The Extract

Centre for Sustainable Resource Processing

April 2008 Edition

From the CEO

Over the past few months, I have been visiting our industry and research partners giving presentations highlighting our accomplishments and summarising the significant progress made by CSRP over the past 4 years. The development of research capabilities, enhancement of research facilities, support of students at various levels, and the contribution to the scientific understanding of mineral processing by publishing more than 300 reports, articles and proceedings is in itself a significant legacy. Add to this at least three pilot plants with the potential for large scale trials and the contribution and value of CSRP is evermore apparent.

Planning for the CSRP Conference for 2008 is underway. This year's conference will be held in Brisbane at the University of Queensland's Customs House facility on 17-19 November. Further details will be published soon on the CSRP website www.csrp.com.au.

Stevan Green, CEO, presenting CSRP's highlights to participants at Murdoch University. (Photo Courtesy of CSRP)

Work on a bid for a new CRC (CSRP2) continues in parallel to the Innovation Program review by Senator Kim Carr. Following the review, guidelines for the next round of CRC bids will be issued, probably towards the end of this year. Work on the formal bid will continue and the selection process is expected to take until mid 2009. I will keep you informed on the bid process as we progress.

Stevan Green
CEO

Alcoa Technology Development Group Secondment

Cooperative Research Centres (CRCs) were developed to forge a tighter collaborative linkage between Australian industry and the Australian research community. Since the establishment of CSRP in 2003, Alcoa has been a core participant and shares our aims to:

- **create new methods to produce minerals and metals in a way that benefits the community, the environment and industry; and**
- **find technical solutions for progressively eliminating waste and emissions in the materials cycle, while enhancing business performance and meeting community expectations.**

Evan Jamieson of Alcoa's Technology Development Group, has been seconded part-time to CSRP to assist with the management of the Bauxite Residue Program. "This secondment represents a significant commitment to the CSRP and the ideals that it represents", Evan said. CSRP has a vision of sustainable minerals processing, where global material needs are satisfied with

Stevan Green, CEO, welcoming Dr Evan Jamieson to the CSRP staff office. (Photo courtesy of CSRP)

significantly reduced impacts upon the environment and communities. "It is fantastic to be a part of this process, particularly as Alcoa has taken a lead in this field for some time". Stevan Green, CEO of CSRP said "We are delighted to have Evan join our team. He brings a wealth of knowledge and experience to our research program. I greatly appreciate the serious contribution that this represents from Alcoa, who have been a strong supporter of our activities since our inception in 2003".

CSRP's Bauxite Residue Program is continuing the research and development of technologies to reduce the volume of bauxite residue sent to storage, to recover valuable minerals and to find applications for by-products particularly in the construction industry.

Wayne Harding (AMMTEC Labs), Tony Rickards (CSRP) and Marko Hilden (JKMRC/UQ) beside the pilot-scale HPGR unit situated in Perth WA. (Photo courtesy of CSRP)

Geopolymer Concrete from Regional Waste Streams

Most tailings, residues, slags and fumes produces by the minerals processing industries contain large quantities of valuable components, such as aluminium and silicon. These waste streams have the potential to be separated, treated and transformed into more usable products. Our "Geopolymer Concrete from Regional Waste Streams" project enables industry to turn their aluminium and silicon bearing wastes into geopolymer products that can be widely used within

High Pressure Grinding Rolls

Finding more energy efficient methods to grind and crush ore is particularly attractive from a sustainability basis since it enables the reduction of the overall net energy consumption per tonne of product.

The high pressure grinding roll (HPGR) consists of two counter-rotating rolls that compress and break rock under very high pressure. The interest in the HPGR is driven by its potential to reduce direct grinding energy in a milling circuit by as much as 30%. The technology also eliminates the use of steel grinding media (used in mills), which contributes to about a 50% "hidden" consumption of energy in the grinding process.

The Köppern pilot-scale HPGR unit is used by the manufacturer for sizing full-scale industrial units based on a near production size (1.0 m diameter) unit that does not suffer from scale-up errors of small laboratory-scale rolls.

Our HPGR Triple Pass project aims to quantify the energy savings that can be achieved in three passes through high pressure grinding rolls compared with traditional semi-autogenous and ball mill grinding mill circuits. In addition to tests carried out on these 1.0 m diameter rolls, a smaller laboratory HPGR unit at CSIRO Pinjarra Hills (Qld) will be used to test a variety of different three-pass HPGR circuit configurations.

HPGR is a dry process which is also attractive from a sustainability perspective as it reduces water consumption during processing when coupled with a suitable dry separation process. This project offers long term energy and grinding media benefits to processing operations. The development of this research capability will also provide a platform from which to execute a multitude of other related research initiatives that involve HPGR technology in existing plants.

Professional Development

CSRP's School Teacher Professional Development Program has expanded to Victoria with an after school workshop offered in Geelong (7 April) and a one-day course presented in Ballarat (8 April). These PDs are a collaborative effort with the University of Ballarat. There was also a full-day professional development course run at Murdoch University on 24 April. More workshops are scheduled for WA and Victoria in July, as well as teacher PDs running in Queensland.

CSRP is again a co-sponsor of the Financial Management and Project Evaluation in the Minerals Industry professional development course along with Murdoch University.

The 4-day course on 9-13 June will be open to CSRP postgraduate students as well as Murdoch year 3 and 4 Extractive Metallurgy students. If places are available, they will be offered to interested staff of industrial participants. Dr Pietro Guj, Associate Professor in Mineral Economics, Western Australia School of Mines, Curtin University of Technology, will be the principal presenter.

Visit the Education section of the CSRP website www.csrp.com.au/education/ for details of upcoming courses, or contact our Education Manager, Dr Dan Churach on 08 6436 8735 or email dan.churach@csrp.com.au

The CSRP Education Program has made a submission to the Cooperative Research Centre Association's Awards for Excellence in Innovation. This year's entry was for the CSRP-Murdoch Teacher Professional Development Program. Award winners will be announced at the CRCA Conference in Sydney on 22 May.

their region, as well as being a low greenhouse gas alternative to Ordinary Portland Cement based concretes. A number of organisations have recently approached CSRP with interest in this area.

The geopolymers team has been comparing samples of geopolymer concrete created from waste streams against Ordinary Portland Cement by using country-based regulatory tests designed to ensure that the environment is safeguarded.

The toxicity characterization leaching procedure (TCLP) is one of the four characteristics used to identify whether a particular hazardous waste is adequately immobilised in a solid to be used for landfill disposal. We have been able to immobilise Lead, Chromium III (Cr3+), Barium and Silver in a geopolymer matrix separately to pass the TCLP test for 1% by weight of the metal.

Radioactive elements Caesium and Strontium have half-lives of about 30 years and are soluble in water, especially Caesium. They therefore pose a significant threat to the biosphere if they are not immobilised in a solid to prevent leaching for at least 300 years. By using simulated Caesium and Strontium added as hydroxides it was possible to immobilise them in a geopolymer matrix containing up to 5% by weight of the equivalent element. A regulatory test for high level radioactive borosilicate glass was used. Uranium was also similarly immobilised at levels of up to 2% by weight.

By passing these two regulatory tests, geopolymer concrete created from waste streams can be shown to be successfully transformed into a more valuable product. By utilising waste streams in this way, industry can make a significant step towards zero net waste and emissions.

Students

Study within CSRP allows a student to be at the forefront of helping eliminate waste and emissions in the minerals cycle while at the same time improving business performance and contributing to the general good of the community at large. We welcome several new students beginning their research with CSRP in 2008:

Narantuya Batmunkh,	Curtin University of Technology (Civil Engineering, PhD)	"Using Industry By-Products in Western Australia for Reducing Shrinkage Cracks of Soil-Cement for Base Course Materials"
Ashfaque Ahmed Chowdhury,	Central Queensland University (Sciences, Engineering and Health, PhD)	"Modelling and Simulation of the Thermodynamic Processes of Vertical Shaft Kiln used in the Production of Dead-Burned Magnesia"
John William Reuter,	University of Queensland (Sustainable Minerals Institute, PhD)	"Development of Decision Making Framework for the Optimisation of High Pressure Metallurgy Unit Operations Incorporating Power Recovery"
William Rickard,	Curtin University of Technology (Physics, PhD)	"Geopolymers"
Daniel Tuazon,	University of Queensland (Sustainable Minerals Institute, PhD)	"A Structured Approach for Incorporating Sustainable Design Principles into the Decision-Making Processes at Mineral Processing Operations"
Alison Prior,	Murdoch University (School of Environmental Science, Honours)	"Water Auditing and Conservation for Kwinana Industry Council"
Sonam Tashi,	Curtin University of Technology (Chemistry, Honours)	"The Impact of Silicate Species on the Microstructure of Geopolymers"
Anthony Leung,	University of Queensland (JKMRC, 4th Year Project)	"Measuring Material Interaction Properties for Discrete Element Modelling (DEM)"

There are currently 25 PhD, 5 Masters and 2 Honours students pursuing degrees as CSRP researchers in addition to the 3 PhD, 5 Masters and 21 Honours graduates in the CSRP alumni to date. Our latest PhD graduate is **Murray Johnston** (University of Western Australia) whose thesis entitled "Thermodynamics of Selenium and Tellurium in Molten Metallurgical Slags and Alloys" was passed late in 2007. Murray has accepted a post-doctoral position at the University of Toronto where he will be partly funded by Hatch and will work on the steel making process.

Meet and Greet

Jason Donnelly

CSIRO Minerals' Jason Donnelly, a qualified fabricator who also holds a Certificate in Laboratory Techniques, has worked on several CSRP projects during his career. These include biomass (he built the pyrolysis rig for the project), the early removal of arsenic using flotation, and his current project - dry granulation of slags.

Jason was initially brought in for his engineering expertise to help build the rig. "Funnily enough, I was told it was simply a matter of welding two pieces of pipe together, but it certainly proved to be more complex than I initially thought," he says

Although he found constructing the rig technically challenging, Jason is pleased with the end result. "It's been great to build something that performs as it should and looks good as well. Now I'm looking forward to the next stage of the project – hot commissioning and eventually scaling-up the rig for plant trials."

Michael Rutledge

Michael Rutledge is a research associate with the centre for materials research at Curtin University of Technology in Perth. After completing his honours degree in Nanotechnology, Michael began working with the geopolymers team at Curtin in March 2007.

Michael has seen his role diversify into what he calls a "jack of all trades". In any one day he can find himself arranging team meetings, using the centrifuge to remove air from liquid samples, cutting cured samples to size, or performing compression and corrosion tests as well as obtaining microstructural information.

"I really like the independence", says Michael who will often be asked to carry out various tests or follow up on leads with the prospect of finding new applications for geopolymers. In what began as a bit of creative fun, Michael and his colleague Temuujin Jadambaa, have constructed a chess set from fly-ash (dark coloured) and metakaolin (light coloured) geopolymers which will soon be on display in the John Curtin Prime Ministerial Library at Curtin University.

Jason Donnelly (top) inspecting the new pilot-scale integrated process for recovery of high grade heat from molten slags. (Photo courtesy of CSIRO)

Michael Rutledge (bottom) with the new geopolymer vibration table, yet to be installed in the geopolymers laboratory at Curtin University. (Photo courtesy of CSRP)

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