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SLAG—IRON AND STEEL [ADVANCE RELEASE]

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Slag—Iron and Steel

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Following declines in sales tonnage and value of about 4% and 3%, respectively, in 2013, total sales of iron and steel slag by U.S. slag processors rose to an estimated 16.6 million metric tons (Mt) in 2014, up by 7%, with a value of about $315 million, up by about 17% (table 1).

Iron and steel slags are silicate melts that result from the addition of slagging agents and fluxes (chiefly limestone or dolomite and silica sand) to blast furnaces and steel furnaces to strip impurities from iron ore, 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 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, in some cases, returned to the furnace. Processed slags have much lower unit values than do iron and steel (metal); accordingly, iron and steel (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, crushes it to various marketable sizes, uses screens and magnetic separators to recover entrained metal from the slag (metal to be returned to the furnace for a low charge), 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. At a number of sites, some slag is returned to the furnaces for use as flux and as a supplemental source of iron but, despite having a value, this return flow commonly is not 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 stems from the transfer of processing contracts to other companies during the year and because integrated iron and steel plants may have processing or marketing contracts with different companies for the different types of slag produced at the plant. In some cases, the 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 and those that promote the use of "alternative" raw materials in construction. Likewise, the slag market is affected by policies that influence the availability or promote the use of competing materials. Slags can substitute directly or indirectly for virgin materials in certain 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 can partially substitute for clinker in finished cement or for some of the portland cement in concrete. With respect to clinker (cement) manufacture, 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 introduced as GGBFS, or unground material (GBFS)] in the 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) was scheduled to take effect on September 9, 2015, and sets very low limits for cement plant emissions of mercury, total hydrocarbons, hydrochloric acid, and particulates (U.S. Environmental Protection Agency, 2013). A number of 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. The resulting loss of cement production capacity might not be able to be offset in some markets by increased cement imports. This has the potential to increase demand for alternative or supplementary cementitious materials (SCMs), such as GGBFS and fly ash. The NESHAP likely would make fly ash (typically high in mercury) less attractive as an alternative raw material for clinker manufacture and thus might increase demand for slag for this purpose.

Production

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 generally unavailable. Output levels 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 metric ton of crude or pig iron produced. For ores of lower than average grade, the slag output 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 output. Using these ratios and data for U.S. and world iron and steel production from the American Iron and Steel Institute (2014, p. 115–120), U.S. blast furnace slag production in 2014 was estimated to be in the range of about 7 to 9 Mt, and world output, 296 to 355 Mt. Similarly, U.S. output of steel slag (after metal removal) in 2014 was estimated to be 9 to 13 Mt, and world output, 167 to 250 Mt.

The method by which ferrous slag is cooled is the main determinant of the commercial uses for the slag. Blast furnace slags are cooled to three main 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. By quenching molten slag in water, GBFS is formed as sand-sized particles of glass. The disordered structure of this glass gives the material inherent moderate 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. When 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 containing large amounts of dicalcium silicate are prone to expansion and commonly are cured in piles for several months to allow for the 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 remain 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 2014, USGS canvasses were sent to 26 companies, covering 140 processing and (or) importation sites, and at least partial data (some within consolidated responses) were received for 129 sites, accounting for 90% of the total slag tonnage listed for 2014 in table 1. For 2013, the same number of companies and sites were canvassed, yielding data for 132 sites, accounting for 93% of the total slag sales tonnage listed for the year. 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. For both years, 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) in both years exclude 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 is sold separately.

Domestic output of crude iron fell by 3.1% in 2014 and that of crude steel rose by 1.5% (American Iron and Steel Institute, 2014, p. 115–120), which would imply similar shifts in overall slag production and availability. However, estimates of slag production (given above), or in relative shifts thereof, can significantly differ from total sales of slag in a given year because of a combination of undocumented returns of slag to the furnaces, stockpiling of slag by processors, 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. This difference is well illustrated by the 2014 sales data: overall U.S. sales of blast furnace slag increased by nearly 10%, and steel slag sales were up by 5% (table 1). Overall slag sales data reported to the USGS commonly exclude a significant fraction of the slag (especially steel furnace slag) returned to the furnaces. In 2014, the amount of slag reported as returned to the furnaces doubled to 1.49 Mt, but the reported returns in 2013 were 39% less than those reported in 2012. Thus, it is unclear if the shifts in returns reflected actual trends or just variations in incomplete reporting. Slag returns to the furnaces would be expected to increase if the price of major ferrous feeds (ores and, especially, scrap) increased; scrap prices appear to have increased modestly (about 3%) in 2014.

Air-cooled blast furnace slag and steel furnace slag together continued to account for about 85% of total sales tonnages (table 1). These two types of slag are mainly used as general construction aggregates (table 3). Because of their low unit values, these slags generally can only compete with natural aggregates in market regions close to active iron and steel furnaces or to slag banks so as to avoid long-distance transportation charges. Transportation costs, along with the common existence of long-term sales contracts and tendencies by processors to stockpile slag to allow bidding on large contracts, results in trends in slag external (not returned to furnace) sales volumes that do not always match, at least in percentage change terms, trends in sales of competing natural aggregates and in portland and blended cement (a proxy for concrete). In 2014, the 7% increase (relative to 2013) in overall slag sales was similar to that for construction sand and gravel (up by about 6%), crushed stone (up by 5%), and cement (up by about 8%). However, the 4% overall sales decline for slag in 2013 relative to 2012 was in contrast to USGS data for sales of construction sand and gravel (up by about 4%), crushed stone (stagnant), and portland and blended clement (up by 4%).

Steel slag has many of the same uses as air-cooled slag (table 3), but because of potential expansion problems, steel slag is rarely used in applications requiring maintenance of a fixed volume (for example, concrete). Both slag types can be used as a raw material 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 reported uses as "Other," leaving the less common uses understated. The percentage changes seen for slag use in asphaltic concrete appear significant; the increase for air-cooled slag is in line with a modest increase in construction spending for roads in 2014. In contrast, the decline in steel slag for this use may simply reflect a higher percentage of unspecified sales (that is, a reporting issue in 2014) or a problem with the 2013 data (asphaltic concrete showed a large percentage increase that year, whereas the unspecified sales declined significantly). The shifts in use of air-cooled slag for road bases and surfaces (sharp decline) and for fill (large increase) may represent a change in reporting specificity; steel slag trended opposite to air-cooled slag for these uses. The 21% decline in use of steel slag for clinker manufacture in table 3 is supported by USGS data for the cement industry that show a nearly 20% decline in steel slag consumption for this use.

Although accounting only for about 15% of the total slag sales tonnage, GGBFS in 2013–14 contributed about 69% to 73% of the total value of slag sales in table 1 and 83% to 84% of the total blast furnace slag sales. Sales of GGBFS increased by 17% to 2.7 Mt (table 1). Actual sales of GGBFS in some years have been higher than those shown in table 1 because of some imports being missed by the USGS canvass; however, it is unclear if this was significant in 2013–14. Although the USGS slag survey does not distinguish between GGBFS sold for cementitious use to cement companies from that sold to concrete companies, USGS canvasses of the U.S. cement industry show consumption (not purchases) of granulated slag of about 0.29 Mt in 2014, up by 28%; this indicates that the majority 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 output and sales. The SCA reported sales by its members of nearly 2.5 Mt in 2014, up by 7%; 2.3 Mt of this total was as direct sales and the remainder was material within blended cements (Slag Cement Association, 2014; Slag Cement Association, unpub. data, 2015).

Prices

Price data are lacking for many slag canvasses sent to the USGS, or the USGS is provided with an average unit price on the total sales only and not on the sales breakouts by different types of uses. Accordingly, the data in table 2 include many estimates or application of reported averages to all usage types. Although the data are reported unrounded to better show the range of reported values, small unit differences (of less than $1 per metric ton) are likely of no statistical significance. Unit prices did not change significantly for air-cooled blast furnace slag and, probably, for steel furnace slag. Major 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. The average high unit sales value of granulated slag, which showed a 7.5% increase in 2014, reflects the use of GGBFS primarily as a partial substitute for portland cement in blended cements and, especially, in concrete. Despite its relatively high unit price, GGBFS sold at a 20% to 25% discount to gray portland cement for many years, but the discount in 2013 was only about 8% and was about 12% in 2014, owing to stability of slag prices compared to those for portland cement.

Foreign Trade

Actual iron and steel slag imports are of granulated slag (GBFS or GGBFS), but import data within the granulated slag Harmonized Tariff Schedule of the United States (HTS) code (HTS 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). For example, trade data from the U.S. Census Bureau listed imports of "granulated iron and steel slag" under tariff code HTS 2618.00 totaling about 1.6 Mt in 2014, but only about 1.4 Mt of this appeared to be GBFS or GGBFS, and this total becomes about 1.80 Mt if likely granulated slag imports within tariff code HTS 2619.00 (which mainly includes a variety of high-unit-value metallic residues) are included. The equivalent imports for 2013 were 1.3 Mt for HTS 2618.00 plus 0.1 Mt for HTS 2619.00. Most of the material excluded in the adjusted totals above was inexpensive copper slag from Japan imported for use mainly as sand-blasting grit.

Data from the United Business Media Ltd.'s PIERS trade database has, in some years, revealed higher totals for tariff code HTS 2618.00 imports than did the U.S. Census Bureau. The PIERS total in 2014 was about 1.7 Mt (1.9 Mt in 2013), or about 1.6 Mt (1.8 Mt in 2013) after excluding material (mostly copper slag) revealed or suspected not to be GBFS. The 2014 total becomes about 1.8 Mt if possible GGBFS from HTS 2619.00 is included. The PIERS totals included about 0.38 Mt in 2013 and 0.34 Mt in 2014 of material from Italy that was either missing entirely from the U.S. Census Bureau data or was partly or wholly labelled as being from Spain.

Slag export data from the U.S. Census Bureau included many low tonnage shipments of very high unit value that were unlikely to be iron and steel slag. Exports with unit values suggestive of GBFS or GGBFS totaled only about 44,000 t in 2013 and 40,500 t in 2014; however, PIERS reported only 900 t and 1,350 t, respectively. These differences may result because the U.S. Census Bureau data show Canada as the destination for most of the material; if these flows were dominantly overland, then they would not have been accounted for in the PIERS database used, which only reports ocean shipments.

Outlook

Growth potential exists for ferrous slag sales into relatively specialized use markets such as for sewage and water treatment and filtration, and as raw materials in clinker manufacture and glass manufacture; data for these types of uses are likely to remain incomplete. Most slag, however, will continue to be sold into the construction sector. The long-term economic viability of U.S. blast furnaces is in doubt, with several having closed in recent years and seemingly no prospects for the construction of new ones; this will constrain the supply of air-cooled slag. As of yearend 2014, only 3 of the 21 U.S. blast furnaces were equipped with granulation cooling, and 1 of these blast furnaces closed in 2015. Although some other U.S. blast furnaces were being evaluated for addition of granulators, the equipment for this is expensive and it was unclear if any such projects would be economic. Efforts by the U.S. cement and concrete companies to reduce their overall and unit emissions of carbon dioxide will likely lead to an increase in demand for GGBFS (and other SCMs) in concrete to reduce the clinker content; the quality of the concrete is generally improved by use of SCMs as well. However, in the case of GGBFS, the domestic supply constraints noted above will seemingly ensure that growth in demand will have to be met through increased slag imports, but the availability of imported granulated slag, too, is facing constraints from growing demand for GGBFS in many countries overseas. The cement industry also is seeking to reduce its carbon dioxide emissions by using other calcium-rich materials, most notably steel slag, as a partial substitute for limestone. Apart from being a non-carbonate raw material, steel slag burns relatively easily and thus allows for a reduction of fuel consumption (and associated emissions) in the kilns. Unlike blast furnace slag, steel slag from U.S. electric arc furnaces is in more assured supply because these furnaces are numerous, most of them are at plants not connected with integrated iron and steel complexes, and the furnaces rely on scrap for all or most of their ferrous feeds. As an alternative raw material for clinker manufacture, slag commonly competes with fly ash, and demand for slag 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 the fly ash. Closure of U.S. coal-fired powerplants, or their conversion to natural gas, is likely to constrain the supply of coal combustion ashes in many market regions.

References Cited

American Iron and Steel Institute, 2014, Annual statistical report: Washington, DC, American Iron and Steel Institute, 120 p.

Slag Cement Association, 2014, U.S. slag cement shipments: Farmington Hills, MI, Slag Cement Association. (Accessed January 30, 2016, at http://www.slagcement.org/News/Shipments.html.)

U.S. Environmental Protection Agency, 2013, National emissions standards for hazardous air pollutants from the portland cement manufacturing industry and standards of performance for portland cement plants: Federal Register, 40 CFR Parts 60 and 63, v. 78, no. 29, February 12, p. 10006–10054.

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
IRON AND STEEL SLAG SOLD OR USED IN THE UNITED STATES

(Million metric tons and million dollars)

	2013					2014				
	Blast furnace slag[1]			Steel	Total iron	Blast furnace slag[1]			Steel	Total iron
	Air-cooled	Granulated	Total[2]	furnace slag	and steel slag[2]	Air-cooled	Granulated	Total[2]	furnace slag	and steel slag[2]
Quantity[e]	5.4 r	2.3	7.7 r	7.8	15.5 r	5.8	2.7	8.4	8.2	16.6
Value[e]	40 r	186 r	225 r	43 r	268 r	44	231	275	40	315

[e]Estimated. [r]Revised.
[1]Excludes expanded (pelletized) slag to protect company proprietary data. The quantities are very small (about 0.1 unit or less).
[2]Data may not add to totals shown because of independent rounding.

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

(Dollars per metric ton)

	2013		2014	
Slag type	Range	Average[r]	Range	Average
Blast furnace:				
Air-cooled	3.31–20.89	7.41	2.20–20.15	7.62
Granulated[2]	77.16–99.54 r	80.79	79.37–104.72	86.85
Steel furnace	0.00–32.71	5.44	0.06–34.36	4.88

[r]Revised.
[1]Data contain a large component of estimates and some respondents provide 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 2013–14, although such sales certainly took place; the price ranges shown are thus just for ground material. Sales other than for cementitious use were generally at unit values below the ranges shown.

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

(Percentage of total tons sold)

	2013			2014		
	Blast furnace slag[2]		Steel furnace slag	Blast furnace slag[2]		Steel furnace slag
Use	Air-cooled	Granulated		Air-cooled	Granulated	
Ready-mixed concrete	10.5 r	--	(3)	9.7	--	(3)
Concrete products	2.6	--	--	1.9	--	--
Asphaltic concrete	19.7 r	--	15.9 r	21.4	--	11.9
Road bases and surfaces	49.4	--	49.8 r	44.7	--	49.7
Fill	4.8 r	--	15.6	10.2	--	12.6
Cementitious material	--	100.0	--	--	99.7	--
Clinker raw material	--	--	3.3	--	--	2.6
Miscellaneous[4]	5.2	(3)	1.5	6.4	0.3	1.2
Other or unspecified[5]	7.8	--	13.9	5.7	--	22.0

[r]Revised. -- Zero.
[1]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 and thus should be viewed as accurate to no more than two significant figures.
[2]Excludes expanded or pelletized slag; this material is generally sold as lightweight aggregate.
[3]Less than 0.05%.
[4]Reported as used for railroad ballast, roofing, mineral wool, or soil conditioner.
[5]Including return to furnaces (likely underreported) and other uses.

TABLE 4
PROCESSORS OF IRON AND STEEL SLAG IN THE UNITED STATES IN 2014

			Slag and furnace types[1]					
			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.[4]	Tampa, FL	Foreign		X				
Ash Grove Cement Co.	Portland, OR	do.		X				
Barfield Enterprises, Inc.	LaPlace, LA	ArcelorMittal USA						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 Co.	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	Miscellaneous 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.[6]	X			X		
Do.	Detroit (Ecorse), MI	United States Steel Corp.	X			X		
Do.	Columbus, MS	Steel Dynamics, Inc.[6]						X
Do.	Canton, OH	The Timken Co.						X
Do.	Delta, OH	North Star BlueScope Steel LLC						X
Do.	Huger, SC	Nucor Corp.						X
Do.	Memphis, TN	do.						X
Do.	Seattle, WA	do.						X
Essroc Corp.	Middlebranch, OH	Miscellaneous domestic and foreign		X				
Fritz Enterprises, Inc.	Fairfield, AL[7]	United States Steel Corp.	X	X		X		
Do.	Indiana Harbor, IN	ArcelorMittal USA (Indiana Harbor Long Carbon)						X
Do.	Sparrows Point, MD	Slag pile (former RG Steel LLC)	X					
Gerdau Long Steel North America	Jacksonville, FL	Gerdau Long Steel North America						X
Do.	Charlotte, NC[8]	do.						X
Go Green American Recycling, LLC	Mingo Junction, OH	Slag pile (former RG Steel LLC)	X			X		X
Harsco Metals & Minerals	Birmingham, AL	CMC Steel						X
Do.	Blytheville, AR[9]	Nucor Corp.						X
Do.	Blytheville (Armorel), AR	Nucor-Yamato Steel Co.						X
Do.	Newport, AR[10]	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

See footnotes at end of table.

TABLE 4—Continued

PROCESSORS OF IRON AND STEEL SLAG IN THE UNITED STATES IN 2014

			Slag and furnace types[1]					
			Blast furnace slag			Steel furnace slag		
Slag processing company	Plant location	Steel company serviced[2, 3]	AC	GG	Exp	BOF	OHF	EAF
Harsco Metals & Minerals—Continued								
Do.	Ghent, KY	Gallatin Steel Co.						X
Do.	do.	North American Stainless						X
Do.	Ahoskie (Cofield), NC	Nucor Corp.						X
Do.	Brackenridge, PA	Allegheny						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.	Midland, PA	do.						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					
Holcim (US) Inc.	Birmingham (Fairfield), AL[7]	United States Steel Corp.		X				
Do.	Camden, NJ	Foreign		X				
Do.	Gary, IN	United States Steel Corp.		X				
Lafarge North America Inc.	South Chicago, IL	ArcelorMittal USA		X				
Do.	East Chicago (Indiana Harbor), IN[11]	do.		X	X			
Do.	Sparrows Point, MD	Domestic and foreign		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.	Cementon, NY	do.		X				
Do.	Evansville, PA	do.		X				
Mountain Materials, Inc.	Ashland, KY[5]	AK Steel Corp.	X					
Phoenix Services, LLC	Blytheville, AR[9]	Nucor Corp.				X		X
Do.	Riverdale, IL	ArcelorMittal USA				X		
Do.	Indiana Harbor, East Chicago, IN	do. (“E” and “W” sides)	X			X		
Do.	Burns Harbor, IN	do.	X			X		
Do.	Wilton, IA	Gerdau Long Steel North America						X
Do.	Sparrows Point, MD	Slag pile (former RG Steel LLC)				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.	Georgetown, SC	ArcelorMittal USA						X
Do.	Vinton (El Paso), TX	do.						X
Do.	Roanoke, VA	Steel Dynamics, Inc.						X
Do.	Weirton, WV	Old slag pile site					X	

See footnotes at end of table.

TABLE 4—Continued

PROCESSORS OF IRON AND STEEL SLAG IN THE UNITED STATES IN 2014

			Slag and furnace types[1]					
			Blast furnace slag			Steel furnace slag		
Slag processing company	Plant location	Steel company serviced[2, 3]	AC	GG	Exp	BOF	OHF	EAF
St. Marys Cement Inc.	Detroit, MI	Foreign		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[5]	AK Steel Corp.	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		
Do.	Mansfield, OH	AK Steel Corp.				X		
Do.	Warren, OH	Warren Steel Holdings LLC						X
Do.	Coatsville, PA	ArcelorMittal USA						X
Tervita Corp.	Rancho Cucamonga, CA	Gerdau Long Steel North America						X
Tube City IMS, LLC	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.	Claymont, DE[12]	Evraz Inc. NA						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.	Ashland, KY[12]	Kentucky Electric Steel LLC						X
Do.	Jackson, MI	Gerdau Special Steel North America						X
Do.	Monroe, MI	do.						X
Do.	St. Paul, MN	Gerdau Long Steel North America						X
Do.	Jackson, MS	Nucor Corp.						X
Do.	Charlotte, NC[8]	Gerdau Long Steel North America						X
Do.	Norfolk, NE	Nucor Corp.						X
Do.	Perth Amboy, NJ	Gerdau Long Steel North America						X
Do.	Sayreville, NJ	do.						X
Do.	Auburn, NY	Nucor Corp.						X
Do.	Middletown, OH	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		
Do.	Bridgeville, PA	Universal Stainless & Alloy Products, Inc.						X
Do.	New Castle, PA	Ellwood Quality Steels Co.						X

See footnotes at end of table.

TABLE 4—Continued

PROCESSORS OF IRON AND STEEL SLAG IN THE UNITED STATES IN 2014

			Slag and furnace types[1]					
			Blast furnace slag			Steel furnace slag		
Slag processing company	Plant location	Steel company serviced[2, 3]	AC	GG	Exp	BOF	OHF	EAF
Tube City IMS, LLC—Continued								
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	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
Uniserve LLC	Newport, AR[10]	Arkansas Steel Associates, LLC						X

Do., do. Ditto.

[1]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.

[2]"Foreign" refers to the fact that the facility imports unground granulated blast furnace slag and grinds it onsite to make ground granulated blast furnace slag—commonly now refered to as "slag cement." "Domestic" implies grinding of slag sourced from the domestic market.

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

[4]Argos USA Corp. purchased the Florida Rock Division of Vulcan Materials Corp. in March 2014.

[5]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), Lafarge North America Inc. (Cleveland, OH), and Mountain Materials, Inc. (Ashland, KY), respectively.

[6]In late 2014, Severstal North America, Inc. sold its Dearborn, MI, steel plant to AK Steel Corp., and its Columbus, MS, steel plant to Steel Dynamics, Inc.

[7]For granulated slag, Fritz Enterprises, Inc. operated the granulator but Holcim (US) Inc. owned the apparatus and marketed the slag.

[8]The processing contract at Charlotte, NC, was transferred to Tube City IMS, LLC in June 2014.

[9]The contract at Blytheville was transferred to Phoenix Services, LLC in August 2014.

[10]The contract at Newport, AR, was transferred to Harsco Metals & Minerals in late January 2014.

[11]Lafarge North America Inc. ground some of the granulated slag from East Chicago, IN, at various of its cement plants located elsewhere.

[12]Steelmaking (and hence slag generation) ceased in 2013, but slag sales continued in 2014.