

## SAF Slag

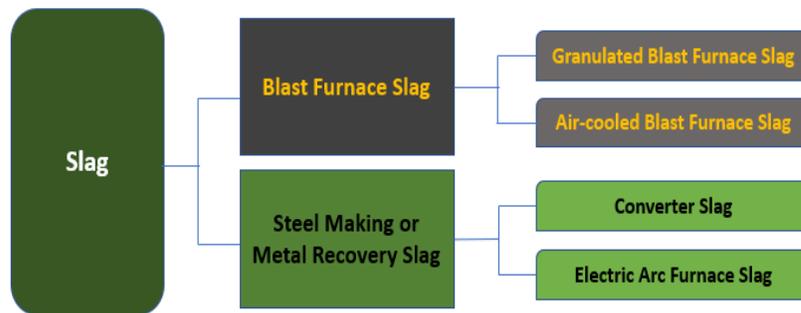
### Submerged Arc Furnace Slag. For Use in Construction Applications

#### Introduction

What is aggregate?

An aggregate is an aggregation of non-metallic minerals, and or synthetic materials obtained in particulate form, that can be processed and used for civil and highway engineering construction. Aggregates are mainly classified into two categories: Fine Aggregate and Coarse Aggregate. Aggregates strongly influence a road base or concrete freshly mixed and hardened properties, mixture proportions, and economy. Consequently, the selection of an aggregate is an important process.

Slag, broadly speaking, can also function as an aggregate. The term "slag" originally referred to slag produced by metal manufacturing processes, nowadays, it is also used to describe slag that is generated from the recycled metal and scrap-based steel industry. Slags are named based on the furnaces from which they are generated, and can broadly be categorized as blast furnace slag, and steel making or metal recovery slag. See Fig 1. The composition and properties of a slag depend on the type of process used to produce it, the cooling conditions of the slag, and processes adopted to possibly enhance the slag. In electric arc smelting, there are two types of furnaces, an Open Arc, and a Submerged Arc furnace.



**Fig 1:** Types of Iron and Steel Slag

#### Product Description & Manufacture

SAF Slag is a slag that was produced in a submerged arc furnace, and thus, will be a synthetic material aggregate. It has a granulated form as a result of the molten slag suddenly being quenched in water upon exiting the furnace. Due to the material that was smelted to produce SAF Slag, its elemental composition is somewhat reminiscent of an aluminosilicate material, since the two largest components of the slag are Silicon and Aluminum almost in equal amounts. See the "Composition" section of this document for an Oxide breakdown of SAF Slag.

For use as an aggregate in cement or road bases, aggregates must conform to certain standards for optimum engineering use: they must be clean, hard, strong, durable particles, free of absorbed chemicals, and other fine materials, that could affect performance of the cement or road base.

SAF Slag is not harmed by alkalis, and contains no clay, shale, chert, organic compounds, or other harmful substances usually restricted in specifications for natural aggregates.

The pore spaces within SAF Slag are not interconnected, resulting in a structurally strong, stable aggregate, that is less susceptible to moisture damage. Physical property wise, SAF Slag is made up of a mixture of textured, angular granules, of various sizes, as well as needle like pieces. Because of this, the mechanical properties of mixes that use SAF Slag may exceed the mechanical properties of mixes made with natural aggregates. SAF Slag mixes may be more resistant to permanent deformation, have higher stiffness, and good frictional quality.

#### SAF Slag Advantages

Advantages when used in Road Base or Sub-Bases:

- Resistance to wear
- High stability

- Higher stiffness
- Resistance to permanent deformation
- Compatible with typical Road Base binders

Advantages when used in Concrete pavements:

- Improved mechanical properties
- Better abrasion resistance
- Low permeability
- Acid and alkali resistant
- Potentially reduced cost as compared to the use of other aggregates

**Note:** For steel making and metal recovery slag in general, because the current methods of stockpiling and landfilling are not sustainable, the disposal of these slags are a significant concern to both the slag processing companies and the environmental agencies. Utilizing slag as a premium performing material or aggregate, is a unique and sustainable way to help minimize the impact of construction activity on the environment and preserve natural resources.

## Product Conformity

Our factory produced SAF Slag conforms to in house quality and operating standards. SAF Slag meets the Fine Aggregate Acid Insolubility requirement as set forth by TxDOT, for “Fine Aggregate for Concrete Pavement or Riding Surfaces” applications.

## SAF Slag Applications (Basic Use)

SAF Slag can conditionally be used for the following basic use applications, *among others*:

- Replacement for Natural Sand products
- Key ingredient in non-structural Road Base and Concrete pavement surface treatments. Steel slags have been utilized successfully both as bound and unbound layers of pavement structures.
- As an aggregate either in bound surface layers of pavements, or in unbound sub-base or base layers of roads.
- For use in Backfill applications for utilities and Utility Line Bedding.
- Can be used as railroad ballast.
- SAF Slag can be used in geotechnical engineering projects, such as in the construction of highway embankments or in subgrade stabilization.
- SAF Slag can also be considered for use in soil stabilization, which can be attributable to chemical reactions and mechanical stabilization (due to the angularity and roughness of SAF Slag particles).

## Specifications

SAF Slag has the following physical properties:

Property	SAF Slag Value
Form	Mostly Granular with some Needle-like Pieces
Color	Black and Grayish
Specific Gravity	Pending
Bulk Density	Compacted: Pending Uncompacted: Pending
pH	Pending



Picture of SAF Slag

## Composition

Unlike quarried aggregates, SAF Slag is produced in a batch process where the chemistry of the raw materials is consistent. The below table list the oxide composition of SAF Slag.

The below concentration percentages were calculated from X-ray fluorescence (XRF) elemental data. These results are not X-ray diffraction (XRD) data.

Element	Symbol	Concentration %
Aluminum	Al <sub>2</sub> O <sub>3</sub>	26.90
Silicon	SiO <sub>2</sub>	26.47
Magnesium	MgO	13.07
Sulfur	SO <sub>3</sub>	0.64
Potassium	K <sub>2</sub> O	0.29
Calcium	CaO	2.20
Titanium	TiO <sub>2</sub>	6.30
Iron	Fe <sub>2</sub> O <sub>3</sub>	2.66
Total of other constituents in µg/g quantities		9.50

The main limitation to using Steel Slag aggregates in concrete is the presence of free calcium oxide (CaO) and free magnesium oxide (MgO) in the Steel Slag, both of which expand when reacted with water, which can cause cracking and accelerated deterioration. It is our belief that most of the lime (CaO) or periclase (MgO) in SAF Slag, exists in bound crystalline forms with other constituents. If there is free (unbound) CaO or MgO in SAF Slag, it will be a low amount.

## Technical Support

For SAF Slag technical, and other questions, see our contact information below.

### Lennox Leotaud

President

Olive & Branch M&D

Email: [Lennox@olivebranchmd.com](mailto:Lennox@olivebranchmd.com)

Mobile: 832-801-5238

## Supply

Supply of SAF Slag is limited to:

- Approximately 80,000 lbs per day
- A little over 2,400,000 lbs per month

## Ordering

Orders will be processed on a first call, first-serve basis. Please contact Lennox Leotaud (832-801-5238) to place an order.

### Delivery

SAF Slag will be delivered in Bulk, via Trucks.  
We are open to packaging and delivering SAF Slag in Super Sacks depending on the opportunity.

### Prices and Conditions of Sale

SAF Slag per Ton pricing is subject to change without notice and is not guaranteed, except that pricing for an order that has already been accepted by Olive & Branch M&D is not subject to change after acceptance. Prices stated do not include any sales, use, or excise tax or any other tax, duty, or charge. Terms are payment-in-advance or net 30 days from the date of Seller's invoice.

### Health & Safety

Wear gloves, eye protection, and face protection as needed. Do not eat, drink, or smoke when in close proximity of this product. MAY CAUSE EYE, SKIN, AND RESPIRATORY TRACT IRRITATION. MAY CAUSE ALLERGIC RESPIRATORY REACTION IF SWALLOWED OR INHALED.

**Please refer to Safety Data Sheet (SDS) for additional and complete health and safety information.**

All statements, information, and data given herein are believed to be accurate, but are presented without warranty, expressed, or implied. Statements concerning possible use are made without representation or warranty that any such use is free of patent infringement and is not a recommendation to infringe on any patent. The user should not assume that all safety measures are indicated or that other measures may not be required. Any determination of the suitability of a particular product for any use contemplated by the user is the sole responsibility of the user.