

Technical Brief

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Office of the
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Production and Types of Ferrous Slags

Overview

Slag is a by-product of pyrometallurgical ore processing, formed when impurities, gangue minerals, and reacted fluxing agents separate from molten metal during smelting. Its composition and properties are influenced by the source material, cooling conditions, furnace process, and flux additions, which together determine its physical characteristics, environmental impact, and suitability for reuse.

Slag is classified as either ferrous or non-ferrous, depending on the metal production process from which it is derived. Ferrous slag originates from iron and steelmaking, whereas non-ferrous slag is generated during the extraction of metals such as copper, lead, zinc, and nickel. Ferrous slags are the primary slags used in the transportation and construction industry. The production of different types of ferrous slag from ironmaking and steel-making process is shown in Figure 1, including blast-furnace slag (BFS), basic oxygen furnace slag (BOFS), electric arc furnace slag (EAFS), and ladle furnace slag (LFS).

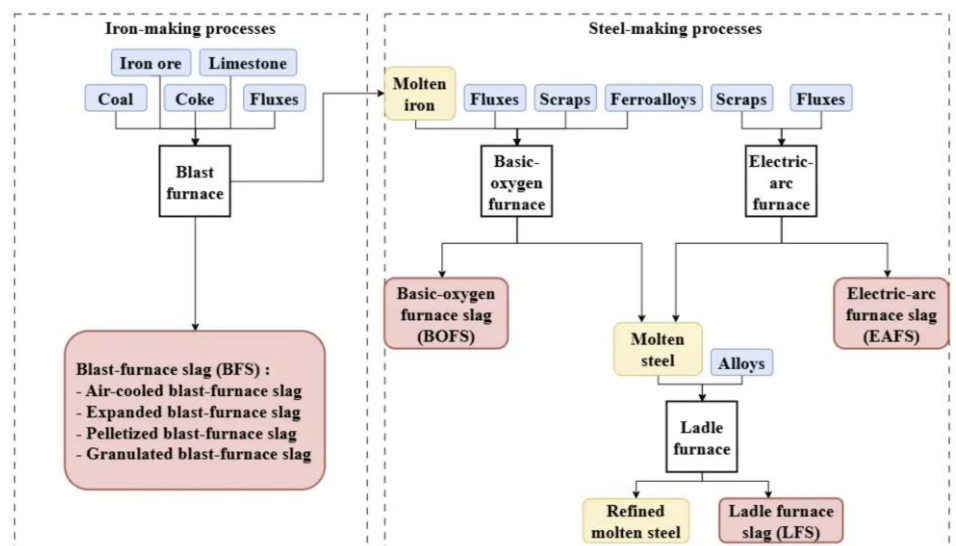


Figure 1: Ferrous slag production processes

USDOT Steel Slag Initiative

Industry Assessment

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Key Takeaways

- Slag is a by-product of high-temperature metal production.
- Ferrous slag includes blast-furnace slag (BFS) (also known as iron slag) and steel slag.
- BFS can be classified by the cooling method, which controls engineering properties and end uses.
- Steel slag includes basic oxygen furnace slag (BOFS), electric arc furnace slag (EAFS), and ladle furnace slag (LFS) with distinct characteristics.

Blast-Furnace Slag (Iron Slag)

Blast-furnace slag (BFS) is produced during the ironmaking process, where iron ore is smelted in a blast furnace to produce molten iron. A key feature of BFS is that its engineering properties depend strongly on how the molten material is cooled. It is commonly classified into four forms:

- *Air-cooled blast-furnace slag* cools slowly under atmospheric conditions and develops into a hard, dense, crystalline material.
- *Expanded slag* is cooled suddenly with water, air, or steam under controlled conditions, producing a porous and lightweight material.
- *Pelletized slag* is cooled by water first and then air quenched in a spinning drum, creating smooth, rounded particles.
- *Granulated slag* is rapidly quenched with high-pressure water, producing a glassy material; once ground, it becomes ground-granulated blast-furnace slag (GGBFS).

Steel Slag

Steel slag is generated downstream of iron slag, during the conversion of the molten iron into steel. Two primary steel-making processes exist: (1) basic oxygen furnace (BOF) which uses molten iron from the blast furnace as its primary feed, and (2) electric arc furnace (EAF) which operates predominantly on recycled steel scrap charged into the furnace alongside fluxing agents. Steel produced by either the BOF or EAF process may undergo further processing in a ladle furnace to produce high-grade steel, generating an additional slag type at this secondary refining stage. Each process produces slag with distinct chemical composition reflecting the specific metallurgical reaction that took place.

This brief summarizes findings on Ferrous Slag Production and Types as part of the Industry Assessment for USDOT-SLAG, “Research Initiative on the Use of Steel Slag in Concrete and Cement” under cooperative agreement 693JK42550005. Information supporting these findings can be found at: <https://cait.rutgers.edu/usdotsteelslag/>. Inquiries about this work can be sent to: usdotsteelslaginitiative@rutgers.edu