## **GRAPHITE (NATURAL)**

(Data in thousand metric tons, unless otherwise noted)

<u>Domestic Production and Use</u>: Although natural graphite was not produced in the United States in 2002, approximately 200 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 remained the same as in 2000: refractory applications led the way in use categories with 22%; brake linings was second with 21%; dressings and molds in foundry operations, 8%; lubricants, 5%; and other uses made up the remaining 44%.

Salient Statistics—United States:	<u>1998</u>	<u> 1999</u>	<u>2000</u>	<u>2001</u>	2002 <sup>e</sup>
Production, mine	_	_	_		_
Imports for consumption	62	56	61	52	50
Exports	28	29	22	24	23
Consumption, apparent	34	26	39	28	27
Price, imports (average dollars per ton at foreign ports):					
Flake	514	540	550	560	560
Lump and chip (Sri Lankan)	1,200	1,100	1,150	1,200	1,100
Amorphous (Mexican)	192	225	230	230	240
Stocks, yearend	NA	NA	NA	NA	NA
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. Primary recycling of refractory articles is growing with the recycling market being principally in less demanding service conditions, such as brake linings and thermal insulation.

Past research has established the technical feasibility of recovering high-quality flake graphite from steelmaking kish.<sup>2</sup> Abundance of graphite in the world market and continuing low prices, however, inhibit increased recycling efforts. Information on the quantity and value of recycled graphite is not available.

Import Sources (1998-2001): China, 30%; Mexico, 27%; Canada, 18%; Brazil, 6%; and other, 19%.

Tariff: Item	Number	Normal Trade Relations 12/31/02
Crystalline flake (not including flake dust)	2504.10.1000	Free.
Other	2504.90.0000	Free.

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

## **Government Stockpile:**

## Stockpile Status—9-30-02<sup>3</sup>

	Uncommitted	Committed	Authorized	Disposal plan	Disposals
Material	inventory	inventory	for disposal	FY 2002	FY 2002
Sri Lanka, amorphous lump	1.70	_	1.70	3.76	1.68
Madagascar, crystalline flake	1.98	_	1.98	_	2.13

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Events, Trends, and Issues: Graphite was near supply-demand balance in 2002. Imports of flake from Canada, China, Madagascar, and Mexico; lump and chip from Sri Lanka; and amorphous graphite from China and Mexico generally met demand. There has been a marked decrease in the consumption of graphite electrodes, owing to development of more efficient iron and steel production techniques during the late 1980s. Use of natural graphite in lubrication applications is also decreasing because of changes in requirements for lubricants and in processing technologies. 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 already 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), will probably be the fastest growing market. Large-scale fuel cell applications currently under development could consume as much graphite as all other uses combined.

World Mine Production, Reserves, and Reserve Base: Mine production for Brazil and China have been revised upward, while production for India, Madagascar, and Mexico were revised downward based on new information from those countries. Reserves and reserve base estimates for China and India also have been revised based on new information.

	Mine production		Reserves⁴	Reserve base <sup>4</sup>
	<u>2001</u>	2002 <sup>e</sup>		
United States	_	_	_	1,000
Brazil	72	70	360	1,000
Canada	25	25	_	_
China	450	430	64,000	220,000
India	140	130	800	3,800
Madagascar	2	13	940	960
Mexico	21	20	3,100	3,100
Other countries	<u>116</u>	<u>120</u>	<u>5,100</u>	44,000
World total (may be rounded)	826	810	74,000	270,000

<u>World Resources</u>: Domestic resources are relatively small, but the rest of the world's inferred reserve base exceeds 800 million tons of recoverable graphite.

<u>Substitutes</u>: 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>&</sup>lt;sup>e</sup>Estimated. NA Not available. — Zero.

<sup>&</sup>lt;sup>1</sup>Defined as imports - exports + adjustments for Government and industry stock changes. Data on changes in stocks were not available and were assumed to be zero in the calculations.

<sup>&</sup>lt;sup>2</sup>Laverty, P.D., Nicks, L.J., and Walters, L.A.,1994, Recovery of flake graphite from steelmaking kish: U.S. Bureau of Mines Report of Investigations 9512, 23 p.

<sup>&</sup>lt;sup>3</sup>See Appendix B for definitions.

<sup>&</sup>lt;sup>4</sup>See Appendix C for definitions.