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IRON AND STEEL, SLAG

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Slag—Iron and Steel

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Sales of ferrous slag in the United States in 2008 totaled about 18.8 million metric tons (Mt), down by about 4% from sales in 2007. Because of a significant decline in sales of the most valuable type of slag, the overall value of slag sales fell 22% to about $332 million (table 1).

Iron and steel slags are formed through 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 slag forms as a silicate melt that floats on top of the molten crude iron or steel and is tapped from the furnace separately from the liquid metal. After cooling to solid form, the slag is processed and may then be sold and/or returned to the furnace. Most forms of processed slag have very low unit values compared with those of iron and steel products and, for this reason, iron and steel companies generally contract with outside slag-processing companies to cool the slag and to remove it. Although the financial arrangements vary, 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 pays a small percentage of the net slag sales revenues or profits to the iron or steel company. Slag may be returned to the furnaces for use as flux and as a supplemental source of iron; this return of slag is typically not reported as a sale.

A list of slag processors, processing sites, and the iron and steel companies serviced is provided in table 4. Apparent duplication at some sites is because processing contracts may have been transferred to other companies during the year, and integrated iron and steel plants may have processing and/or marketing contracts with different companies for different slag types produced at the plant. In some cases, the slag is cooled by one company but is then further processed and/or marketed by another company or at another site.

Legislation and Government Programs

Consumption of slag in the construction sector is influenced by Federal and State programs that affect construction spending levels. The U.S. Environmental Protection Agency (2008), under mandate from Congress, released a study that recommended increasing the use of "recovered mineral components" (including slag) in federally funded construction projects. In such projects and elsewhere, slags are promoted as "sustainable" construction materials, mainly on the basis that slags substitute directly or indirectly for virgin raw materials (for example, for natural stone aggregates in concrete and for natural raw materials in cement manufacture) or, in the specific case of ground granulated blast furnace slag (GGBFS), can partially substitute for portland cement in concrete. With respect to portland cement manufacture, substitution of slags for natural raw materials to make clinker 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 (ground or unground) in the finish mill allows more finished cement to be made from the same amount of clinker.

Production

Data on actual annual production of slag are generally unavailable because not all slag formed is tapped during a heat and the amount of slag tapped is not routinely measured. However, U.S. and world production of ferrous slags can be broadly estimated 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 tons (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—sometimes 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 slag is entrained metal, most of which is generally 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 (2008, p. 121–126), U.S. blast furnace slag production in 2008 was estimated to be in the range of about 8 to 10 Mt, and world output, 230 to 280 Mt. Similarly, U.S. output of steel slag (after metal removal) in 2008 was estimated to be 9 to 14 Mt, and world output, 130 to 200 Mt. Apparent production of slag may differ from the sales of slag (table 1) because of a combination of undocumented returns of slag to the furnaces and stockpiling of slag by the processors.

The market uses for ferrous slag are largely determined by how the slag is cooled. Marketed blast furnace slags are of three main types—air-cooled, granulated, and pelletized (or expanded). Air-cooled blast furnace slag is formed by allowing the molten slag to cool relatively slowly under ambient conditions; final cooling can be accelerated with a water spray. Although it can have a vesicular texture with closed pores, the cooled slag is hard and dense and is especially suitable for use as construction aggregates. Granulated blast furnace slag (GBFS) is formed by quenching molten slag in water to form sand-sized particles of glass. The disordered structure of this glass gives the material inherent moderate hydraulic cementitious properties when the slag is very finely ground. However, if GGBFS can access free lime during hydration, then its cementitious properties become strong. 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. The vesicular texture reduces the overall density of the slag and allows for good mechanical binding with hydraulic cement paste. This slag type is most commonly used as a lightweight aggregate, but if very finely ground it can have cementitious properties similar to GGBFS. Blast furnace slag (generally air-cooled) also can be made into mineral wool. Slag for this purpose 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.

Consumption

Data in this report are based on an annual U.S. Geological Survey (USGS) canvass of slag processors and relate to sales of processed slag, not the amount of slag processed during the year or the actual production of slag by iron and steel companies. Processed slag is sold from stockpiles, and although most of the material is a byproduct of current or recent iron and steel output or is of imported material, some slag sales are of material mined from old slag piles (slag banks) produced by iron and steel plants now closed. In 2008, canvasses were sent to 28 companies, covering 135 processing sites, and at least partial data (some as consolidated responses) were received for 122 of the sites; the reported data accounted for slightly more than 90% of the gross tonnage listed in table 1. For 2007, canvasses were sent to 27 companies, covering 143 processing sites, and at least partial data were received for 127 of the sites, accounting for 96% of the gross tonnages listed for the year. Owing to a wide range in the level of data detail reported to the USGS, and the need to estimate activities of the survey nonrespondents, the data in table 1 have been heavily rounded. For both years, data on pelletized blast furnace slag have been withheld to avoid disclosing company proprietary data, but the quantities sold were very small. Sales data for granulated slag in both years exclude material sold by importers who as yet do not take part in the USGS canvass.

About 83% of the total sales tonnage in 2008 and nearly 78% of that in 2007 were of air-cooled blast furnace slag and steel slag (table 1). Data for both (and previous) years exclude most of the ferrous slag returned to the furnaces and exclude the weight of free metal recovered from the slag and returned to the furnaces; data on these returns are very incomplete. Sales of air-cooled blast furnace slag fell by about 7% during the year. In contrast, after a 10% decline in sales volumes in 2007, steel slag sales rose substantially in 2008. Although both slag types are used in the general construction sector, their market areas tend to be somewhat restricted geographically relative to natural construction materials, and sales are commonly based upon long-term contracts. This may partly explain why the slag sales fared better in 2008 than those for certain other, more widely consumed, construction materials canvassed by the USGS [cement (as a proxy for concrete overall), down by 16%; crushed stone, down by 13%; and sand and gravel, down by nearly 21%].

Air-cooled blast furnace and steel furnace slags are used primarily for a variety of aggregate applications (table 3). Because of potential expansion problems, steel slag finds little use in applications requiring maintenance of a fixed volume (for example, concrete). Both slag types also find significant use as a raw material for cement (clinker) manufacture (the slag contributes aluminum, calcium, iron, and silicon oxides), but steel slag has proven to be especially suitable for this use. Differences evident among the usage breakout percentages for these two slag types in table 3 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. Thus, the less common uses are likely understated.

Because of the incorporation of estimates and a lack of response detail on many canvasses, the modest changes in average selling prices for air-cooled blast furnace and steel slags listed in table 2 may not be statistically significant. Because of generally low unit sales values, slag sold for aggregate generally cannot be economically transported over long distances, particularly overland. Thus, the major factors affecting the sales volumes and prices of these two slag types are dominated by local competition from natural aggregates, the overall level of construction activity (particularly that 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 do the aggregate applications. Pelletized slag (not revealed in tables 1–3) can sell for prices well above those for air-cooled slag.

Sales of GBFS slag fell 27% to 3.2 Mt. Although accounting for less than 25% of total ferrous slag sales tonnages, sales of GBFS dominate the slag market in terms of value. In 2008, sales of GBFS accounted for 82% of the total value of blast furnace slag sales and about 71% of all ferrous slag sales combined (table 1). These percentages were lower than those in 2007, owing to declines in both tons sold and in average unit sales value (table 2). For both years, it is likely that the GBFS tonnages listed in table 1 understate the true market for this material owing to incomplete data. Of total GBFS sales, about 86% was of GGBFS and the rest was of unground material. The high unit sales value of GBFS relative to the other major slag types (table 2) reflects the fact that the dominant use of GGBFS is as a partial substitute for portland cement in blended cements and in concrete. In concrete containing a proportion of GGBFS, 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, have reduced permeability, and generally exhibit improved resistance to chemical attack. Despite its relatively high unit price, GGBFS still sells at a 20% to 25% discount to portland cement. Unground GBFS was sold primarily to cement plants, to dedicated slag-grinding plants for conversion to GGBFS, or to cement plants to be used as a grinding aid (for portland cement) in their finish mills. Overall sales for cementitious uses of GBFS and GGBFS totaled 2.8 Mt in 2008, down by 25%. A small fraction of the unground GBFS on the market has been sourced from old slag piles and lacks cementitious character as a result of weathering; this material still has use in concrete (as a fine grain aggregate), but sells for much lower prices than those indicated for the cementitious material in table 2.

The USGS slag survey does not distinguish between GBFS sold directly to cement companies and that sold directly to concrete companies, but data from recent USGS cement surveys indicate that cement producers consume about 15% of the total granulated slag sold. Sales in the United States of GGBFS under the designation “slag cement” are promoted by the Slag Cement Association (SCA), whose members accounted for much of the country’s GGBFS output. The SCA reported sales by its members of 3.0 Mt of GGBFS in 2008, a decline of 11% (Slag Cement Association, 2009). This percentage decline was lower than that (about 16%) noted above for cement (as a proxy for concrete), indicating that GGBFS is gaining market share in concrete construction. Although the USGS has in most years reported somewhat higher tonnages of GGBFS sold than has the SCA, in 2008, the USGS tonnage was the lower volume (2.8 Mt, down by 25%). Importantly, the USGS data show a sales decline in 2008 significantly larger than that for cement, indicating—in contrast to the SCA—a significant loss of market share. However, anecdotal evidence suggests that any loss or gain in GGBFS market share in 2008 was likely not large. It thus appears that the USGS data for 2008 may be incomplete or, possibly, that some GGBFS data reported to the USGS were in metric rather than the requested short ton units.

Foreign Trade

Data from the U.S. Census Bureau list imports of ferrous slag (excluding iron scales) totaling about 1.3 Mt in 2008, down by about 32% from levels in 2007. Apart from reflecting the weak construction market, the 2008 decline also reflected the permanent closure at midyear of a large, dedicated slag-grinding plant in New Orleans, LA. Nearly all of the imported slag was coded as granulated slag, but the exact amount of granulated material is unclear because the tariff code, although specific to slag, seems to include some imports of unrelated “recovered mineral materials” such as some shipments of fly ash, cenospheres (an extract from fly ash), and silica fume. The leading sources of granulated slag imports were Japan (57%), Canada (36%), and Italy (4%). With the principal exception of some GGBFS coming into the San Francisco customs district, nearly all of the granulated slag imported was unground material. Exports of granulated slag in 2008 were listed as just 0.007 Mt.

Comparison of the U.S. Census Bureau import data for slag with data from the Journal of Commerce’s Port Import Export Reporting Service (PIERS), suggests that the U.S. Census Bureau import data for 2008 are substantially incomplete but less so than for previous years. For 2008, the PIERS data show total waterborne (alone) imports of granulated slag of about 1.56 Mt (or a bit less, subtracting those imports noted as being of other materials). This difference (about 0.26 Mt) has large, but essentially, offsetting differences (relative to Census data) for Canada and Japan, and a large residual difference for Italy. The difference in 2007 between Census and PIERS was about 0.4 Mt.

Outlook

Consumption of ferrous slags for use as aggregates will continue to reflect trends in the consumption of natural aggregates and cement, and thus will depend on overall construction spending levels. Demand for slag is expected to benefit from Government programs to promote the use of recovered mineral components in public sector construction projects but may not be able to capture a large share of this market because of limited slag availability. The relatively small (and declining) number of operating blast furnaces in the United States makes the future supply of air-cooled blast furnace slag highly vulnerable to even temporary closure of integrated iron and steel complexes. Such closures were expected to be widespread in 2009. Steel slag supplied from basic oxygen furnaces was also vulnerable to closures, although slag availability from electric arc furnaces was more assured. A growing constraint on steel slag availability is a recent tendency for steel plants to retain more slag for return to the furnaces at times of high prices for iron ore and scrap. The short-term effects of increased returns to the furnace are hard to quantify, however, because of the tendency of slag processors to stockpile slag so as to be able to bid on large projects.

Slags are useful alternative raw materials for clinker production, and such use reduces a cement plant’s output of carbon dioxide. Availability of sufficient slag nearby the cement plant will continue to be a major determinant of demand for this purpose.

Growing acceptance of GGBFS as a component of finished cement and concrete would seem to assure a steady demand for this slag type, contingent on overall construction levels. The supply of GBFS from domestic blast furnaces is severely constrained by the fact that granulation cooling is currently installed at only four blast furnaces in the United States. Installation of granulators at other blast furnaces is possible but expensive and would hinge on the perception of the specific furnace’s future viability. Further, some blast furnaces produce a slag that, while suitable for aggregate use, is chemically unsuitable for use as GBFS. It is likely that significant future growth in the domestic market for GGBFS will hinge on increased availability of imported material.

References Cited

American Iron and Steel Institute, 2008, Annual statistical report: Washington, DC, American Iron and Steel Institute, 126 p.

Slag Cement Association, 2009, U.S. slag cement shipments: Woodstock, GA, Slag Cement Association. (Accessed September 10, 2009, via http://www.slagcement.org/.)

U.S. Environmental Protection Agency, 2008, Study on increasing the usage of recovered mineral components in federally funded projects involving procurement of cement or concrete to address the Safe, Accountable, Flexible, Efficient Transportation Equity Act—A Legacy for Users: U.S. Environmental Protection Agency Report to Congress, EPA530–R–08–007, June 3, 222 p.

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publication

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)

	2007					2008				
	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, 3]	7.4	4.4	11.8	7.8	19.6	6.9	3.2	10.1	8.7	18.8
Value[e, 4]	54	332	386	43	428	53	236	288	43	332

[e]Estimated.
[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 because of independent rounding.
[3]Quantities are rounded to reflect inclusion of some estimated data and to reflect inherent accuracy limitations of reported data.
[4]Values are rounded to reflect the inclusion of a large component of estimated or reported consolidated data.

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

(Dollars per metric ton)

	2007		2008	
Slag type	Range	Average	Range	Average
Blast furnace slag:				
Air-cooled	2.77 – 16.53	7.26	1.84 – 19.84	7.64
Granulated[2]	17.08 – 93.70	84.89 [r]	24.65 – 100.50	82.64
Steel furnace slag	0.47 – 11.90	5.48	0.20 – 15.39	5.02

[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. Material at or near the low end of the range was sold in unground form. 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)

	2007			2008		
	Blast furnace slag[2]		Steel	Blast furnace slag[2]		Steel
Use	Air-cooled	Granulated	slag	Air-cooled	Granulated	slag
Ready-mixed concrete	15.2	--	--	18.1	--	--
Concrete products	4.2	--	--	3.2	--	--
Asphaltic concrete	11.8	--	14.4	13.4	--	10.9
Road bases & surfaces	41.4	6.3	51.5	40.2	9.4	60.3
Fill	13.0	--	13.3	12.7	--	10.8
Cementitious material	--	86.1	--	--	87.1	--
Clinker raw material	4.9	5.0	6.7	2.8	2.5	5.0
Miscellaneous[3]	6.7	0.7	2.3	8.2	--	0.5
Other or unspecified	2.7	2.2	12.0	1.3	1.0	12.7

-- 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 good to no more than 2-significant figures.
[2]Excludes expanded or pelletized slag; this material is generally sold as a lightweight aggregate.
[3]Reported as used for railroad ballast, roofing, mineral wool, or soil conditioner.

TABLE 4
PROCESSORS OF IRON AND STEEL SLAG IN THE UNITED STATES IN 2008

			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
Barfield Enterprises, Inc.	LaPlace, LA	ArcelorMittal USA[4]						X
Do.	Lone Star, TX	U.S. Steel Corp.[5]						X
Beaver Valley Slag	Aliquippa, PA	Old slag pile site	X			X	X	
Beelman Truck Co.	Granite City, IL[6]	U.S. Steel Corp.	X					
Beemsterboer Slag Corp.	East Chicago, IN	ArcelorMittal USA (East side)	X					
Do.	Gary, IN[7]	U.S. Steel Corp.	X					
Blackheart Slag Co.	Muscatine (Montpelier), IA	SSAB North America[8]						X
Buzzi Unicem USA, Inc.	New Orleans, LA[9]	Foreign, some domestic.		X				
Dragon Products Co., Inc.	Thomaston, ME	Miscellaneous domestic & foreign		X				
Edward C. Levy Co.	Decatur (Trinity), AL	Nucor Corp.						X
Do.	Butler, IN	Steel Dynamics, Inc.						X
Do.	Columbia City, IN	do.						X
Do.	Crawfordsville, IN	Nucor Corp.						X
Do.	East Chicago (Indiana Harbor), IN	ArcelorMittal USA (West side)	X					
Do.	Detroit, MI	Severstal North America, Inc.	X			X		
Do.	do.	U.S. Steel Corp.	X			X		
Do.	Columbus, MS	Severstal North America, Inc.						X
Do.	Delta, OH	North Star Bluescope Steel LLC						X
Do.	Canton, OH	The Timken Co.						X
Do.	Huger, SC	Nucor Corp.						X
Do.	Seattle, WA[10]	do.						X
Essroc Corp.	Middlebranch, OH	Miscellanous domestic & foreign		X				
Fritz Enterprises, Inc.	Fairfield, AL[11]	U.S. Steel Corp.	X	X		X		
Do.	Sparrows Point, MD[12]	Severstal North America, Inc.[13]	X					
Gerdau Ameristeel Corp.	Jacksonville, FL	Gerdau Ameristeel Corp.						X
Do.	Charlotte, NC	do.						X
Holcim (US) Inc.	Birmingham (Fairfield), AL[11]	U.S. Steel Corp.		X				
Do.	Gary, IN	do.		X				
Lafarge North America Inc.	South Chicago, IL	ArcelorMittal USA		X				
Do.	East Chicago (Indiana Harbor), IN[14]	do.		X	X			
Do.	Sparrows Point, MD	Severstal North America, Inc.[13]		X				
Do.	Cleveland (Cuyahoga Co.), OH[6]	ArcelorMittal USA	X					
Do.	Lordstown, OH	Old slag pile site		X				
Do.	McDonald, OH	do.	X					
Do.	Salt Springs (Youngstown), OH	do.	X					
Do.	Warren, OH	Severstal North America, Inc.[15]	X					
Do.	West Mifflin (Duquesne), PA	U.S. Steel Corp. (ET Works)	X					
Do.	Seattle, WA[10]	Foreign		X				
Lehigh Cement Co.	Evansville, PA	do.		X				
Lehigh/Hanson Slag Cement, Inc.	Cape Canaveral, FL	do.		X				
Lehigh Northeast Cement Co.	Cementon, NY	do.		X				

See footnotes at end of table.

TABLE 4—Continued
PROCESSORS OF IRON AND STEEL SLAG IN THE UNITED STATES IN 2008

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			Blast furnace slag			Steel furnace slag		
Slag Processing Company	Plant Location	Steel Company Serviced[2, 3]	AC	GG	Exp	BOF	OHF	EAF
The Levy Co., Inc.	Burns Harbor, IN	ArcelorMittal USA	X			X		
Do.	Gary, IN[7]	U.S. Steel Corp.	X					
Mountain Enterprises, Inc.	Ashland, KY[6]	AK Steel Corp.	X					
MultiServ	Birmingham, AL	SMI/CMC Steel Group						X
Do.	Blytheville, AR	Nucor Corp.						X
Do.	Blytheville (Armorel), AR	Nucor-Yamato Steel Co.						X
Do.	Pueblo, CO	Evraz Inc. NA						X
Do.	Wilton (Muscatine), IA	SSAB North America[8]						X
Do.	Riverdale, IL[16]	ArcelorMittal USA				X		
Do.	Indiana Harbor, East Chicago, IN	do.				X		
Do.	Pittsboro, IN	Steel Dynamics, Inc.						X
Do.	Ghent, KY	Gallatin Steel Co.						X
Do.	do.	North American Stainless						X
Do.	Sparrows Point, MD[12]	Severstal North America, Inc.[13]	X					
Do.	Ahoskie (Cofield), NC	Nucor Corp.						X
Do.	Canton, OH	Republic Engineered Products, Inc.						X
Do.	Mansfield, OH	AK Steel Corp.				X		
Do.	Warren, OH	Severstal North America, Inc.[15]				X		
Do.	Brackenridge, PA	Allegheny Ludlum Corp.						X
Do.	Butler, PA	AK Steel Corp.						X
Do.	Coatsville, PA	ArcelorMittal USA						X
Do.	Koppel, PA	TMK IPSCO[17]						X
Do.	Latrobe, PA	Allegheny Ludlum Corp.						X
Do.	Natrona Heights, PA	do.						X
Do.	Steelton, PA	ArcelorMittal USA						X
Do.	Midlothian, TX	Gerdau Ameristeel Corp.						X
Do.	Geneva (Provo), UT	Old slag pile site	X			X		
Do.	Seattle, WA	Nucor Corp.						X
Phoenix Services LLC	Riverdale, IL[16]	ArcelorMittal USA				X		
Do.	Wilton, IA[18]	Gerdau Ameristeel						X
Do.	Sparrows Point, MD	Severstal North America, Inc.[13]				X		
Do.	Latrobe, PA	Latrobe Specialty Steel Co.						X
Do.	Vinton (El Paso), TX	ArcelorMittal USA						X
Do.	Roanoke, VA	Steel Dynamics, Inc.						X
Do.	Weirton, WV	Old slag pile site					X	X
Recmix of PA, Inc.	Ghent, KY	North American Stainless LP						X
Do.	Sarver (Brackenridge), PA	Allegheny Ludlum Corp.						X
Rinker Materials Corp.	Miami, FL	Foreign		X				
St. Lawrence Cement Inc.	Camden, NJ	do.		X				
St. Marys Cement Inc.	Detroit, MI	do.		X				
Do.	Milwaukee, WI	Domestic and foreign		X				
Stein, Inc.	Alton, IL	Alton Steel Inc.						X

See footnotes at end of table.

TABLE 4—Continued
PROCESSORS OF IRON AND STEEL SLAG IN THE UNITED STATES IN 2008

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			Blast furnace slag			Steel furnace slag		
Slag Processing Company	Plant Location	Steel Company Serviced[2, 3]	AC	GG	Exp	BOF	OHF	EAF
Stein, Inc.—Continued:	Granite City, IL[6]	U.S. Steel Corp.	X			X		
Do.	Sterling, IL	Sterling Steel Co.						X
Do.	Ashland, KY[6]	AK Steel Corp.	X			X		
Do.	Cleveland, OH[6]	ArcelorMittal USA	X			X		
Do.	Loraine, OH	Republic Engineered Products, Inc.	X			X		
Do.	Georgetown, SC	Georgetown Steel Corp.						X
Tube City IMS, LLC	Axis, AL	SSAB North America[8]						X
Do.	Birmingham, AL	Nucor Corp.						X
Do.	Tuscaloosa, AL	do.						X
Do.	Fort Smith, AR	GerdauMACSTEEL						X
Do.	Rancho Cucamonga, CA	TAMCO Steel						X
Do.	Claymont, DE	Evraz Inc. NA						X
Do.	Cartersville, GA	Gerdau Ameristeel Corp.						X
Do.	Wilton (Muscatine), IA[18]	do.						X
Do.	Kankakee, IL	Nucor Corp.						X
Do.	Peoria, IL	Keystone Steel & Wire Co.						X
Do.	Gary, IN	U.S. Steel Corp.				X		
Do.	Portage, IN	Beta Steel Corp.						X
Do.	Ashland, KY	Kentucky Electric Steel LLC						X
Do.	Jackson, MI	GerdauMACSTEEL						X
Do.	Monroe, MI	do.						X
Do.	St. Paul, MN	Gerdau Ameristeel Corp.						X
Do.	Jackson, MS	Nucor Corp.						X
Do.	Norfolk, NE	do.						X
Do.	Perth Amboy, NJ	Gerdau Ameristeel Corp.						X
Do.	Sayreville, NJ	do.						X
Do.	Auburn, NY	Nucor Corp.						X
Do.	Marion, OH	do.						X
Do.	McMinnville, OR	Cascade Steel Rolling Mills, Inc.						X
Do.	Middletown, OH	AK Steel Corp.	X			X		
Do.	Mingo Junction, OH	Severstal North America, Inc.[19]	X			X		X
Do.	Youngstown, OH	V&M Star						X
Do.	Sand Springs, OK	Gerdau AmeriSteel Corp.						X
Do.	Bethlehem, PA	Old slag pile site	X			X		
Do.	Braddock, PA	U.S. Steel Corp.				X		
Do.	Bridgeville, PA	Universal Stainless & Alloy Products Inc.						X
Do.	Midland, PA	Allegheny Ludlum Corp.						X
Do.	New Castle, PA	Ellwood Quality Steels						X
Do.	Park Hill (Johnstown), PA	Old slag pile site	X				X	
Do.	Pricedale, PA	do.				X		
Do.	Reading, PA	Carpenter Technology Corp.						X
Do.	Cayce, SC	SMI/CMC Steel Group						X

See footnotes at end of table.

TABLE 4—Continued
PROCESSORS OF IRON AND STEEL SLAG IN THE UNITED STATES IN 2008

			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 Corp., IMS Division—Continued:	Darlington, SC	Nucor Corp.						X
Do.	Jackson, TN	Gerdau Ameristeel Corp.						X
Do.	Knoxville, TN	do.						X
Do.	Beaumont, TX	do.						X
Do.	Jewett, TX	Nucor Corp.						X
Do.	Longview, TX	LeTourneau Technologies Steel Products						X
Do.	Seguin, TX	SMI/CMC Steel Group						X
Do.	Plymouth, UT	Nucor Corp.						X
Do.	Petersburg, VA	Gerdau Ameristeel Corp.						X
Do.	Saukville, WI	Charter Steel						X
Uniserve LLC	Newport, AR	Arkansas Steel Associates, LLC						X
Do.	Gallatin, TN	Hoeganaes Corp.						X
Vulcan Materials Co.	Tampa, FL	Foreign		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 slag sourced from the domestic market, not a service contract.

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

[4]ArcelorMittal USA purchased Bayou Steel Corp. in July 2008.

[5]U.S. Steel Corp. purchased Lone Star Corp. in June 2007.

[6]For the air-cooled slag, Stein was responsible for the cooling but the processing and marketing were handled by Beelman Trucking (Granite City, IL), Lafarge Corp. (Cleveland, OH), and Mountain Enterprises, Inc. (Ashland, KY), respectively.

[7]Beemsterboer Slag Corp. captured the air-cooled slag contract for U.S. Steel at Gary, IN, in early 2008.

[8]SSAB North America purchased the Axiz, AL, and Montpelier, IA, and facilities of IPSCO Steel, Inc. in June 2008.

[9]The New Orleans slag plant was closed permanently in mid-2008.

[10]The processing contract for Nucor Corp. at Seattle was transferred to Edward C. Levy Co. at about mid-2008.

[11]For granulated slag, Fritz Enterprises operates the granulator but Holcim owns the apparatus and markets the slag.

[12]The processing contract for air-cooled slag at Sparrows Point, MD, was transferred to Fritz Enterprises in 2008.

[13]Severstal North America, Inc. purchased the Sparrows Point, MD, iron and steel complex from ArcelorMittal USA in 2008.

[14]Lafarge grinds some of the granulated slag from East Chicago, IN, at various of its cement plants located elsewhere.

[15]Plant was formerly owned by WCI Steel, Inc., but was purchased by Severstal in 2008.

[16]The contract for the Riverdale, IL, plant was transferred to Phoenix Services LLC in April 2008.

[17]TMK IPSCO purchased Koppel Steel Corp. in June 2008.

[18]The contract for the Wilton, IA, plant was transferred to Phoenix Services LLC in August 2008.

[19]Severstal North America purchased Wheeling Pittsburgh Steel Corp. in 2008.