

## GRAPHITE (NATURAL)

(Data in thousand metric tons unless otherwise noted)

**Domestic Production and Use:** Although natural graphite was not produced in the United States in 2013, approximately 90 U.S. firms, primarily in the Northeastern and Great Lakes regions, used it for a wide variety of applications. The major uses of natural graphite in 2013 were, in decreasing order by tonnage, refractory applications, steelmaking, brake linings, foundry operations, batteries, and lubricants. These uses consumed 70% of the total natural graphite used during 2013.

<b>Salient Statistics—United States:</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013<sup>e</sup></b>
Production, mine	—	—	—	—	—
Imports for consumption	33	65	72	57	60
Exports	11	6	6	6	8
Consumption, apparent <sup>1</sup>	22	60	66	50	51
Price, imports (average dollars per ton at foreign ports):					
Flake	694	720	1,180	1,370	1,360
Lump and chip (Sri Lankan)	1,410	1,700	1,820	1,960	1,720
Amorphous	249	257	301	339	433
Net import reliance <sup>1</sup> as a percentage of apparent consumption	100	100	100	100	100

**Recycling:** Refractory brick and linings, alumina-graphite refractories for continuous metal castings, magnesia-graphite refractory brick for basic oxygen and electric arc furnaces, and insulation brick led the way in recycling of graphite products. The market for recycled refractory graphite material is growing, with material being recycled into products such as brake linings and thermal insulation.

Recovering high-quality flake graphite from steelmaking kish is technically feasible, but not practiced at the present time. The abundance of graphite in the world market inhibits increased recycling efforts. Information on the quantity and value of recycled graphite is not available.

**Import Sources (2009–12):** China, 48%; Mexico, 25%; Canada, 17%; Brazil, 6%; and other, 4%.

<b>Tariff:</b>	<b>Item</b>	<b>Number</b>	<b>Normal Trade Relations 12–31–13</b>
	Crystalline flake (not including flake dust)	2504.10.1000	Free.
	Powder	2504.10.5000	Free.
	Other	2504.90.0000	Free.

**Depletion Allowance:** 22% (Domestic lump and amorphous), 14% (Domestic flake), and 14% (Foreign).

**Government Stockpile:** None.

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**Events, Trends, and Issues:** Worldwide demand for graphite steadily increased throughout 2012 and into 2013. This increase resulted from the improvement of global economic conditions and its impact on industries that use graphite. Principal import sources of natural graphite were, in descending order of tonnage, China, Mexico, Canada, Brazil, and Madagascar, which combined accounted for 97% of the tonnage and 90% of the value of total imports. Mexico and Vietnam provided all the amorphous graphite, and Sri Lanka provided all the lump and chippy dust variety. China, Canada, and Madagascar were, in descending order of tonnage, the major suppliers of crystalline flake and flake dust graphite.

During 2013, China produced the majority of the world's graphite. Graphite production increased in China, Madagascar, and Sri Lanka from that of 2012, while production decreased in Brazil from 2012 production levels.

Advances in thermal technology and acid-leaching techniques that enable the production of higher purity graphite powders are likely to lead to development of new applications for graphite in high-technology fields. Such innovative refining techniques have enabled the use of improved graphite in carbon-graphite composites, electronics, foils, friction materials, and special lubricant applications. Flexible graphite product lines, such as graphoil (a thin graphite cloth), are likely to be the fastest growing market. Large-scale fuel-cell applications are being developed that could consume as much graphite as all other uses combined.

**World Mine Production and Reserves:** The reserve data for Brazil were revised based on information reported by Associação Brasileira do Alumínio, 2012–2013; Instituto Brasileiro de Mineração, 2012–2013; and Summário Mineral 2011–2012.

	Mine production		Reserves <sup>2</sup>
	2012	2013 <sup>e</sup>	
United States	—	—	—
Brazil	110	105	58,000
Canada	25	25	( <sup>3</sup> )
China	800	810	55,000
India	160	160	11,000
Korea, North	30	30	( <sup>3</sup> )
Madagascar	4	10	940
Mexico	8	8	3,100
Norway	2	2	( <sup>3</sup> )
Russia	14	14	( <sup>3</sup> )
Sri Lanka	4	5	( <sup>3</sup> )
Turkey	5	5	( <sup>3</sup> )
Ukraine	6	6	( <sup>3</sup> )
Zimbabwe	6	6	( <sup>3</sup> )
Other countries	2	2	( <sup>3</sup> )
World total (rounded)	1,170	1,190	130,000

**World Resources:** Domestic resources of graphite are relatively small, but the rest of the world's inferred resources exceed 800 million tons of recoverable graphite.

**Substitutes:** Manufactured graphite powder, scrap from discarded machined shapes, and calcined petroleum coke compete for use in iron and steel production. Finely ground coke with olivine is a potential competitor in foundry facing applications. Molybdenum disulfide competes as a dry lubricant but is more sensitive to oxidizing conditions.

<sup>e</sup>Estimated. — Zero.

<sup>1</sup>Defined as imports – exports.

<sup>2</sup>See Appendix C for resource/reserve definitions and information concerning data sources.

<sup>3</sup>Included with "World total."