

APPLICATIONS OF AMD SLUDGE IN THE STEEL INDUSTRY

Mark A. Conedera, P.E.
Senior Environmental Engineer
United States Steel Corporation

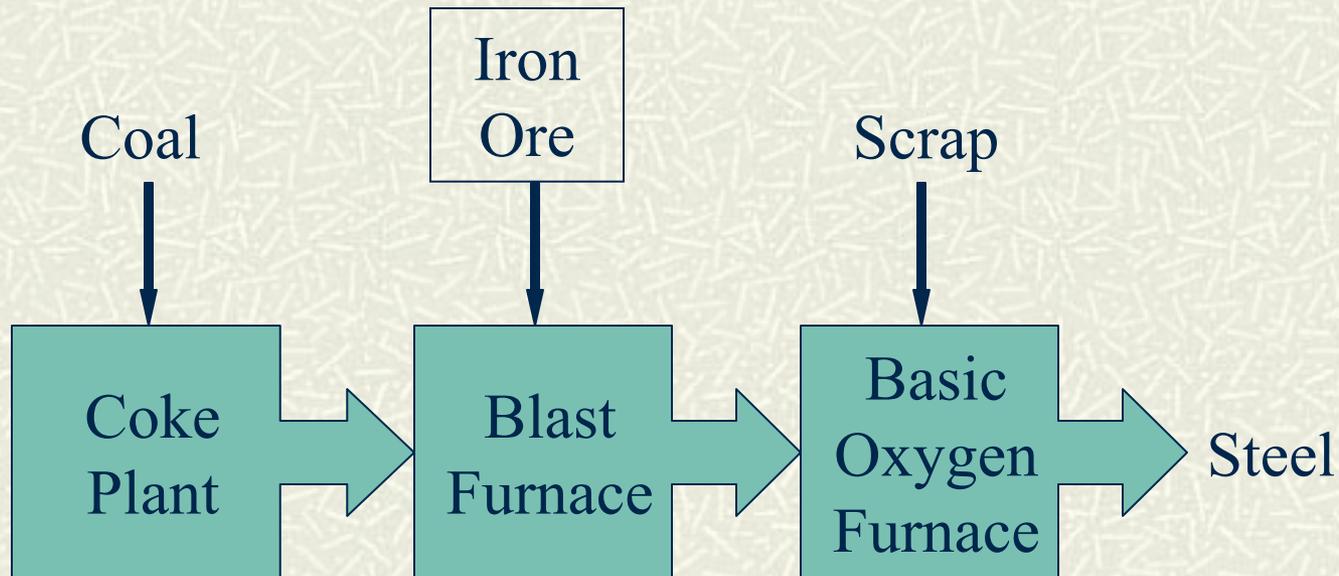


Integrated vs. EAF Steelmaking

- # Integrated Facilities – Produce steel by processing iron ore and other raw materials in blast furnaces.
 - # Electric Arc Furnace (EAF) – Steelmaking furnace where scrap is generally 100% of the charge. Heat is supplied from electricity that arcs from the graphite electrodes to the metal bath.
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STEELMAKING AT USS

- # Components of Integrated Steelmaking
 - Coke, Iron Ore, Scrap



AGGLOMERATION OF FINE IRON BEARING PARTICLES

Pelletizing

- Iron ore particles are rolled into $\sim 1/2$ " diameter balls in a balling drum and hardened by heat. Typically used at large scale taconite ore mining operations.

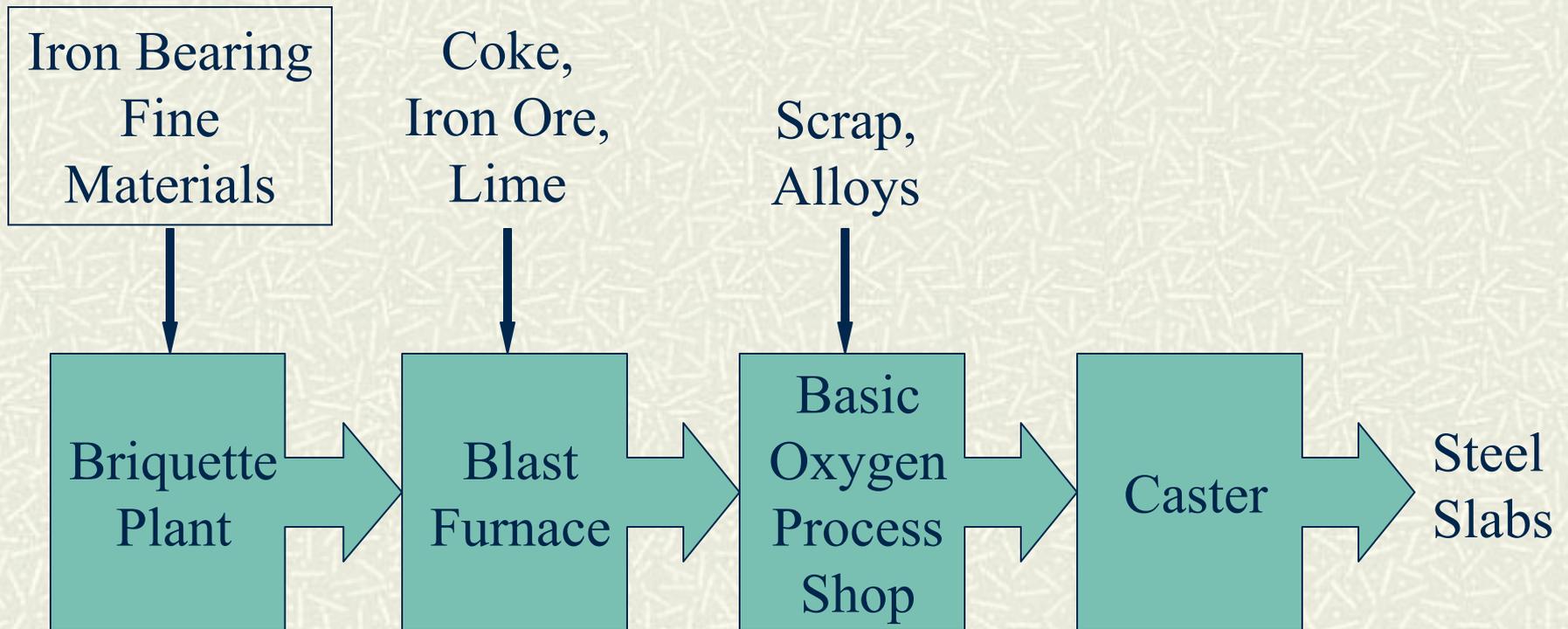
Sintering

- Baking of fine iron bearing particles into roughly one-inch chunks. Diminishing capacity in the United States

Briquetting

- Up to 4" by 4" blocks or pillows of iron bearing materials are formed by pressing material together with a binding agent. Primary alternative to Sinter Plants.
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USS Edgar Thomson Plant



Actual Versus Preferred Composition of AMD Solids

Component	Results (%)	Target (%)
Total Fe	17.36	55.00
SiO ₂	5.85	1.20
Al ₂ O ₃	4.68	0.96
CaO	29.16	5.99
MgO	3.14	0.65
S	1.03	0.08
Cu	0.19	0.039
Ni	0.06	0.012
Zn	0.12	0.025
CO ₂	20.19	4.15

Behavior of AMD

Impurities in Ironmaking

- # Sulfur (S) – Will report to hot metal product. Coke rate must be increased.
 - # Copper (Cu) and Nickel (Ni) – Will report to hot metal product. Input must be limited to meet steel specifications.
 - # Zinc (Zn) – Volatilizes in hearth region of furnace. Forms accretions on furnace refractory and attacks copper components.
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Behavior of AMD

Impurities in Ironmaking

- # Calcium and Magnesium Carbonates (CaCO_3 and MgCO_3) – Carbonates require energy (coke) for calcination in the blast furnace. Blast furnaces consume significant amounts lime (CaO) and Magnesium (MgO), but mainly in the carbonate free form found in iron ore pellets and recycled steelmaking slags.
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Behavior of AMD

Impurities in Ironmaking

- # Silica and Alumina (SiO_2 and Al_2O_3) – These slag forming constituents are fluxed by CaO and MgO to form a fluid slag at acceptable temperatures. Elevated amounts of silica or alumina increase flux requirements, slag output, and coke requirements.
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Follow-Up Considerations

- # Can AMD solids with suitable chemistry for steelmaking be generated?
 - # The economic value of the AMD solids.
Will depend on several factors:
 - Transportation costs.
 - Chemical and physical (particle size, moisture) properties.
 - Characteristic of briquetted product.
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Next Steps

- # Continued evaluation of AMD solids for steelmaking will require both laboratory and full scale plant testing.
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Questions?

