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FLUORSPAR

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FLUORSPAR

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There was no mine production of fluorspar in the United States in 2005. The bulk of U.S. demand was supplied by imports, although supply was 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 increased by 5%, imports of hydrofluoric acid (HF) increased by 7%, and exports of fluorspar increased by 75% compared with those in 2004 (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 2005, the Defense National Stockpile Center (DNSC) sold about 10,400 metric tons (t) of acid grade (11,444 short dry tons) and about 57,300 t of metallurgical grade (63,177 short dry tons). Unsold quantities that remain in the NDS are documented in the "Stocks" section of this report.

Production

In 2005, 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, all reported production, representing 100% of the quantity reported.

In 2005, there were three companies producing marketable byproduct FSA at phosphoric acid plants (part of a phosphate fertilizer operation). Mosaic Fertilizer (a subsidiary of The Mosaic Co.), PCS Phosphate Co., Inc. and U.S. Agri-Chemicals Corp. operated seven plants in Florida, Louisiana, and North Carolina and reported production of 50,000 t of byproduct FSA. They sold or used 49,800 t of byproduct FSA (equivalent to approximately 87,700 t of fluorspar grading 92% CaF_2). This material was valued at about $8.56 million.

FSA, which is primarily used for water fluoridation, was in short supply during the latter half of 2005. The shutdown of U.S. Agri-Chemicals' Fort Meade, FL, phosphate fertilizer plant coupled with increased demand for FSA for water fluoridation (especially in California) were the causes. Some municipalities had to scramble to locate new supplies and faced significantly higher prices (McCoy, 2005).

Additional domestic supplies of FSA are expected in 2006 when J.R. Simplot Co. begins production and distribution of FSA from its phosphate fertilizer plant in Rock Springs, WY. Initial plans call for production of 13,600 metric tons per year (t/yr), but future expansions could double production to around 27,000 t/yr. Output from the Rock Springs plant is expected to supply the municipal water fluoridation markets in the Western United States (Green Markets, 2005).

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 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 metallurgical- and acid-grade fluorspar. These materials were either purchased from the NDS or imported from Mexico.

Environment

The consumer advocacy group U.S. Public Interest Research Group (PIRG) released a report that discussed the dangers of using HF in petroleum alkylation and identified some of the companies and refineries that use HF. The report called for refiners to switch to the use of solid acid catalysts, sulfuric acid, or modified HF (HF mixed with an additive that reduces the effective vapor pressure). The report noted that 50 of the estimated 148 refineries scattered across the United States use and store HF, which PIRG contended is a danger to more than 17 million people (Bourge, 2005).

After some HF accidents in the late 1980s, the safety of HF was studied in some detail in the early 1990s as required by the Clean Air Act Amendments of 1990. The U.S. Environmental Protection Agency (EPA) was directed to carry out a study of HF manufacturing and uses to identify potential hazards to public health and the environment. In the report, published in 1993, the EPA determined that "owners/operators can achieve an adequate margin of protection both for their workers and the surrounding community by assiduously applying existing industry standards and practices, existing regulations, and future guidance and regulations applicable to various classes of hazardous substances in various settings" (U.S. Environmental

Protection Agency, 1993). The study and its conclusions, however, did not examine disaster scenarios related to possible terrorist attacks.

Consumption

Domestic consumption data for fluorspar 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 averages. 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 nearly 6% in 2005 compared with the revised figure for 2004. There was some significant double counting of acid grade consumed for HF and AlF_3 in 2004; revised consumption data are listed in tables 1 and 2. Consumption of acid grade for HF and AlF_3 decreased by 4.5% to 508,000 t and consumption of fluorspar for metallurgical and other uses decreased by nearly 15% (table 2).

Acid-grade fluorspar 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. Most acid-grade fluorspar is converted to HF before consumption. In 2005, production of HF for use in manufacturing fluorocarbons accounted for the bulk of the increased consumption of acid-grade fluorspar.

The leading use of HF was for the production of a wide range of fluorocarbon chemicals, including hydrofluorocarbons (HFCs), hydrochlorofluorocarbons (HCFCs), and fluoroelastomers or fluoropolymers. HCFCs and HFCs were produced by Arkema Inc. (formerly ATOFINA Chemicals Inc.), DuPont, Great Lakes Chemical Corp., Honeywell, INEOS Fluor Americas LLC, MDA Manufacturing Ltd., and Solvay Solexis Inc.

Some of the existing or potential fluorocarbon replacements for banned chlorofluorocarbons (CFCs) are HCFCs 22, 123, 124, 142b, and 225. These HCFC substitutes have ozone-depletion potentials that are much lower than those of CFCs 11, 12, and 113, and are used individually or in mixtures in home air conditioning systems, in chillers, as foam blowing agents, as solvents (in addition to perfluorocarbons and hydrofluoroethers), and as a diluent in sterilizing gas.

The HFC replacements have no ozone-depletion potential because they contain no chlorine atoms. The most successful HFC replacement compound is HFC 134a, which is primarily used as the refrigerant in automobile air conditioners, new commercial chillers and refrigerators, and as the propellant in aerosols. Other HFCs also are being produced domestically but in much smaller quantities and are being used individually or in blends as replacements for CFCs and HCFCs.

In the foam blowing market, HFCs 134a, 152a, 245fa, and 365mfc are the primary compounds that have replaced banned CFCs and HCFCs. For blowing polyurethane, the primary fluorocarbon blowing agents used in the United States are HFCs 134a and 245fa. HFC 152a has been approved for use in several types of foams but is primarily used for blowing polystyrene and polyolefin foams.

HCFCs 22, 123, and 124; HFCs 23, 125, 134a, and 227ea; and a number of other fluorine compounds have been approved by the EPA as acceptable substitutes (some subject to use restrictions) for halon 1211 as a streaming agent and for halon 1301 as a total flooding agent for fire suppression. Although the production of halons has been banned in the United States since 1993, the use of recycled halon material is allowed.

The use of HF for the manufacture of fluoroelastomers and fluoropolymers continued to display strong growth. These compounds have desirable physical and chemical properties that allow them to be used in products that include pipes, valves, seals, architectural coatings, and cookware. This strong market was one of the factors behind increased HF imports in recent years.

HF was consumed in the manufacture of uranium tetrafluoride, which was used in the process of concentrating uranium isotope 235 for use as nuclear fuel and in fission explosives. It also was used in glass etching, petroleum alkylation, stainless steel pickling, and treatment of oil and gas wells and as a cleaner and etcher in the electronics industry. HF was used as the feedstock in the manufacture of a group of inorganic fluorine chemicals that include chlorine trifluoride, lithium fluoride, sodium fluoride, stannous fluoride, sulfur hexafluoride, tungsten hexafluoride, and others that are used in decay-preventing dentifrices, dielectrics, metallurgy, mouthwashes, water fluoridation, and wood preservatives. It was used as the feedstock for producing potassium fluoride, which is the preferred fluorine source in a number of insecticides and herbicides, and in some proprietary analgesic preparations, antibiotics, and antidepressants.

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. In the Hall-Héroult aluminum process, alumina is dissolved in a bath that consists primarily of molten Na_3AlF_6, AlF_3, and fluorspar to allow electrolytic recovery of aluminum. In countries with strong environmental regulations, a modern aluminum smelter that uses prebaked anode technology will contain high-efficiency scrubbers that recover 96% to 99% of fluorine emissions. 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. This type of smelter will consume about 20 kilograms (kg) of AlF_3 for each metric ton of aluminum produced. Plants that use the older Soderburg technology with minimal recovery of fluorine emissions have significant losses of fluorine and sodium, which are replaced by adding a combined 40 to 50 kg of AlF_3 and Na_3AlF_6 per ton of aluminum produced.

Minor uses of AlF_3 included its use by the ceramics industry for some body and glaze mixtures, in the production of specialty refractory products, in the manufacture of aluminum silicates, in the glass industry as a filler, as a catalyst for organic synthesis, and as an inhibitor of fermentation.

Most AlF_3 is produced directly from acid-grade fluorspar or from byproduct FSA. In 2005, Alcoa World Alumina LLC (a business unit of Alcoa Inc.) produced AlF_3 from fluorspar at Point Comfort, TX.

The aluminum fluoride industry was being investigated for possible antitrust violations or anticompetitive conduct by industry suppliers. The U.S. Department of Justice, the Competition Bureau Canada, and the Australian Competition and Consumer Commission requested documents from at least some of the major aluminum fluoride producers (Dow Jones Newswires, 2005§[1]).

The merchant fluorspar market in the United States includes sales of metallurgical and acid grade mainly to steel mills, but also to smaller markets, such as cement plants, foundries, glass and ceramics plants, and welding rod manufacturers. Depending on the size of the customer, the sales are made in rail car, truckload, and less-than-truckload quantities. In 2005, this merchant market totaled 73,500 t, which included sales of 44,500 t of acid grade (61% of the merchant market) and sales of 29,000 t of metallurgical grade (39% 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.

Acid- or ceramic-grade fluorspar was used by the ceramics industry as a flux and an opacifier in the production of flint glass, white or opal glass, and enamels. These grades also were used in welding fluxes and as a flux in the steel industry. In welding, fluxes are commercially termed “welding consumables” and are manufactured as a flux coating to electrodes, as a flux core in a wire electrode, or as powdered flux product. These products are broadly categorized as “acid,” “basic,” “rutile,” and “cellulosic.” Fluorspar is used in basic compositions where it can make up 30% to 40% of the flux composition (O’Driscoll, 2002).

Metallurgical-grade fluorspar was used primarily as a fluxing agent by the steel industry, frequently in stainless steel production. Fluorspar is added to the slag to make it more reactive by increasing its fluidity (by reducing its melting point), which also helps avoid crust formation. Reducing the melting point of the slag brings lime and other fluxes into solution to allow the absorption of impurities. Fluorspar of different grades was used in the manufacture of aluminum, brick, and glass fibers and by the foundry industry in the melt shop.

In the United States, consumption of fluorspar in metallurgical markets (mainly steel) decreased by about 19% compared with that of 2004. Consumption in this sector was 60% metallurgical grade and 40% acid grade; the bulk of the decrease was in metallurgical grade. Most of this decrease was in metallurgical.

[1]References that include a section mark (§) are found in the Internet References Cited section.

Metallurgical- or submetallurgical-grade fluorspar is used in cement production where it acts mainly as a flux. It is added to the mix of cement raw materials before introduction to the rotary kiln. The addition of fluorspar provides a savings in thermal energy by allowing the kiln to operate at a lower temperature, thus saving fuel. It also increases the amount of tricalcium silicate produced. More tricalcium silicate results in a softer clinker product, which requires less grinding time, thus saving electrical energy. Fluorspar use, however, can damage the refractory lining in the cement kiln, and this factor has limited its use in the cement industry.

About 36,100 t of byproduct fluorosilicic acid valued at $6.44 million was sold for water fluoridation, and about 13,700 t valued at $4.13 million was sold or used for other uses. There were no sales for AlF_3 production in 2005.

Stocks

Data for stocks were available from fluorspar distributors and HF and AlF_3 producers. Known consumer and distributor stocks totaled about 131,000 t, which included 80,800 t at consumer or distributor facilities and 50,200 t purchased from the NDS but still located at NDS depots. At the end of 2005, unsold NDS material consisted of about 30,500 t of metallurgical-grade fluorspar and about 4,750 t of acid-grade fluorspar.

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 kinds of dryers before treating with sulfuric acid to produce HF. In recent years, most acid-grade imports have come from China and South Africa and are usually shipped by ocean freight using bulk carriers of 10,000 to 50,000 t deadweight; 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.

In 2005, problems were reported involving the liquefaction of acidspar flotation concentrates loaded in China. In all cases, the liquefaction resulted in severe listing with disastrous results—one ship capsized off Sri Lanka, another ship had to be abandoned (it subsequently grounded on the China coast), and a third ship was forced to seek a port of refuge (North of England P&I Club, 2006§). International shipping regulations require that concentrates or other cargoes that may liquefy should only be accepted for loading when the actual moisture content of the cargo is less than its transportable moisture limit (TML). The TML is the upper moisture limit of a cargo and is defined as 90% of its flow moisture point, which is the point at which it liquefies. It appears that some cargoes shipped from China did not have TML certificates, or, on some occasions, the reported

TML was suspect (United Kingdom Cabinet Office, Office of Public Sector Information, 1999§). It is not known if any of the lost cargoes were bound for the United States.

Maritime shipping rates are tracked by several different indices, which are differentiated by the size of ships included. The Baltic Handymax Index (BHMI) is calculated from the weighted average rates on major timecharter routes, with two trial voyage routes, as assessed by a panel of brokers. The BHMI was quite high in late winter and early spring, but decreased by about 61% between April and the beginning of August before rebounding somewhat the rest of the year, although it was still down by about 32% compared with the spring high (Hayley-Bell, 2006). The large swing in the BHMI was reflected most specifically in the range of insurance and freight costs United States fluorspar importers paid for Chinese shipments; these costs were reportedly $30 to $45 per metric ton.

Prices

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 increased by $35 per ton (table 3). The average price of standard Mexican acid-grade fluorspar [free on board (f.o.b.) Tampico] decreased by 19%, and the price of low-arsenic acid grade decreased by about 2%. The South African average price for acid grade (f.o.b. Durban) increased by about $25 per ton (Industrial Minerals, 2005d). 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 increased by 75% to 36,100 t from those of 2004 (table 4). All U.S. exports were believed to be reexports of material imported into the United States or exports of material purchased from the NDS.

In 2005, imports for consumption of fluorspar increased by 5% compared with those of 2004 (table 5). The leading suppliers of fluorspar to the United States were China (67%), Mexico (14%), South Africa (12%), and Mongolia (7%).

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 ton for acid-grade imports than that derived from the unadjusted U.S. Census Bureau data. The average unit value, including c.i.f., was $202 per ton for acid grade and $93 per ton for metallurgical grade (table 1).

Driven by the strong fluorocarbon market, imports of HF increased by 7% to 137,000 t (table 6). Imports of synthetic and natural Na_3AlF_6 decreased by more than 19% to 3,110 t and imports of AlF_3 decreased by about 10% to 4,250 t (tables 7, 8).

There are no tariffs on fluorspar from normal-trade-relations countries. There are no tariffs on other major fluoride minerals and chemicals, such as natural or synthetic Na_3AlF_6, HF, and AlF_3.

World Review

Estimated world production increased only slightly compared with that of 2004. The leading producers, in descending order, were China, Mexico, Mongolia, and South Africa.

European Union.—The European Union's antidumping duties on imports of fluorspar from China expired on September 27, 2005. The duties, in the form of a minimum import price of €113.50 per metric ton, had been in place since the mid-1990s. Owing to the decrease in fluorspar exports from China and the significant increase in prices, fluorspar producers in Europe offered no objection to the expiration of the antidumping duties (Industrial Minerals, 2005b).

China.—The second round of bidding for fluorspar export quotas was held in June. As in the first round, 225,000 t was offered for "agreement" bidding, and 150,000 t, for "open" bidding. The average bid price for "agreement" bidding was Y464 per metric ton (about $56 per ton). Average bid prices for the "open" bidding, which are normally much higher than "agreement" bids, were not available (Mineral PriceWatch, 2005).

China's Ministry of Finance announced that, effective May 1, 2005, the 5% rebate paid to exporters of various minerals, including fluorspar, was being repealed. This followed the January 2004 reduction in the export rebate from the then rate of 12% to 15% (depending on the mineral), which "has had the net impact of increasing prices by $16-20/tonne according to traders in the country (Mineral PriceWatch, 2005)." The repeal was part of the Government's policy to restrict the amount of raw materials (such as fluorspar) exported overseas, in order to provide more material for domestic consumption.

In October, China's Ministry of Commerce issued the 2006 export quotas for various agricultural, industrial, and textile commodities, including an export quota of 710,000 t for fluorspar for 2006. This was a further reduction in the announced fluorspar quota, which had been set at 750,000 t in 2004 and 2005 and which had been as high as 1.2 million metric tons in 2000 (Beijing Antaike Information Development Co., Ltd., 2005).

France.—Aluminum producer Alcan Inc. announced that its fluorspar mining subsidiary, Société Générale de Recherches et d'Exploitations Minières (Sogerem), would cease production in the first half of 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. Sogerem had produced fluorspar in the area since the early 1970s, although initial production dated from the 1940s (Industrial Minerals, 2005c).

Russia.—Russia's primary fluorspar mining company, Yaroslavsky Mining and Dressing Complex (YMDC), has new owners and a new name. In 2004, one-half of YMDC (which had been in bankruptcy since 1997) was purchased by Russian Coal (Rossugol, the state-owned Russian coal company). In early 2005, the remaining one-half was acquired by Siberian-Urals Aluminum Co. The company is now known as Russian Ore Mining Co. LLC with Russian Coal as the operator. The new owner-operator intends to invest in new mining and processing equipment with a goal of increasing capacity to 350,000 t/yr. The plans also called for the installation of a 100,000-t/yr briquetting plant to produce metspar briquets, some of which would be intended for Japanese and Korean steel markets (Industrial Minerals, 2005a).

South Africa.—Sallies Ltd. [parent of South African fluorspar producer Witkop Mining (Pty.) Ltd.] announced that it had entered into an agreement (subject to a due diligence review) to purchase Buffalo Fluorspar from Intercoal (Pty.) Ltd. The Buffalo Fluorspar operation is in northern South Africa near Naboomspruit in Limpopo Province east of Sallies' Witkop operation. Sallies planned to raise R47 million by a rights offer to fund the acquisition, pay down existing debt, and finance the expansion of existing operations (Business Day, 2006a§). The Buffalo Fluorspar Mine ceased production in 1994, but recycling operations resumed in 2000 under different owners. A flotation mill was overhauled and recommissioned in 2000, which processed tailings from the previous mining operation. There has been, however, little or no reported output since 2001. The property reportedly still contains recoverable fluorspar in the tailings and large undeveloped reserves of low-grade fluorspar.

Sallies also announced that it intended to sell 30% of the company to black economic empowerment group African Renaissance Investments (Pty.) Ltd. in order to comply with black empowerment laws and codes passed in recent years. The two parties also entered into a joint-venture agreement (70% for Sallies and 30% for African Renaissance), which included an agreement wherein Sallies will manage and operate the business while assisting in the transfer of skills to historically disadvantaged South Africans [Ernst & Young Sponsors (Pty.) Ltd., 2006§].

Sallies announced that it had canceled its supply contract with Honeywell as a result of a dispute over payments. The 5-year contract, which would have expired at the end of 2006, capped the price Honeywell paid at $116 per ton (excluding insurance and freight costs). In the past, Honeywell had consumed as much as 60% of Sallies' annual production. Almost all Sallies' fluorspar is exported in dollar-denominated prices, which made the contract unprofitable to Sallies because of the significant appreciation of the rand against the dollar in recent years. After obtaining legal advice, Sallies canceled the contract in November (Business Day, 2006b§).

A consortium that included the Government and private, local, and international investors was conducting a feasibility study on the construction of a 30,000- to 50,000-t/yr HF and AlF_3 plant. Completion of the study was expected in mid-2006. About 60% of the plant's production would be consumed by South African industries producing aluminum, stainless steel, and petrochemicals. In addition, the HF could be feedstock for future South African refrigeration and fluorochemical industries. Exports would account for 40% of production as AlF_3, HF, or downstream fluorochemicals. With large fluorspar reserves, South Africa could easily expand mine capacity to supply such a plant and maintain current export levels (Venter, 2005§).

Vietnam.—On behalf of Nui Phao Mining Joint Venture Co. Ltd., Tiberon Minerals Ltd. announced that it had been granted a mining license by the Vietnamese Government to develop and mine the Nui Phao tungsten-fluorspar deposit. The license is valid for 30 years and covers about 0.9 square kilometer, which includes the proven and probable reserves located from past exploration drilling (Tiberon Minerals Ltd., 2005b§).

On July 12, Tiberon announced the completion of the "final" feasibility study for the Nui Phao tungsten-fluorspar project. The study concluded that the project could successfully produce more than 210,000 t/yr of fluorspar, about 4,700 t/yr of tungsten, and quantities of bismuth, copper, and gold from an open-pit mining operation with a mine life of 16.3 years. Total capital costs were calculated to be $229.8 million, and based on conservative prices for fluorspar and tungsten (which would account for 80% of the revenue stream), the project's internal rate of return was calculated to be 23.6%. Completion of this final feasibility study allows the company to proceed with project financing, construction, commissioning, and startup of the Nui Phao Mine (Tiberon Minerals Ltd., 2005a§).

Outlook

Demand for acid-grade fluorspar is expected to remain strong in North America because of growing demand for fluorocarbon-base refrigerants. The continued growth in the fluoropolymer and fluoroelastomers markets also will contribute to strong demand. With HF producers DuPont and Honeywell operating their plants at high-capacity rates, supplies of fluorspar will continue to be supplemented by large amounts of imported HF.

With China further restricting exports and export license fees at $56 per ton or more, prices for Chinese acidspar are expected to remain high. Export prices for acidspar will remain high for other major exporting countries, such as Mexico, Mongolia, and South Africa, although significantly lower than the Chinese prices. Despite some recent production capacity increases by non-Chinese producers, there is still insufficient capacity to replace the supplies from China, so consumers will be forced to pay the higher Chinese prices. The closure of Sogerem's fluorspar mines in France reduces world supply by about 100,000 t/yr, which increases the world's dependency on Chinese fluorspar. Additional fluorspar supplies are expected in the next few years from capacity increases in Mongolia (although infrastructure problems make exporting to the West difficult) and possibly South Africa and from the startup of the Nui Phao Mine in Vietnam. But as long as China maintains its export license system on fluorspar, there is likely to be a two-tier pricing system where the price of Chinese acidspar is roughly $30 to $50 per ton higher than that of other exporters on an f.o.b. basis.

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TABLE 1
SALIENT FLUORSPAR STATISTICS[1, 2]

		2001	2002	2003	2004	2005
United States:						
Exports:[3]						
Quantity	metric tons	21,200	24,300	30,700	20,600	36,100
Value[4]	thousands	$3,250	$3,540	$4,610	$3,200	$7,840
Imports:[3]						
Quantity	metric tons	522,000	494,000	567,000	599,000	629,000
Value[5]	thousands	$69,000	$62,000	$76,300	$95,300	$122,000
Average value:[5]						
Acid grade	dollars per metric ton	135	128	138	167	202
Metallurgical grade	do.	80	89	85	83 r	93
Consumption:						
Reported	metric tons	536,000	588,000	616,000	618,000 r	582,000
Apparent	do.	543,000 [6]	477,000 [6]	589,000 [7]	691,000 [7]	616,000 [7]
Stocks, December 31:						
Consumer and distributor[8]	do.	221,000	245,000	206,000	105,000	131,000
Government stockpile	do.	112,000	109,000	95,000	83,400	35,200
World, production	do.	4,600,000 r	4,430,000 r	4,910,000 r	5,220,000 r	5,260,000 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	2004	2005	2004	2005	2004	2005
Hydrofluoric acid and aluminum fluoride	532,000 r	508,000	--	--	532,000 r	508,000
Metallurgical	20,400	19,600	39,400	29,000	59,700	48,600
Other[2]	26,400	24,900	--	--	26,400	24,900
Total	579,000 r	553,000	39,400	29,000	618,000 r	582,000
Stocks, consumer, December 31[3]	59,500	69,600	15,700	11,200	75,200	80,800

[r]Revised. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes acid 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	2004	2005
Chinese, dry basis, cost, insurance, and freight (c.i.f.) Gulf port, acidspar filtercake	195-205	230-240
Mexican, free on board (f.o.b.) Tampico, acidspar filtercake	168-178	130-150
Mexican, f.o.b. U.S. Gulf port, arsenic <5 parts per million	180-190	175-186
Mexican, c.i.f. port of U.S. entry, metspar[1]	83	93
South African, f.o.b. Durban, acidspar	128-145	157-167

[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. 447, December 2004, p. 72; no. 459, December 2005, p. 70.

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

	2004		2005	
Country	Quantity (metric tons)	Value[2]	Quantity (metric tons)	Value[2]
Canada	13,700	$2,100,000	28,300	$6,580,000
China	713	127,000	232	38,500
Denmark	11	3,200	--	--
Dominican Republic	308	52,400	758	138,000
Germany	--	--	1	5,000
Japan	37	10,800	--	--
Korea, Republic of	28	4,040	9	9,140
Netherlands	86	12,000	--	--
Taiwan	5,550	834,000	6,680	1,040,000
Venezuela	239 r	55,800 r	120	30,200
Total	20,600	3,200,000	36,100	7,840,000

[r]Revised. -- 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	2004 Quantity (metric tons)	2004 Value[2] (thousands)	2005 Quantity (metric tons)	2005 Value[2] (thousands)
Containing more than 97% calcium fluoride (CaF_2):				
China:				
Houston, TX	151,000	$28,800	229,000	$48,600
Laredo, TX	--	--	2,670	601
New Orleans, LA	179,000	30,300	188,000	39,900
Total	330,000	59,200	420,000	89,200
France, Philadelphia, PA	66	24	39	21
Germany, Savannah, GA	19	9	19	9
Japan, Los Angeles, CA	--	--	1	5
Mexico:				
Houston, TX	16,000	2,920	--	--
Laredo, TX	31,000	5,110	40,000	7,060
New Orleans, LA	32,400	4,060	6,540	730
Total	79,300	12,100	46,500	7,790
Mongolia:				
Houston, TX	10,800	1,570	22,400	4,050
New Orleans, LA	38,300	6,120	20,200	3,200
Total	49,200	7,690	42,600	7,250
South Africa:				
Houston, TX	23,500	3,080	15,000	3,270
New Orleans, LA	64,000	8,830	62,000	10,800
Total	87,400	11,900	77,000	14,100
United Kingdom:				
Houston, TX	1	4	2	8
Los Angeles, CA	507	60	147	18
New York, NY	12	18	--	--
Total	520	82	149	26
Grand total	546,000	91,000	586,000	118,000
Containing not more than 97% CaF_2:				
Canada, Buffalo, NY	13	5	75	29
Mexico:				
Laredo, TX	1,100	120	931	99
New Orleans, LA	50,000	4,100	42,500	3,920
Total	51,100	4,220	43,400	4,020
Venezuela, Virgin Islands	1,880	102	--	--
Grand total	53,000	4,330	43,500	4,050
Grand total, all grades	599,000	95,300	629,000	122,000

-- 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]

	2004		2005	
Country	Quantity (metric tons)	Value[2] (thousands)	Quantity (metric tons)	Value[2] (thousands)
Canada	45,500	$48,700	44,100	$46,100
China	950	661	895	599
Germany	261	540	355	704
India	37	33	84	75
Italy	38	58	188	28
Japan	1,370	3,310	1,300	3,100
Korea, Republic of	123	416	172	582
Mexico	79,500	76,200	89,900	86,700
Netherlands	58	245	85	310
Singapore	65	143	32	62
Spain	15	20	--	--
Switzerland	18	80	1	17
Taiwan	58	127	78	110
United Kingdom	-- r	-- r	--	--
Other	-- r	-- r	--	--
Total	128,000	131,000	137,000	138,000

rRevised. -- 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]

	2004		2005	
Country	Quantity (metric tons)	Value[2] (thousands)	Quantity (metric tons)	Value[2] (thousands)
Australia	72	$58	--	--
Belgium	18	16	150	$137
China	647	529	735	576
Denmark	323	525	99	189
Germany	1,970	1,820	1,570	1,720
Hong Kong	382	256	30	18
Hungary	294	293	379	380
United Kingdom	126	119	119	215
Other[3]	32 r	43 r	24	26
Total	3,860	3,660	3,110	3,260

rRevised. -- 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 France, Japan, Spain, and Turkey.

Source: U.S. Census Bureau.

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

	2004		2005	
Country	Quantity (metric tons)	Value[2] (thousands)	Quantity (metric tons)	Value[2] (thousands)
Canada	1,660	$1,500	2,240	$2,340
China	15	36	169	120
Italy	--	--	6	18
Mexico	2,950	2,060	1,660	1,500
Other[3]	75 r	149 r	180	187
Total	4,700	3,750	4,250	4,170

[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 Japan, 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]	2001	2002	2003	2004	2005[e]
Argentina	9,075	5,168	5,422 r	6,891 r	6,200
Brazil, marketable:					
Acid grade	31,263	32,774	34,462 r	40,948 r	45,000
Metallurgical grade	12,471	15,125	21,884 r	16,824 r	18,000
Total	43,734	47,899	56,346 r	57,772 r	63,000
China:[e]					
Acid grade	1,250,000	1,250,000	1,300,000	1,300,000	1,300,000
Metallurgical grade[5]	1,200,000	1,200,000	1,350,000	1,400,000	1,400,000
Total	2,450,000	2,450,000	2,650,000	2,700,000	2,700,000
Egypt[e]	500	500	500	500	500
France:[e]					
Acid and ceramic grades	90,000	90,000	79,000	80,000	80,000
Metallurgical grade	20,000	15,000	10,000	10,000	10,000
Total	110,000	105,000	89,000	90,000	90,000
Germany[e]					
Acid grade	29,400	33,400	32,300	32,200 r	32,200
Metallurgical grade	1,000	1,000	1,000	1,000	1,000
Total	30,400	34,400	33,300	33,200 r	33,200
India:[6]					
Acid grade	6,900	4,188 r	4,200 e	4,300 e	4,400
Metallurgical grade	13,866	6,296	6,300 e	6,400 e	6,500
Total	20,766	10,484 r	10,500 e	10,700 e	10,900
Iran[7]	58,486 r	32,006	47,730 r	54,052 r	54,000
Italy:[e]					
Acid grade	30,000	30,000	30,000	30,000	30,000
Metallurgical grade	15,000	15,000	15,000	15,000	15,000
Total	45,000	45,000	45,000	45,000	45,000

See footnotes at end of table.

TABLE 9—Continued

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

(Metric tons)

Country and grade[3, 4]	2001	2002	2003	2004	2005[e]
Kenya, acid grade	118,850	85,015	95,278	108,000 e	97,261 8
Korea, North, metallurgical grade[e]	12,000 r	12,000 r	12,000 r	12,000 r	12,500
Kyrgyzstan	1,175	2,750 e	3,973	4,000 e	4,000
Mexico:[9]					
Acid grade	343,486	343,332	409,122	401,753 r	436,000
Metallurgical grade	275,982	279,145	347,136	440,945 r	437,000
Total	619,468	622,477	756,258	842,698 r	873,000
Mongolia:					
Acid grade	127,000	86,000	120,000 e	148,200 r	134,100 8
Other grades[10]	72,000	99,000	155,000 e	206,700 r	233,400 8
Total	199,000	185,000	275,000 e	354,900 r	367,500 8
Morocco, acid grade	96,500	94,911	81,225	112,100 r, p	95,000
Namibia, acid grade[11]	81,551 r	81,084	79,349 r	104,785 r	115,886 8
Pakistan, metallurgical grade[e]	1,000	1,000	1,000	1,000	1,500
Romania, metallurgical grade[e]	15,000	15,000	15,000	15,000	15,000
Russia	200,000	169,000	170,000 e	200,000 r	210,000
South Africa:[12]					
Acid grade	272,068 r	216,000 r, e	221,000	250,000 r, e	252,000
Metallurgical grade	14,319 r	11,000 r, e	14,000	15,000 e	13,000
Total	286,387 r	227,000 r, e	235,000	265,000 r, e	265,000
Spain:					
Acid grade	126,535	131,155	129,195	130,000 e	130,000
Metallurgical grade	7,504	10,279	10,503	10,000 e	10,000
Total	134,039	141,434	139,698	140,000 e	140,000
Tajikistan[e]	9,000	9,000	9,000	9,000	9,000
Thailand, metallurgical grade	3,020	2,271	40,180 r	2,375	295 8
Turkey, metallurgical grade	4,093	5,344	718	880 r	800
United Kingdom[e]	50,000	45,000	60,000	50,000	50,000
Grand total	4,600,000 r	4,430,000 r	4,910,000 r	5,220,000 r	5,260,000

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

[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, 2005.

[3]In addition to the countries listed, Bulgaria is believed 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]Year beginning March 21 of that stated. Data for 2001-2004 are reported by Iranian Mines and Mining Development and Renovation Organization.

[8]Reported figure.

[9]Data are reported by Consejo de Recursos Minerales, but the production of metallurgical and acid grades has been redistributed on the basis of industry data.

[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 fluorpsar within reported totals.