

FELDSPAR AND NEPHELINE SYENITE

By Michael J. Potter

Feldspar

Feldspars are aluminosilicates having varying amounts of sodium, potassium, or calcium. In glassmaking, the largest end use, feldspar provides alumina for improving hardness, durability, and resistance to chemical corrosion. In ceramics, feldspar is used as a flux, lowering the vitrifying temperature of a ceramic body during firing and forming a glassy phase.

Most data in this report are rounded by the U.S. Geological Survey to three significant digits. Table footnotes indicate which statistics have been rounded.

Production.—U.S. production of marketable feldspar (including aplite) in 1997 was about 900,000 metric tons with an estimated value of \$42 million, according to the U.S. Geological Survey (USGS). Feldspar was mined in seven States, which were, in descending order of output, North Carolina, California, Virginia, Oklahoma, Georgia, Idaho, and South Dakota. North Carolina accounted for about 52% of the total. Twelve companies had a total of 14 mine/plant operations—North Carolina had 5, California had 4, and the remaining 5 States listed above each had 1. South Carolina had a grinding facility.

Corona Industrial Sand Co., Corona, CA, ceased operation in the latter part of 1997. FMC Lithium Div. was phasing out its spodumene production at yearend at Cherryville (Bessemer City), NC, in favor of its new, low-cost Fenix brine operation in Argentina. The feldspathic-sand by-product from Bessemer City reportedly will be shipped from stockpiles to Spartan Minerals Corp., Pacolet, SC, for grinding for several months into 1998 (North American Mineral News, 1997).

Domestic production data for feldspar were collected by the USGS by means of a voluntary survey. Of the 14 known mine/plant operations, three, representing 21% of the total operations canvassed, responded by the closeout date. This low response rate resulted from a combination of factors, including plant shutdowns, changes in company office personnel, and not receiving canvass data by the closeout date.

Consumption.—Of feldspar (including aplite) sold or used in the United States, 70% went into the manufacture of glass, including glass containers and glass fiber. Feldspar used in making pottery and other uses was 30% of the output.

Glass container shipments have been sluggish during the past few years. According to an estimate by Cahners Economics, glass container shipments in 1997 were projected to be down by 2.3% from those of the previous year (Marcelonis, 1997). Glass has faced competition from other materials, including plastic, paper, and metal (especially aluminum). The home construction and renovation industries utilize plumbing fixtures, tile, and glass fiber insulation. Housing starts were about 1.48 million units in 1997, or just short of the 1996 level, which was an 8-year high (Duff, 1998).

World Review.—**China.**—Technical improvements in the sanitaryware industry have included the purchase of new technology from abroad and an effort to improve the technical

level of production equipment built within the country. Imported sanitaryware increased from 0.75 million pieces in 1992 to approximately 2 million pieces in 1996.

An example of a recent development is Tangshan Zhuangtoubei Building Materials Co. Ltd., which began construction of a 0.65-million-piece-per-year sanitaryware plant in 1996 with targeted commissioning in early 1998. Total cost of the facility could reach \$48 million. Zhejiang APT Sanitaryware Co. Ltd.'s 0.5-million-piece-per-year plant was targeted to be in operation at the end of 1997. This company, a joint venture with a British company, will produce high-grade sanitaryware. Equipment for the plant has been imported from Italy and the United Kingdom. The Wuhan "Shield Brand" Group Ltd. announced its intention to construct medium and high-grade sanitaryware production lines at its Wuhan factory. Expected production of 0.6 million pieces per year will comprise a variety of colored toilets and upright wash basins (Asian Ceramics, 1997b).

India.—Although ceramic tiles have been perceived as a luxury item, the situation has been changing. Improvements in overall product quality, the development of fast-firing technology and manufacture of stronger, vitrified tiles, and more decorative designs have broadened the market. Currently, unglazed, cement-based, mosaic "tiles" are the most commonly used flooring material.

Some major ceramic tile producers which have had recent increases in capacity or business ventures are Bell Ceramics Ltd., Kejaria Ceramics Ltd., Murudeshwar Ceramics Ltd., SPL Ltd., and Spartek Ceramics India Ltd. (Asian Ceramics, 1997d). Bell Ceramics recently completed two projects, one of which was a new 10,000-square-meter-per-day unit at Bangalore to produce glazed floor and wall tiles. A similar-sized expansion took place at the company's Baroda unit. Bell Ceramics' markets include domestic and foreign destinations such as the Gulf States, Singapore, and Africa (Asian Ceramics, 1997a).

Italy.—Maffei SpA began producing rhyolite grits in the first part of 1997 from its new plant at Boca, in northwest Italy. The company had acquired earlier an open pit, feldspar-containing rhyolite mine at Mare. The grits are used as flux material in ceramic tile production. Expected output at Boca is in excess of 200,000 tons per year of finished product.

Elsewhere, Maffei completed construction of a new processing plant at its subsidiary company Mac Min Srl at Gallese, 50 kilometers from Rome. The \$3.1 million investment increased production capacity to over 60,000 tons per year of milled products, including feldspar, quartz, and kaolin (Industrial Minerals, 1997).

Thailand.—Two companies were each aiming to complete construction of a sanitaryware facility by yearend 1997. American Standard Sanitaryware's plant, located in the eastern part of the country at Rayong, will have a capacity of 0.5 million pieces per year. Output is intended to be primarily export oriented. Siam Sanitaryware Industry Co. Ltd.'s facility is 15 kilometers from

Saraburi and will have a capacity of 0.5 million pieces per year. Exports will be about 30% of production, with France, Germany, the Middle East, the United States, and the United Kingdom being the principal destinations (Asian Ceramics, 1997c).

Turkey.—Feldspar sales have increased from 139,000 tons in 1989 to about 1,040,000 tons in 1996. Exports rose from 49,000 tons to 742,000 tons, and domestic sales increased from 90,000 tons to about 300,000 tons in the same time period. A major reason for the expansion is said to be the increased production of granito (tile with a granite-like appearance) and white body tiles across the region. Italy and Spain have been the largest recipients of exported material. Other growing market areas are the Far East, the Middle East, and North Africa.

Of nine feldspar producers, ESAN Eczacıbaşı Endüstriyel Hamaddeler Sanayii ve Ticaret A.Ş. is the largest and is part of a corporate group that is said to operate the largest sanitaryware factory in the world. Following two retrofitting projects and a new flotation plant in 1997, ESAN's overall flotation capacity is 160,000 tons per year. Matel Hammadde Sanayi ve Tic. A.Ş., another large producer, had an estimated feldspar output of 250,000 tons in 1997, all for ceramics (Bozdoğan, 1997).

Outlook.—Glass recycling and competition from other materials have prevented growth in glass container output in the United States. Of the total domestic building insulation market, fiberglass represents over 50%. This segment is projected to have an annual growth rate of 2.2% to the year 2000, according to the Freedonia Group, Inc. Fiberglass insulation growth will be similar to that of foamed plastics (Ceramic Industry, 1997b).

Shipments of U.S. plumbing fixtures in 1996 (latest available), by material, were fiberglass and plastic, 47%; vitreous china, 30%; ceramic metal, 21%; and other, 4%. According to the Freedonia Group, Inc., the best growth opportunities will be found in whirlpool baths, hot tubs and spas, and showers. Acrylic, fiberglass and other plastic materials are projected to continue making inroads at the expense of ceramic metal and other materials because of advantages in weight, design flexibility and cost (Ceramic Industry, 1997c).

The United States imports about 60% of its ceramic tile; major sources in 1996 (latest data) were Italy, 34%; Mexico, 25%; and Spain, 19%. At yearend 1997, major challenges facing the U.S. tile industry's effort to expand its market included a lack of trained and skilled tile installers and sales people, potential new restrictive environmental standards, and increased imports from low labor cost countries (Ceramic Industry, 1997a).

Nepheline Syenite

Nepheline syenite is a light-colored feldspathic rock comprising mostly soda and potash feldspars and nepheline. In glass and ceramics, nepheline syenite, like feldspar, provides alkali, which, as a flux, lowers the melting temperature, prompting faster melting and fuel savings. In glass, nepheline syenite supplies alumina, which gives increased resistance to scratching and breaking, improved thermal endurance, and increased chemical durability.

Canada and Norway produce nepheline syenite for glass and ceramic use. In contrast, nepheline concentrates in Russia are used for the production of alumina, sodium and potassium carbonates, and portland cement in integrated industrial

complexes (Guillet, 1994). In Canada, Unimin Canada, Ltd., has two deposits, at Nepton and Blue Mountain, and two processing plants 175 kilometers northeast of Toronto. An estimated 60% of the output went to U.S. markets; 20% to the Canadian market; and 20% to other countries.

Prices at yearend 1997 for Canadian nepheline syenite were estimated to be about \$34 to \$41 per ton for glass-grade material, depending on iron content.

In Norway, North Cape Minerals AS produced about 294,000 tons of nepheline syenite in 1996 (latest data) from an underground mining operation on the arctic island of Stjernoya. An estimated 70% of the output went to glass manufacturing, 28% to ceramics, and 2% to filler.

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¹Prior to January 1996, published by the U.S. Bureau of Mines.

TABLE 1
SALIENT FELDSPAR AND NEPHELINE SYENITE STATISTICS 1/

		1993	1994	1995	1996	1997
United States:						
Feldspar:						
Produced 2/	metric tons	770,000	765,000	880,000	890,000	900,000 e/
Value	thousands	\$31,400	\$31,200	\$37,400	\$39,400	\$42,500 e/
Exports	metric tons	17,700	17,300	14,700	10,200	7,220
Value	thousands	\$1,840	\$1,940	\$1,970	\$1,390	\$993
Imports for consumption	metric tons	7,050	7,360	8,980	7,150	8,580
Value	thousands	\$514	\$513	\$813	\$594	\$753
Nepheline syenite:						
Imports for consumption	metric tons	289,000	333,000	316,000	247,000	346,000
Value	thousands	\$15,400	\$18,700	\$19,700	\$20,900	\$23,900
Consumption, apparent 3/ (feldspar plus nepheline syenite)	thousand metric tons	1,050	1,090	1,190	1,130	1,250 e/
World: Production (feldspar)	do.	6,170 r/	6,490 r/	7,890 r/	8,080 r/	8,050 e/

e/ Estimated. r/ Revised.

1/ Data are rounded to three significant digits.

2/ Includes hand-cobbed feldspar, flotation-concentrate feldspar, feldspar in feldspar-silica mixtures and aplite; includes potash feldspar (8% K₂O or higher).

3/ Production plus imports minus exports.

TABLE 2
FELDSPAR PRODUCED IN THE UNITED STATES 1/

(Thousand metric tons and thousand dollars)

Year	Flotation concentrate		Other 2/		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1996	379	17,700	510	21,700	890	39,400
1997 e/	377	17,800	522	24,700	900	42,500

e/ Estimated.

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Includes hand-cobbed, feldspar-silica mixtures (feldspar content), and aplite.

TABLE 3
PRODUCERS OF FELDSPAR AND FELDSPATHIC MATERIALS IN 1997

Company	Plant location	Product
APAC Arkansas Inc.	Muskogee, OK	Feldspar-silica mixture.
Corona Industrial Sand Co.	Corona, CA	Do.
The Feldspar Corp.	Monticello, GA	Potash feldspar.
Do.	Spruce Pine, NC	Soda-potash feldspar.
FMC Lithium Div.	Bessemer City, NC	Feldspar-silica mixture.
Franklin Industrial Minerals	Kings Mountain, NC	Potash feldspar.
PW Gillibrand Co.	Simi Valley, CA	Feldspar-silica mixture.
KT Feldspar Corp.	Spruce Pine, NC	Soda-potash feldspar.
Pacer Corp.	Custer, SD	Potash feldspar.
Santa Cruz Aggregates Co.	Felton, CA	Feldspar-silica mixture.
Spartan Minerals Corp.	Pacolet, SC	Do.
Unimin Corp.	Byron, CA	Do.
Do.	Emmett, ID	Do.
Do.	Spruce Pine, NC	Soda-potash feldspar.
U.S. Silica Co.	Montpelier, VA	Aplite.

TABLE 4
FELDSPAR SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY USE 1/ 2/

(Thousand metric tons and thousand dollars)

Use	1996		1997 e/	
	Quantity	Value	Quantity	Value
Flotation concentrate:				
Glass	151	7,970	148	7,950
Pottery	231	14,900	233	15,100
Total	382	22,900	382	23,000
Other: 3/				
Glass	459	22,200	478	24,500
Pottery	W	W	W	W
Miscellaneous	W	W	W	W
Total	493	25,200	513	27,600
Total:				
Glass 4/	610	30,200	626	32,400
Pottery	W	W	W	W
Miscellaneous	W	W	W	W
Total	875	48,000	895	50,600

e/ Estimated. W Withheld to avoid disclosing company proprietary data; included in " Total."

1/ Includes potash feldspar (8% K₂O or higher).

2/ Data are rounded to three significant digits; may not add to totals shown.

3/ Includes hand-cobbed, feldspar-silica mixtures (feldspar content), and aplite.

4/ Includes container glass, glass fiber, and other glass.

TABLE 5
PRICES FOR U.S. FELDSPAR, YEAREND 1997

(Dollars per metric ton)

	Price 1/
Glass grade:	
30 mesh, soda	44-55
80 mesh, potash	88
Ceramic grade:	
170 to 250 mesh, soda	66-77
200 mesh, potash	105

1/ Bulk, ex-works, USA.

Source: Industrial Minerals (London), no. 363,
December 1997, p. 78.

TABLE 6
U.S. EXPORTS OF FELDSPAR, BY COUNTRY 1/

Country	1996		1997	
	Quantity (metric tons)	Value	Quantity (metric tons)	Value
Canada	1,250	\$190,000	1,490	\$223,000
Dominican Republic	--	--	271	35,900
Ecuador	1,990	135,000	2,630	255,000
France	736	78,000	--	--
Italy	1,310	487,000	1,140	181,000
Mexico	1,600	227,000	857	151,000
Panama	2,510	133,000	--	--
Thailand	320	59,500	319	59,500
Venezuela	271	32,900	254	31,000
Other	174	50,500	266	56,400
Total	10,200	1,390,000	7,220	993,000

1/ Data are rounded to three significant digits; may not add to totals shown.

Source: Bureau of the Census.

TABLE 7
U.S. IMPORTS FOR CONSUMPTION OF FELDSPAR, BY COUNTRY 1/

Country	1996		1997	
	Quantity (metric tons)	Value 2/	Quantity (metric tons)	Value 2/
Mexico	6,920	\$516,000	8,210	\$630,000
Other	233	78,000	369	122,000
Total	7,150	594,000	8,580	753,000

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Customs value.

Source: Bureau of the Census.

TABLE 8
FELDSPAR: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country 3/	1993	1994	1995	1996	1997 e/
Algeria	6,500	6,900 r/	7,000 r/	7,000 r/ e/	7,000
Argentina	55,764	42,516 r/	37,095 r/	72,539 r/	40,000
Australia e/	15,000	16,000	16,000	17,000	20,000
Austria	8,492	4,883	-- r/	-- r/	--
Brazil (crude)	205,000	214,054 r/	220,144 r/	224,000 r/	225,000
Burma 4/	5,728 r/	5,605 r/	8,749 r/	9,000 r/ e/	10,000
Chile	4,150 r/	9,967	7,293 r/	3,702 r/	4,000
Colombia	60,458	76,188	58,100	60,000 e/	60,000
Ecuador	8,015 r/	5,692 r/	7,000 r/ e/	7,000 r/ e/	7,000
Egypt e/	38,900	39,745 5/	39,800	40,000 r/	40,000 5/
Finland	51,477	43,483	41,808 r/	42,000 r/ e/	42,000
France	274,000 e/	390,000 e/	632,000	546,000 r/	550,000
Germany	416,854 r/	379,427	329,624 r/	359,666 r/	360,000
Greece e/	22,210 r/ 5/	35,000	30,000	30,000	30,000
Guatemala e/	7,500	7,500 r/	7,600 r/	7,500 r/	7,500
India	66,792	64,693	99,618 r/	85,213 r/	90,000
Iran	76,873	79,000 r/	80,000 r/ e/	80,000 r/ e/	80,000
Italy	1,534,210	1,806,935	2,199,000 r/	2,310,000 r/	2,300,000
Japan 6/	71,568	56,007	65,086	35,122 r/	55,000
Kenya e/	1,200	1,200	500 r/	100 r/	100
Korea, Republic of	321,964	319,658	367,578 r/	319,112 r/	320,000
Macedonia e/	15,000	15,000	15,000	15,000	10,000
Mexico	123,512	133,441	121,779	142,621 r/	143,000
Morocco	1,000 e/	1,000 e/	17233 r/	833 r/	800
Nigeria e/	700	1,000 r/	1,000 r/	1,000 r/	1,000
Norway 7/	75,000 e/	62,905	75397 r/	75000 r/ e/	75000
Pakistan	17,034	15,335	21,163	32,572 r/	30,000
Peru e/	11,400 5/	11,400	11,400	11,400	11,400
Philippines e/	44,600 5/	30,000	30,000	40,000	40,000
Poland	43,000	46,000	46,000 e/	45,000 e/	45,000
Portugal	90,547	92,440	106,559 r/	100,000 r/ e/	100,000
Romania	87,701	31,123 r/	30,920 r/	35,229 r/	35,000
Russia e/	70,000	55,000	55,000	45,000	45,000
Serbia and Montenegro	2,679	3,238	3,200 e/	3,200 e/	3,500
South Africa	43,400	37,156	47,874	54,193 r/	60,400
Spain 8/	239,000	250,000 r/ e/	379,284 r/	350,000 r/ e/	350,000
Sri Lanka	8,000 e/	12,280	7,500 r/	11,200 r/	10,000
Sweden	35,492	44,520	45,000 r/ e/	45,000 r/ e/	50,000
Taiwan	2,102 r/	854 r/	--	20 r/	--
Thailand	600,835	554,227	670,178	650,000 e/	660,000
Turkey	366,166 r/	502,608	760,250 r/	1,040,000 r/ e/	1,000,000
United Kingdom (china stone) e/	6,960 5/	7,000	7,000	8,000	8,000
United States	770,000	765,000	880,000	890,000	900,000 5/
Uruguay e/	3,000	3,000	3,000	2,500	2,500

See footnotes at end of table.

TABLE 8--Continued
 FELDSPAR: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country 3/	1993	1994	1995	1996	1997 e/
Uzbekistan e/	70,000	70,000	70,000	70,000	70,000
Venezuela	187,000 r/	136,507	227,000 r/	156,000 r/	150,000
Zambia e/	100	-- r/	-- r/	-- r/	--
Zimbabwe	1,553	1,617	3,920 r/	3,248 r/	3,000
Total	6,170,000 r/	6,490,000 r/	7,890,000 r/	8,080,000 r/	8,050,000

e/ Estimated. r/ Revised.

1/ World totals, U.S. data, and estimated data are rounded to three significant digits; may not add to totals shown.

2/ Table includes data available through April 24, 1998.

3/ In addition to the countries listed, former Czechoslovakia, Madagascar, and Namibia produce feldspar, but output is not officially reported, and available general information is inadequate for the formulation of reliable estimates of output levels.

4/ Data are for fiscal years beginning April 1 of that stated.

5/ Reported figure.

6/ In addition, the following quantities of aplite ore were produced in metric tons: 1993--403,724; 1994--381,160; 1995--388,000; 1996--365,021 (revised); and 1997--360,000 (estimated).

7/ Excludes nepheline syenite.

8/ Includes pegmatite.

TABLE 9
 U.S. IMPORTS FOR CONSUMPTION
 OF NEPHELINE SYENITE 1/ 2/

Year	Quantity (metric tons)	Value 3/ (thousands)
1996	247,000	\$20,900
1997	346,000	23,900

1/ Crude and ground combined.

2/ Data are rounded to three significant digits.

3/ Customs value.

Source: Bureau of the Census.