HILT CRC

Australian Government
Department of Industry, Science and Resources

AusIndustry
Cooperative Research Centres Program

PROJECT SUMMARY

RP1.010: HYBRID HYDROGEN DIRECT AND PLASMA REDUCTION OF IRON ORE

OVERVIEW

For decarbonised steel production, the hydrogen direct reduction (HDR) pathway is most technologically mature, whether coupled with an electric arc furnace (EAF) or potentially with a melter and basic oxygen furnace (BOF). Some concerns about these pathways when applied to Pilbara ores in particular are the high cost of hydrogen relative to conventional fuels, the likelihood of increased hydrogen use associated with carrying through the gangue and needing additional flux to remove it, and the need for increased temperatures in the final wüstite to iron reduction step, to effect reduction of low-purity ores. Hydrogen plasma reduction (HPR) offers the potential overcome these barriers through the use of highly active hydrogen plasma that penetrates into the impermeable wüstite layer—offering the potential for a more efficient and effective use of hydrogen, at the cost of some added (and relatively cheap, vs hydrogen) electricity. HPR causes melting of the product, which may eliminate the need for a separate downstream melter and its associated energy demand.

PROJECT DETAILS

The overall goal of this project is to establish whether hybridised HDR-HPR offers a technological and economical feasible pathway to large-scale green steel production. More specifically to:

- Conduct limited initial bench-scale tests to establish experimental proof of concept for combined HDR-HPR iron production, via in-sequence HDR and HPR tests with selected ore samples,
- Assess the technoeconomics of this concept and clarify that the use of HPR finishing can contribute to an overall lower steel cost, and
- Investigate the scale-up challenges for this technology and conceptualise a workable large-scale design.

IDENTIFIED PATHWAYS

Low-carbon iron exports from direct shipping ores.

OUTCOMES

The outcome of the project will be convincing proof of the technical as well as economic feasibility of the HDR-HPR process, sufficient to determine if it warrants further in-detail development. This proof will be achieved via experimental testing, assessment of risks and scale-up challenges, and technoeconomic modelling via process flowsheet simulation. If successful, modelling will show how HDR-HPR achieves lower green iron cost, and more compact equipment due to the shorter expected particle residence times. The conducted experiments will provide kinetics data to support large-scale reactor design. By conducting lab-scale HDR followed by HPR of a single set of samples, the project will take the HDR-HPR concept from TRL2 through to TRL4.

PROJECT LEADER

- Alireza Rahbari, Australian National University

INDUSTRIES

- Iron & Steel

TOTAL PROJECT VALUE

- $530,483 (cash and in kind)

COMMENCED

01 June 2023