

# Steel Slag: Availability, Specifications, and Environmental Considerations

The Use of Industrial Minerals in Highway and Road Construction

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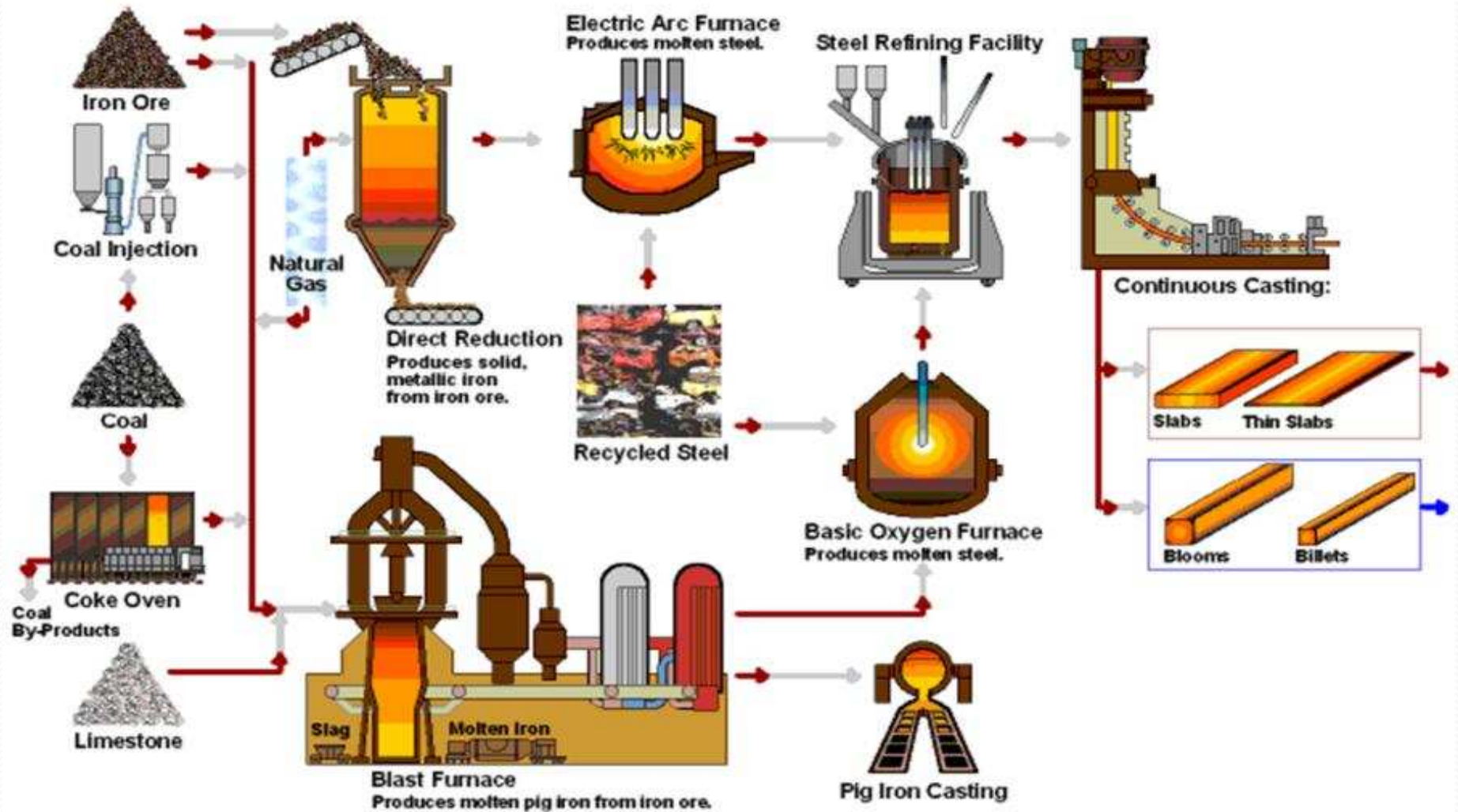


NATIONAL SLAG  
ASSOCIATION

# Definition of Steel Slag

- The American Society for Testing Materials (ASTM) defines Steel Slag as a non-metallic by-product, consisting of essentially calcium silicates and ferrites combined with fused oxides of iron, aluminum, manganese, calcium and magnesium, that is developed simultaneously with steel in basic oxygen, electric arc, or open-hearth furnaces.

# Steel Making Flow





# Integrated Steel Mills



# EAF (Mini) Mills





# SFS Slag



# Availability - USGS 2010

United States of America





# Steel Furnace Slag(s)

- BOS / BOF:
  - Basic Oxygen Steelmaking
  - Basic Oxygen Furnace
- EAF:
  - Electric Arc Furnace
- LMF:
  - Ladle Metallurgy Furnace
- AOD:
  - Argon-Oxygen Decarburization (Stainless Steel)





# Characterization

- Physical
  - Gradation
  - Durability
- Chemical
  - Volumetric Stability
  - Chemistry
  - Available Lime
- Environmental
  - TAL - metals



# Applications

- Chemical
  - Phosphorous Reduction
  - Animal Waste
  - Metals Removal
  - Soil Stabilization
- Agricultural
  - Liming
  - Micro Nutrients
- Construction
  - Asphalt
  - Base
  - Cement
    - R & D > Concrete
  - Secondary Road Stabilization
  - Railroad Ballast



# Chemical – Phosphorous Removal



# Animal Waste





# PRB – Permeable Reactive Barrier



# Reactive Material - (zero valent iron)





# Soil Stabilization





# Agricultural





# Construction



# Friction





# Asphalt – 2,000,000 tons





I-55





I-65





# Base





# Cement



# Concrete





# Secondary Roads





# Railroad Ballast





# Environmental Considerations

- Slag is not Slag / Characterization
  - Iron and Steel Slag
    - Copper
    - Lead
    - Etc.
- Benefits
  - CO<sub>2</sub> Reduction
  - Mining / Landfill Reduction
- Concerns
  - Risk Assessments



# CO2 Reduction





# Available SFS Tonnage



- USA (USGS): 9 Million tons per year

- ~6 Million Cubic Yards



# RCRA



- Iron and Steel Slag are Excluded as a Hazardous Waste
- **Processing Wastes Covered by the Mining Waste Exclusion**
  - Iron blast furnace slag
  - Basic oxygen furnace and open hearth furnace slag from carbon steel production





# HHRA 2002 (Human Health Risk Assessment)

- *Over the past several years, the Steel Slag Coalition ("SSC"), a group of 63 companies that produce steel, process slag, or both, has undertaken a comprehensive study of the chemical composition of three slag types generated during the steelmaking process and the potential human health and ecological risks associated with possible exposure to such slag.*



# HHRA 2011

- Exposure: Contact / Ingestion / Inhalation
- Characterization by particle size.
- Based on new slag characterization data and the most current risk assessment guidance, including the new exposure models and toxicity information. As described herein, the current **HHRA confirmed the previous assessment finding that commercial and construction uses of steel industry slags do not pose a health risk.**







# Thank you – Questions?

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