

KYANITE AND RELATED MINERALS

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: One firm in Virginia with integrated mining and processing operations produced kyanite from two hard-rock open pit mines and mullite by calcining kyanite. Another company produced synthetic mullite in Georgia from materials mined from two domestic sites, one in Alabama and the other in Georgia. Commercially produced mullite is synthetic, made by sintering or fusing such feedstock materials as kyanite or bauxitic kaolin. Natural mullite occurrences typically are rare and uneconomic to mine. Of the kyanite-mullite output, 90% was estimated to have been used in refractories and 10% in other uses. An estimated 60% to 65% of the refractory usage, was used by the iron and steel industries and the remainder was used by industries that manufacture chemicals, glass, nonferrous metals, and other materials. Andalusite was commercially mined in North Carolina as part of a mineral mixture of high-purity silica and alumina for use in a variety of refractory mineral products for the foundry and ceramics industries.

Salient Statistics—United States:	2009	2010	2011	2012	2013^e
Production:					
Mine ¹	71	93	98	99	95
Synthetic mullite ^e	40	40	40	40	40
Imports for consumption (andalusite)	5	2	5	3	6
Exports	26	38	38	36	37
Consumption, apparent ^e	90	97	105	105	104
Price, average, dollars per metric ton: ²					
U.S. kyanite, raw concentrate	283	283	300	300	310
U.S. kyanite, calcined	422	422	448	448	450
Andalusite, Transvaal, South Africa	352	336	335	340	350
Employment, kyanite mine, office, and plant, number ^e	110	115	120	115	120
Employment, mullite plant, office, and plant, number ^e	170	180	190	180	180
Net import reliance ³ as a percentage of apparent consumption	E	E	E	E	E

Recycling: Insignificant.

Import Sources (2009–12): South Africa, 81%; France, 8%; Peru, 7%; and other, 4%.

Tariff: Item	Number	Normal Trade Relations 12–31–13
Andalusite, kyanite, and sillimanite	2508.50.0000	Free.
Mullite	2508.60.0000	Free.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: None.

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Events, Trends, and Issues: Crude steel production in the United States, which ranked third in the world in steel production, decreased by 4% in the first 9 months of 2013 compared with that of the same period in 2012, potentially indicating a future decrease in consumption for kyanite-mullite refractories if the trend continues. Mostly the result of increases in steel production in Asia, total world steel production rose 2.9% during the first 9 months of 2013 compared with the same period in 2012. Of the total world refractories market, estimated to be approximately 40 million tons, crude steel manufacturing consumed up to 70% of refractories production.

Less-than-expected increases in world steel production during 2013 was, in part, the result of a sluggish economy in Western Europe and slower-than-expected economic growth in Eastern Europe and the United States. With steel production expanding in Asia, andalusite and mullite could receive increasing consideration as alternative aluminosilicate refractory minerals to refractory bauxite owing to a continuing lack of readily available, inexpensive refractory-grade bauxite from China, which accounted for about three-quarters of market share worldwide.

China is expected to continue to be the largest market for refractories, comprising the majority of global demand. Above-average growth is expected in India. Eastern Europe, North America, and Western Europe are expected to continue to have significant refractory demand because of their large industrial bases, with Eastern Europe having the highest growth of these regions, reflecting the area's expanding industrialization. North America and Western Europe are expected to have slower growth in the near term, showing continued recovery in manufacturing and steel production, but in the longer term, growth may lag behind the worldwide average with steel production shifting to less-developed areas. Demand for refractories in iron and steel production is expected to have the greatest increases in countries with higher rates of increase in steel production. Increased demand also is anticipated for refractories used to produce other metals and in the industrial mineral market because of increasing production of cement, ceramics, glass, and other mineral products.

A research group found that using mullite as a catalyst in place of platinum in diesel engines could reduce nitric oxide and nitrogen-dioxide pollutants by up to 45% more than using a platinum catalyst. A mullite alternative product was undergoing commercialization; the group explored other applications for mullite, such as in fuel cells.

World Mine Production and Reserves:

	Mine production		Reserves ⁴
	2012	2013 ^e	
United States ^e	99	95	Large
France	65	65	NA
India	44	50	1,600
South Africa	200	220	NA
Other countries	1	5	NA
World total (rounded)	408	440	NA

World Resources: Large resources of kyanite and related minerals are known to exist in the United States. The chief resources are in deposits of micaceous schist and gneiss, mostly in the Appalachian Mountains and in Idaho. Other resources are in aluminous gneiss in southern California. These resources are not economical to mine at present. The characteristics of kyanite resources in the rest of the world are thought to be similar to those in the United States.

Substitutes: Two types of synthetic mullite (fused and sintered), superduty fire clays, and high-alumina materials are substitutes for kyanite in refractories. Principal raw materials for synthetic mullite are bauxite, kaolin and other clays, and silica sand.

^eEstimated. E Net exporter. NA Not available.

¹Source: Virginia Department of Mines, Minerals and Energy.

²Source: Average of prices reported in Industrial Minerals.

³Defined as imports – exports.

⁴[See Appendix C for resource/reserve definitions and information concerning data sources.](#)