Analysis of current knowledge of hydrogen application as a reducing agent in metallurgical processes of iron production.

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UMET ÚSTAV METALURGIE

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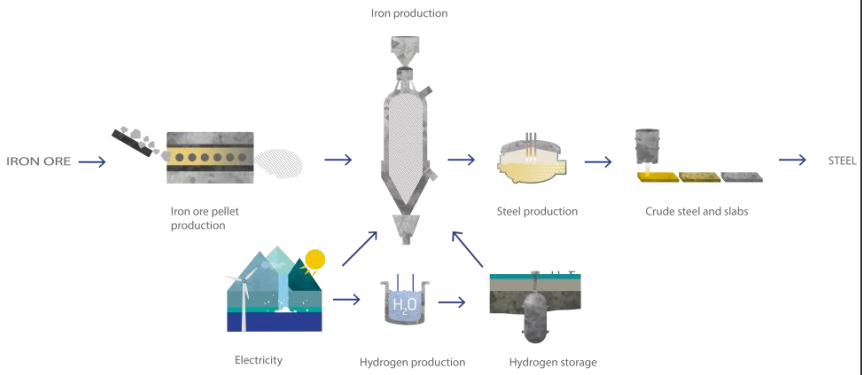
Potential Uses of Hydrogen in Metallurgy

- Enrichment of blast furnace gas with H_2
- Utilization of synthesis gas ($CO+H_2$) in direct reduced Iron (DRI) production
- **Direct reduction of ores using 100% H_2 as a reducing agent**
- Hydrogen production from coking gas
- Utilization of hydrogen-based protective atmospheres
- Reduction of iron Ore in hydrogen plasma

In the world, there are already technologies for utilizing hydrogen in metal production, most commonly in connection with the production of iron and steel (DRI, HBI) – **HYL/Energiron, SALCOS, H2FUTURE**



HYBRIT

Pilot testing of hydrogen as a reducing agent in semi-operational conditions

Laboratory research on the reduction of Fe materials using Hydrogen

Studied Fe materials

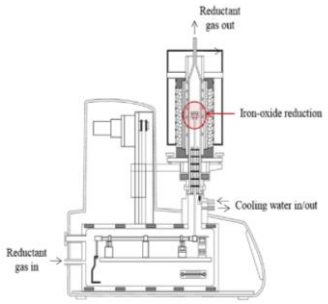
Ores/Concentrates

Pellets

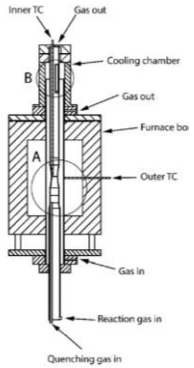
Synthetic Powders

Laboratory equipment

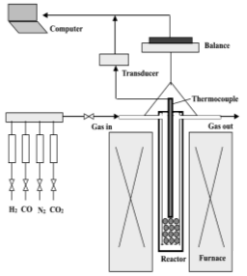
TGA Equipment



Fluidization equipment



Custom laboratory equipment



Monitored Parameters

- Influence of the composition of the reducing atmosphere
- Impact of reaction temperature
- Effect of Rreaction time
- Influence of Flow rate of reducing Gas

Insights into the use of Hydrogen as a reducing agent in the reduction of Fe materials

Reduction using H_2 occurs more intensely and rapidly than using CO or a mixture of H_2/CO

Hydrogen has a higher reduction and diffusion capacity than CO

The reduction by hydrogen occurs more intensively at higher temperatures (approximately 800°C)

H_2

The reaction rate and the degree of reduction increase with an increase in the reduction temperature

The reduction of hematite to magnetite and the reduction of magnetite to wüstite are very fast processes.

CO

The slowest step within the reduction reactions is the transformation of wüstite into iron

In the presence of CO in a mixture with H_2, a carbon precipitation reaction occurs, which slows down the rate of reduction

SLOVAK RESEARCH AND DEVELOPMENT AGENCY

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