

BAUXITE AND ALUMINA

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Bauxite is a naturally occurring, heterogeneous material comprised primarily of one or more aluminum hydroxide minerals plus various mixtures of silica (SiO_2), iron oxide (Fe_2O_3), titania (TiO_2), aluminosilicates (clay, etc.), and other impurities in trace amounts. The principal aluminum hydroxide minerals found in varying proportions within bauxite are gibbsite [$\text{Al}(\text{OH})_3$] and the polymorphs, boehmite and diaspore [both $\text{AlO}(\text{OH})$].

Bauxite is typically classified according to its intended commercial application, such as abrasive, cement, chemical, metallurgical, and refractory. Of all bauxite mined, approximately 85% is converted to alumina (Al_2O_3) for the production of aluminum metal, an additional 10% goes to nonmetal uses as various forms of specialty alumina, and the remaining 5% is used for nonmetallurgical bauxite applications. The bulk of world bauxite production is, therefore, used as feed for the manufacture of alumina via a wet chemical caustic leach process known as the Bayer process. Most of the alumina produced from this refining process is smelted using the Hall-Héroult process to produce aluminum metal by electrolytic reduction in a molten bath of natural or synthetic cryolite (NaAlF_6).

Specifications for the nonmetallurgical grades of bauxite are more stringent than those for bauxite used to produce metal and are based on the processing requirements and special properties required of their final commercial products. The natural chemical impurities that exist within these specialty-grade raw materials are not chemically removed by refining as is the case for metallurgical-grade bauxite. Nonmetallurgical ores in an essentially unrefined chemical form are used as direct feed for the production of their ultimate end products. Although figures on bauxite production and consumption within nonmetallurgical markets are not commonly available, the principal industrial end uses for nonmetallurgical-grade bauxite are considered to be in refractories and abrasives, followed by cement applications. In addition, the aluminum chemicals and steel industries also consume significant quantities of bauxite.

In 2001, 22 countries reported bauxite mine production, and total world production increased by 2% compared with that of 2000. Australia, Brazil, Guinea, and Jamaica accounted for about 70% of the total bauxite mined in 2001. The principal sources of nonmetallurgical-grade bauxite are limited to only a handful of countries: abrasive grade is produced in Australia, China, Greece, Guinea, Guyana, and Italy; refractory grade, in Brazil, China, and Guyana (Russell, 1999, p. 49, 58).

Total reported world reserves of bauxite are sufficient to meet cumulative world primary aluminum metal demand well

into the 21st century. Although bauxite reserves are unevenly distributed throughout the world, with approximately 90% in about a dozen countries, the sheer magnitude of these reserves (24 billion metric tons) is sufficient to ensure a readily accessible supply for the future (Plunkert, 2002b).

U.S. production of alumina (calcined equivalent), derived almost exclusively from imported metallurgical-grade bauxite, decreased by 9% in 2001 compared with that of 2000. An estimated 91% of the alumina shipped by U.S. refineries went to domestic primary smelters for aluminum metal production. Consumption by the abrasives, chemicals, refractories, and specialties industries accounted for the remainder of U.S. alumina shipments.

World output of alumina decreased slightly in 2001. The principal producing countries, in descending order of alumina output, were Australia, China, the United States, and Brazil. These countries accounted for almost 60% of the world's production; Australia alone accounted for about one-third of total world production.

Legislation and Government Programs

In October 2001, the Defense Logistics Agency (DLA) released its Annual Materials Plan (AMP) for the National Defense Stockpile (NDS) for fiscal year 2002. The 2002 AMP, including its subsequent revisions, provided for the sale of 2.03 million metric tons (Mt) (2 million long tons) of Jamaica type, metallurgical-grade bauxite. Also, as part of the plan, the DLA was authorized to dispose of 43,700 calcined tons (43,000 long calcined tons) of refractory-grade bauxite in fiscal year 2002 (Defense Logistics Agency, 2002b). These were the maximum amounts recommended for disposal during the fiscal year, and the actual level of sales was to be dependent upon prevailing market conditions.

During calendar year 2001, the DLA announced the following sales of bauxite from the NDS: 8,530 metric tons (t) (8,400 long tons) of metallurgical-grade bauxite, Suriname type, for approximately \$10,000 to Marvic Minerals, Inc. (Defense Logistics Agency, 2001b); and 1.17 Mt (1.15 million long tons) of metallurgical-grade bauxite, Jamaica type, with a provisional value of \$2.5 million to Ferrous American Co. (Defense Logistics Agency, 2001a).

At yearend 2001, the NDS uncommitted inventory for metallurgical-grade bauxite was 2 Mt (1.97 million long tons) of Jamaica type, and the Suriname type was exhausted. The NDS calcined refractory-grade bauxite inventory was 42,900 calcined tons (42,300 long calcined tons) (Defense Logistics Agency, 2002a).

Production

Bauxite.—For many years, domestic mines have supplied less than 1% of the U.S. requirement for bauxite. Essentially all the domestic bauxite production is used in nonmetallurgical products, such as abrasives, chemicals, proppants, and refractories. Thus, the United States imports almost all the bauxite, especially the metallurgical grade, that it requires.

Alumina.—Alcoa Inc. announced the permanent closure of its 600,000-metric-ton-per-year (t/yr) alumina refinery in St. Croix, Virgin Islands, which had been closed since the beginning of the year (Alcoa Inc., 2001c, p. 5). In February, Alcoa announced a reduction in the operating rate of its 2.3-million-metric-ton-per-year (Mt/yr) Point Comfort, TX, refinery to between 1.6 and 1.9 Mt/yr. The reduction, which was effective immediately, reportedly was in response to decreased internal and external demand for alumina (Alcoa Inc., 2001a).

In December, Ormet Corp. announced the temporary closure of its 600,000-t/yr alumina refinery at Burnside, LA. The facility was expected to curtail production by early February 2002. The company cited excess world capacity, depressed prices, and low demand as reasons for the shutdown. The company stated that the plant would be kept ready to reopen when market and economic conditions improved (Ormet Corp., 2001b).

Ormet and the United Steelworkers of America signed a new 3-year contract covering workers at the Burnside, LA, alumina refinery and the Burnside Bulk Marine Terminal, reportedly one of the largest deepwater ports on the Gulf Coast. The contract, which provided wage and benefit increases, was effective through September 25, 2004 (Ormet Corp., 2001a).

Alcoa announced the temporary closure of its 24,000-t/yr aluminum fluoride plant in Fort Meade, FL, effective March 31. Aluminum fluoride is used primarily in the aluminum smelting process (Alcoa Inc., 2001a).

Consumption

Bauxite.—Total domestic consumption of bauxite decreased by about 9% compared with that of 2000. Most of the decrease in consumption resulted from the continued loss of alumina production. In 2001, 93% of the bauxite consumed in the United States was refined to alumina (an estimated 2.1 t of dried bauxite was required to produce 1 t of alumina); the remaining 7% was consumed in nonmetallurgical applications (table 4). Domestic production and consumption data for bauxite and alumina were obtained by the U.S. Geological Survey from three voluntary surveys of U.S. operations. One of these surveys is "Bauxite Consumption," sent to 45 operations, 35 of which responded, representing 89% of the bauxite consumed for uses other than cement listed in table 4.

Washington Mills Co. Inc. acquired Exolon-ESK Co. In addition to the acquisition of silicon carbide capacity, the purchase of Exolon's 35,000-t/yr fused alumina plant in Thorold, Ontario, increased Washington Mills' brown fused

alumina (fused calcined bauxite) capacity. North American fused alumina capacity was in the range of 190,000 to 200,000 t/yr. With imports from China, the market size was about 250,000 to 300,000 t/yr. Of this, 79% was brown fused alumina and 21% was white fused alumina (fused Bayer alumina). Washington Mills was the leading U.S. producer of both brown fused and white fused alumina (Industrial Minerals, 2001b).

Alumina.—An estimated 91% of the alumina shipped by U.S. alumina plants went to domestic primary aluminum smelters for metal production. In 2001, 18 primary aluminum smelters consumed 5.45 Mt of alumina. Consumption in various forms by the abrasives, chemicals, refractories, and specialties industries accounted for the remainder of U.S. alumina use.

Prices

Most metallurgical-grade bauxite and alumina are purchased under long-term contracts. Contract terms for these commodities normally are not made public. Spot prices for metallurgical-grade alumina and specialty forms of bauxite and alumina for nonmetallurgical applications, however, are published in trade journals.

Industrial Minerals (2001d) quoted end-of-year prices for several types of imported refractory-grade bauxite from China and Guyana. The price quotes for Chinese refractory-grade bauxite, minimum 87% Al_2O_3 f.o.b. Chinese ports, were as follows: Shanxi, shaft, lump, \$65 to \$75 per metric ton; Shanxi rotary, lump, \$80 to \$90 per ton; and Guizhou, round, lump, \$65 to \$75 per ton. The price ranges for Guyanese refractory-grade bauxite were as follows: \$160 to \$170 per ton, f.o.b. barge, U.S. Gulf Coast; and \$165 to \$182 per ton, c.i.f. Europe.

The 2001 annual average values of U.S. imports of metallurgical-grade bauxite are listed in table 7.

The market or spot prices for alumina continued to decrease in 2001, a trend that began in May 2000, when the spot price range began a precipitous decline from a high of \$420 to \$440 per ton. According to Metal Bulletin, metallurgical-grade alumina spot prices on international markets began 2001 at \$165 to \$175 per ton. By yearend, the price range had decreased to \$130 to \$140 per ton. Trade data released by the U.S. Census Bureau indicated that the average annual value of U.S. imports of calcined alumina was \$206 per ton, f.a.s. port of shipment, and \$219 per ton, c.i.f. U.S. ports.

Trade

In addition to the trade data listed in tables 8-10, various specialty aluminum compounds were also exported from and imported to the United States. The compounds exported in 2001 included 7,670 t of aluminum sulfate; 15,700 t of aluminum chloride; 8,650 t of aluminum oxide abrasives; and 18,900 t of various fluoride-based compounds of aluminum, including synthetic cryolite and aluminum fluoride. The compounds imported in 2001 included 8,140 t of aluminum sulfate; 1,160 t of aluminum chloride; 203,000 t of aluminum oxide abrasives; and 17,400 t of various fluoride-based

aluminum compounds. U.S. import data for aluminum oxide abrasives in 2000 were revised to 227,000 t.

World Review

In 2001, world production of bauxite increased 2% compared with that of 2000 (table 11). Mine production was reported in 22 countries, and total world production amounted to more than 138 Mt. The largest producers of bauxite, in decreasing order of tonnage mined, continued to be Australia, Guinea, Brazil, and Jamaica, accounting for about 70% of total world production.

World output of alumina decreased slightly in 2001 compared with that of 2000 (table 12). The four principal producing countries, in order of quantity of alumina produced, were Australia, China, the United States, and Brazil. These countries accounted for almost 60% of the world's production; Australia alone accounted for about one-third.

Industry Merger.—On June 29, BHP Limited (BHP) and Billiton Plc (Billiton) announced the completion of their merger to form a diversified resources group to be known as BHP Billiton. BHP Billiton has grouped its major operating assets into the following "Customer Sector Groups" (CSG): Aluminium, Base Metals, Carbon Steel Materials, Stainless Steel Materials, Thermal (Steaming) Coal, Petroleum, and Steel (BHP Billiton, 2001). The Aluminium CSG contains the aluminum assets formerly held by Billiton. The bauxite mining operations include a 14.8% share in Mineração Rio do Norte (MRN) in Brazil, a 76% share in Billiton Maatschappij Suriname (BMS) in Suriname, and an 86% interest in the Worsley bauxite mine in Australia. Alumina refining assets of BHP Billiton comprise a 36% interest in the Alumar refinery in Brazil, a 45% interest in the BMS refinery in Suriname, and an 86% share in the Worsley refinery in Australia. Aluminum metal production assets include the wholly owned Bayside and Hillside smelters in South Africa, a 46% interest in both the Alumar and Valesul smelters in Brazil, and a 47.6% share in the Mozambique Aluminium Co. (Mozal) smelter in Mozambique. The attributable annual production capacity from these facilities was approximately 4 Mt of alumina and 1 Mt of aluminum (Billiton Plc, 2001, p. 21-22).

Australia.—Rio Tinto plc. approved the start of construction of the new Comalco Alumina Refinery in Gladstone, Queensland. The first stage of the Comalco Alumina Refinery, which was expected to cost \$750 million, would produce about 1.4 Mt/yr of alumina, using bauxite from Comalco Limited's Weipa mine in north Queensland. The refinery could be expanded to 4 Mt/yr in the future if warranted. Site preparation began in December and large-scale construction was scheduled to begin in 2002. Initial shipments from the refinery were expected in the first quarter of 2005 (Rio Tinto plc., 2001).

Kaiser Aluminum & Chemical Corp. completed the sale of an 8.3% interest in Queensland Alumina Limited (QAL) to Comalco, the wholly owned subsidiary of Rio Tinto (Kaiser Aluminum & Chemical Corp., 2001a). The total value of the transaction was \$189 million. Subsequent to the sale, ownership of the 3.65 Mt/yr QAL refinery at Gladstone was Comalco, 38.6%; Alcan Inc., 21.4%; Kaiser, 20%; and

Pechiney, 20% (Kaiser Aluminum & Chemical Corp., 2001b).

Azerbaijan.—In December, the Gyandzha alumina refinery was forced to close owing to a lack of bauxite feed material. After May, monthly production levels during the year were below those of 2000 (Interfax Mining & Metals Report, 2001b).

China.—China Aluminum Corp. Group (Chalco) merged the country's five alumina producers, a major ingot producer, and two research institutes into a new holding company, China Aluminum Industry Corp. (Chinalco). The merged plants were Guizhou Aluminum Plant, Great Wall Aluminum Corp., Pingguo Aluminum Co., Qinghai Aluminum Co. Ltd., Shandong Aluminum Plant, and Shanxi Aluminum Plant. These companies accounted for practically all of the country's alumina production capacity (4.2 Mt/yr) and approximately 700,000 t/yr of aluminum ingot production capacity (Platts Metals Week, 2001).

Later in the year, Chinalco transferred the bulk of its assets to the Aluminium Corp. of China (Chalco) for a 45.1% share of the new company. In December, Chalco held its initial public offering of stock on the New York and Hong Kong exchanges, which raised some of the capital needed for planned refinery and smelter expansions (Metal Bulletin, 2001b). Announced expansion plans could increase China's refinery capacity to more than 6 Mt/yr over the next 3 to 5 years. The plans include 400,000 t/yr expansions at each of the refineries at Pingguo, Zhongzhou, and Guizhou, an expansion of the Great Wall refinery to approximately 1.2 Mt/yr, and an expansion of Shandong capacity to about 1 Mt/yr (Metal Bulletin, 2001a).

France.—Pechiney announced plans to double capacity for superground aluminas by constructing a new facility at its Gardanne refinery in southern France. The new capacity, which was expected to be several thousand tons per year, would be used to produce alumina for the refractories industry and also for ceramic grade alumina for electronic applications (Industrial Minerals, 2001c).

Germany.—Alcoa sold its 50% interest in the Aluminium Oxide Stade GmbH alumina refinery in Stade, Germany, to Dadco Alumina and Chemicals Ltd., a private investment and trading company. Alcoa obtained a share in the 800,000-t/yr refinery as part of its merger with Reynolds last year, and was required to dispose of its share as one of the conditions for approval of the merger by the European Commission. VAW AG owns the other 50% of the Stade refinery (Alcoa Inc., 2001b). Later in the year, VAW announced that it planned to increase its production of alumina trihydrate (ATH) at the Stade refinery by 20% in the second half of 2002. About 40% of VAW's share of production was sold for non-metallurgical applications (Industrial Minerals, 2001e).

Alcan announced the sale of its alumina specialties production plant, Alusuisse Martinswerk GmbH, in Bergheim, Germany, to Albemarle Corporation. Albemarle, which is headquartered in Richmond, VA, is a global supplier of specialty chemicals and chemical intermediates. The sale was part of the divestment requirements imposed by the European Commission as a condition to its approval of the merger between Alcan and Alusuisse Group Ltd. in October 2000 (Alcan Inc., 2001c).

India.—Trial production began at the newly expanded National Aluminium Co. (Nalco) alumina refinery. Capacity at the refinery increased from 800,000 t/yr to 1.58 Mt/yr. Commercial production at full capacity levels was expected by the end of the year (Metal Bulletin, 2001d).

The Government of India sold a 51% stake in Bharat Aluminium Co. (Balco) to Sterlite Industries Ltd. The sale included a 200,000 t/yr alumina refinery, a 100,000 t/yr smelter, and a 40,000 t/yr rolling mill, all of which are located at Balco's Korba complex in central India (Mining Journal, 2001).

Norsk Hydro ASA informed its partners in Utkal Alumina International Ltd. (UAIL) that it was withdrawing from the Utkal alumina refinery project. The Norwegian aluminum producer reportedly cited its assessment of the future market for alumina and the lack of progress on the construction of the 1 Mt/yr refinery as reasons for its withdrawal. Norsk Hydro was a 45% shareholder in UAIL, with Alcan holding 35%, and Hindustan Aluminium Co. Ltd. (Hindalco), the remaining 20%. The partners will have a preemptive right to acquire Norsk Hydro's stake in the project (Metal Bulletin, 2001e).

Jamaica.—Alcan sold its 93% interest in the Alcan Jamaica Company to Glencore International AG, a privately held natural resources company based in Switzerland (Alcan Inc., 2001a). The remaining 7% was owned by Jamaica Bauxite Mining Ltd., a state-owned Jamaican company. The assets included two alumina refineries, Kirkvine and Ewarton, which had a combined capacity of 1.2 Mt/yr of alumina, as well as related bauxite reserves and active mine sites. Alcan has secured a long-term contract from Glencore for the total annual production of both refineries (Alcan Inc., 2001b).

Kaiser announced plans to increase capacity at its Alumina Partners of Jamaica (Alpart) refinery from 1.45 Mt/yr to 1.7 Mt/yr. Production was expected to be increased through debottlenecking and improving technical performance. The upgrade was expected to be completed by 2003 (Metal Bulletin, 2001c).

Romania.—Russian Aluminum (RusAl), operator of the Oradea refinery, announced that production at the 240,000-t/yr plant would be suspended. Operating costs that exceeded the contract and spot price for alumina on the world markets were cited as the reason for the suspension. RusAl reported that the plant would be maintained so that it could be restarted if necessary (Interfax Mining & Metals Report, 2001c).

Russia.—Achinsk Alumina Combine increased alumina production capability at its refinery in Krasnoyarsk to 1 Mt/yr. Included in the upgrade was the conversion of a cement furnace to an alumina sintering furnace (Interfax Mining & Metals Report, 2001a).

Siberian-Urals Aluminium Co. (SUAL) purchased a controlling stake in Yurginsky Abrasive Production Plant in Kemerovo. The plant produced 12,000 to 25,000 t/yr of refractory and abrasive products, including white fused alumina (Metal Bulletin Monthly, 2001).

Volkhov Aluminium, operator of Russia's smallest aluminum smelter (25,000 t/yr), and Pikalevo Production Assn. Glinozem, operator of a 268,000-t/yr alumina refinery near St. Petersburg, merged to form a new joint-stock company, JSC Metallurg. Of the new company shares, almost

82% was held by offshore companies, 14% by the Russian Government, and about 4% by local companies and private investors (Metal Bulletin, 2001h).

Slovenia.—Alusil, a new producer of tabular alumina, initiated a cold start of its plant in Kidrecevo during October. Alusil was a joint venture between German minerals producer and trader Mineralmühle Leun Rau GmbH & Co. and Silkem, a Slovenian alumina producer. Main uses for tabular alumina include refractories, ceramics, petrochemicals, and furnace equipment (Industrial Minerals, 2001a).

Ukraine.—Sale of the Government's 68% interest in the Zaporozhye Aluminum Complex (ZALK) to Kremenchug Auto Works (Kraz) Foreign Trade Company, announced late in 2001, was overruled by the Ukrainian high court (Plunkert, 2002a, p. 6.9). The State Property Fund then signed an agreement with AvtoVAZ-Invest whereby the latter would purchase 68% of ZALK for \$70 million, as well as assuming the plant's debt and agreeing to undertake a \$200 million, 5-year modernization program. The modernization program would increase capacity at the 110,000-t/yr smelter to 200,000 t/yr and upgrade the captive 250,000-t/yr alumina refinery. The state planned to retain a 25% stake in the complex and the employees held the remaining 7%. AvtoVAZ-Invest was a joint venture between Russian auto maker AvtoVAZ and trader Arlan and reportedly was backed by Russia's Vnesheconombank (Metal Bulletin, 2001f).

Venezuela.—Corporación Venezolana de Guayana (CVG) announced that it had undertaken the administrative unbundling of its four aluminum sector companies—Alcasa, Industria Venezolana de Aluminio C.A. (Venalum), CVG Bauxilum C.A. (Bauxilum), and CVG Carbones del Orinoco C.A. (Carbonorca). Corporación Aluminios de Venezuela (Cavsa), the state-owned holding company that was formed in 1997 to facilitate the sale of these companies as a single block, was dissolved at yearend. The four companies will continue to be state-owned through CVG but would revert to the management structures they had prior to 1997 (Kinch, 2001).

Vietnam.—Vietnam National Mineral Corp. (Vimico) signed a memorandum of understanding with China Nonferrous Corp. to develop bauxite mining in the Dac Nong district of Dac Lac Province in southern Vietnam. Total bauxite reserves at the site were estimated at 4 to 5 billion tons. The bulk of the bauxite mined was expected to be exported. Both parties also agreed to invest in the construction of a railway track between the mine site and the port of Thi Vai (Metal Bulletin, 2001g).

Outlook

Identified world bauxite reserves are sufficient to meet cumulative world demand well into the 21st century. Considering the probability of discovering additional bauxite deposits plus the added possibility of employing lower grade bauxite occurrences and various alternative sources of alumina, world resources of aluminum remain adequate to satisfy demand for the foreseeable future.

The world aluminum market continued to be in an oversupply situation during the first half of 2002. By mid-June, inventories on the London Metal Exchange had risen to

more than 1.2 Mt. Aluminum demand was showing some signs of increasing but did not appear to be high enough to draw down inventories and to absorb the production from new and/or previously idled capacity that was coming onstream. Demand is expected to increase over the next few years as the world economies begin to grow. If announced expansion plans are completed, then supply should be adequate to meet the anticipated growth in demand.

The world alumina market was also in an oversupply condition during the first half of 2002; thus, existing alumina refinery capacity should be sufficient to meet increased demand in the short term. A long-term growth in metal demand, however, would probably require the expansion of current refinery capacity above and beyond what has already been announced.

References Cited

- Alcan Inc., 2001a, Alcan closes sale of its Jamaican operations: Montreal, Quebec, Canada, Alcan Inc. press release, June 1, 1 p.
- Alcan Inc., 2001b, Alcan Inc. completes negotiations on the sale of its Jamaican operations to Glencore: Montreal, Quebec, Canada, Alcan Inc. press release, May 16, 1 p.
- Alcan Inc., 2001c, Alcan sells Martinswerke hydrate and alumina specialties plant: Zurich, Alcan Inc. press release, April 27, 1 p.
- Alcoa Inc., 2001a, Alcoa adjusts alumina refining and aluminum fluoride production: Pittsburgh, PA, Alcoa Inc. press release, February 9, 1 p.
- Alcoa Inc., 2001b, Alcoa completes sale of Stade alumina refinery to Dadco Alumina and Chemicals Ltd.: Pittsburgh, PA, Alcoa Inc. press release, April 11, 1 p.
- Alcoa Inc., 2001c, Form 10-Q—Quarter ended June 30, 2001: Securities & Exchange Commission, 30 p.
- BHP Billiton, 2001, BHP Billiton merger complete: London, BHP Billiton press release, June 29, 6 p.
- Billiton Plc, 2001, BHP and Billiton merge to create a premier diversified global resources group: London, Billiton Plc press release, March 18, 27 p.
- Defense Logistics Agency, 2001a, Stockpile accepts metallurgical grade, Jamaican type bauxite offers: Fort Belvoir, VA, Defense Logistics Agency news release, September 28, 1 p.
- Defense Logistics Agency, 2001b, Stockpile accepts Surinam[e] type bauxite offers: Fort Belvoir, VA, Defense Logistics Agency news release, March 30, 1 p.
- Defense Logistics Agency, 2002a, Inventory of stockpile material R-1: Defense Logistics Agency, January 15, 3 p.
- Defense Logistics Agency, 2002b, Revised FY 2002 annual materials plan: Fort Belvoir, VA, Defense Logistics Agency news release, May 6, 2 p.
- Industrial Minerals, 2001a, Alusil tubular alumina plant to come on-stream: Industrial Minerals, no. 410, November, p. 19.
- Industrial Minerals, 2001b, More fusion in fused minerals Washington Mills to buy Exolon-ESK: Industrial Minerals, no. 404, May, p. 8-9.
- Industrial Minerals, 2001c, Pechiney to double superground alumina capacity: Industrial Minerals, no. 407, August, p. 13-14.
- Industrial Minerals, 2001d, Prices: Industrial Minerals, no. 411, December, p. 82.
- Industrial Minerals, 2001e, VAW increases ATH capacity by 20%: Industrial Minerals, no. 410, November, p. 17, 19.
- Interfax Mining & Metals Report, 2001a, Achinsk Combine to raise alumina output 11.6%: Interfax Mining & Metals Report, v. 10, no. 16, April 13-19, p. 14.
- Interfax Mining & Metals Report, 2001b, Ganja alumina refinery grinds to a halt: Interfax Mining & Metals Report, v. 10, issue 51, December 14-20, p. 13.
- Interfax Mining & Metals Report, 2001c, RusAl shuts Romanian alumina plant: Interfax Mining & Metals Report, v. 10, issue 47, November 19-23, p. 13.
- Kaiser Aluminum & Chemical Corp., 2001a, Kaiser Aluminum completes previously announced sale of partial interest in alumina refinery: Houston, TX, Kaiser Aluminum & Chemical Corp. press release, September 4, 1 p.
- Kaiser Aluminum & Chemical Corp., 2001b, Kaiser Aluminum signs agreement to sell portion of interest in alumina refinery: Houston, TX, Kaiser Aluminum & Chemical Corp. press release, June 17, 1 p.
- Kinch, Diana, 2001, Venezuela plans to unravel aluminum merger done in 1997: American Metal Market, v. 109, no. 248, December 24, p. 4.
- Metal Bulletin, 2001a, Alcoa and Chalco—Enjoying the inside track: Metal Bulletin, no. 8633, December 13, p. 5.
- Metal Bulletin, 2001b, IPO gives impetus to Chalco refinery expansions: Metal Bulletin, no. 8632, December 10, p. 5.
- Metal Bulletin, 2001c, Kaiser to expand Alpart, targets higher cash flow: Metal Bulletin, no. 8578, May 28, p. 4.
- Metal Bulletin, 2001d, Nalco progresses with expansion: Metal Bulletin, no. 8604, September 3, p. 5.
- Metal Bulletin, 2001e, Norsk Hydro leaves Utkal alumina project: Metal Bulletin, no. 8635, December 20, p. 5.
- Metal Bulletin, 2001f, Ukraine sells Zalk to Russian consortium: Metal Bulletin, no. 8550, February 15, p. 6.
- Metal Bulletin, 2001g, Vietnam, China sign accord on bauxite mining: Metal Bulletin, no. 8594, July 23, p. 4.
- Metal Bulletin, 2001h, Volkhov and Pikalevo complete merger: Metal Bulletin, no. 8621, November 1, p. 4.
- Metal Bulletin Monthly, 2001, SUAL buys Yurginsky plant: Metal Bulletin Monthly, no. 403, April, p. 76.
- Mining Journal, 2001, Bharat sale triggers strike: Mining Journal, v. 336, no. 8624, March 9, p. 173, 175.
- Ormet Corp., 2001a, Contract reached between USWA and Ormet: Burnside, LA, Ormet Corp. press release, September 26, 1 p.
- Ormet Corp., 2001b, Ormet announces temporary curtailment of Burnside alumina plant: Burnside, LA, Ormet Corp. press release, December 4, 2 p.
- Platts Metals Week, 2001, Chalco alumina plant merger to raise funds for expansion: Platts Metals Week, v. 72, no. 9, February 26, p. 6.
- Plunkert, P.A., 2002a, Aluminum, in Metals and minerals: U.S. Geological Survey Minerals Yearbook 2000, v. I, p. 6.1-6.20.
- Plunkert, P.A., 2002b, Bauxite and alumina: U.S. Geological Survey Mineral Commodity Summaries 2002, p. 30-31.
- Rio Tinto plc., 2001, Construction of Comalco Alumina Refinery to commence: London, Rio Tinto plc. news release, October 26, 1 p.
- Russell, Alison, 1999, Bauxite & alumina—A guide to non-metallurgical uses and markets: Surrey, United Kingdom, Metal Bulletin plc, 112 p.

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

- Aluminum. Ch. in Mineral Commodity Summaries, annual.
- Aluminum. Mineral Industry Surveys, monthly.
- Aluminum and bauxite. Ch. in United States Mineral Resources, Professional Paper 820, 1973.
- Bauxite and alumina. Ch. in Mineral Commodity Summaries, annual.
- Primary Aluminum Plants Worldwide, 1998.
- U.S. Trade in Bauxite and Alumina. Mineral Industry Surveys, quarterly.
- World Bauxite Resources, Professional Paper 1076-B, 1986.
- World Nonbauxite Aluminum Resources—Alunite, Professional Paper 1076-A, 1978.
- World Nonbauxite Aluminum Resources Excluding Alunite, Professional Paper 1076-C, 1990.

Other

- Aluminum. Ch. in Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675, 1985.
- Alumina Plants Worldwide, U.S. Bureau of Mines, 1993.
- Bauxite Mines Worldwide, U.S. Bureau of Mines, 1994.
- CRU. Alumina Monitor (monthly).

TABLE 1
SALIENT BAUXITE STATISTICS 1/

(Thousand metric tons)

	1997	1998	1999	2000	2001
United States:					
Production, crude ore (dry equivalent)	NA	NA	NA	NA	NA
Value	NA	NA	NA	NA	NA
Exports (as shipped):					
Crude and dried	64	83	115	133	67
Calcined	21	16	34	9	14
Imports for consumption (as shipped):					
Crude and dried	10,700	11,000	9,890	8,550	8,300
Calcined	369	393	299	310	242
Consumption (dry equivalent)	11,500	12,700	11,700	10,800 r/	9,740
World, production	122,000	123,000 r/	128,000	135,000	138,000

r/ Revised. NA Not available.

1/ Data are rounded to no more than three significant digits.

TABLE 2
ESTIMATED PRODUCTION AND SHIPMENTS OF ALUMINA IN THE UNITED STATES 1/

(Thousand metric tons)

Year	Calcined alumina	Other alumina 2/	Total	
			As produced or shipped 3/	Calcined equivalent
Production:				
2000 r/	4,320	687	5,010	4,790
2001	3,930	608	4,540	4,340
Shipments:				
2000	4,300	691	4,990	4,770
2001	4,030	617	4,650	4,440

r/ Revised.

1/ Data are rounded to no more than three significant digits.

2/ Trihydrate, activated, tabular, and other aluminas. Excludes calcium and sodium aluminates.

3/ Includes only the end product if one type of alumina was produced and used to make another type of alumina.

TABLE 3
CAPACITIES OF DOMESTIC ALUMINA PLANTS, DECEMBER 31 1/ 2/

(Thousand metric tons per year)

Company and plant	2000	2001
Alcoa Inc.:		
Point Comfort, TX	2,300	2,300
St. Croix, VI 3/	600	--
Total	2,900	2,300
BPU Reynolds, Inc., Corpus Christi, TX	1,600	1,600
Kaiser Aluminum & Chemical Corp., Gramercy, LA	1,250 4/	1,250
Ormet Corp., Burnside, LA	600	600
Grand total	6,350	5,750

-- Zero.

1/ Capacity may vary depending on the bauxite used.

2/ Data are rounded to no more than three significant digits; may not add to totals shown.

3/ Permanently shut down in 2001.

4/ Damaged in an explosion, partial restart in December 2000.

TABLE 4
U.S. CONSUMPTION OF BAUXITE, BY INDUSTRY 1/

(Thousand metric tons, dry equivalent)

Industry	2000	2001
Abrasive	111	61
Alumina	10,100	9,010
Cement 2/	268	269
Chemical	W	W
Refractory	160	175
Other 3/	222 r/	222
Total	10,800 r/	9,740

r/ Revised. W Withheld to avoid disclosing company proprietary data, included with "Other."

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

2/ Data from the D15-Cement Annual Survey Form, U.S. Geological Survey Form 9-4041-A.

3/ Includes municipal water works, oil, and steel and ferroalloys.

TABLE 5
STOCKS OF BAUXITE IN THE UNITED STATES, DECEMBER 31 1/ 2/

(Thousand metric tons, dry equivalent)

Sector	2000	2001
Producers, processors, consumers	1,300	1,750
Government	5,710	2,070
Total	7,000	3,820

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

2/ Domestic and foreign bauxite; crude, dried, calcined, activated, all grades.

TABLE 6
STOCKS OF ALUMINA IN THE UNITED STATES, DECEMBER 31 1/ 2/

(Thousand metric tons, calcined equivalent)

Sector	2000	2001
Producers	381 r/	308
Primary aluminum plants	950	1,100
Total	1,330 r/	1,400

r/ Revised.

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

2/ Excludes consumers stocks other than those at primary aluminum plants.

TABLE 7
AVERAGE VALUE OF U.S. IMPORTS OF CRUDE AND DRIED BAUXITE 1/

(Per metric ton)

Country	2000		2001	
	Port of shipment (f.a.s.)	Delivered to U.S. ports (c.i.f.)	Port of shipment (f.a.s.)	Delivered to U.S. ports (c.i.f.)
Australia	\$13.50	\$25.53	\$13.35	\$26.97
Brazil	23.51	29.82	25.13	32.23
Guinea	23.05	29.09	26.05	32.71
Guyana	26.01	36.80	29.02	38.79
Jamaica	19.53	24.97	19.37	21.89
Weighted average	23.09	29.94	23.27	29.09

1/ Computed from quantity and value data reported to U.S. Customs Service and compiled by the U.S. Census Bureau, Department of Commerce. Not adjusted for moisture content of bauxite or differences in methods used by importers to determine value of individual shipments.

TABLE 8
U.S. IMPORTS FOR CONSUMPTION AND EXPORTS OF BAUXITE, CRUDE AND DRIED,
BY COUNTRY 1/

(Thousand metric tons)

Country	2000	2001
Imports: 2/		
Australia	108	175
Brazil	1,560	968
Guinea	3,350	2,620
Guyana	1,020	716
Jamaica 3/	2,120	3,620
Other	391	207
Total	8,550	8,300
Exports:		
Canada	128	61
Mexico	2	(4/)
Other	3	5
Total	133	67

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

2/ Includes bauxite imported to the U.S. Virgin Islands from foreign countries.

3/ Dry equivalent of shipments to the United States.

4/ Less than 1/2 unit.

NOTE: Total U.S. imports of crude and dried bauxite (including the U.S. Virgin Islands) as reported by the U.S. Census Bureau were as follows: 2000--6,800,000 tons and 2001--7,430,000 tons.

Sources: U.S. Census Bureau and the Jamaica Bauxite Institute.

TABLE 9
U.S. IMPORTS FOR CONSUMPTION AND EXPORTS OF CALCINED BAUXITE, BY COUNTRY 1/

(Thousand metric tons and thousand dollars)

Country	2000				2001			
	Refractory grade		Other grade		Refractory grade		Other grade	
	Quantity	Value 2/	Quantity	Value 2/	Quantity	Value 2/	Quantity	Value 2/
Imports:								
Australia	--	--	28	\$2,740	--	--	61	\$5,790
Brazil	9	\$934	11	1,070	10	\$1,130	2	148
China	117	9,440	82	6,200	59	5,010	75	6,220
Guyana	36	4,100	8	613	18	2,100	3	477
Other	20	1,460	(3/)	29	4	310	11	365
Total	181	15,900	129	10,700	90	8,550	152	13,000
Exports:								
Canada	1	237	4	363	3	558	3	263
Japan	--	--	--	--	(3/)	196	(3/)	15
Mexico	1	208	(3/)	67	3	446	(3/)	43
Other	1	327	1	596	2	1,250	2	386
Total	4	772	5	1,030	9	2,450	5	707

-- Zero.

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

2/ Value at foreign port of shipment as reported to U.S. Customs Service.

3/ Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 10
U.S. IMPORTS FOR CONSUMPTION AND EXPORTS OF ALUMINA, BY COUNTRY 1/

(Thousand metric tons, calcined equivalent, and thousand dollars)

Country	2000		2001	
	Quantity	Value 2/	Quantity	Value 2/
Imports:				
Australia	2,440	\$497,000	1,810	\$325,000
Brazil	126	30,000	165	36,000
Canada	100	60,600	84	53,300
France	14	19,900	12	18,400
Germany	65	78,000	41	60,600
India	131	26,300	3	1,380
Jamaica	276	55,100	278	51,900
Japan	13	15,200	6	12,300
Suriname	559	105,000	654	118,000
Venezuela	10	4,290	1	186
Other	86	41,000	48	28,200
Total	3,820	933,000	3,100	704,000
Exports:				
Brazil	1	2,080	1	3,660
Canada	990	263,000	1,100	248,000
China	1	2,680	2	3,930
Finland	(3/)	772	(3/)	196
Mexico	42	28,400	35	19,600
Netherlands	4	5,840	2	5,260
Norway	(3/)	108	(3/)	149
Russia	(3/)	76	(3/)	501
Sweden	1	1,090	1	1,140
Other	47	148,000	103	141,000
Total	1,090	452,000	1,250	424,000

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

2/ Value at foreign port of shipment as reported to U.S. Customs Service.

3/ Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 11
BAUXITE: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Thousand metric tons)

Country	1997	1998	1999	2000	2001
Albania e/	1	--	--	--	--
Australia	44,465	44,553	48,416	53,802	53,285
Bosnia and Herzegovina e/	75	75	75	75	75
Brazil	11,671	11,961	13,839	13,224 r/	13,900 e/
China e/	8,000	8,200	8,500	9,000	9,500
Ghana	519	443	355	504	715
Greece	1,877	1,823	1,883	1,991	2,052
Guinea 3/	16,359 r/	15,570 r/	15,590 r/	15,700 r/	15,700 e/
Guyana 3/	2,467	2,267	2,359	2,471 r/	1,985
Hungary	743	1,138	935	1,047	1,000 e/
India	6,019	6,102	6,712	7,562 r/	8,387
Indonesia	809	1,056	1,116	1,151 r/	1,237
Iran	92 r/ e/	124 r/	137 r/	140 r/	130 e/
Jamaica 3/ 4/	11,987	12,646	11,688	11,127	12,370
Kazakhstan	3,380 e/	3,437	3,607	3,730 r/	3,668
Malaysia	279	160	224	123	64
Mozambique	8	6	8	8	8 e/
Pakistan	5	5	11	9	9 e/
Romania	127	162	--	--	-- e/
Russia e/	3,350	3,450	3,750	4,200	4,000
Serbia and Montenegro	470	226	500	630	610
Suriname	3,877	3,890	3,715	3,610	4,512
Turkey 5/	369	458	208	459	242 p/
United States	NA	NA	NA	NA	NA
Venezuela	4,967	4,826	4,166	4,361 r/	4,400 e/
Total	122,000	123,000 r/	128,000	135,000	138,000

e/ Estimated. p/ Preliminary. r/ Revised. NA Not available. -- 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 July 25, 2002.

3/ Dry bauxite equivalent of crude ore.

4/ Bauxite processed for conversion to alumina in Jamaica plus kiln-dried ore prepared for export.

5/ Public-sector production only.

TABLE 12
ALUMINA: WORLD PRODUCTION, BY COUNTRY 1/ 2/ 3/

(Thousand metric tons)

Country	1997	1998	1999	2000	2001 e/
Australia	13,385	13,853	14,532	15,037 r/	16,271 4/
Azerbaijan	10 e/	(5/)	76 r/	217 r/	95 4/
Bosnia and Herzegovina e/	50	50	50	50	50 4/
Brazil	3,088	3,322	3,515	3,754 r/	3,750
Canada	1,165	1,229	1,233	1,023 r/	1,036 4/
China e/	2,940	3,330	3,840	4,330	4,700
France e/	454	450	400	200 r/ 4/	150
Germany	738	600 e/	583	700 e/	100
Greece	616 r/	625 r/ e/	626 r/	667 r/	660
Guinea	650	500 r/	568 r/	541 r/	550
Hungary	76	138	145	150 e/	150
India e/	1,860	1,890	2,080 r/	2,280 r/	2,400
Ireland e/	1,273 4/	1,200	1,200	1,200	1,100
Italy	913	930	973	950 e/	500
Jamaica	3,394	3,440	3,570	3,600	3,542 4/
Japan 6/	368	359	335	369 r/	350
Kazakhstan	1,095	1,085	1,158 r/	1,217 r/	1,220 4/
Romania	282	250	277	417	400
Russia	2,400 e/	2,465	2,657	2,850 e/	3,050
Serbia and Montenegro	160 e/	153	156	250 e/	250
Slovakia e/	100	100	100	110 r/	10 4/
Slovenia e/	85 4/	70	70	70	34
Spain e/ 7/	1,110 4/	1,100	1,200	1,200	1,100
Suriname e/	1,600	1,600	--	-- 4/	--
Turkey	164	157	159	155	100
Ukraine	1,080 e/	1,291	1,230	1,360	1,370 4/
United Kingdom	100 e/	96	90	80 r/ e/	90
United States	5,090	5,650	5,140	4,790 r/	4,340 4/
Venezuela	1,730	1,553	1,469 r/	1,755 r/	1,700
Total	46,000	47,500 r/	47,400 r/	49,300	49,000

e/ Estimated. r/ Revised. -- Zero.

1/ Figures represent calcined alumina or the total of calcined alumina plus the calcined equivalent of hydrate when available; exceptions, if known, are noted.

2/ World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

3/ Table includes data available through July 25, 2002.

4/ Reported figure.

5/ Production sharply curtailed or ceased.

6/ Data presented are for alumina used principally for specialty applications. Information on aluminum hydrate for all uses is not adequate to formulate estimates of production levels. Production of aluminum hydroxide: 1997--728,133; 1998--737,582; 1999--736,591; 2000--781,690; and 2001--735,000 (estimated).

7/ Hydrate.