

GRAPHITE (NATURAL)

(Data in thousand metric tons, unless otherwise noted)

World Production and Use: Although natural graphite was not produced domestically in 2000, it was consumed by approximately 200 firms primarily in the Northeastern and Great Lakes regions. The major uses of natural graphite remained the same as those of 1999 as refractory applications led the way in use categories with 44%; brake linings was second with 19%; lubricants 5%, dressings and molds in foundry operations, 4%; and other uses making up the remaining 28%.

Salient Statistics—United States:	1996	1997	1998	1999	2000^e
Production, mine	—	—	—	—	—
Imports for consumption	53	58	62	56	58
Exports	26	40	28	29	30
Consumption, apparent	27	18	34	26	28
Price, imports (average dollars per ton at foreign ports):					
Flake	699	622	514	540	550
Lump and chip (Sri Lankan)	675	1,010	1,200	1100	1150
Amorphous (Mexican)	134	153	192	225	230
Stocks, yearend	NA	NA	NA	NA	NA
Net import reliance ¹ as a percent 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 in particular led the way in recycling of graphite products. Primary recycling of refractory articles is growing with the recycled market being principally in less demanding service conditions, such as safety linings and thermal insulation.

Recent research on the technical feasibility of recovering high-quality flake graphite from steelmaking kish, by the former Bureau of Mines research staff, may further boost graphite recycling efforts.⁵ The current (2000) low prices, however, stand in the way of increased recycling efforts. Information on the quantity and monetary value of recycled graphite is not available.

Import Sources (1996-99): China, 33%; Mexico, 23%; Canada, 22%; Brazil 9%; and other, 13%.

Tariff:	Item	Number	Normal Trade Relations 12/31/00
	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—9-30-00²

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2000	Disposals FY 2000
Sri Lanka, amorphous lump	4.84	—	4.84	3.42	3.42
Madagascar, crystalline flake	3.85	5.50	3.85	—	3.35

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Events, Trends, and Issues: Graphite was near to supply-demand balance in 2000. Demand was met largely by imports of flake from Canada, China, and Madagascar; lump and chip from Sri Lanka; and amorphous graphite from China and Mexico. Graphite electrode consumption in steelmaking has been decreasing since the late 1980's because of increased efficiency by the iron and steel producers. Use of natural graphite in lubrication applications is also decreasing because of changes in requirements for lubricant compositions and in processing technologies. Advances in graphite thermal technology and acid-leaching techniques, which enable the production of higher purity graphite powders, will find new application areas in high-technology fields for graphite. Such innovative refining techniques have enabled the use of improved graphite in friction materials, electronics, foils, and special lubrication applications.⁶ Flexible graphite product lines, such as graphoil (a thin graphite cloth), will probably be the fastest growing market. Industry trends, common to advances in graphite technology and market, include higher purity and consistency in specifications for high-tech applications. Production of higher purity graphite, using newly developed thermal processing techniques, for such applications as advanced carbon-graphite composites will continue to be the trend.

World Mine Production, Reserves, and Reserve Base:

	Mine production		Reserves ⁴	Reserve base ⁴
	1999	2000 ^e		
United States	—	—	—	1,000
Brazil	60	65	360	1,000
China	280	300	4,800	310,000
India	145	150	360	620
Madagascar	12	15	940	960
Mexico	44	45	3,100	3,100
Other countries	<u>143</u>	<u>145</u>	<u>5,100</u>	<u>44,000</u>
World total (may be rounded)	685	720	15,000	360,000

World Resources: Domestic resources are relatively small, but the rest of the world's inferred reserve base exceeds 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 operations. Molybdenum disulfide competes as a dry lubricant but is more sensitive to oxidizing conditions.

^eEstimated. NA Not available.

¹Defined 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.

²See Appendix B for definitions.

³Less than ½ unit.

⁴See Appendix C for definitions.

⁵Laverty, 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.

⁶Hand, G.P., 1997, Outlook for graphite and graphite technology: Mining Engineering, v. 49, no. 2, February, p. 34-36.