2019 Minerals Yearbook

SLAG—IRON AND STEEL [ADVANCE RELEASE]

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Slag—Iron and Steel

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The quantity of iron and steel slag sold or used in 2019 decreased by 3% to an estimated 16.3 million metric tons (Mt) from 16.8 Mt in 2018. In 2019, the value of slag sold or used decreased by 6% to $416 million (table 1).

Iron and steel slags are silicate melts created by adding agents and fluxes, such as dolomite, lime, limestone, or silica sand, to blast furnaces, steel furnaces, or associated ladles. This process removes impurities from iron ore, crude iron, direct-reduced iron, steel scrap, and other ferrous feeds. Molten slag floats on top of molten crude iron or steel and is tapped from the furnace or ladle separately from the liquid metal. After cooling to solid form, the slag is processed and either sold, stockpiled for eventual sale, or returned to the furnace. Processed slags have much lower unit values than do iron and steel metal; accordingly, the iron and steel companies generally contract with outside slag-processing companies to cool and remove the slag. Typically, the processing company receives the slag for free, cools and crushes the slag, screens and magnetically separates the entrained metal from the slag (which usually is sold back to the furnace operator), sells the slag on the open market, and may pay a small percentage of the sales revenues to the steel company. The value of entrained metal typically exceeds the value of the slag itself. However, some companies return slag to the furnace as a flux and supplemental source of iron; this return flow is not always included in the reported sales tonnages.

A comprehensive listing of slag processors, processing sites, slag types, and steel companies serviced was unavailable for 2019.

Legislation and Government Programs

Most slag is sold to the construction sector and its market is influenced by Federal and State programs that affect construction spending, especially those that allow and encourage the use of "alternative" raw materials in construction or that restrict the use of natural construction materials. Slags can substitute for raw materials in some construction applications, such as substituting for natural stone aggregates in concrete and raw materials in cement manufacture. Ground granulated blast furnace slag (GGBFS) is a supplementary cementitious material (SCM), which can partially substitute for clinker in finished cement or for some of the portland cement in concrete. Substituting slags for raw materials in the manufacture of clinker can reduce fuel consumption and the amount of limestone in the kiln, which can reduce emissions, including carbon dioxide. Use of GGBFS or unground granulated blast furnace slag (GBFS) in the cement plant's finish mill produces more cement from the same amount of clinker.

The National Emissions Standards for Hazardous Air Pollutants (NESHAP), which took effect in September 2015, set very low limits for cement plant emissions of mercury, total hydrocarbons, hydrochloric acid, and particulates (U.S. Environmental Protection Agency, 2015). The NESHAP limits have resulted in some, generally older, cement plants being idled or closed. This reduction in cement capacity has the potential to increase demand for SCMs, such as GGBFS and fly ash.

Production

The amount of slag tapped from a furnace is not routinely measured, and not all slag is tapped in a heat. Thus, data on annual production of slag are usually unavailable. Production of slag can be estimated based on typical slag-to-metal ratios, which are related to the chemistry of the ferrous feeds to the furnace. For typical iron ore grades (60% to 66%), a blast furnace will normally produce 0.25 to 0.30 metric ton (t) of slag per metric ton of crude or pig iron produced. Lower-than-average ore grades will produce more slag, in some cases as much as 1.0 to 1.2 t of slag per metric ton of crude iron. Steel furnaces typically produce about 0.1 to 0.15 t of marketable steel furnace slag (SFS) per metric ton of crude steel. Using these ratios and data for U.S. and world iron and steel production from the World Steel Association (2020, p. 9, 18), domestic blast furnace slag production in 2019 was estimated to be between 5.5 and 6.5 Mt, with world production between 320 to 390 Mt. SFS production by U.S. furnaces was estimated to be 9 to 13 Mt, with world production from 180 to 270 Mt.

The commercial uses of ferrous slag depend on the method by which the slag is cooled. Blast furnace slag (BFS) can be cooled to three main product types—air-cooled, granulated, and pelletized (or expanded). Air-cooled BFS is made by slowly cooling molten slag under ambient conditions and final cooling can be accelerated with a water spray. Air-cooled slag is especially suitable for use as a construction aggregate. GBFS is made by quenching molten slag in water to form sand-sized granules of glass. When finely ground into GGBFS, the glass has moderate cementitious properties. These properties become strong if the GGBFS has access to free lime, such as when it is included in a concrete mix and the portland cement is hydrated. GGBFS concretes are generally slower to develop strength than concretes with only portland cement, but have similar or even superior long-term strength, release less heat during hydration, exhibit improved resistance to chemical attack, and have reduced permeability. Pelletized (expanded) slag is cooled by a water jet, generating steam and developing vesicles, which reduces the slag's overall density and allows for good mechanical binding with hydraulic cement paste. Very finely ground, pelletized slag is commonly used as a lightweight aggregate and can have cementitious properties similar to those of GGBFS. BFS, generally air-cooled, can be made into mineral wool. Mineral wool is made by remelting slag, pouring it through a gaseous stream or passing through a fast-spinning perforated disc to make molten droplets, which elongate into long fibers that are collected and layered and used for thermal insulation.

SFS is cooled similarly to air-cooled BFS, has similar properties to BFS, and is used for some of the same purposes. SFSs, especially those commingled with ladle slags, contain large amounts of dicalcium silicate. SFSs are prone to expansion and are commonly cured in piles for several months to allow for this expansion and for leaching out of lime.

Consumption

The data in this report are based on an annual U.S. Geological Survey (USGS) canvass of slag processors and importers and pertain only to sales of processed slag. Data on pelletized BFS have been withheld to avoid disclosing company proprietary data. Sales for GBFS and GGBFS missed some material sold by a few importers who did not take part in the USGS canvass. Data in table 1 do not include free metal recovered from slag, which was sold separately. Iron and steel slags also are used in environmental applications, such as water filtration, although the data on such uses are incomplete.

Slag sales and production do not correlate in a given year because of several factors, such as imports, returns of slag to the furnace, changes in processing protocols affecting slag marketability, and because slag sales are sometimes from stockpiles, including old slag banks from iron and steel plants long-since closed. In 2019, domestic production of crude iron decreased by 7.5% and that of crude steel increased slightly (World Steel Association, 2020, p. 9, 18). By comparison, sales of BFS decreased 7% and sales of SFS increased slightly (table 1).

Because of transportation costs, long-term sales contracts, restricted geographic availability, and processors stockpiling slag to allow bidding on large contracts, trends in sales volumes for slag can differ from those of competing natural aggregates and those of portland and blended cement. About 80% of total slag sales in 2019 were of air-cooled BFS and SFS (table 1). Both slag types were used mainly as construction aggregates. Because of their low unit values (table 2), these slags generally only competed with natural aggregates in market regions near active iron and steel furnaces or slag banks, which avoided long-distance transportation charges.

Expansion problems with SFS, especially ladle slags or commingled ladle and SFS, reduced its usage for maintenance of a fixed volume, such as ready-mixed concrete. Air-cooled and SFS can be used for the manufacture of clinker for cement, but SFS is most suitable. Changes in slag sales by type of use are difficult to evaluate because of data estimates and consolidation of plant-level data into the dominant use of the slag or into the "Other" category on the USGS canvass, leaving the minor use categories understated. The usage breakouts in table 3 appear to be broadly similar for both years shown.

In 2019, GBFS (reported as GGBFS) sales decreased from 3.4 Mt to 3.2 Mt, accounting for 40% of BFS sales quantity and 19% of total iron and steel slag sales quantity (table 1). GGBFS total value decreased by $25 million to $320 million, accounting for 88% of BFS sales value and 77% of total iron and steel slag sales value. Material consumption data from USGS canvasses of cement producers continued to indicate that the major component of GGBFS sales were to the concrete industry, although this was not distinguished on the USGS slag survey. An alternative source of data for GGBFS sales, under the designation "slag cement," was the Slag Cement Association, whose members accounted for much of the country's GGBFS production and sales. The Slag Cement Association (undated) reported slag cement shipment sales of 3.8 Mt in 2019 excluding the content of GGBFS in blended hydraulic cements and thus was not strictly comparable to the data in table 1.

Prices

As in previous years, many of the 2019 slag canvasses returned to the USGS lacked price data or included only an average price for total tons sold. Accordingly, data in table 2 include many estimates but have been left unrounded to show the range of reported values. Small unit differences of less than $1 per metric ton are likely of no statistical significance, commonly reflecting modest changes in tonnages sold or the amount of detail provided in the use breakouts. The average prices of air-cooled BFS and GGBFS decreased by 7% each and the average price of SFS increased slightly (table 2).

As noted above, air-cooled BFS and SFS have many similar uses, primarily as aggregates. The prices of these two slag types were affected by competition from natural aggregates, level of construction activity, particularly for roads, and long-term supply contracts. Air-cooled BFS and SFS sold for uses other than aggregates could command higher prices than slags sold as aggregates. Pelletized slag, not shown in tables 1–3, could sell for prices well above those for air-cooled slag.

Foreign Trade

Most of the iron and steel slag imported into the United States was GBFS or GGBFS, which are covered under the Harmonized Tariff Schedule of the United States (HTS) code 2618.00.0000. Import data under this HTS code commonly contained entries that are other slags, such as copper slag, or nonslag materials, such as silica fume, fly ash or its cenospheres, other industrial residues, or metal concentrates. Granulated slag imports in 2019, under HTS code 2618.00.0000, were reported to be 2.08 Mt by the U.S. Census Bureau; however, only 1.99 Mt of this appeared to be GBFS or GGBFS, based on unit values. HTS codes 2619.00.3000 and 2619.00.9000 include some granulated slag imports, although this amount was negligible in 2019. Unit values were typically within the range of $15 and $40 per ton in 2019 with outliers likely owing to incorrect attribution and specialty materials. In 2019, granulated slag imports were supplied mostly by, in descending order by quantity, Brazil, Canada, China, France, and Germany. Exports of granulated slag were reported to be 13,200 t by the U.S. Census Bureau.

Outlook

Most ferrous slag used in the United States will continue to be used as construction aggregate. Ferrous slags have significant growth potential in more specialized uses, such as raw materials for manufacturing clinker and glass. Demand for GGBFS and other SCMs will likely increase over the long-term, following the trends of steel production, because SCMs reduce the clinker content of hydraulic cement and concrete, limit the emissions of carbon dioxide from concrete construction, and improve concrete quality.

Basic oxygen furnace (BOF) SFS has the same supply constraints as BFS because the BOFs are located at the same plants and mostly rely on the crude iron feed supplied by the blast furnaces. Domestic electric arc steel furnace (EAF) slag likely does not face the same supply constraints because the EAFs are numerous and rely on scrap for most of their ferrous feed.

Ferrous slags, especially SFS, can substitute for some of the limestone in portland cement production, thereby reducing carbon dioxide emissions. Fly ash and bottom ash are also substitutes, and thus commonly compete with ferrous slags. To meet NESHAP limits on mercury emissions, the cement industry may turn from fly ash to ferrous slags, especially if the industry is unable to substitute bottom ash for the fly ash. Demand for ferrous slag also may increase owing to closure of U.S. coal-fired powerplants, or their conversion to natural gas, which may constrain the supply of coal combustion ashes, including fly ash.

References Cited

Slag Cement Association, [undated], Shipments: Farmington Hills, MI, Slag Cement Association. (Accessed June 23, 2021, at https://www.slagcement.org/resources/shipments.aspx.)

U.S. Environmental Protection Agency, 2015, 40 CFR Parts 60 and 63—National emissions standards for hazardous air pollutants from the portland cement manufacturing industry and standards of performance for portland cement plants: Federal Register, v. 80, no. 143, July 27, p. 44772–44793.

World Steel Association, 2020, World Steel in figures 2020: Brussels, Belgium, World Steel Association, 32 p. (Accessed June 15, 2021, at https://www.worldsteel.org/en/dam/jcr:f7982217-cfde-4fdc-8ba0-795ed807f513/World%2520Steel%2520in%2520Figures%25202020i.pdf.)

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Historical Statistics for Mineral and Material Commodities in the United States. Data Series 140.

Iron and Steel Slag. Ch. in Mineral Commodity Summaries, annual.

Other

National Slag Association.

Portland Cement Association.

Slag Cement Association.

TABLE 1
ESTIMATED IRON AND STEEL SLAG SOLD OR USED IN THE UNITED STATES[1]

(Million metric tons and million dollars)

	2018					2019				
	Blast furnace slag[2]			Steel	Total iron	Blast furnace slag[2]			Steel	Total iron
	Air-cooled	Granulated	Total	furnace slag	and steel slag	Air-cooled	Granulated	Total	furnace slag	and steel slag
Quantity	5.2	3.4	8.6	8.2	16.8	4.8	3.2	8.0	8.3	16.3
Value	46	345	392	52	444	43	320	363	53.0	416

[1]Table includes data available through May, 28, 2021. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Excludes expanded (pelletized) slag to avoid disclosing company proprietary data. The quantities are very small (about 0.1 unit or less).

TABLE 2
SELLING PRICES FOR IRON AND STEEL SLAG IN THE UNITED STATES[1]

(Dollars per metric ton)

	2018		2019[e]	
Slag type	Range	Average	Range	Average
Blast furnace slag:				
Air-cooled	3.46–24.80	8.89	3.22–23.06	8.27
Granulated[2]	75.79–115.74	102.14	70.48–107.64	94.98
Steel furnace slag	1.10–22.57	6.33	1.12–22.81	6.41

[e]Estimated.

[1]Table includes data available through May 28, 2021. Data, although unrounded, contain a large component of estimates, and some respondents provided values only on their total sales of a slag type, not value by type of use. Thus, the value ranges shown are likely too restrictive.

[2]Values are for material reported for use as a cementitious additive in cement or concrete manufacture.

TABLE 3
SALES OF FERROUS SLAGS IN THE UNITED STATES, BY USE[1]

(Percentage of total tons sold)

	2018			2019[e]		
	Blast furnace slag[2]		Steel furnace slag	Blast furnace slag[2]		Steel furnace slag
Use	Air-cooled	Granulated		Air-cooled	Granulated	
Asphaltic concrete	13.4	--	12.3	13.6	--	12.4
Cementitious material	--	99.8	--	--	99.8	--
Clinker raw material	--	--	3.1	--	--	3.2
Concrete products	1.1	--	--	1.0	--	--
Fill	2.0	--	13.7	1.9	--	13.3
Ready-mixed concrete	18.6	--	--	18.3	--	--
Road bases and surfaces	51.1	--	44.5	52.4	--	44.4
Miscellaneous[3]	8.5	0.2	5.9	7.9	0.2	6.0
Other or unspecified[4]	5.3	--	20.5	4.9	--	20.7

[e]Estimated. -- Zero.

[1]Table includes data available through May 28, 2021. A number of respondents provided breakouts that represent only the dominant use(s) of their slag; accordingly, the minor use categories are likely underreported. The data also incorporate some estimates; precision is probably no more than two significant digits.

[2]Excludes expanded or pelletized slag; this material generally is sold as a lightweight aggregate.

[3]Used for railroad ballast, roofing, mineral wool, or as a soil conditioner.

[4]Including returns to furnaces (likely underreported) and other uses.

TABLE 4

PROCESSORS OF IRON AND STEEL SLAG IN THE UNITED STATES IN 2019[1]

			Slag and furnace types[4]					
			Blast furnace slag			Steel furnace slag		
Slag-processing company	Plant location	Steel company serviced[2, 3]	AC	GG	Exp	BOF	OHF	EAF
Alexander Mill Services Inc.	Hollsopple, PA	North American Höganäs, Inc.						X
Argos USA Corp.	Tampa, FL	Foreign		X				
Ash Grove Cement Co.	Portland, OR	do.		X				
Barfield Enterprises, Inc.	LaPlace, LA	Bayou Steel Group						X
BDM Warren Recycling LLC	Warren, OH	Slag pile (former RG Steel LLC)	X			X		
Beaver Valley Slag, Inc.	Aliquippa, PA	Old slag pile site	X			X	X	
Beelman Truck Co.	Granite City, IL[5]	United States Steel Corp.	X					
Beemsterboer Slag Corp.	East Chicago, IN	ArcelorMittal USA (“East side”)	X					
Do.	Gary, IN	United States Steel Corp.	X			X		
Blackheart Slag, LLC	Muscatine (Montpelier), IA	SSAB Americas						X
CEMEX, Inc.	Miami, FL	Foreign		X				
City Slag LLC	Sharon (Hermitage), PA	Old slag pile site					X	
Commercial Metals Co.	Jacksonville, FL	CMC Steel Florida						X
Diproinduca (USA) Ltd.	Sparrows Point, MD	Slag pile (former RG Steel LLC)				X		
Dragon Products Co., Inc.	Thomaston, ME	Domestic and foreign		X				
Edw. C. Levy Co.	Butler, IN	Steel Dynamics, Inc.						X
Do.	Columbia City, IN	do.						X
Do.	Crawfordsville, IN	Nucor Corp.						X
Do.	Detroit (Dearborn), MI	AK Steel Corp.	X			X		
Do.	Detroit (Ecorse), MI	United States Steel Corp.	X			X		
Do.	Columbus, MS	Steel Dynamics, Inc.						X
Do.	Canton, OH	The Timken Co.						X
Do.	Delta, OH	North Star BlueScope Steel Ltd.						X
Do.	Huger, SC	Nucor Corp.						X
Do.	Memphis, TN	do.						X
Do.	Seattle, WA	do.						X
Fritz Enterprises, Inc.	Fairfield, AL	United States Steel Corp.	X			X		
Harsco Metals & Minerals	Blytheville (Armorel), AR	Nucor-Yamato Steel Co.						X
Do.	Newport, AR	Arkansas Steel Associates, LLC						X
Do.	Pueblo, CO	Evraz Inc. NA						X
Do.	Wilton (Muscatine), IA	SSAB Americas						X
Do.	Pittsboro, IN	Steel Dynamics, Inc.						X
Do.	Ahoskie (Cofield), NC	Nucor Corp.						X
Do.	Brackenridge, PA	Allegheny Technologies Inc. (ATI)						X
Do.	Butler, PA	AK Steel Corp.						X
Do.	Koppel, PA	TMK IPSCO						X
Do.	Latrobe (Natrona Heights), PA	Allegheny Technologies Inc. (ATI)						X
Do.	Steelton, PA	ArcelorMittal USA						X
Do.	Midlothian, TX	Gerdau Long Steel North America						X
Do.	Geneva (Provo), UT	Old slag pile site	X					
LafargeHolcim Ltd.	South Chicago, IL	ArcelorMittal USA		X				
Do.	East Chicago (Indiana Harbor), IN[6]	do.		X	X			
Do.	Sparrows Point, MD	Domestic and foreign		X				
Do.	Detroit, MI	do.		X				
Do.	Cleveland (Cuyahoga Co.), OH[5]	ArcelorMittal USA	X					
Do.	Lordstown, OH	Old slag pile site					X	
Do.	West Mifflin (Duquesne), PA	United States Steel Corp. (ET Works)	X					
Do.	Seattle, WA	Foreign		X				
Lehigh Hanson, Inc.	San Francisco, CA	do.		X				
Do.	Cape Canaveral, FL	do.		X				
Do.	Camden, NJ	do.		X				
Do.	Cementon, NY	do.		X				
Do.	Middlebranch, OH	Domestic and foreign		X				
Do.	Evansville, PA	Foreign		X				

See footnotes at end of table.

TABLE 4—Continued

PROCESSORS OF IRON AND STEEL SLAG IN THE UNITED STATES IN 2019[1]

Slag-processing company	Plant location	Steel company serviced[2, 3]	Slag and furnace types[4]					
			Blast furnace slag			Steel furnace slag		
			AC	GG	Exp	BOF	OHF	EAF
LoMc LLC	Mingo Junction, OH	Slag pile (former RG Steel LLC)	X			X		X
Mountain Materials, Inc.	Ashland, KY	Old slag pile site	X					
Ozinga Cement, Inc.	Chicago, IL	Foreign		X				
Phoenix Services, LLC	Blytheville, AR	Nucor Corp.						X
Do.	Rancho Cucamonga, CA	CMC Steel California						X
Do.	Riverdale, IL	ArcelorMittal USA				X		
Do.	Burns Harbor, IN	do.	X			X		
Do.	Indiana Harbor, East Chicago, IN	ArcelorMittal USA (“E” and “W” sides)	X			X		
Do.	Wilton, IA	Gerdau Long Steel North America						X
Do.	Ghent, KY	North American Stainless						X
Do.	do.	Nucor Corp.						X
Do.	Blytheville, AR	do.						X
Do.	Cool Springs/Steubenville, OH	Old slag pile site				X		
Do.	Marion, OH	Nucor Corp.						X
Do.	Johnstown, PA	Old slag pile site	X					
Do.	Latrobe, PA	Latrobe Specialty Steel Co.						X
Do.	Roanoke, VA	Steel Dynamics, Inc.						X
Do.	Weirton, WV	Old slag pile site					X	
Skyway Cement Co. (Eagle Materials Inc.)	Chicago, IL and Gary, IN	United States Steel Corp.		X				
St. Marys Cement Inc.	Detroit, MI	Domestic and foreign		X				
Do.	Milwaukee, WI	do.		X				
Stein, Inc.	Decatur (Trinity), AL	Nucor Corp.						X
Do.	Alton, IL	Alton Steel Inc.						X
Do.	Granite City, IL[5]	United States Steel Corp.	X			X		
Do.	Sterling, IL	Sterling Steel Co., LLC						X
Do.	Ashland, KY	Old slag pile site	X			X		
Do.	Canton, OH	Republic Engineered Products, Inc.						X
Do.	Cleveland, OH[5]	ArcelorMittal USA	X			X		
Do.	Lorain, OH	Republic Engineered Products, Inc.	X			X		X
Do.	Mansfield, OH	AK Steel Corp.						X
Do.	Middletown, OH	do.	X			X		
Do.	Durant, OK	CMC Steel Oklahoma						X
Do.	Coatsville, PA	ArcelorMittal USA						X
TMS International Corp. (Tube City IMS)	Axis, AL	SSAB North America						X
Do.	Birmingham, AL	Nucor Corp.						X
Do.	Calvert, AL	Outokumpu Stainless USA, LLC						X
Do.	Tuscaloosa, AL	Nucor Corp.						X
Do.	Fort Smith, AR	Gerdau Special Steel North America						X
Do.	Osceola, AR	Big River Steel LLC						X
Do.	Mesa, AZ	CMC Steel Arizona						X
Do.	Cartersville, GA	Gerdau Long Steel North America						X
Do.	Kankakee, IL	Nucor Corp.						X
Do.	Peoria, IL	Keystone Steel & Wire Co.						X
Do.	Gary, IN	United States Steel Corp.				X		
Do.	Portage, IN	NLMK Indiana						X
Do.	Jackson, MI	Gerdau Special Steel North America						X
Do.	Monroe, MI	do.						X
Do.	St. Paul, MN	do.						X
Do.	Jackson, MS	Nucor Corp.						X
Do.	Charlotte, NC	Gerdau Long Steel North America						X
Do.	Norfolk, NE	Nucor Corp.						X
Do.	Sayreville, NJ	CMC Steel New Jersey						X
Do.	Auburn, NY	Nucor Corp.						X
Do.	Cleveland, OH	Charter Steel						X

See footnotes at end of table.

TABLE 4—Continued

PROCESSORS OF IRON AND STEEL SLAG IN THE UNITED STATES IN 2019[1]

			Slag and furnace types[4]					
			Blast furnace slag			Steel furnace slag		
Slag-processing company	Plant location	Steel company serviced[2, 3]	AC	GG	Exp	BOF	OHF	EAF
TMS International Corp. (Tube City IMS) —Continued	Youngstown, OH	Vallourec Star, LP						X
Do.	McMinnville, OR	Cascade Steel Rolling Mills, Inc.						X
Do.	Braddock, PA	United States Steel Corp.				X		
Do.	Bridgeville, PA	Universal Stainless & Alloy Products, Inc.						X
Do.	Burnham, PA	Standard Steel, LLC						X
Do.	New Castle, PA	Ellwood Quality Steels Co.						X
Do.	Park Hill (Johnstown), PA	Old slag pile site	X				X	
Do.	Reading, PA	Carpenter Technology Corp.						X
Do.	Cayce, SC	CMC Steel South Carolina						X
Do.	Darlington, SC	Nucor Corp.						X
Do.	Gallatin, TN	Hoeganaes Corp.						X
Do.	Jackson, TN	Gerdau Long Steel North America						X
Do.	Knoxville, TN	CMC Steel Tennessee						X
Do.	Beaumont, TX	Optimus Steel, LLC						X
Do.	Jewett, TX	Nucor Corp.						X
Do.	Lone Star, TX	United States Steel Corp.						X
Do.	Longview, TX	Nucor Corp.						X
Do.	Seguin, TX	CMC Steel Texas						X
Do.	Plymouth, UT	Nucor Corp.						X
Do.	Petersburg, VA	Gerdau Long Steel North America						X
Do.	Saukville, WI	Charter Steel						X
Vinton Steel, LLC	Vinton (El Paso), TX	Vinton Steel, LLC						X

Do., do. Ditto.

[1]Table consists of data from the previous annual cycle.

[2]Currently operating iron and (or) steel company. Company is not shown for old slag pile sites.

[3]"Foreign" refers to the fact that the facility imports unground granulated blast furnace slag and grinds it on site to make ground granulated blast furnace slag, commonly referred to as "slag cement." "Domestic" implies grinding of slag sourced from the domestic market, not a service contract.

[4]Blast furnace slag type abbreviations: AC, air-cooled; GG, granulated; Exp, expanded. Steel furnace slag types: BOF, basic oxygen furnace; OHF, open hearth furnace; EAF, electric arc furnace.

[5]For air-cooled slag, Stein, Inc. was responsible for the cooling but the processing and marketing were handled by Beelman Truck Co. (Granite City, IL) and Lafarge North America Inc. (Cleveland, OH).

[6]LafargeHolcim Ltd. ground some of the granulated slag from East Chicago, IN, at some of its cement plants located elsewhere.