

IRON AND STEEL SLAG

(Data in million metric tons unless otherwise noted)

Domestic Production and Use: Ferrous slags are produced during iron- and steelmaking and, after cooling and processing, are sold primarily to the construction industry. Data on U.S. slag production are unavailable, but it is estimated to have been in the range of 18 to 25 million tons in 2013. Domestic slag sales¹ in 2013 amounted to an estimated 17 million tons, valued at about \$290 million (f.o.b. plant). Iron (blast furnace) slag accounted for about 45% of the tonnage sold and had a value of about \$225 million; nearly 85% of this value was from sales of granulated slag. Steel slag produced from basic oxygen and electric arc furnaces accounted for the remainder.² Slag was processed by nearly 30 companies servicing active iron and (or) steel facilities or reprocessing old slag piles at about 120 sites in 32 States; included in this tally 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 weighted, rounded averages for iron and steel slags sold for a variety of applications. Actual prices per ton ranged widely in 2013 from a few cents for some steel slags at a few locations to about \$100 for some GGBFS. Air-cooled iron slag and steel slag are mainly used as aggregates in concrete (air-cooled iron slag only), asphaltic paving, fill, and road bases; both slag types also are used as a feed for cement kilns. Almost all GGBFS is used as a partial substitute for portland cement in concrete mixes or in blended cements. Pelletized slag is generally used for lightweight aggregate but can be ground into material similar to GGBFS. Owing to their low unit values, most slag types can be shipped by truck only over short distances, but rail and waterborne transportation can be longer. The much higher unit value of GGBFS allows this slag to be shipped economically over longer distances.

Salient Statistics—United States:	2009	2010	2011	2012	2013^e
Production, marketed ^{1, 3}	12.5	15.8	15.4	16.1	17.0
Imports for consumption ⁴	1.3	1.4	1.6	1.2	1.3
Exports	(5)	0.1	(5)	(5)	(5)
Consumption, apparent ^{4, 6}	12.5	15.8	15.5	16.2	17.1
Price average value, dollars per ton, f.o.b. plant	19.00	17.00	17.00	17.00	17.00
Employment, number ^e	2,000	2,100	2,000	1,800	1,800
Net import reliance ⁷ as a percentage of apparent consumption	10	8	9	7	8

Recycling: Slag is commonly returned to the blast and steel furnaces as ferrous and flux feed, but data on these returns are incomplete. Entrained metal, particularly in steel slag, is routinely recovered during slag processing for return to the furnaces, but data on metal returns are unavailable.

Import Sources (2009–12): Granulated blast furnace slag (mostly unground) is the dominant type of ferrous slag imported, but official import data include significant tonnages of nonslag materials (such as cenospheres, fly ash, and silica fume) and slags or other residues of various metallurgical industries (such as copper slag) whose unit values are outside the range expected for granulated slag. The official data appear to have underreported the granulated slag imports in some recent years, but likely not in 2011–12. Based on official data, the principal country sources for 2009–12 were Canada, 40%; Japan, 40%; Italy, 7%; South Africa, 6%; and other, 7%.

Tariff: Item	Number	Normal Trade Relations 12–31–13
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: The availability of blast furnace slag is becoming problematic in the United States because of a decline in the number of active U.S. blast furnaces in recent years, the lack of construction of new furnaces, and the depletion of old slag piles. At yearend 2013, granulation cooling was available at only three active blast furnaces. Pelletized blast furnace slag was in very limited supply (one site only), but it was uncertain if any additional pelletizing capacity was being planned. Production of steel slag from basic oxygen and electric arc furnaces increased, but the long-term supply of steel slag was expected to become increasingly reliant on the electric arc furnaces. Where slag availability has not been a problem, slag (as aggregate) sales to the construction sector have sometimes been less volatile than those of natural aggregates or of cement. In contrast, demand for GGBFS has trended more in line with those of cement, but, although increasingly popular as a cementitious additive, sales volumes can be constrained by restricted supply. Sales prices for GGBFS remain lower than those for portland cement; however, the differences have become small owing to significant declines in cement prices in recent years. Recent draft regulations to restrict emissions (especially of mercury) from U.S. cement plants and to potentially reclassify fly ash as a hazardous waste for disposal purposes have the potential to reduce the supply of these cementitious materials to the U.S. market and could lead to an increase in demand for GGBFS. Long-term growth in the supply of GGBFS will mainly depend on imports, either of ground or unground material. However, not all potential exporting countries produce high-quality granulated slag, and for some of them that do, the amount of slag available for export to the United States is limited by the number of operational furnaces and increasing local and international demand for the 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 2013 was on the order of 260 to 320 million tons, and steel slag about 170 to 250 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, natural pozzolans, and silica fume are common alternatives to GGBFS as cementitious additives in blended cements and concrete, and in this respect also compete with portland cement itself. 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. Some other metallurgical slags, such as copper slag, can compete with ferrous slags in some specialty markets but are generally in much more restricted supply than ferrous slags.

⁰Estimated.

¹The 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, and are incomplete regarding slag returns to the furnaces.

²There were very minor sales of open hearth furnace steel slag from stockpiles but no domestic production of this slag type in 2009–13.

³Data 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.

⁴Comparison of official (U.S. Census Bureau) with unofficial import data suggest that the official data may have understated the true imports of granulated slag, at least prior to 2010, by amounts up to about 1 million tons per year. The USGS canvass appears to capture only part of the imported slag.

⁵Less than 0.05 million metric tons.

⁶Although definable as total sales of slag (including those from imported feed) minus exports, apparent consumption of slag does not significantly differ from total sales owing to the very small export tonnages.

⁷Defined as total imports of slag minus exports of slag.