Material Classification of Electric Arc Steel Furnace Slag (EAFS) - Inert

Electric Arc Furnace Slag

Electric Arc Furnace Slag (EAFS) is a by-product of the steel making process. Steel and molten slag is produced during the melting and refining of recycled steel using electrical energy and fluxes.

Lime is used as a flux to remove silicates and phosphorus from the molten steel to form slag. Energy is supplied by an electric arc, melting the steel and fluxes. During the refining or superheating stage (of the slag process), slag is poured out of the slag door. On tapping, steel is drained from the furnace via a submerged taphole and the furnace is back tilted to prevent slag entering the steel ladle.
Directed into pits adjacent to the process, molten slag (and residual molten steel) flows out the slag door of the furnace. The molten slag then begins to solidify fairly quickly into a rock-like product.

EAFS solidifies in a similar manner to lava from a volcano. Its cooled structure is best described as a solid solution of oxides. Since the molten slag is accompanied by residual solidified steel (metallics), the solidified material is excavated by a front-end loader from the bays when cooled, and transported by road to a metallic separation, crushing and screening plant. Metallics are removed and recycled as ferrous feed or scrap to the iron and steel making processes of the steelworks.

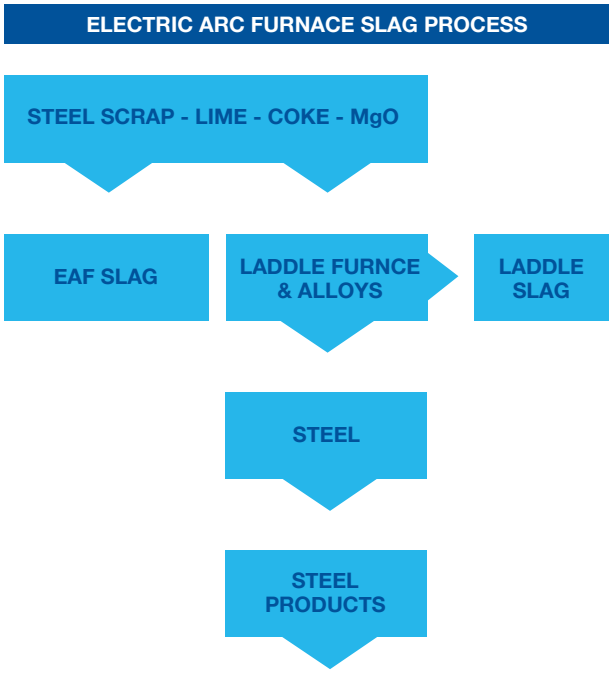

Figure 1 Electric Arc Furnace Slag Process Stream

Figure 2 Electric Arc Steel Making Furnace

Quality Systems

From the selection of the raw materials through to the finished aggregates or cementitious materials, slag products are controlled by a range of well established quality systems.

From raw material selection to slag production, quality systems include: composition determination prior to production; process and chemical monitoring during and post production.

Cooling regimes and materials handling (including stockpile management) are carried out under the slag processors quality systems.

EAFS aggregates are produced to comply with relevant Australian Standards & State Authority specifications and are included in industry based technical publications. From a resource use perspective, slag is a competent alternative for virgin raw materials.

Figure 3 Electric Arc Furnace Slag Aggregate

Environmental Classification

Whilst slag products are produced, marketed and sold on a commercial basis (equal to virgin raw materials), from an environmental classification perspective, slag is deemed to be 'waste' in most States of Australia.

State Environmental legislation typically deems by-products from any process to be 'wastes' due to outmoded definitions, for example, a substance [by-product] is not precluded from being waste, merely because it can be reprocessed, re-used or recycled.

State Environmental Agencies typically do not classify wastes into categories. The generator determines the classification according to developed Environmental Guidelines where they exist in each State. For example, the NSW EPA operate Environmental Guidelines allocating wastes into one of four categories (inert, solid, industrial, or hazardous) based on the nature and mobility of the chemical species they contain. Each category requires different material handling and management practices.

Figure 4 Steel Furnace Asphalt Sand

Research Results

Numerous research studies have quantified the environmental performance of Electric Arc Furnace Slag. For example, in 1997 Golder & Associates carried out extensive trials including chemical and ecotoxological studies on experimental leachates from Electric Arc Furnace Steel Slags. Methodology design and conduct of these trials were carried out in agreement with the NSW EPA. **This major study in 1997 found EAFS to be environmentally classifiable as inert**.

The Golder & Associates study has been validated in a study by Moeyan & Associates conducted during 2003/2004. The aim being: to investigate the chemical nature of iron and steel furnace slags of three different metallurgical processes. Each of these by-products were analysed and the results assessed against the NSW Environmental Guidelines (EG's).

The methodology consisted of collecting differently aged samples from the product range. Samples were tested for total metal concentrations followed by leachate analysis according to the process contained in the Environmental Guidelines, and then assessed against acceptance criteria.

The majority of results for total metals were within the initial total concentration acceptance levels. For those elements exceeding these initial acceptance levels (total concentration), investigations were conducted using the TCLP method.

Using the 95% UCI, all results were found to be below the accepted concentration levels for Inert classification.

These results are consistent with previous investigations by Golder Associates in the mid 1990's, further confirming the stable and consistent nature of the metallurgical processes.

Conclusion

Based on experimental results EAFS can be classified by producers as INERT.

Further reading

A copy of the full Aynsley report, Australasian (iron and steel) Slag Association Inc. Material Classification of Iron and Steel Slag By-product Waste Classification Investigation Report 2004, can be obtained by contacting the Executive Director.

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