Contribution ID: **199** Type: **Oral**

Influence of the mineral gangue on pellets softening melting properties in Blast Furnace. Experimental study of phase equilibria during the melting of pre-reduced pellets

Wednesday 8 October 2025 12:10 (20 minutes)

The progressive decarbonization of the steel industry is being undertaken through the transformation of Blast Furnaces (BF) and by limiting the quantity of coke.
The reduction of coke rates may impact the permeability at the Cohesive Zone (CZ) level, a viscous and impermeable layer resulting from the softening and melting of Iron Ore. The control of this CZ, its shape, thickness, and permeability, is essential for the proper functioning of BF. The use of adapted raw materials, i.e. their softening melting properties, is an indirect way to control the CZ and to increase permeability.
In this study, we experimentally investigated the melting of different Iron Ore pellets linked to their chemical compositions (acid and fluxed pellets). Pellets were pre-reduced in the counter-current reduction pilot BORIS in conditions representative of BF up to 1000℃. Reduced pellets were then melted using different tools: differential thermal analysis (DTA) and a quenching furnace.
Results make it possible to better understand the behavior of pellets in a BF and confirm that the use of basic pellets is preferable to acid pellets. The amount of liquid inside basic pellets remains low up to higher temperatures, which promotes mechanical properties and better reductive gas distribution. This also imply a deeper and thinner CZ.
Attention was paid to the microstructure (nano scale) as the deformation of reduced materials is triggered by the partial melting of pellets and the formation of primary slag. Results also indicate that thermodynamic modeling could be a suitable and rapid tool to anticipate the behavior of different pellets at the CZ level of blast furnaces. Thermodynamic databases must, however, be adapted to better model the real phase equilibria, representative of pellet melting.

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Session Classification: Burden Materials & Quality

Track Classification: Ironmaking - Blast furnace ironmaking