

## IRON AND STEEL SLAG

(Data in million metric tons unless otherwise noted)

**Domestic Production and Use:** Ferrous slags are marketable coproducts of iron- and steelmaking. Actual production data are unavailable, but may be estimated as being in the range of 20 to 25 million tons. In 2007, at least 20.0 million tons of domestic iron and steel slag, valued at about \$400 million<sup>1</sup> (f.o.b.), was sold. Iron or blast furnace slag accounted for about 60% of the tonnage sold and had a value of about \$380 million; about 90% of this value was granulated slag. Steel slag produced from basic oxygen and electric arc furnaces accounted for the remainder.<sup>2</sup> Slag processing was by about 30 companies servicing active iron and/or steel facilities or reprocessing old slag piles: iron slag at about 40 sites in 14 States and steel slag at about 100 sites in 30 States. Included in these data are about a dozen facilities that grind and sell ground granulated blast furnace slag (GGBFS) based on imported unground feed.

The prices listed in the table below are the weighted average for a variety of ferrous slag types. Actual prices per ton ranged widely in 2007 from about \$0.50 for steel slags in areas having abundant natural aggregates to nearly \$95 for some GGBFS. The major uses of air-cooled iron slag and for steel slag are as aggregates for asphaltic paving, fill, and road bases, and as a feed for cement kilns; air-cooled slag also is used as an aggregate for concrete. In contrast, almost all GGBFS is used as a partial substitute for portland cement in concrete mixes and in blended cements. Owing to their low unit values, most slag types are shipped by truck over short distances only (rail and waterborne transportation can be longer). Because of its much higher unit value, GGBFS can be shipped economically over longer distances.

<b>Salient Statistics—United States:</b> <sup>3</sup>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007<sup>e</sup></b>
Production, marketed <sup>1, 4</sup>	19.7	21.2	21.6	20.3	20.0
Imports for consumption <sup>5</sup>	1.1	1.0	1.6	1.6	1.5
Exports	0.1	0.1	(6)	0.1	0.1
Consumption, apparent <sup>5, 7</sup>	19.7	21.1	21.6	20.2	19.9
Price average value, dollars per ton, f.o.b. plant	15.00	15.50	17.60	20.00	20.00
Stocks, yearend	NA	NA	NA	NA	NA
Employment, number <sup>e</sup>	2,700	2,700	2,600	2,500	2,500
Net import reliance <sup>8</sup> as a percentage of apparent consumption	5	4	7	8	7

**Recycling:** Some slags are returned to the blast and steel furnaces as ferrous and flux feed. Entrained metal, particularly in steel slag, is routinely recovered during slag processing for return to the furnaces. However, data for such furnace-feed uses are unavailable.

**Import Sources (2003-06):** Year-to-year import data for ferrous slags show that the dominant form is granulated blast furnace slag (mostly unground), but show significant variations in both tonnage and unit value. Many past data contain discrepancies; and the official data in recent years appear to significantly underreport (by nearly 2 million tons per year) imports of granulated blast furnace slag. Principal sources for 2003-06 were Canada, 47%; Italy, 20%, France, 16%; Japan, 10%; and other, 7%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations 12-31-07</b>
Granulated slag	2618.00.0000	Free.
Slag, dross, scale, from manufacture of iron and steel	2619.00.3000	Free.

**Depletion Allowance:** Not applicable.

**Government Stockpile:** None.

## IRON AND STEEL SLAG

**Events, Trends, and Issues:** Domestic supplies of air-cooled blast furnace slag have been declining in recent years because of the depletion of old slag piles and the closure of many blast furnaces for economic and/or environmental reasons. No new blast furnaces are under construction or are planned. Steel slag from integrated iron and steel works also is in decline, but slag from electric arc furnaces (largely fed with steel scrap) remains abundant. Both of these slag types compete with natural aggregates. For performance and environmental reasons, demand is growing for GGBFS in concrete, although the demand is subject to fluctuations related to public sector construction funding levels. The high unit sales prices for GGBFS relative to other slag types has led to the addition of granulation cooling at two domestic blast furnaces in recent years, and other blast furnaces are currently being evaluated as candidates for this type of cooling. An incentive in this regard is the replacement of granulation capacity lost as a result of the likely permanent idling of one granulator-equipped blast furnace in 2005. Absent new granulators, growth in demand for granulated slag will have to be met through imports and this likely will result in additional domestic grinding facilities being built to process the material. Pelletized blast furnace slag, used mainly as a lightweight aggregate, remains in limited supply, but it is unclear if any additional pelletizing capacity is being planned.

**World Mine Production, Reserves, and Reserve Base:** Slag is not a mined material and thus the concept of reserves does not apply to this commodity. Slag production data for the world are unavailable, but it is estimated that annual world iron slag output is on the order of 220 to 280 million tons, and steel slag about 130 to 200 million tons, based on typical ratios of slag to crude iron and steel output.

**World Resources:** Not applicable.

**Substitutes:** Slag competes with crushed stone and sand and gravel as aggregates in the construction sector. Fly ash, certain rock types, and silica fume, are common alternatives to GGBFS as cementitious additives in blended cements and concrete. Slags (especially steel slag) can be used as a partial substitute for limestone and some other natural (rock) materials as raw material for cement kilns.

<sup>6</sup>Estimated. NA Not available.

<sup>1</sup>The data (obtained from an annual survey of slag processors) pertain to the quantities of processed slag sold rather than that processed or produced during the year. The data exclude any entrained metal that may be recovered during slag processing and returned to iron and, especially, steel furnaces, or any slag itself returned to the furnaces. Data for such recovered metal and returned slag were unavailable.

<sup>2</sup>There were very minor sales of open hearth furnace steel slag from stockpiles but no domestic production of this slag type in 2003-07.

<sup>3</sup>Owing to inclusion of more complete information (especially for granulated slag), data in 2003-07 are not strictly comparable to those of recent years prior to 2002.

<sup>4</sup>Data include sales of imported granulated blast furnace slag, either after domestic grinding or still unground, and exclude sales of pelletized slag (proprietary but very small). Overall, actual production of blast furnace slag may be estimated as equivalent to 25% to 30% of crude (pig) iron production and steel furnace slag as about 10% to 15% of crude steel output.

<sup>5</sup>Comparison of official (U.S. Census Bureau) with unofficial import data suggest that the official data understate the true imports of granulated slag by nearly 2 million tons per year. Of these apparently missing imports, the USGS canvass appears to capture only about 0.6 million tons within its sales data. Thus the apparent consumption statistics are likely too low by about 1.0 to 1.3 million tons per year.

<sup>6</sup>Less than ½ unit.

<sup>7</sup>Defined as total sales of slag (includes that from imported feed) – exports. Calculation is based on unrounded original data.

<sup>8</sup>Defined as total sales of imported slag – exports of slag. Data are not available to allow adjustments for changes in stocks.