

GRAPHITE (NATURAL)

(Data in thousand metric tons, unless otherwise noted)

Domestic Production and Use: Although natural graphite was not produced domestically in 2001, 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 those of 2000: Refractory applications led the way in use categories with 45%; brake linings was second with 20%; lubricants, 5%, dressings and molds in foundry operations, 5%; and other uses making up the remaining 25%.

Salient Statistics—United States:	1997	1998	1999	2000	2001^e
Production, mine	—	—	—	—	—
Imports for consumption	58	62	56	61	60
Exports	40	28	29	22	25
Consumption, apparent	18	34	26	39	35
Price, imports (average dollars per ton at foreign ports):					
Flake	622	514	540	550	560
Lump and chip (Sri Lankan)	1,010	1,200	1,100	1,150	1,200
Amorphous (Mexican)	153	192	225	230	230
Stocks, yearend	NA	NA	NA	NA	NA
Net import reliance ¹ 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 in particular 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 on the technical feasibility of recovering high-quality flake graphite from steelmaking kish may further boost graphite recycling efforts under favorable economic conditions.² 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 (1997-2000): China, 33%; Mexico, 23%; Canada, 22%; Brazil, 9%; and other, 13%.

Tariff:	Item	Number	Normal Trade Relations 12/31/01
	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—9-30-01³

Material	Uncommitted inventory	Committed inventory	Authorized for disposal	Disposal plan FY 2001	Disposals FY 2001
Sri Lanka, amorphous lump	1.60	—	1.60	3.75	3.30
Madagascar, crystalline flake	3.90	—	3.90	—	0.13

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Events, Trends, and Issues: Graphite was near supply-demand balance in 2001. 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 develop new applications for graphite in high-technology fields. Such innovative refining techniques already have enabled the use of improved graphite in friction materials, electronics, foils, and special lubricant applications.⁴ Flexible graphite product lines, such as graphoil (a thin graphite cloth), will probably be the fastest growing market. Production of higher purity graphite, using newly developed thermal processing techniques, for such applications as advanced carbon-graphite composites are expected to open new applications for graphite. 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		Reserves ⁵	Reserve base ⁵
	2000	2001 ^e		
United States	—	—	—	1,000
Brazil	12	70	360	1,000
Canada	25	25	—	—
China	220	250	4,800	310,000
India	140	150	800	2,000
Madagascar	13	15	940	960
Mexico	30	35	3,100	3,100
Other countries	<u>131</u>	<u>130</u>	<u>5,100</u>	<u>44,000</u>
World total (may be rounded)	571	675	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 applications. Molybdenum disulfide competes as a dry lubricant but is more sensitive to oxidizing conditions.

^eEstimated. NA Not available. — Zero.

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.

²Lavery, 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.

³See Appendix B for definitions.

⁴Hand, G.P., 1997, Outlook for graphite and graphite technology: Mining Engineering, v. 49, no. 2, February, p. 34-36.

⁵See Appendix C for definitions.