HILTCRC

Australian Government
Department of Industry, Science and Resources

AusIndustry
Cooperative Research Centres Program

PROJECT SUMMARY

RP1.008: GREEN PYROMET/HYDROMET BENEFICIATION PATHWAYS

OVERVIEW

There is a strong market value associated with high-grade (>65%Fe) iron ores, due to the costs of gangue removal in downstream processes. Moving to green steel processing, specifically the hydrogen direct-reduced ironmaking pathway, the costs of gangue removal could rise substantially, due to the high energy (including lime making) costs of gangue removal in the electric arc furnace (EAF), or, potentially to a lesser extent, in a proposed melter/basic oxygen furnace stage that may replace the EAF. Producing a high (>65%) Fe/low solid contaminant product from most Pilbara fine iron ores is difficult to unfeasible using conventional wet or dry physical beneficiation methods.

PROJECT DETAILS

Combined low-to-mid-temperature pyrometallurgical-hydrometallurgical processes for iron ores generally have the potential to achieve >64% Fe concentrate grade and at high mass yields. The pyromet pre-treatments processes could use heating from renewables, including green hydrogen or solar thermal, or from high temperature waste heat recovered from other processes for further upgrading the ore to products such as DRI. Whilst these have been discounted in the past, due to being more expensive (opex,capex) than conventional wet physical beneficiation, due to a higher level of product Fe, under a higher iron ore price and the need to achieve carbon neutrality, they have the potential to add value by:

- Significantly reduce gangue content, hence lower emissions and cost in downstream processing.
- Dehydroxylation of goethite, which would otherwise be detrimental to many subsequent downstream processes including pellet physical properties.
- Provide beneficiated feedstock for DRI/HBI suitable for downstream EAF or melter-BOF.
- Lowered transport costs due to removal of moisture (or other LOI).
- Potential for production of useful by-products from the hydrometallurgical process including alumina, zeolites and other Al-silicates.
- Utilising locally available resources, e.g., air, sea water, dolomite and or limestone, renewable energy.

PROJECT LEADER

- Alfonso Chinnici,
  The University of Adelaide

INDUSTRIES

- Cement & Lime
- Iron & Steel

TOTAL PROJECT VALUE

- $1,047,024
  (cash and in kind)

COMMENCED

01 June 2023

IDENTIFIED PATHWAYS

The project will focus on the assessment of existing and novel pyromet pathways (mid to high temperature), either via moving grate or fluidised bed technologies, to upgrade the ore quality while facilitating liberation and recovery. This in addition with other downstream separation processes including ultra-fine grinding, leaching and/or magnetic separation to achieve a high Fe-low solid contaminant product from low-grade iron ores from Pilbara and Whyalla. The key focus in on the upgrade of iron ore fines and in providing concentrates (magnetite or hematite) and/or beneficiated feedstock suitable for DRI/HBI routes. Another pathway identified is the use of novel, low temperature pyromet technologies to assist with the removal of total organic carbon (TOC) from bauxite ores.

OUTCOMES

The work undertaken in this project will include preliminary results for the upgradability of Pilbara DSO fine ores using low-mid temperature pyrometallurgical-hydrometallurgical, pyrometallurgical-DMS, FBMR-hydrometallurgical, and FBMR-DMS processes, the potential for a significant reduction in scope 3 emissions due to a reduction in gangue levels, and a set of research recommendations and directions for subsequent experimental bench-scale and/or pilot-scale testing, validation, and modelling research. It will also provide information on the impact of utilising novel thermal roasting techniques to reduce/eliminate TOC from bauxite. Ultimately the project outcomes will provide a current understanding of the technologies with strong potential to contribute to decreasing CO_2 emissions and water consumption from the iron and steel making industry within the 2030-2050 time-horizon for Australian industry.