FELDSPAR AND NEPHELINE SYENITE

By Michael J. Potter

Feldspar

Feldspars are alumino-silicates with varying amounts of sodium, potassium or calcium. In glassmaking, 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.

Feldspar consumption in plumbing fixtures, tile, and glass fiber reflected trends in construction activity. In residential construction, total housing starts decreased about 8% to 1.3 million units in 1995. However all segments of nonresidential construction posted good growth: commercial (office, retail, and hotel construction), industrial, and institutional. As a result, total construction spending was projected to show an increase of 2% to 3% compared with that of 1994.[1] Shipments of glass containers, a major end use of feldspar, have been flat, reflecting competition from plastic and other types of containers.

Production.—U. S. production of marketable feldspar (including aplite) in 1995 was 880,000 metric tons with a value of $37.4 million, according to the U.S. Geological Survey (USGS). These data included some producers which were not previously included. (This annual canvassing of data was formerly conducted by the U.S. Bureau of Mines.) Feldspar was mined in seven States, led by North Carolina, and followed in descending order by Virginia, California, Oklahoma, Georgia, Idaho, and South Dakota. North Carolina accounted for about 55% of the total. Twelve U.S. companies had a total of 15 operations: North Carolina had five, California had four, and the remaining five States listed above each had one, and South Carolina had a grinding facility.

Domestic production data for feldspar were developed by the USGS by means of a voluntary survey. Of the 14 known mine/plant operations, data were obtained from 9 by the data close-out date, representing 64% of the total operations canvassed. The nine respondents reported a production of about 675,000 tons, or 77% of the total production shown in table 1. The estimated production of the nonrespondents, about 205,000 tons, was derived from past years' production levels and trends.

The Feldspar Corp. was expanding its existing capacity at Spruce Pine, NC, by 60%. Work on the 120,000 ton-per-year expansion was targeted for completion in late 1995. The company was also planning development of a new mine in Georgia to serve its Monticello beneficiation plant.[2]

Consumption.—Sixty-nine percent of feldspar (including aplite) sold or used in the United States went into the manufacture of glass, including glass containers and glass fiber. Feldspar used in making pottery and other uses was 31% of the output.

Some actual end uses of feldspar products sold by the Feldspar Corp., for example, included ceramic wall and floor tiles, plumbing fixtures, dinnerware, electrical porcelain, glass, TV tubes, and glass fiber insulation.[3] Despite a small market for feldspathic minerals as a filler/extender in paints, plastics, rubber, and other products, usage was still significant.[4]

World Review.—The data in table 8 are an approximation of rated capacity as of December 31, 1995. Rated capacity is defined as the maximum quantity of product that can be produced in 1 year on a normally sustainable long-term operating rate, based on the physical equipment of the plant, and given acceptable routine operating procedures involving labor, energy, materials, and maintenance. Capacity includes both operating plants and plants temporarily closed that, in the judgement of the author, can be brought into production fairly quickly with minimum capital expenditure. Because actual capacity data were not available, rated capacity was considered to approximate recent peak production during the past 5 years for the United States and foreign countries.

In Canada, Canspar Resources Inc., was said to be developing a mine and plant at Baie Johan Beetz, on the south shore of Quebec. Initial output, targeted for 1995, was proposed to be 50,000 tons per year. The product, a mixed soda/potash feldspar, would be targeted at the European market.[5]

In India, Mahavir Minerals Ltd. was increasing its mining capacity by 75,000 tons per year to around 225,000 tons per year of crude feldspar. Grinding capacity was being increased by 50,000 tons per year to approximately 150,000 tons per year. The company had mines in Rajasthan with reserves reportedly of over 25 million tons. Feldspar products were being supplied to users in India (about 75%), Japan, Kuwait, the Philippines, Singapore, and Taiwan.[6]

In Italy, feldspar imports from Turkey, reached 350,000 tons in 1994. Milan-based Maffei SpA, with several subsidiaries, was the largest producer of feldspathic materials in Italy. The company's output of soda and potash feldspar and aplite in 1994 was 790,000 tons. Minerali Industriali SpA, with its three associate companies, was the second largest producer with about 680,000 tons in 1994. Output of potash feldspar was relatively low, but the company was building a new plant, slated to come on-line in late 1995.[7]

In Spain, Industrias del Cuarzo S.A. operated a feldspathic sand quarry 50 kilometers from Segovia. Output was 85,000 tons per year of potash feldspar, 60,000 tons per year of feldspathic sand, and 220,000 tons per year of glass sand. The company planned to increase feldspar capacity to 120,000 tons per year in 1996. Other producers included Llansa S.A., with an output in 1994 of 70,000 tons per year from a pegmatite

deposit, and Compania Minera de Rio Piron, which was producing 80,000 tons per year of potash feldspar from a feldspathic sand deposit.[8]

In Turkey, production increased substantially in recent years to 900,000 tons of mostly soda feldspar in 1994, according to a non-U.S. Government source. Turkish exports were 515,000 tons the same year. Esan Eczacibasi Industrial Minerals Co. anticipated an increase in capacity at its Milas flotation plant from 40,000 tons per year to 70,000 tons per year. Matel Hammadde SvT AS's 1994 output of 100,000 tons per year was 60% higher than that of 1993. The company was projecting a further increase of 30% of soda feldspar in 1995, reaching an annual output of 130,000 tons.[9]

Outlook.—The increasing level of ceramic imports has been a significant factor in the U.S. ceramics industry. For example, in 1993, imports of ceramic tiles comprised over 57% of total tile sales in the United States, compared with about 50% in 1988. Also, tile usage faces strong competition from vinyl flooring. Sanitaryware products (officially referred to as vitreous plumbing fixtures) from Mexico and South America have supplied a significant part of the U.S. market. Vitreous fixtures have also faced competition from plastics, especially glass fiber-reinforced plastics and acrylics.[10]

A non-Government source projected housing starts to increase about 1% to 1.36 million in 1996. Residential remodeling was put at a 1.5% increase and plumbing fixture shipments at a 2.7% increase in 1996.[11]

Nepheline Syenite

Although no reported nepheline syenite has been produced for ceramic use in the United States, a new nepheline syenite operation was being planned by Addwest Minerals, Inc., of Arvada, CO. Material mined from the Wind Mountain deposit in the Cornudos Mountains of New Mexico would be shipped to a processing plant to be built 50 miles east of the mine at El Paso, TX. Production, planned for the end of 1995, would begin gradually. Potential markets included amber and flat glass, glass fiber, dark and buff ceramic tiles, sanitaryware, as a filler/extender in paints, plastics, and rubber, and sandblast media.[12]

Nepheline syenite is a light-colored feldspathic rock composed largely of soda and potash feldspars and nepheline. In glassmaking, nepheline syenite provides alumina and alkalai and as a flux lowers the melting temperature, prompting faster melting and fuel savings. Nepheline syenite is used as a flux in sanitaryware, dinnerware, floor and wall tile, and other whiteware. About 15% of Canadian nepheline syenite output was going into paints, plastics, etc., as a filler and extender.[13]

In Canada, Unimin Canada Ltd. produced about 600,000 tons of nepheline syenite in 1994. The company had two deposits, at Nephton and Blue Mountain, and two processing plants, 175 kilometers northeast of Toronto. About 60% of the output went to U.S. markets, 20% to the Canadian market, and 20% to Europe and other countries:[14]

Prices for Canadian nepheline syenite at yearend 1995 were approximately $22 to $24 per ton (depending on iron content), for glass grade, 30 mesh material, bulk, in car lots/truck lots; and $69 per ton for ceramic grade, 200 mesh, bagged, 1-ton lots.[15]

In Norway, North Cape Minerals A/S produced 280,000 tons of nepheline syenite in 1994 at Stjernoya. Of the production, 75% was glass grade, 19% ceramic grade, 5% amber grade, and 1% filler grade. Sales were largely to Europe, with some material going to Asia and Australia.[16]

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[1]Kennedy, K., S. Malik, A. Bulkley, and A. Steele. Midyear Economic Forecast, 1995-96. Ceramic Industry, v. 145, No. 3, Aug. 1995, pp. 26-27.

[2]North American Minerals News. Company Profile. Issue 2, July 1995, p. 11.

[3]Work cited in footnote 2.

[4]Bolger, R. Feldspar and Nepheline Syenite. Ind. Miner. (London), No. 332, May 1995, p. 29.

[5]P. 31 of work cited in footnote 4.

[6]Industrial Minerals (London). World of Minerals. No. 339, Dec. 1995, p. 13.

[7]P. 37 of work cited in footnote 4.

[8]Regueiro Y. Gonzales-Barros, M. Spanish Industrial Minerals and Rocks. Ind. Miner. (London), No. 332, May 1995, p. 67.

[9]Pp. 41 and 42 of work cited in footnote 4.

[10]Fattah, Hasan. U.S. Frits and Glazes. Ind. Miner. (London), No. 332, May 1995, pp. 87-88.

[11]Ceramic Industry. Business Outlook. V. 145, No. 7, Dec. 1995, p. 14.

[12]Industrial Minerals (London). World of Minerals. No. 332, May 1995, p. 17.

[13]Guillet, G. R. Nepheline Syenite. Ch. in Industrial Minerals and Rocks, 6th ed., 1994, pp. 711, 719.

[14]Work cited in footnote 5.

[15]Industrial Minerals (London). Prices. No. 339, Dec. 1995, p. 65.

[16]Olerud, S. Norway's Industrial Minerals. Ind. Miner. (London), No. 339, Dec. 1995, p. 26.

TABLE 1
SALIENT FELDSPAR AND NEPHELINE SYENITE STATISTICS 1/

		1991	1992	1993	1994	1995
United States:						
Feldspar:						
Produced 2/	metric tons	580,000	725,000	770,000	765,000	880,000
Value	thousands	$26,000	$28,500	$31,400	$31,200	$37,400
Exports	metric tons	8,430	17,700	17,700	17,300	14,700
Value	thousands	$1,330	$2,210	$1,840	$1,940	$1,970
Imports for consumption	metric tons	17,900	13,000	7,050	7,360	8,980
Value	thousands	$1,120	$923	$514	$513	$813
Nepheline syenite:						
Imports for consumption	metric tons	289,000	335,000	289,000	333,000	316,000
Value	thousands	$13,100	$14,700	$15,400	$18,700	$19,700
Consumption, apparent 3/ (feldspar plus nepheline syenite)	thousand metric tons	878	1,060	1,050	1,090	1,190
World: Production (feldspar)	do.	5,670 r/	6,200 r/	6,070 r/	5,970 r/	6,110 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
1994	384	16,400	381	14,800	765	31,200
1995	397	17,400	485	20,000	880	37,400

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 1995

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.
PW Gillibrand Co.	Simi Valley, CA	Do.
KMG Minerals, Inc.	Kings Mountain, NC	Potash feldspar.
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)

	1994		1995	
Use	Quantity	Value	Quantity	Value
Flotation concentrate:				
Glass	128	6,430	132	7,000
Pottery	243	14,900	230	14,700
Total	371	21,300	362	21,700
Other: 3/				
Glass	341	16,800	440	20,000
Pottery	W	W	W	W
Miscellaneous	W	W	W	W
Total	379	20,000	473	24,200
Total:				
Glass 4/	469	23,200	572	27,000
Pottery	W	W	W	W
Miscellaneous	W	W	W	W
Total	750	41,300	835	45,900

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 and glass fiber.

TABLE 5
PRICES FOR FELDSPAR IN 1995

(Dollars per metric ton, bulk, ex-works, USA)

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

Source: Industrial Minerals (London), No. 339, Dec. 1995, p. 64.

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

	1994		1995	
Country	Quantity (metric tons)	Value	Quantity (metric tons)	Value
Canada	1,630	$203,000	1,780	$240,000
Italy	510	108,000	3,780	564,000
Mexico	11,800	973,000	7,980	870,000
Taiwan	1,810	239,000	217	63,800
Thailand	654	138,000	343	63,200
Other	888	275,000	546	161,000
Total	17,300	1,940,000	14,700	1,970,000

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	1994 Quantity (metric tons)	1994 Value 2/	1995 Quantity (metric tons)	1995 Value 2/
Mexico	7,210	$468,000	8,490	$642,000
Other	141	45,700	488	171,000
Total	7,360	513,000	8,980	813,000

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

Source: Bureau of the Census.

TABLE 8
WORLD FELDSPAR ANNUAL PRODUCTION CAPACITY, DECEMBER 31, 1995 1/ 2/

(Thousand metric tons)

	Rated capacity
North America:	
Mexico	160
United States	880
Total	1,040
South America:	
Argentina	55
Brazil	145
Colombia	78
Venezuela e/	325
Other	41
Total	644
Europe:	
Finland	53
France e/	400
Germany e/	404
Italy	1,690
Norway e/	100
Poland	43
Portugal	99
Romania	87
Russia e/	100
Spain	247
Uzbekistan e/	80
Other	78
Total	3,380
Africa:	
South Africa	70
Other	51
Total	121
Asia and Oceania:	
India	67
Iran	76
Japan	88
Korea, Republic of	322
Thailand	703
Turkey	465
Other	104
Total	1,830
World total	7,010

e/ Estimated.
1/ Includes capacities of operating plants as well as plants on standby basis.
2/ Data are rounded to three significant digits; may not add to totals shown.

TABLE 9
FELDSPAR: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country 3/	1991	1992	1993	1994	1995 e/
Algeria	4,500	4,650	6,500	6,000 e/	6,000
Argentina	42,300	48,500	55,800	50,000 e/	45,000
Australia e/	16,000	15,000	15,000	16,000	16,000
Austria	10,400	11,100	8,490	4,880 r/ e/	5,000
Brazil	119,000	140,000	145,000	145,000 e/	145,000
Burma 4/	3,740	1,620	6,290	6,980 r/	7,000
Chile	4,010	5,740	4,150	9,970 r/	10,000
Colombia	45,600	78,400	60,500	70,000 e/	70,000
Ecuador	5,010	3,250	3,300 e/	8,200 r/ e/	10,000
Egypt	32,600	32,300 r/	38,900 e/	39,700 r/	39,800
Finland	53,300 r/	47,500	51,500	51,500 e/	50,000
France e/	400,000	282,000	274,000	300,000	300,000
Germany e/	404,000	385,000	360,000	350,000	350,000
Guatemala	6,960	8,050	7,500 e/	7,600 e/	7,700
India	65,100	67,700	66,800 r/	65,000 r/	65,000
Iran	64,800	52,100	76,900 r/	75,000 r/ e/	75,000
Italy	1,300,000	1,690,000	1,550,000 r/ e/	1,600,000 e/	1,600,000
Japan 5/	88,500	72,300	71,600	56,000 r/	57,000
Kenya e/	1,200	1,200	1,200	1,200	1,200
Korea, Republic of	248,000	281,000 r/	322,000 r/	320,000 r/	320,000
Macedonia e/	XX	20,000	15,000	15,000	15,000
Mexico	152,000	160,000	124,000	130,000 e/	140,000
Morocco e/	1,000	1,000	1,000	1,000	1,000
Nigeria e/	700	700	700	700	700
Norway e/ 6/	90,000	100,000	100,000	100,000	100,000
Pakistan	10,200	19,200	17,000	17,000 e/	15,000
Peru	3,000	10,000	10,000 e/	10,000 e/	10,000
Philippines	48,000	45,000 e/	24,200	30,000 e/	30,000
Poland	24,000 r/	34,000	43,000 r/	35,000 e/	35,000
Portugal	93,000 r/ e/	99,600 r/	90,500 r/	90,000 r/ e/	90,000
Romania	40,000 e/	27,700	87,700	10,400 r/	10,000
Russia e/	XX	100,000	70,000	55,000	55,000
Serbia and Montenegro	XX	5,110	2,680	3,240 r/	3,200
South Africa	70,300	49,400	43,400 r/	37,200 r/	40,000
Spain 7/	214,000 r/	247,000 r/	239,000	225,000 r/ e/	225,000
Sri Lanka	9,910	7,520	8,000 e/	12,300 r/	12,000
Sweden	32,900	34,600	30,000	30,000 e/	30,000
Taiwan	1,340	2,220	1,720 r/	778 r/	800
Thailand	703,000	560,000	601,000	600,000 e/	590,000
Turkey	235,000 r/	465,000	366,000 r/	400,000 r/ e/	400,000
U.S.S.R. e/ 8/	250,000	XX	XX	XX	XX
United Kingdom (china stone)	6,420	8,240	6,960 r/	7,000 e/	6,500
United States	580,000	725,000	770,000	765,000	880,000 9/
Uruguay e/	3,000	3,000	3,000	3,000	3,000
Uzbekistan e/	XX	80,000	70,000	70,000	70,000
Venezuela	138,000	169,000	220,000	137,000 r/	170,000 9/
Yugoslavia 10/	40,000	XX	XX	XX	XX
Zambia e/	70	113 9/	100	100	100
Zimbabwe	3,820	2,700	1,550	1,620 r/ e/	1,700
Total	5,670,000 r/	6,200,000 r/	6,070,000 r/	5,970,000 r/	6,110,000

e/ Estimated. r/ Revised. XX Not applicable.

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

2/ Table includes data available through May 20, 1996.

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 Apr. 1 of that stated.

5/ In addition, the following quantities of aplite ore were produced in metric tons: 1991--500,000; 1992--416,000; 1993--404,000; 1994--381,000 (revised); and 1995--380,000 (estimated).

6/ Excludes nepheline syenite.

7/ Includes pegmatite.

8/ Dissolved in Dec. 1991; however, information for 1992-94 is inadequate to formulate reliable estimates for individual countries other than those listed in this table.

9/ Reported figure.

10/ Dissolved in Apr. 1992.

TABLE 10
U.S. IMPORTS FOR CONSUMPTION OF NEPHELINE SYENITE 1/ 2/

Year	Quantity (metric tons)	Value 3/ (thousands)
1994	333,000	$18,700
1995	316,000	19,700

1/ Crude and ground combined.
2/ Data are rounded to three significant digits.
3/ Customs value.

Source: Bureau of the Census.