An alternative methodology for evaluating the reduction potential of BF pellets with hydrogen

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ABSTRACT

The issue of iron production is a key issue and trends show that it will remain so for the next decades. The principle method of reduction of primary raw materials aims to use environmentally acceptable reducing agents, of which hydrogen and especially green hydrogen appear to be the most acceptable. Assessing the reduction potential of feedstocks under conditions of a hydrogen atmosphere will therefore be key for iron production, whether through a modern hydrogen blast furnace or alternative methods with this reducing agent. The paper reports on the pilot results of pellet reduction under specific conditions of 100% hydrogen in the laboratory apparatus of a tube furnace. The results of the achieved reduction stages brought knowledge about the reduction potential of the pellets and the differences in the achieved reduction stages. This new methodology makes it possible to detect the necessary differences in reducibility and, with proper validation with standard tests and relatively simple equipment, can effectively categorize individual pellets from the point of view of reducibility.

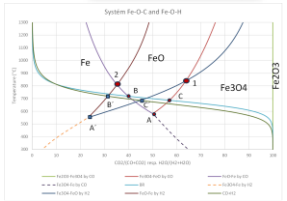
METHODOLOGY

Inputs pellets information

- Chemical (XRF) and phase XRD composition
- Grain size
- SEM-EDX microstructure
- Porosity
- Strength and abrasion
- Density

Prediction and simulation by

- reduction theory



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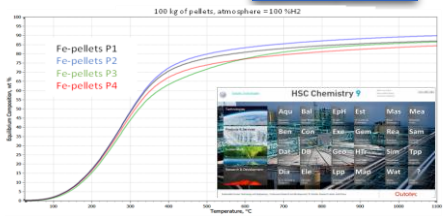
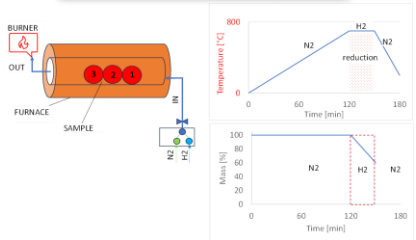


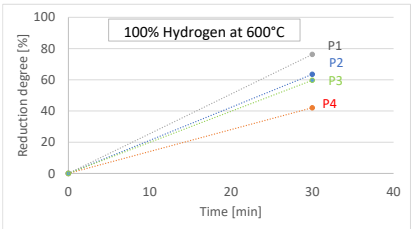
Reductin tests by H2



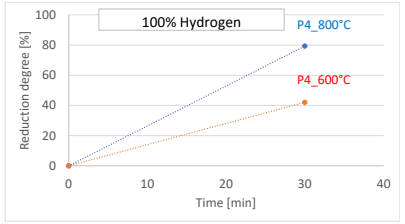
Outputs pellets after reduction

- Reduction index
- Chemical (XRF) and phase XRD composition
- SEM-EDX microstructure
- Thermal stability

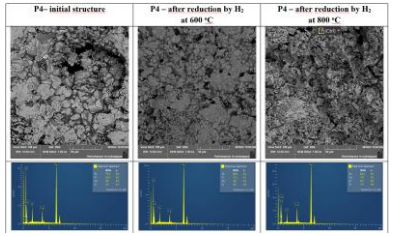
RESULTS AND CONCLUSIONS



	600°C	800°C
	Ri30 by H_2	Ri30 by H_2
P1	76.29	NA
P2	63.53	NA
P3	59.71	NA
P4	42.09	79.35



Sample	mass.% O		Loss % O	mass.% O	Loss % O
	initial	reduction at 600 °C in H_2		Reduction at 800 °C in H_2	
P1	26.5	5.2	80.4	-	-
P2	15.0	10.2	32	-	-
P3	26.4	21.6 middle / 6.7 edge	18.2 middle / 74.6 edge	-	-
P4	16.7	13.1	21.5	6.5	61.1



- Different degrees of reduction and structural changes occur at temperatures of 600 °C and 800 °C.
- A higher temperature significantly increases the rate of reduction, which is evident from the results for P4 pellets, where at 800 °C the oxygen content decreases by up to 61%.
- After reduction, the oxides are reduced to FeO and metallic iron. This process is associated with the formation of fine-grained formations and increased porosity of the structure.
- High-temperature reduction causes the formation of bright areas with significant porosity, which dominate the structure of the pellets.
- Changes in chemical composition and structure vary in different parts of the pellets.
- The results of the achieved reduction stages brought knowledge about the reduction potential of the pellets and the differences in the achieved reduction stages. This new methodology allows to detect the necessary differences in reducibility and can categorize individual pellets from the point of view of reducibility.

ACKNOWLEDGMENETS

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