

## IRON AND STEEL SLAG

(Data in million metric tons unless otherwise noted)

**Domestic Production and Use:** Iron and steel slags are coproducts of iron- and steelmaking. Data on U.S. slag production are unavailable but output is estimated as having declined by nearly one-half to a range of 8 to 12 million tons in 2009, as a result of numerous idlings of steel plants during the year. Slag sales are estimated to have declined less severely, based on their being largely from stockpiles. An estimated 13 million tons of iron and steel slag, valued at nearly \$300 million<sup>1</sup> (f.o.b. plant), was sold during the year. Iron or blast furnace slag accounted for about 60% of the tonnage sold and had a value of about \$260 million; nearly 85% of this value was granulated slag. Steel slag produced from basic oxygen and electric arc furnaces accounted for the remainder.<sup>2</sup> Slag was processed by about 30 companies servicing active iron and/or steel facilities or reprocessing old slag piles; iron slag at about 40 sites in about 14 States and steel slag at about 100 sites in 30 States. Included in these data are a number of 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 2009 from about \$0.20 for steel slags for some applications to more than \$100 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 only over short distances, but 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>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009<sup>e</sup></b>
Production, marketed <sup>1, 3</sup>	21.6	20.3	19.6	18.8	13.0
Imports for consumption <sup>4</sup>	1.6	1.6	1.9	1.3	1.0
Exports	(5)	0.1	0.1	(5)	(5)
Consumption, apparent <sup>4, 6</sup>	21.6	20.2	19.6	18.8	13.0
Price average value, dollars per ton, f.o.b. plant	17.60	20.00	22.00	18.00	23.00
Stocks, yearend	NA	NA	NA	NA	NA
Employment, number <sup>e</sup>	2,600	2,500	2,200	2,100	2,000
Net import reliance <sup>7</sup> as a percentage of apparent consumption	7	8	9	7	8

**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 (2005-08):** 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 imports of granulated blast furnace slag. Principal country sources for 2005-08 were Japan, 36%; Canada, 35%; Italy, 19%; France, 5%; and other, 5%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Normal Trade Relations 12-31-09</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.

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**Events, Trends, and Issues:** Depletion of old slag piles and the closure of many blast furnaces have led to a steady decline in the availability of air-cooled blast furnace slag in recent years, and especially in 2008-09. No new blast furnaces are under construction or are planned. Granulation cooling is currently installed at only four active blast furnaces, but others are under evaluation as candidates for this type of cooling, contingent on the furnaces remaining active. 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. Steel slag from integrated iron and steel works is in significant decline, owing to the idling of several plants and an increasing trend of returning slag to the furnaces. Slag from electric arc steel furnaces (largely fed with steel scrap) remains abundant. Slags compete with natural aggregates in various construction applications but are more geographically restricted than natural aggregates overall. Within the relatively restricted slag markets, slag sales in 2008 declined less than did those for natural aggregates and for cement. In 2009, however, slag sales were estimated to have declined more significantly than those of natural aggregates because of limited slag availability. For performance and environmental reasons, demand has been growing for GGBFS as a cementitious ingredient in concrete, and GGBFS prices have generally increased in recent years. Long-term growth in the supply of GGBFS is likely to hinge on imports, either of the ground or unground material.

**World Mine Production and Reserves:** Slag is not a mined material and thus the concept of reserves does not apply to this mineral commodity. Slag production data for the world are unavailable, but it is estimated that annual world iron slag output in 2009 was on the order of 200 to 250 million tons, and steel slag about 110 to 160 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 clinker (cement) manufacture.

<sup>0</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 2005-09.

<sup>3</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>4</sup>Comparison of official (U.S. Census Bureau) with unofficial import data suggest that the official data significantly understate the true imports of granulated slag. Of these apparently missing imports, the USGS canvass appears to capture only about 30% within its sales data. Thus the apparent consumption statistics are likely too low by about 0.5 to 1.3 million tons per year.

<sup>5</sup>Less than ½ unit.

<sup>6</sup>Defined as total sales of slag (includes that from imported feed) minus exports. Calculation is based on unrounded original data.

<sup>7</sup>Defined as total sales of imported slag minus exports of slag. Data are not available to allow adjustments for changes in stocks.