TiZir – Fra kull til hydrogen

H₂ symposium – Tyssedal 6th of February 2018

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www.tizir.co.uk
TiZir Titanium & Iron production process

Raw material
- Ilmenite
- Coal

Prereduction
- Rotary kiln

Arc furnace
- Electric arc furnace

Product
- High titania slag
- High purity pig iron

Customer
- TiO$_2$ pigment
- Ti metal
- Casting goods
CO$_2$ emissions (Norway)
TiZir Titanium & Iron emits 3 % of «Norsk Industri og Bergverk» GHG emissions. Emissions have decreased by 10 % between 2007 – 2014. Decrease mainly due to technical development.
Process industry challenge

Energy generation:

\[ C + O_2 = CO_2 + Energy \]

Material reduction:

\[ C + 2MeO + Energy = Me + CO_2 \]
Process industry challenge

- Not an energy carrier question
- Change of chemical reactants
- Development of new processes
- Technology development
- Raw material development
Ilmenite reduction with carbon

$$2FeTiO_3 + C \rightarrow 2Fe + 2TiO_2 + CO_2$$

Ilmenite reduction with hydrogen

$$FeTiO_3 + H_2 \rightarrow Fe + TiO_2 + H_2O$$
Hydrogen benefits

Reduction of ilmenite at ~1000°C

Stage 1 – 2015

- Upgrade of the arc furnace
- Enabling handling of H₂ reduced material
- Decreased specific CO₂ emission (~10 %)
- Decreased specific energy consumption
- Improved gas cleaning system
- 47 % investment support from ENOVA
TTI today

- Coal
- Ilmenite
- Rotary Kiln Pre-reduction
- Charging
- Smelting Furnace
- Furnace off gas (CO) Flare
- Slag & Iron
New technology

- Natural Gas
- Ilmenite

- SMR Plant
- Electrolyser Plant

- Hydrogen Pre-Reduction

- Charging

- Furnace off gas (CO)

- Smelting Furnace

- Slag & Iron
Development

- Start in 2012 with technology screening
- 2013 bench scale batch testing
- 2014 – bench scale continuous testing
- 2016 – testing special issues
- 2016 DFS demonstration plant
- 2014 PFS full scale plant

- 2015 PhD thesis – Hydrogen reduction of ilmenite
Risk management

- Risk
  - Climate goals
  - Globalization
  - New technology
  - Replacing existing equipment
  - Power pricing
  - Capex

- Incentives
  - Norwegian Research Council
  - Innovasjon Norge
  - ENOVA
  - New market opportunities
It’s a rocky road ahead

But if we don’t start we’ll never get there
Thank you for your attention

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