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2017 Minerals Yearbook

SLAG—IRON AND STEEL [ADVANCE RELEASE]

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Slag—Iron and Steel

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Total sales of iron and steel slag in 2017 increased slightly to an estimated 16.0 million metric tons (Mt) (table 1). In 2017, slag sales increased by 14% to $398 million.

Iron and steel (or ferrous) slags are silicate melts that result from the addition of slagging agents and fluxes (chiefly limestone or dolomite, lime, and silica sand) to blast furnaces and steel furnaces (and to any associated ladles) to remove impurities from iron ore, crude iron, direct-reduced iron, steel scrap, and other ferrous feeds. The molten slag floats on top of the molten crude iron or steel and is tapped from the furnace or ladle separately from the liquid metal. After cooling by various means to solid form, the slag is processed and may then be 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 the slag and remove it. Typically, the processing company receives the slag for free, cools the slag, crushes it to various marketable sizes, uses screens and magnetic separators to recover 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 net slag sales revenues or profits to the steel company. Although not included in the slag sales data, the value of the metal recovered from slag processing generally greatly exceeds that of the processed slag itself. At a number of sites, some slag is returned to the furnaces for use as flux and as a supplemental source of iron; despite having a value, this return flow is not always included in the reported sales tonnages.

A listing of slag processors, processing sites, slag types, and the steel companies serviced is provided in table 4. Apparent duplication at some sites results from the transfer of processing contracts to other companies during the year and can also stem from integrated iron and steel plants that have processing or marketing contracts with different companies for different types of slag produced at the plant. In some cases, slag is cooled by one company but is then further processed or marketed by another company or at another site.

Legislation and Government Programs

Most slag is sold into the construction sector, and the market for slag is influenced by Federal and State programs that affect construction spending, especially those that allow for or encourage the use of "alternative" raw materials in construction and those that may restrict the use or availability of natural construction materials. Slags can substitute directly or indirectly for virgin materials in certain construction applications and are thus considered to be sustainable raw materials. The main examples of such substitution are for natural stone aggregates in concrete and for natural raw materials in cement manufacture. In the specific case of ground granulated blast furnace slag (GGBFS), the material is a supplementary cementitious material (SCM) that can partially substitute for clinker in finished cement or for some of the portland cement in concrete. In the manufacture of the clinker precursor to portland cement, substitution of slags for natural raw materials can reduce the unit consumption of fuel and limestone in the kiln, which then reduces the overall and unit emissions of certain pollutants, most notably carbon dioxide. Use of granulated blast furnace slag [either as GGBFS or as unground material (GBFS)] in the cement plant's finish mill allows more finished cement to be made from the same amount of clinker.

The 2010 final rule within the National Emissions Standards for Hazardous Air Pollutants (NESHAP) took effect in September 2015 and set very low limits for cement plant emissions of mercury, total hydrocarbons, hydrochloric acid, and particulates (U.S. Environmental Protection Agency, 2015). Some U.S. cement plants may find it uneconomic to install the monitoring and emissions abatement equipment or enact abatement procedures to comply with the NESHAP limits for the plants overall or for specific, currently idle kilns (commonly older, or of older technology), and such plants or specific kilns may thus be closed or used only sparingly in the future. The resulting loss of cement production capacity has the potential to increase demand for SCMs, such as GGBFS and fly ash.

Production

As an operational parameter, the ferrous slag content of iron and steel furnaces during a heat will be known, but the amount of slag tapped from the furnaces is not routinely measured and not all of the slag formed is tapped during a heat; accordingly, data on annual production of slag are usually unavailable. Production of slag can, however, be estimated broadly based on typical slag-to-metal production ratios, which in turn are related to the chemistry of the ferrous feeds to the furnaces. For typical iron ore grades (60% to 66% iron), a blast furnace normally will produce about 0.25 to 0.30 metric ton (t) of slag per ton of crude or pig iron produced. For ores of lower than average grade, the slag production will be higher (in some cases, as much as 1.0 to 1.2 t of slag per ton of crude iron). Steel furnaces typically produce about 0.2 t of slag per ton of crude steel, but up to 50% of this melt is entrained metal, much of which would likely be recovered during slag processing and returned to the furnace. The amount of marketable steel slag remaining after entrained metal removal is thus usually equivalent to about 10% to 15% of the crude steel production. Using these ratios and data for U.S. and world iron and steel production from the World Steel Association (2018, p. 1–2, 89–90), domestic blast furnace slag production in 2017 was estimated to be in the range of about 6 to 7 Mt, and world production was 295 to 354 Mt. Steel slag (after metal removal) production by U.S. furnaces was estimated to be in the range of 8 to 12 Mt, and world production of steel slag, 169 to 254 Mt.

The commercial uses of ferrous slag depend on the method by which the slag is cooled. Blast furnace slags are cooled to three main product types—air-cooled, granulated, and pelletized (or expanded). Air-cooled blast furnace slag results from allowing the molten slag to cool relatively slowly under ambient conditions; final cooling can be accelerated with a water spray. Although commonly having a vesicular texture with closed pores, air-cooled slag is hard and dense and is especially suitable for use as construction aggregates. To make GBFS, molten slag is quenched in water to form sand-sized particles ("granules") of glass. The disordered structure of this glass gives the material inherent moderate ("latent") hydraulic cementitious properties when the slag is finely ground into GGBFS, and the cementitious properties become strong if the GGBFS accesses free lime. In concrete with GGBFS in the mix, hydration of portland cement releases the lime needed to fully activate the slag. Concretes incorporating GGBFS generally develop strength more slowly than concretes that contain only portland cement but can have similar or even superior long-term strength, release less heat during hydration, generally exhibit improved resistance to chemical attack, and have reduced permeability. Pelletized or expanded slag is cooled through a water jet, which leads to rapid steam generation and the development of innumerable vesicles within the slag, which itself is glassy. The vesicles reduce the overall density of the slag and allow for good mechanical binding with hydraulic cement paste. This slag type is most commonly used as a lightweight aggregate but, if very finely ground, pelletized slag has cementitious properties similar to those of GGBFS. Blast furnace slag (generally air-cooled) also can be made into mineral wool. To make mineral wool, slag is remelted and then poured through an air stream or jet of steam or other gas to produce a spray of molten droplets; alternatively, the droplets can be formed by passing the melt through a perforated or fast spinning disc. The droplets elongate into long fibers that are collected and layered, and this material is suitable for use as thermal insulation.

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

Iron and steel slags are also used in environmental applications, such as water filtration, although the data on such uses are incomplete.

Consumption

The data in this report are based on an annual U.S. Geological Survey (USGS) canvass of slag processors and importers and pertain to sales of processed slag rather than the amount of slag produced or processed during the year. In 2017, canvasses were sent to 24 companies, covering 133 processing and (or) importation sites, and at least partial data (some within consolidated responses) were received for 119 sites, accounting for 82% of the total slag tonnage (including 88% of the GBFS tonnage) listed for 2017 in table 1. Responses to the USGS canvasses varied greatly in the detail provided and estimates for missing data were made where needed; accordingly, the tonnage data in table 1 have been rounded to the nearest 0.1 Mt and the value data to the nearest $1 million. Data on pelletized blast furnace slag have been withheld to avoid disclosing company proprietary information, but the quantities sold were very small. Sales data for granulated slag (mostly GGBFS) miss some material sold by a few importers who as yet do not take part in the USGS canvass. The data in table 1 also do not include the free metal recovered from the slag; this metal was sold separately.

Processed slag sales volumes commonly bear little relation to slag production (and hence apparent slag availability) in a given year because of a combination of undocumented returns of slag to the furnaces, stockpiling of slag by processors, imports, changes in processing protocols that affect slag marketability (such as segregating ladle from steel furnace slags as opposed to processing a commingled steel slag), and the fact that all slag sales are from stockpiles, including material in old piles (slag banks) from iron and steel plants long-since closed. In 2017, however, changes in domestic production of crude metal and sales of slag were similar. Domestic production of crude iron increased slightly in 2017, and that of crude steel increased by 4.0% (World Steel Association, 2018, p. 1–2, 89–90). In comparison, sales of blast furnace slag increased slightly, and sales of steel slag increased by 4.1% (table 1), although the latter may reflect a change in completeness of reporting of returns to furnaces within the "Other" use category in table 3.

Because of transportation costs, the common existence of long-term sales contracts, more restricted geographic availability, and tendencies by processors to stockpile slag to allow bidding on large contracts, trends in external (not returned to furnaces) sales volumes for slag can differ significantly from those for competing natural aggregates and for portland and blended cement (a proxy for concrete). The slight increase in overall sales of ferrous slags in 2017, however, was in line with the slight increase in domestic cement sales. About 80% of total slag sales in 2017 were air-cooled blast furnace slag and steel slag. Both slag types are mainly used as construction aggregates. Because of their low unit values (table 2), these slags generally can compete only with natural aggregates in market regions close to active iron and steel furnaces or to slag banks to avoid long-distance transportation charges.

Potential expansion problems with steel slag, especially ladle slags or commingled ladle and steel furnace slags, reduce its applicability for uses that require maintenance of a fixed volume (for example, ready-mixed concrete). Both air-cooled and steel slags can be used as raw materials for cement (clinker) manufacture, but steel slag has proven to be especially suitable for this use. Relative changes, especially small percentages, in sales by type of use are difficult to evaluate because the data incorporate estimates and much of the plant-level data reported in recent years have revealed only the dominant use(s) for the slag or have combined the uses as "Other," leaving the minor use categories understated. The usage breakouts in table 3 appear to be broadly similar for both years shown.

Sales of granulated slag, reported as GGBFS, increased by about 0.2 Mt (table 1). Although this slag type accounted for only about 19% of the total iron and steel slag sales tonnage in 2017, it accounted for 87% of the total value of blast furnace slag sales and 77% of the total value of slag sales; the relative value contribution of GGBFS reflected the high unit price for this material in its primary role as an SCM. Actual sales of GGBFS in some years have been higher than those shown in table 1 because some imports were missed by the USGS canvass; however, it was unclear if this was significant in 2017. The USGS slag survey does not distinguish between GGBFS sold for cementitious use to cement companies (to make blended cement) from that sold as an SCM to concrete companies, but material consumption data from USGS canvasses of cement producers continue to indicate that by far the major component of GGBFS sales are to the concrete industry. An alternative source of data for sales of GGBFS, under the designation "slag cement," is the Slag Cement Association (SCA), whose members account for much of the country's GGBFS production and sales. The SCA reported slag cement sales of 3.1 Mt in 2017, which excluded the content of GGBFS in blended hydraulic cements (Slag Cement Association, 2018) and was thus not strictly comparable to the data in table 1.

Prices

As in previous years, many slag canvasses sent to the USGS lacked price data, or an average price was given for the total tons sold but not for the breakout of sales by use. Accordingly, the data in table 2 include many estimates or assignments of reported averages to all use types but have been left unrounded to better show the range of reported values. Small unit differences (less than $1 per metric ton) are likely of no statistical significance and commonly reflect a modest difference in the tonnages sold at the upper or lower bounds of the price ranges or a change in the amount of detail provided in the use breakouts. The average prices did not change significantly for air-cooled blast furnace slag but showed significant increases for GGBFS and, possibly, for steel furnace slag. The large increase in unit price for GGBFS was in accord with significant price increases for portland cement, for which GGBFS is a partial substitute.

As noted above, air-cooled blast furnace slag and steel slags have many similar (mainly aggregates) market uses. Market factors affecting the prices of these two slag types include local competition from natural aggregates, the overall level of construction activity (particularly for roads), and the existence of long-term supply contracts. Air-cooled and steel furnace slags sold for uses other than aggregates can command higher prices than slags sold as aggregates. Pelletized slag (not shown in tables 1–3) can sell for prices well above those for air-cooled slag.

Foreign Trade

Most of the iron and steel slag imported into the United States is GBFS (for grinding at domestic facilities) or GGBFS; both forms of slag are covered by the dedicated Harmonized Tariff Schedule of the United States (HTS) code 2618.00. Import data within HTS code 2618.00 commonly contain entries that, based on excessively high or low unit dollar values, are either slags of other metallurgical industries (especially copper slag) or are unrelated materials altogether (such as silica fume, fly ash pozzolan, cenospheres from fly ash, other industrial residues, or metal concentrates). Trade data from the U.S. Census Bureau showed total supposed granulated slag imports in 2017 under HTS code 2618.00 of 2.44 Mt, but only about 2.10 Mt of this appeared to be GBFS or GGBFS, based on unit values. The total increases only negligibly (a few thousand tons) if likely granulated slag imports within HTS code 2619.00 (which otherwise mainly includes various metallic residues of high unit value) are included. The major sources of the apparent granulated slag in 2017 were, in descending order, Japan, Brazil, Canada, Italy, France (but the material could include material from Spain), and Spain (as listed). Much of the material excluded in the adjusted total was inexpensive copper slag (mostly from Japan) imported for use mainly as sand-blasting grit and as an iron-rich raw material for clinker manufacture.

Import data from Trade Mining LLC's trade database showed a 2017 total for likely granulated slag imports similar to that of the U.S. Census data; however, the component data were distributed differently as to source country and port of entry. For 2017, the Trade Mining data listed imports of likely granulated blast furnace slag of about 2.4 Mt.

After exclusion of very high and low unit value materials, U.S. Census Bureau exports of apparent granulated slag under HTS code 2618.00 totaled only a few hundred tons in 2017, with an additional 1,000 t under HTS code 2619.00.

Outlook

Most ferrous slag will continue to be used in the United States as construction aggregate. Sales for more specialized uses, such as raw materials for clinker and glass manufacture and as media for water treatment and filtration, have significant growth potential, but data on such sales are likely to remain incomplete. The domestic supply of blast furnace slag remains limited by the fact that several blast furnaces have closed or been idled in recent years; only 17 were operating in 2017 (Iron & Steel Technology, 2018), and only 2 U.S. blast furnaces were equipped with granulation cooling. Demand for GGBFS (and other SCMs) will likely increase because of the utility of SCMs in reducing the clinker content of finished hydraulic cement and concrete, thus reducing the overall and unit emissions of carbon dioxide associated with concrete construction. The quality of the concrete is generally improved by use of SCMs as well.

Basic oxygen furnace (BOF) steel slag faces the same supply constraints as blast furnace slag because the BOFs are at the same integrated plants and largely rely on the crude iron (hot metal) feed supplied by the blast furnaces. In contrast, slag from domestic electric arc steel furnaces (EAFs) is in more assured supply because the EAFs are numerous, and most of them are not part of, or dependent upon, integrated iron and steel complexes, instead relying on scrap for all or most of their ferrous feeds.

In the production of portland cement, carbon dioxide emissions can be reduced through the substitution of some of the limestone. Ferrous slags (especially steel furnace slags) have proven to be highly suitable for such substitution but, in this use, commonly compete with fly ash and bottom ash from coal-fired powerplants. Demand for ferrous slag for clinker manufacture could increase if the cement industry reduces its consumption of fly ash to meet more stringent NESHAP limits on mercury emissions, especially if the cement plants are unable to substitute bottom ash for fly ash. Additionally, closure of U.S. coal-fired powerplants, or their conversion to natural gas, could constrain the supply of coal combustion ashes in many market regions, including the domestic supply of SCM-grade fly ash.

References Cited

Iron & Steel Technology, 2018, AIST 2018 North American blast furnace roundup: Iron & Steel Technology, v. 15, no. 3, p. 270–271.

Slag Cement Association, 2018, Shipments: Farmington Hills, MI, Slag Cement Association. (Accessed May 2, 2019, 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, 2018, Steel statistical yearbook 2018: Brussels, Belgium, World Steel Association, 121 p. (Accessed December 20, 2018, at https://www.worldsteel.org/en/dam/jcr:e5a8eda5-4b46-4892-856b-00908b5ab492/SSY_2018.pdf.)

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Historical Statistics for Mineral and Material Commodities in the United States. Data Series140.

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)

	2016					2017				
	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	5.3	2.9	8.2	7.4	15.7	5.2	3.1	8.3	7.7	16.0
Value	45	260	306	44	349	44	306	350	48	398

[1]Table includes data available through May 3, 2019. Data may not add to totals because of independent rounding.

[2]Excludes expanded (pelletized) slag to protect 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)

	2016		2017	
Slag type	Range	Average	Range	Average
Blast furnace slag:				
Air-cooled	3.31–23.42	8.53	3.31–25.35	8.47
Granulated[2]	81.30–103.40	89.18	82.67–113.67	98.91
Steel furnace slag	1.10–20.39	5.88	0.78–20.94	6.21

[1]Table includes data available through May 3, 2019. 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. No sales of unground material were reported in 2016–17, although such sales likely took place; the price ranges shown are thus only for ground material.

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

(Percentage of total tons sold)

	2016			2017		
	Blast furnace slag[2]		Steel	Blast furnace slag[2]		Steel
Use	Air-cooled	Granulated	furnace slag	Air-cooled	Granulated	furnace slag
Ready-mixed concrete	18.8	--	--	21.4	--	--
Concrete products	1.6	--	--	1.7	--	0.4
Asphaltic concrete	18.3	--	20.3	13.2	--	15.1
Road bases and surfaces	46.7	--	42.3	47.6	--	40.8
Fill	3.8	--	15.5	3.5	--	14.8
Cementitious material	--	99.7	--	--	99.8	--
Clinker raw material	--	--	2.4	--	--	2.4
Miscellaneous[3]	8.2	0.3	2.0	9.2	0.2	2.0
Other or unspecified[4]	2.6	--	17.5	3.5	--	24.7

-- Zero.

[1]Table includes data available through May 3, 2019. A number of respondents provide 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 is generally sold as a lightweight aggregate.

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

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

TABLE 4
PROCESSORS OF IRON AND STEEL SLAG IN THE UNITED STATES IN 2017

Slag-processing company	Plant location	Steel company serviced[1, 2]	Slag and furnace types[3]					
			Blast furnace slag			Steel furnace slag		
			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[4]	United States Steel Corp.	X					
Beemsterboer Slag Corp.	East Chicago, IN	ArcelorMittal USA	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	
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		
Gerdau Longsteel North America	Jacksonville, FL	Gerdau Long Steel North America						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[5]	do.		X	X			
Do.	Sparrows Point, MD	Domestic and foreign		X				
Do.	Detroit, MI	do.		X				
Do.	Cleveland (Cuyahoga Co.), OH[4]	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				
LoMc LLC	Mingo Junction, OH	Slag pile (former RG Steel LLC)	X			X		X
Mountain Materials, Inc.	Ashland, KY[4]	AK Steel Corp.	X					
Ozinga Cement, Inc.	Chicago, IL	Foreign		X				

See footnotes at end of table.

TABLE 4—Continued

PROCESSORS OF IRON AND STEEL SLAG IN THE UNITED STATES IN 2017

			Slag and furnace types[3]					
			Blast furnace slag			Steel furnace slag		
Slag-processing company	Plant location	Steel company serviced[1, 2]	AC	GG	Exp	BOF	OHF	EAF
Phoenix Services, LLC	Blytheville, AR	Nucor Corp.						X
Do.	Rancho Cucamonga, CA[6]	Gerdau Long Steel North America						X
Do.	Riverdale, IL	ArcelorMittal USA				X		
Do.	Burns Harbor, IN	do.	X			X		
Do.	Indiana Harbor, East Chicago, IN	do.	X			X		
Do.	Wilton, IA	Gerdau Long Steel North America						X
Do.	Ghent, KY	Gallatin Steel Co.						X
Do.	Ghent, KY	North American Stainless						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.	Vinton (El Paso), TX[7]	Bayou Steel Vinton						X
Do.	Roanoke, VA	Steel Dynamics, Inc.						X
Do.	Weirton, WV	Old slag pile site					X	
Skyway Cement Co. (Eagle Materials)	Chicago, IL	United States Steel Corp.		X				
Do.	Gary, IN	do.		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[4]	United States Steel Corp.	X			X		
Do.	Sterling, IL	Sterling Steel Co., LLC						X
Do.	Ashland, KY[4]	AK Steel Corp.	X			X		
Do.	Canton, OH	Republic Engineered Products, Inc.						X
Do.	Cleveland, OH[4]	ArcelorMittal USA	X			X		
Do.	Lorain, OH	Republic Engineered Products, Inc.	X			X		X
Do.	Mansfield, OH	AK Steel Corp.						X
Do.	Middletown, OH[8]	do.	X			X		
Do.	Coatesville, PA	ArcelorMittal USA						X
Tervita Corp.	Rancho Cucamonga, CA[6]	Gerdau Long Steel North America						X
TMS International Corp.	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.	Mesa, AZ	CMC Steel						X
Do.	Fort Smith, AR	Gerdau Special Steel North America						X
Do.	Osceola, AR	Big River Steel LLC						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.	Norfolk, NE	do.						X
Do.	Sayreville, NJ	Gerdau Long Steel North America						X
Do.	Auburn, NY	Nucor Corp.						X
Do.	Charlotte, NC	Gerdau Long Steel North America						X
Do.	Middletown, OH[8]	AK Steel Corp.	X			X		
Do.	Youngstown, OH	Vallourec Star, LP (ex-V&M Star, LP)						X
Do.	McMinnville, OR	Cascade Steel Rolling Mills, Inc.						X
Do.	Braddock, PA	United States Steel Corp.				X		

See footnotes at end of table.

TABLE 4—Continued

PROCESSORS OF IRON AND STEEL SLAG IN THE UNITED STATES IN 2017

			Slag and furnace types[3]					
			Blast furnace slag			Steel furnace slag		
Slag-processing company	Plant location	Steel company serviced[1, 2]	AC	GG	Exp	BOF	OHF	EAF
TMS International Corp.	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.	Pricedale, PA	do.	X				X	
Do.	Reading, PA	Carpenter Technology Corp.						X
Do.	Cayce, SC	CMC Steel						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	do.						X
Do.	Beaumont, TX	do.						X
Do.	Jewett, TX	Nucor Corp.						X
Do.	Lone Star, TX	United States Steel Corp.						X
Do.	Longview, TX	Nucor (ex-Joy Global Inc.)						X
Do.	Seguin, TX	CMC Steel						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[7]	Vinton Steel, LLC						X

Do., do. Ditto.

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

[2] "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 now referred to as "slag cement." "Domestic" implies grinding of slag sourced from the domestic market, not a service contract.

[3]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.

[4]For the air-cooled slag, Stein, Inc. was responsible for the cooling, but the processing and marketing were handled by Beelman Truck Co. (Granite City, IL), LafargeHolcim Ltd. (Cleveland, OH), and Mountain Materials, Inc. (Ashland, KY).

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

[6]The processing contract at Rancho Cucamonga was transferred to Phoenix Services, LLC in August 2017.

[7]The Bayou Steel Vinton facility in Vinton, TX, was sold to Kyoei Steel Ltd. in December 2016 and renamed Vinton Steel, LLC; the processing contract was transferred to the new owner in July 2017.

[8]The processing contract at Middletown was transferred to Stein, Inc. at yearend 2017.