



## PROJECT CASE STUDY – PROGRAM 1

### RP1.011: Upgrading iron ore for direct reduced iron production using products from seawater reverse osmosis brines

**Project Leaders:** Professor Jacques Eksteen and Dr Lina Hockaday, Curtin University

**HILTCRC partners:** Curtin University, The University of Adelaide, Fortescue, Roy Hill, Minerals Research Institute of Western Australia (MRIWA)

**Project partners:** ARENA, BG&E Resources, PROXA Australia

**Industries:** Iron and steel 

**Commenced:** 01 June 2023

**Total project value:** Stage 1 – Core research: \$3.9 million (cash and in kind)  
Stage 2 – Research commercialisation: \$2 million (cash and in kind)

**Complementary HILTCRC projects:**

RP1.008 Green pyromet/hydromet beneficiation pathways

This project explores how byproducts from seawater desalination – specifically, the salty brine left over after removing fresh water – can be used to improve low-grade iron ore quality. The goal is to upgrade low-grade iron ores and tailings for direct reduced iron (DRI) production, which is particularly relevant for hematite and goethite ores from the Pilbara region in Western Australia.

#### THE CHALLENGE

Beneficiation is the process of improving the quality of ores by separating valuable minerals from waste material. Traditional beneficiation uses physical methods such as crushing and magnetic separation. However, these methods can create large amounts of waste (tailings), which can constitute 40-70% of input material, be costly to manage, and contain some of the iron ore itself.

The project aims to improve beneficiation using seawater brines left behind when reverse osmosis filters fresh water from seawater.

Rather than release the brine into the ocean, which can be economically and environmentally costly, the team is using it to produce sodium hydroxide (NaOH) through a process called salt splitting. This can then be used to leach the ore, or “wash it with soap”, as Project Co-Leader Dr Lina Hockaday describes it, to remove impurities such as silica, alumina and phosphorus.

“This chemical upgrading process has been studied for decades, but it’s never been commercialised because the reagents were too expensive,” she says.

**“IN THE BEGINNING, THIS SOUNDED LIKE A WILD IDEA – WE ARE NOW CONFIDENT THAT IT’S NOT, THAT IT HAS POTENTIAL TO BE A REALISTIC SOLUTION.”**

**- Dr Lina Hockaday, Curtin University**



*Project Co-Leader Dr Lina Hockaday in her lab at Curtin University.*

**INDUSTRY AND ENVIRONMENTAL IMPACTS**

By improving ore quality in a commercially and environmentally beneficial way, the project offers significant potential to boost both the sustainability and value of iron ore exports.

Furthermore, a PhD project has confirmed that the process can produce valuable byproducts, such as zeolites (used in water purification). Future work will investigate also producing geopolymers (which can replace cement in the manufacture of green concrete).

By upgrading the ore closer to where it is mined, the project also reduces the need for long-distance shipping of waste materials and lowers carbon emissions.

In addition to improving the quality of iron ore, the project could also help solve the problem of brine disposal from desalination plants.

“We’re taking two waste streams – iron ore tailings and desalination brine – and turning them into something valuable,” she says.

The initial evaluation phase of the project has been expanded with additional funding support from ARENA, MRIWA, Curtin University and additional project partners coming on board.

Another potential benefit is that for every tonne of iron ore processed, around six kilolitres of fresh water are produced as a byproduct.

“This water could be used for drinking, agriculture, or even in the production of hydrogen for green steel,” says Dr Hockaday.

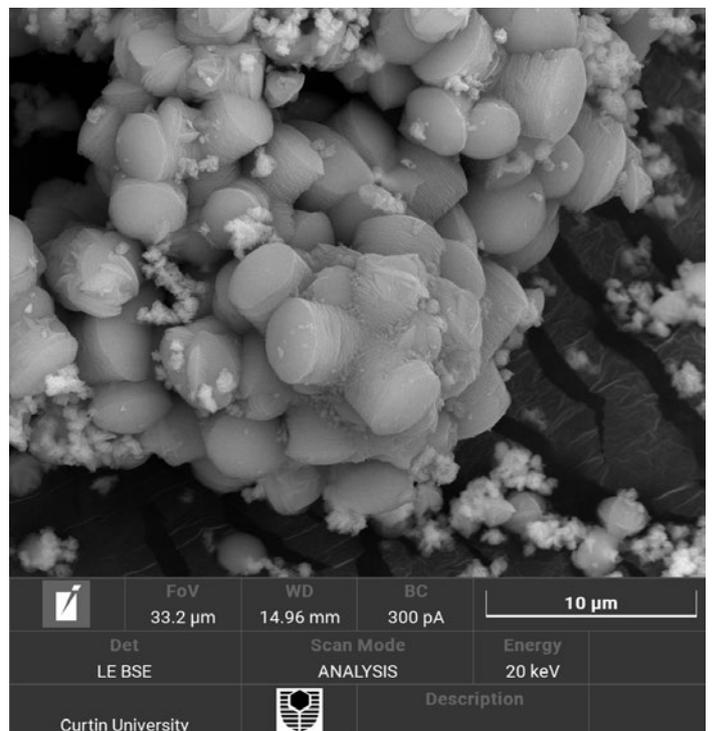
**FUTURE STEPS**

The project’s first year confirmed the feasibility of the technique and developed a detailed business case. It will now focus on testing and refining the process to ensure it is both economically viable and scalable by:

1. Conducting laboratory and mini-plant experiments to integrate the process steps
2. Developing a detailed techno-economic analysis to identify risks and determine the critical research required to develop the technology
3. Costing and designing a pilot plant for the process. This pilot plant will be crucial in demonstrating the scalability if the process in future.

Dr Hockaday emphasises that collaboration with industry partners, such as iron ore producers Fortescue and Roy Hill, is critical.

“Every time we report results, they give us feedback on how it would affect their operations,” she says. “We get that understanding of the value chain, and the value proposition for industry.”



*Scanning electron microscope (SEM) image of zeolite crystals (image courtesy of Curtin University with thanks to John de Laeter Centre for the use their SEM equipment).*