

NEWSLETTER



Centre for
Sustainable
Resource
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From the CEO

The past few months have been an extremely busy time for CSRP. We have come to the end of our third year and with this, the completion of our first suite of projects. There has been a tremendous amount of work done by our researchers to develop the next suite of projects, with an emphasis on translating fundamental research to more applied research, with the necessary fundamental research continuing to be an important part of our research portfolio.



Two of our original projects, "Biomass as Fuel and Reductant in Modern Smelting Processes" and "Control of Minor Elements" are featured in this edition and showcase the diversity of the world class research undertaken by CSRP. Our minor elements program is finding better ways of removing toxic elements from the processing cycle and exploring options for safe disposal; while our Biomass project is exploring alternative sources of carbon that in some cases could have the added benefit of addressing the salinity problem in Australia.

There has been much activity in our Education Program, with the running of the annual Student-Industry-CRC Symposium, this year held in Gladstone, Queensland. Students from the Mining and Energy CRCs, as well as mineral processing students from other research organisations attended this year's event with a large representation of industry from the Gladstone area. I congratulate Dan Churach and Janine Lay on their efforts in co-ordinating and hosting an event that successfully brings together such a diverse group of people, and highlighting to industry the valuable resource we have in our students.

The new projects in our research portfolio mean it is an exciting time going forward for CSRP. I look forward to showcasing more of our research and presenting outcomes that moves towards our vision for a sustainable future.

Stevan Green
CEO

Biomass as an Alternative to Coal

The term "working across boundaries" has never been truer for the recently completed CSRP Project "Biomass as Fuel and Reductant in Modern Smelting Processes." Working on the idea that charcoal can be used to replace fossil carbon as the reductant in high temperature metallurgical processes, CSRP researchers at CSIRO Minerals have investigated the idea of trees to provide charcoal for metallurgical processes.

What makes this project unique is that it brings together 3 different organisations who are attempting to deal with some of Australia's environmental issues, namely salinity and green house gases (GHGs). The CRC for Plant-Based Management of Dryland Salinity (CRC Salinity) is investigating the use of Mallee trees as a method for tackling salinity in agricultural areas. With the assistance of the Western Australian department of Conservation and Land Management (CALM), Mallee trees have been planted in the wheatbelt area of Western Australia.

Mallee trees were chosen for their short harvest cycle. The oils from the trees can be extracted and used in other industries, while the large quantity of woody residue (biomass) provides a potential supply for low cost charcoal.

While the CRC Salinity and CALM are continuing their efforts towards improving the salinity problem, the use of Biomass has the potential to significantly reduce the net carbon emissions or GHGs to the atmosphere during metallurgical processing by providing a cost effective alternative to the use of solid carbon. Research at CSRP has focused on assessing the two fractions (wood and leaf/twig/bark) of Mallee trees as reductants for rotary kiln and bath smelting processes. The literature review and market survey addressed the application, availability and properties of charcoal in high temperature metallurgical processes as well as the social issues associated with using charcoal. Opportunities have been identified through this review that would allow for the replacement of solid carbon with charcoal. Of particular interest to this project have been the iron and steel making processes, and the non-ferrous processes such as aluminium and silicon production. Properties such as the volatiles content, ash content and composition, density, mechanical strength, reactivity and electrical resistivity were investigated and found to be important factors in determining which metallurgical processes charcoal can be used.

The experimental program focused on assessing the performance of Mallee tree derived charcoals as reductants for the reduction of ilmenite and for iron bath smelting. The characterisation of the charcoals showed most properties were equal, if not better than, those of coal currently used in these processes. In particular, it has been shown that the reduction rate for ilmenite reduction is twice that of Collie coal and that the dissolution rate of charcoal in iron bath smelter is equal to that of solid carbon.

The work carried out in this project has produced very interesting results and has demonstrated from a technical view point that charcoals produced from Mallee trees are suitable reductants for processes such as ilmenite reduction and iron bath smelting. CSRP is undertaking further biomass projects to implement the results as well as extending the project to other processes. A pilot study will also be undertaken looking at biomass use in a regional centre where biomass producers and potential customers are co-located. With biomass research being a key strategy within the Breakthrough Enabling Technologies Program in CSRP, our recently completed project, along with the upcoming suite of projects, will make a considerable contribution to the knowledge base and application of biomass in mineral processing.



Sampling a molten iron bath during injection of charcoal (Photo by C Pearson)

Minor Elements - Reducing their Impact

Trace/minor elements in mined materials can be valuable, a nuisance or hazardous, or all three. Minor elements can have a major impact on the processing of ores, the choice of technology and processing flowsheet. They can make a big ore deposit unattractive and "too dirty" to commercialise. Trace levels of potentially eco-toxic elements such as arsenic and mercury can aggregate to significant tonnage in high volume operations; hence introduce large tonnage of toxic elements into biosphere.

The Centre for Sustainable Resource Processing (CSRP) is conducting a number of investigations examining ways to reduce the impact of minor elements through their removal and safe disposal. CSRP's world-class research teams at CSIRO Minerals and ANSTO are looking at the department of these elements through the process and modelling ways of removing them in the early stages of processing. Safe disposal options are also being investigated as the concentration of these elements increase. Selective flotation and roasting of arsenic-containing copper ores has shown promising results and research will continue to better refine this process.

Fundamental studies at CSRP has been aimed at quantifying the department of minor elements, such as arsenic, antimony, bismuth, cadmium, selenium and tellurium, across mineral processing and metal production value chain. This is being done through the determination of thermodynamic properties and application of thermodynamic tools in analysis of existing flow sheets. The research team has also been investigating the early removal and safe disposal of arsenic during production of base metals from sulphide concentrates. Arsenic is a highly toxic element found in a wide range of ores, in particular base metal ores. Thus there are the health and environmental issues associated with processing such ores, but with growing demand for metal products and depleting high quality ores in many countries around the world, there is limited choices but to process lower grade/quality ores.

Conceptually, there are different options for dealing with toxic material in ores and arsenic is no different. Determination of the nature of its occurrence (mineralogy and grain size) as well as how it is dispersed through the ore affects the suitability of



Warren Bruckard

examining the selective flotation of minerals also investigated the safe disposal of arsenic and other toxic elements with good degree of success.

On the other hand, when the arsenic is widely dispersed in mineral phases e.g. a solid solution, then physical separation becomes difficult and alternative steps have to be considered for its removal and safe disposal. The recently developed thermodynamic models of high temperature processes would become an enabling tool for assessing effects of key process variables on enhanced separation of minor elements such as arsenic. Recent application of CSIRO's MPE model has identified a few options for concentrating the arsenic into a few streams, rather than dispersing it.

When arsenic is concentrated in one or two of the mineral phases in the ore, then physical separation by selective floatation of arsenic bearing minerals becomes an attractive option. The separated arsenic bearing phases could then be treated by selective roasting for removal of arsenic from the base metals before its safe disposal. Over the past years, work done at CSIRO has demonstrated the concept when applied to a number of ores, where a high degree of physical and chemical separations were achieved. The study

In summary:

- There is increasingly community and government pressure on metal producers to reduce emissions and manage toxic elements department in an environmentally acceptable and sustainable way. Metal producers are also facing the challenge of ore bodies with higher levels of minor elements, which are difficult to process and hence liable of attracting penalties from smelters.
- There is now an increased focus on minor element department in flowsheet development for base metals ores. The early removal option described above potentially offers competitive advantage in respect of minor element dispersion and management issues, as well as maintaining overall valuable metal recovery.
- Predictive modelling tools can aid in flowsheet development and identify optimum conditions for concentrating minor elements in one or more output streams from pyrometallurgical processes. Such tools also enable plant metallurgists to account for department of major and minor elements across the flowsheet.
- There are several options for safe disposal of low volume highly toxic streams (e.g., slags, concrete, geopolymer and synthesised mineral phases) which could be generated with the early removal in processing.

Education and Training at CSRP

The 2006 Student-Industry-CRC Symposium

The 2nd Annual Student-Industry-CRC Symposium was held at the Central Queensland University, Marina Campus, in Gladstone, Queensland from 18th-23rd June 2006. This event brings together post graduate students and industry people with the aim of presenting a diversity of research in the mining and energy sector to potential employers and future colleagues.

Approximately 25 post graduate students representing 5 energy and minerals CRCs and 9 different universities participated in the symposium. The event included a presentation by each student describing their postgraduate research; workshops on communication, networking, and sustainability and synergies in regional areas; a hypothetical session and tours of area industry with a variety of sun downers and social events.

After an initial tour of the Gladstone region by Dr Glen Corder, the symposium was officially opened by Professor Jennelle Kyd Pro Vice-Chancellor, Central Queensland University (CQU). This was followed by an industry roundtable session entitled Careers in a Regional Area, moderated by Dr Janine Lay of Rio Tinto. A number of industry representatives participated on the panel, including George Bennetts (Gladstone Power Station), Dr Jason Connor (CQU), Bogdan Skomra (Queensland Alumina (QAL)) and the Mayor of Gladstone, Peter Corones.

Comalco General Manager of Operations Stephen Dumble hosted a Rio Tinto sundowner on the Monday evening, where more than a dozen Comalco and QAL employees mixed with students, in conjunction with Rio Tinto's Graduate Recruitment drive. Comments received proved the evening was worthwhile.



Participants of the Student-Industry-CRC Symposium



Jacqueline Medvecka presenting at the Student-Industry-CRC Symposium industry makes to the local Gladstone community.

Mr Johann van Zyl, Managing Director of QAL, made a presentation entitled "Resource Processing and Sustainable Processing in Gladstone". His talk highlighted the Gladstone Area Industrial Network (GAIN) Regional Synergies Project begun in 2003. Mr van Zyl also gave an overview of the QAL refinery and the opportunities and contributions

Tuesday evening Philip Bangerter of Hatch Engineering hosted a hypothetical session "Success, Succession & Secession – Legacy & Innovation in 2026". The panel members included Dr Glen Corder (SMI), Dr Jim Avraamides (Murdoch University), Wes Nichols (Anglo Coal), Galina Ivanova (CQU), Dr Ken King (Gladstone Economic and Industry Development Board) and Melissa Russell (QAL). The session mimicked a radio call in show to involve students in considering a global future in which rising water and energy costs caused industry to develop greater efficiencies in mineral processing. Students were particularly enthusiastic during this session and proved that their thinking went beyond just the boundaries of their research. It included how their research affected their industry and the community and environment in which their industry operates.

Stevan Green, CEO of CSRP, presented a talk, "Sustainability in the Minerals Industry". This interactive session explored the whole concept of sustainability even debating the validity of using the term "sustainable" in a minerals context. This once again highlighted that the current group of students will one day be leading the charge in terms of how industry affects the community and environment and making mineral processing more sustainable for future generations.

Two student workshops were also conducted. "Sustainability and Synergies in the Energy and Minerals Sector" led by Dr Glen Corder had students design strategies that could better utilise the by-products of Gladstone industries with an eye towards a "zero waste" goal in the future. Dr Janine Lay engaged students in a series of exercises aimed at developing communications skills in a session called "The Role of Networking in Your Career". This session provided students with practical examples of how being prepared can make all the difference when talking with future employees and showed students, through interactive exercises, the value of networking.

Industry tours were held on Monday afternoon and Friday morning with students visiting various Gladstone sites. Thank you to Central Queensland Port Authority, the Gladstone Power Station, Comalco Alumina Refinery and the Boyne Aluminium Smelter, for taking the time to show students their operations and how they have been integrated into the community.

The most important part of the symposium was the student presentations. All students made 15 minute Power Point presentations with a 5 minute question and answer session describing their thesis research. For the second consecutive year, Rio Tinto sponsored scholarship prizes totalling \$2500 for the most outstanding presentations. Students were given judging guidelines before the symposium and Drs Janine Lay, Jim Avraamides and Nick



Philip Bangerter leading the hypothetical session

Welham scored the talks. Out of the seven scholarship prizes awarded, 3 of the students are part of CSRP. Congratulations go to Jacqueline Medvecka, University of Queensland, Ross Williams, Curtin University of Technology and Peerapong Jitsangian, Curtin University of Technology (CSRP). The Student-Industry-CRC Symposium would not happen without the sponsorship of industry. This year's event was sponsored by Alcoa, Newmont, Rio Tinto, Comalco, Queensland Alumina Limited, the Central Queensland Port Authority and Queensland Energy Resources Limited. Other organisations contributing to the symposium were Anglo Coal (Callide Mine), Central Queensland University, Gladstone Economic and Industry Development Board, Gladstone Power Station, Hatch Engineering, Process Engineering and Light Metals Centre and the Sustainable Minerals Institute. Finally congratulations to Dr Dan Churach, Education Manager of CSRP, and Dr Janine Lay, Rio Tinto. It is their dedication and enthusiasm that enables such a worthwhile symposium to take place.

More details and photos from the Student-Industry-CRC-Symposium can be found at www.csrp.com.au/education/events/symposium2006.html

Gladstone Community Lecture

A Gladstone Community Lecture entitled "Aluminium through the looking glass – history, production, properties and uses" was presented on Friday evening 16 June by Dr Nick Welham, Senior MTEC Lecturer, Murdoch University. The talk was sponsored in conjunction with GAMSET, CSIRO and QAL and was aimed at making the metallurgy of alumina and aluminium come alive for the general public. The evening offered an exciting insight to the science, technology and historical context of one of Australia's most important metals. Aluminium may be the third most common element in the earth's crust but it is far from ordinary. Dr Welham described how its properties make it extraordinary, why mercury is not permitted on aircraft and why aluminium was once considered a precious metal with 30 grams costing twice the daily wages of a common worker. The lecture was held at Gladstone State High School and was attended by GAMSET teachers, students and the public at large.



Dr Nick Welham (Murdoch University and Dr Dan Churach (CSRP) presenting at the Gladstone Community Lecture

What's been happening at CSRP Green Processing 2006

CSRP sponsored the 3rd International Green Processing Conference, held in Newcastle on the 5th and 6th June. The conference on sustainable processing of minerals was split into several sessions covering minor elements, value from waste, regional synergies, water and industrial ecology, all of which are an important part of the CSRP's research portfolio.

Many of our researchers made presentations with the team from CSIRO Minerals presenting their research on the zero waste and the use of biomass in metallurgical reactors. Researchers from Curtin University and University of Queensland presented their work on the Regional Synergies and Geopolymers. CSRP sponsored the conference dinner, which was held in the Town Hall at Newcastle, as well as the technical session on Minor Elements. It was a successful conference with presentations having both a research and industry focus. Congratulations to those who presented

Meet and Greet

Our staff bring to CSRP a wide range of knowledge and experience. We are pleased to introduce some of them here

Dr Ralph Holmes, CSIRO QCAT

Dr Ralph Holmes has more than 34 years research and management experience with CSIRO. He obtained a BSc degree in Physics from the University of Melbourne in 1967 and subsequently a PhD degree from the same University in 1972 for development of a new electron microscope system and its use in electron diffraction studies of the structure of barium titanate. He joined the CSIRO Division of Mineral Physics in November 1971 to work on the application of nuclear techniques to the on-stream analysis of iron ore and subsequently other mineral commodities, including coal. Over the last 14 years he has been involved in mineral processing research. He is currently Manager - Iron Ore Processing with the CSIRO Division of Minerals, focusing primarily on ore characterisation, comminution, beneficiation, agglomeration, process instrumentation, sampling and quality control. He is also Senior Manager of the CSIRO Mineral's Brisbane Laboratory located at Pullenvale.

Prof Chris Moran, University of Queensland

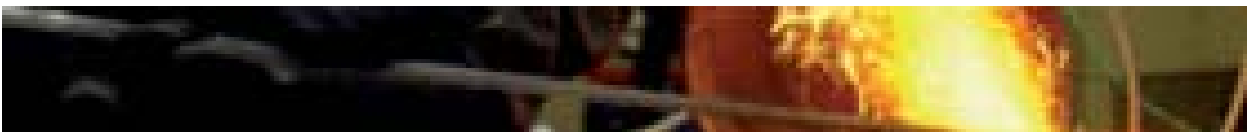
Professor Moran completed his PhD with CSIRO Division of Soils in 1988 and went on to spend two years in CSIRO Information Technology working on image processing and software engineering. In 1993 he was a visiting scientist at the Institut National Agronomique in France and between 1996 and 1997 he worked as assistant to the then CSIRO Chief Executive, Malcolm McIntosh. He previously led the team that developed the CSIRO Water for a Healthy Country National Research Flagship and his work drew new links between landscapes and waterway management. Chris is now the Director of the Centre for Water in the Minerals Industry, based at the University of Queensland. CWiMI sees application of systems approaches an important research priority for helping to bridge the gap between corporate sustainability policies and site operational performance.

Mr Dick van Beers, Curtin University

Dick van Beers gained his BSc in Industrial Engineering from the University of Professional Education Tilburg, Netherlands, and obtained his MSc (Applied Science) in 2000 from the University of Cape Town (UCT), South Africa. Dick has held many positions in the field of industrial ecology, including as a researcher of industrial ecology at UCT and a coordinator for the implementation of Environmental and Energy Management Systems for a large printing company (Roto Smeets Etten) in The Netherlands. He has also been an Independent Environmental Researcher for Yale University (USA) and an Environmental Management Consultant for African Environmental Solutions, South Africa. Dick is a currently a Research Fellow with the Centre of Excellence in Cleaner Production at Curtin University working mainly on the CSRP 3B1 project 'Capturing Regional Synergies in the Kwinana Industrial Area'. This project provides hands-on support to Kwinana industries to develop, evaluate, and implement regional synergies.

Dr Dan Perera, ANSTO

Dr. Dan Perera obtained a B.Sc.Tech. (Hons) in Ceramics Technology from the University of Sheffield in 1970 and a PhD from the University of Newcastle Upon Tyne in 1976 on engineering ceramics. He has worked at universities, government research institutes and in the private sector involved in management, research and development for nearly 40 years. He joined ANSTO in 1989 and has worked on advanced ceramics, refractories, cements and geopolymers. Since 2002 he has been leading the task on geopolymers at ANSTO, on the immobilisation of low-level/intermediate-level radioactive nuclear waste and hazardous wastes. He has been an invited speaker on geopolymers at several international conferences. "Geopolymer Concrete from Regional Waste" is a CSRP project where Dr Perera is a member of a team from ANSTO contributing to this project.



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