

SUSTAINABLE PROCESSING

A visionary mission: towards zero w

By **BRENDA LEAHY**

AS THE old adage goes, you cannot make a silk purse out of a sow's ear.

But pioneering work at the Cooperative Research Centre for Sustainable Resource Processing (CSRP) is proving otherwise, with the development of technical solutions that promise to transform waste from mineral processing and metal production industries into valuable resources.

Iron and steel from smelted red mud (bauxite residue), hematite 'iron ore' from copper-uranium tailings and a biomass-derived charcoal fuel from a salinity solution that may close the carbon loop while reducing coal consumption – these are among some of the breakthrough initiatives and visionary assignments emerging from the CSRP as it explores a new and sustainable way forward for industry under the heading of "Towards Zero Waste and Net Emissions".

Launched in October 2003, the Centre's overall mission is to reduce the ecological impact of resource processing and progressively eliminate waste and emissions, in ways that enhance business performance and are in line with community expectations. So far it has launched a series of innovative projects, each with separate expected outcomes, but connected to the major foundation Towards Zero Waste project.

Essentially, the work examines resources going in and coming out of the mineral processing cycle. On the input side, advanced mineral processing and metal extraction techniques are being applied to help industry efficiently use mineral resources and reduce wastes in materials cycles. At the other end, notorious mineral processing by-products – residue, sludge, slag, fumes and dust – are being put under the microscope to identify and test the potential for the separation, recovery and reuse of valuables.

CSRP Program Leader Dr Sharif Jahanshahi says Towards Zero Waste

is the defining project, which informs and guides the role, scope and extent of the current and future projects in the CSRP's expanding portfolio.

Towards Zero Waste researchers and their strategic partners have looked at a large number of waste streams, developing a systematic approach for characterising and prioritising the top 20 industrial wastes for future investigations, reviewing literature and industry practices and developing conceptual flowsheets with zero-waste outcomes.

"In order to rank and prioritise the top 20, we applied a decision support framework, purpose-designed by our partners at the University of Sydney," says Dr Jahanshahi. "Further, we adopted a consultative, cross-discipline and multi-functional approach involving industry, researchers and agencies such as the EPA."

In the ranking process, a range of factors came into play, including the techno-economic and socio-political dimensions, as well as issues and

challenges specific to each waste.

Among its top priorities, Towards Zero Waste identified the opportunity to address red mud from bauxite processing in the aluminum cycle.

Australia currently produces about 30 million tonnes per annum, and it is estimated that about 80 million tonnes per annum are produced worldwide, a factor influencing its number one ranking in the Towards Zero Waste project.

At a discrete project level, breakthrough technologies to extract valuable resources from red mud are being developed by the research team, with a range of viable options now on the horizon. These include smelting red mud for pig iron, a recycled soda- and alumina- rich stream for alumina production and a slag containing titanium, silica, lime, alumina and magnesium. Simple separation techniques are being applied to the slag to separate a high-grade titania product and a residue suitable as feedstock for a cement

Zero Waste Priorities

AT A GLANCE

Project: Recovery of valuables from red mud.

Focus: Technically and economically viable processing options for recovering valuables from red mud in a sustained way.

Scope: Literature reviews to avoid duplicating previous studies and strategies and ensure relevance and currency, especially key issues confronting the industry, such as red mud disposal. Characterisation studies to pinpoint physical properties of red mud, including chemical and mineralogical analysis and radioactivity department. Laboratory smelting trials on red mud samples aimed at producing a range of value-added products in a zero-waste mode.

Outcomes: Identified the key properties of red mud for future processing and to assess the potential for fractionating valuable constituents into various sizes to enable their separation. Potential to smelt red mud to produce a pig iron product, a soda-rich fume and a slag containing titanium, lime, alumina, silica and magnesium. Application of separation techniques to the slag to beneficiate a high-grade titania product and a residue suitable for cement kiln.

Status: Industry support being sought to continue studies and opportunities to test processing options on more red mud samples.

□ **CONTACT** Sharif.Jahanshahi@csiro.au +61 3 9545 8621

waste

kiln. The net effect, according to the researchers, is that valuables in the mud are deported to saleable product streams in which there is no final waste.

THE VALUE IN RED MUD: MANDIE MATHESON PERFORMS A LOW-TEMPERATURE WATER LEACH ON A SAMPLE.
PHOTO: CHRISTIAN PEARSON



'In many ways, it's a transformational approach to our own work'

Among the other high priorities is a project targeting copper removal from tailings by chloride volatilisation to produce a valuable new iron resource. "This promising project, while still in its early stages, is currently being exposed to industry for comment and we can see a clear path forward," says Dr Jahanshahi.

In another project, the researchers from CSRP, the Salinity Cooperative Research Centre and the West Australian Department of Conservation and Land Management are working on biomass-derived fuels and reductants for high-temperature metallurgical processes,

including rotary kilns and bath smelters.

This R&D team is zoning in on the potential to use woody residues – from short harvest cycle trees (oil mallee) – for generating low-cost charcoals as a sustainable alternative to greenhouse gas producing coal. Notably, the woody residues are from trees being planted in West Australia's wheat belt as part of a salinity treatment program which involves lowering the water table.

"The early indicators from this research are that due to the high reactivity of charcoal, we may be able to replace one tonne of coal with far less charcoal. And there are other benefits: it helps close the carbon loop and reduces dependency on fossil fuels," says Dr Jahanshahi.

He says the success of Towards Zero Waste and the allied projects hinges on its multi-disciplinary approach. It brings together the stakeholders, as well as the scientific and engineering experts, during each phase of research, development, pilots and feasibility studies to examine the full spectrum of issues and opportunities.

"The zero-waste concept and full-value recovery requires chemical and phase transformation. Our expertise in high-temperature processing plays a central role in unlocking elements from crystalline lattices, as well as enabling them to be separated into different product streams.

"We are working across technical boundaries, both scientific and in engineering, and with all key stakeholders. Together we can think critically, differently and strategically about the business case and viable solutions that will take the industry forward to its preferred future. In many ways it's a transformational approach to our own work," he says.

The Centre has national and global capability, with nodes in Perth (its head office), Melbourne, Sydney and Brisbane, and key research partners including CSIRO, Curtin, Queensland and Sydney universities and ANSTO.

Alcoa, Rio Tinto and WMC have been in there from the start, initially providing seed funding and direction towards the research portfolio.

According to the Managing Director of Alcoa World Alumina Australia, Wayne Osborn, the CSRP's work underlines Alcoa's own focus on improving the manufacturing process, and in turn, improving the 'whole of life-cycle' value of aluminium.