|---|---|---|---|---|
| Argentina | 5,168 | 5,422 | 6,891 | 6,962 [r] | 7,000 |
| Brazil, marketable: | | | | | |
| Acid grade | 32,774 | 34,462 | 40,948 | 42,043 [r] | 42,000 [p] |
| Metallurgical grade | 15,125 | 21,884 | 16,824 | 24,469 [r] | 24,500 [p] |
| Total | 47,899 | 56,346 | 57,772 | 66,512 [r] | 66,500 |
| China:[e] | | | | | |
| Acid grade | 1,250,000 | 1,300,000 | 1,300,000 | 1,300,000 | 1,350,000 |
| Metallurgical grade[5] | 1,200,000 | 1,350,000 | 1,400,000 | 1,400,000 | 1,400,000 |
| Total | 2,450,000 | 2,650,000 | 2,700,000 | 2,700,000 | 2,750,000 |
| Egypt[e] | 500 | 500 | 500 | 500 | 500 |
| France:[e] | | | | | |
| Acid and ceramic grades | 90,000 | 79,000 | 80,000 | 80,000 | 35,000 |
| Metallurgical grade | 15,000 | 10,000 | 10,000 | 10,000 | 5,000 |
| Total | 105,000 | 89,000 | 90,000 | 90,000 | 40,000 |
| Germany | | | | | |
| Acid grade | 34,429 [r] | 33,289 [r] | 33,203 [r] | 35,364 [r] | 40,000 |
| Metallurgical grade | -- [r, e] | -- [r, e] | -- [r] | -- [r] | -- |
| Total | 34,429 [r] | 33,289 [r] | 33,203 [r] | 35,364 [r] | 40,000 |

See footnotes at end of table.

TABLE 9—Continued
FLUORSPAR: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons)

| Country and grade[3, 4] | 2002 | 2003 | 2004 | 2005 | 2006[e] |
|---|---|---|---|---|---|
| India:[e, 6] | | | | | |
| Acid grade | 4,188 [7] | 4,200 | 4,300 | 4,400 | 4,600 |
| Metallurgical grade | 6,296 [7] | 6,300 | 6,400 | 6,500 | 6,600 |
| Total | 10,484 [7] | 10,500 | 10,700 | 10,900 | 11,200 |
| Iran[8] | 32,006 | 47,730 | 54,052 | 54,000 [e] | 55,000 |
| Italy[e] | 53,260 | 26,387 | 17,915 | 15,000 [e] | 8,000 |
| Kazakhstan | 3,000 | 3,500 | 4,000 | 4,750 | 4,750 |
| Kenya, acid grade | 85,015 | 95,278 | 108,000 | 97,261 | 83,428 [7] |
| Korea, North, metallurgical grade[e] | 12,000 | 12,000 | 12,000 | 12,500 | 12,500 |
| Kyrgyzstan[e] | 2,750 | 3,973 [7] | 4,000 | 4,000 | 4,000 |
| Mexico:[9] | | | | | |
| Acid grade | 343,332 | 409,122 | 401,753 | 324,568 [r] | 350,000 |
| Metallurgical grade | 279,145 | 347,136 | 440,945 | 550,882 [r] | 588,000 |
| Total | 622,477 | 756,258 | 842,698 | 875,450 [r] | 938,000 |
| Mongolia: | | | | | |
| Acid grade | 86,000 | 120,000 [e] | 148,200 | 134,100 | 137,600 [7] |
| Other grades[10] | 99,000 | 155,000 [e] | 206,700 | 233,400 | 250,000 |
| Total | 185,000 | 275,000 [e] | 354,900 | 367,500 | 387,600 |
| Morocco, acid grade | 94,911 | 81,225 | 112,100 | 95,000 [e] | 95,000 |
| Namibia, acid grade[11] | 81,084 | 79,349 | 104,785 [r] | 115,886 [r] | 130,000 |
| Pakistan, metallurgical grade[e] | 1,000 | 1,000 | 1,026 [r, 7] | 1,040 [r] | 1,050 |
| Romania, metallurgical grade[e] | 15,000 | 15,000 | 15,000 | 15,000 | 15,000 |
| Russia | 169,000 | 170,000 [e] | 226,400 [r] | 245,500 [r] | 210,000 |
| South Africa:[e, 12] | | | | | |
| Acid grade | 216,000 | 221,000 [7] | 250,000 [e] | 252,000 | 250,000 |
| Metallurgical grade | 11,000 | 14,000 [7] | 15,000 | 14,000 [r] | 20,000 |
| Total | 227,000 | 235,000 [7] | 265,000 [e] | 266,000 [r] | 270,000 |
| Spain: | | | | | |
| Acid grade | 131,155 | 129,195 | 135,505 [r] | 133,495 [r] | 122,000 |
| Metallurgical grade | 10,279 | 10,503 | 10,000 [e] | 10,000 [e] | 10,000 |
| Total | 141,434 | 139,698 | 145,505 [r] | 143,495 [r] | 132,000 |
| Tajikistan[e] | 9,000 | 9,000 | 9,000 | 9,000 | 9,000 |
| Thailand, metallurgical grade | 2,271 | 2,180 [r] | 2,375 | 295 | 2,085 [7] |
| Turkey, metallurgical grade | 5,344 | 718 | 880 | 800 | 800 |
| United Kingdom[e] | 53,000 [r] | 56,000 [r] | 50,080 [r, 7] | 50,000 | 55,000 |
| Grand total | 4,450,000 [r] | 4,850,000 [r] | 5,230,000 [r] | 5,280,000 [r] | 5,330,000 |

[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 June 6, 2007.

[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]Year beginning April 1 of that stated.

[7]Reported figure.

[8]Year beginning March 21 of that stated. Data for 2002-05 are reported by Iranian Mines and Mining Development and Renovation Organization.

[9]Data are reported by Servivio Geológico Mexicano.

[10]Principally submetallurgical-grade material.

[11]Data are in wet tons.

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