ELECTRIC SMELTING OF AUSTRALIAN HYDROGEN DIRECT REDUCED IRON

Aim: *To prove a low emission alternative route for ironmaking from hydrogen reduced Australian Hematite-Goethite ores at laboratory and intermediate scale*

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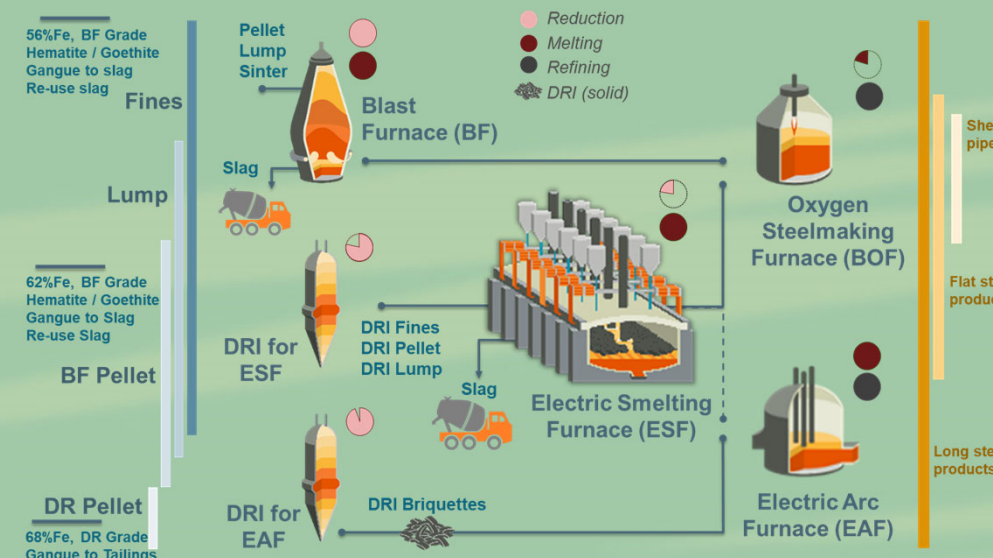
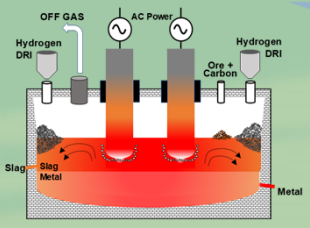
Australian ore fines, hydrogen DRI and laboratory ESF iron

Overview: Reducing the emissions intensity of global steel production is technically challenging. Increasing recovery and melting of scrap steel is the easiest abatement lever, however scrap availability will remain well short of total global demand for steel products. Innovative low-emissions ironmaking technology is therefore required. Given Australia's role as the largest exporter of iron ore by volume, we are compelled to develop solutions that can efficiently utilise Australian ore types. To this end, production of hydrogen direct reduced iron (DRI) followed by an electric smelting furnace (ESF) to separate the contained gangue is proposed as a future low emissions alternative to the Blast Furnace for Australia's Hematite-Goethite resources.



Laboratory Scale Smelting

Intermediate Scale Smelting (Aachen)



Pilot Scale Smelting

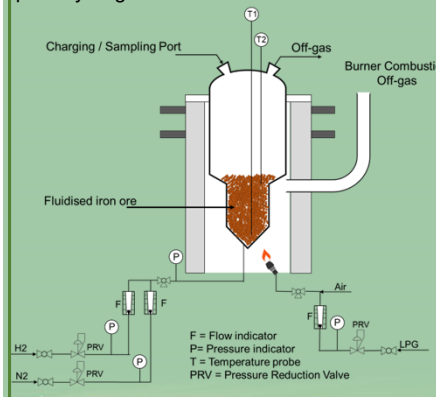
Typical range of feedstocks required, and products produced from the DRI-ESF process route in comparison to the BF and EAF routes
For more information see: https://www.bhp.com/news/bhp-insights/2023/06/pathways-to-decarbonisation-episode-seven-the-electric-smelting-furnace

Hydrogen Direct Reduced Iron

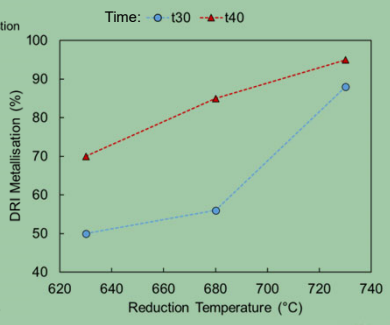
Methods: Laboratory scale shaft and fluid bed retorts at University of Newcastle (UON) and DRI production in a fluid bed at Roundhill Engineering Pty Ltd.

Expected results: Australian Hematite-Goethite iron ore performance evaluation in the process of DRI production by pure hydrogen. Production of DRI with a range of metallisation levels as a function of reduction temperature and ore type. Regular supply of DRI for subsequent ESF experiments.

E.g. 5 kg Medium grade Australian iron ore fines were processed to produce DRI from pure hydrogen in a 200 mm batch fluid bed.



Schematic diagram of fluid bed reactor



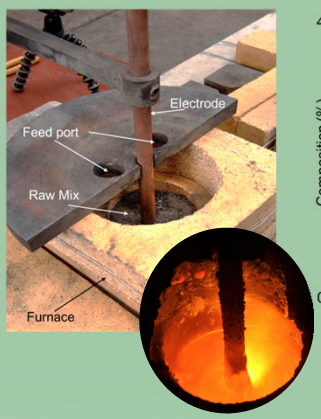
DRI metallisation vs. temperature after 30 and 40 minutes reduction

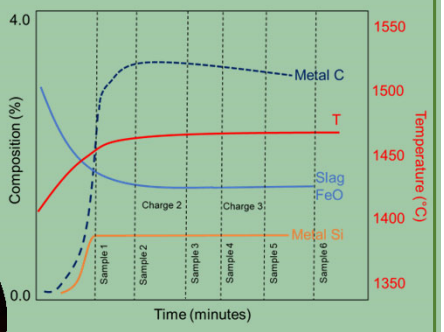
Electric Smelting of Direct Reduced Iron

Methods: Laboratory scale ESF experiments with up to 4 kg DRI charge and up to 1000 A transformer*.

Expected results: Slag and Metal sampling allowing analysis of metallurgical results during the experiments for a range of DRI metallisation, carburiser types and power inputs.

E.g., 2 kg batch and semi-continuous ESF experiment utilising hydrogen DRI.

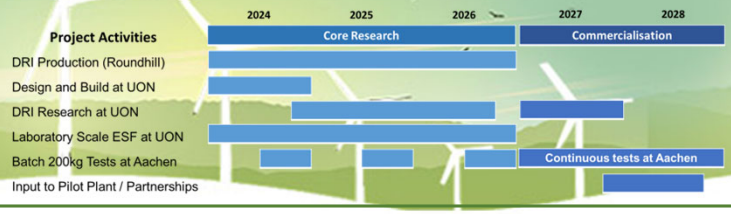




Schematic diagram of expected metallurgical results during a laboratory scale experiment

*RL Maintenance Welding Services.

Timeline



Next Steps

- Install and commission laboratory scale fluid bed at University of Newcastle
- Measure reduction rates for a range of Australian Hematite-Goethite iron ore types
- 2 kg DRI ESF experiments to investigate impact of metallisation on smelting
- First batch tests at 200 kg scale at RWTH Aachen University

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