

The Extract



From the CEO

In March we submitted an application to extend CSRP's Cooperative Research Centre grant beyond January 2010. We have since been notified by the Department of Innovation that our bid for CSRP2 was not selected to go forward to the next stage of the CRC Program selection round. This is of course a disappointment to us all – however we have a very dedicated team of people that are keen to further the work of CSRP and as such, will be considering all options over the coming weeks and months. Our Chairman, Malcolm Macpherson, and the Executive met with the Technical Advisory Panel Working Group in Perth on 30 April to kick off this process.

It was agreed that CSRP has achieved some remarkable results and that we should continue to ensure that this work is completed to a high standard, such that maximum value is obtained from our outputs. In addition, it was agreed that a number of activities could be developed further – beyond CSRP's current scope – and that the team would seek ways to find the required resources to do this.

On 26 May at the recent CRC Association conference in Canberra, the Minister for Innovation announced that a new 12th CRC Selection Round was open and would close on 14 August 2009. This was much sooner than anticipated! At this stage, the Executive and Governing Board are considering the option of submitting another bid in Round 12. In parallel, plans are being developed for the wind-up of the current program of work by June 2010.

I would welcome any feedback on the recent bid process and ideas for the future. We look forward to working to develop

options beyond CSRP and I will keep you posted on these developments.

In other news, I travelled to South Africa to present at the Sustainability through Resource Conservation and Recycling (SRCR 09) conference and to visit with our project affiliates at the University of Cape Town. I also took the opportunity to visit the iThemba Laboratory for Accelerator-Based Sciences – home of the Positron Emission Particle Tracking (PEPT) facility in which CSRP is a participant, and which will greatly enhance the research into efficient comminution and liberation.

I have met with various local and international visitors these past few months. Eduardo Dantas (Director, Sustainable Development) from Vale in Brazil received a presentation of our work in general and SUSOP® in particular. We have received two more requests for proposals for SUSOP® studies. The Technology Delivery Group from Alcoa received an update on our Geopolymer program of work. Corrine Boone (Managing Director, Environment and Community Interface), Philip Bangerter (Global Director, Sustainability) and Tracy Lydiatt (Sustainable Development Project Leader) from Hatch met with us to discuss future work with CSRP.

And I'm pleased to announce that the Geopolymer Alliance is now open for membership. See the article on the back page for details.

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Sustainability assessment forum

Planning is well underway for the CSRP sponsored half-day Sustainability Assessment Forum being run at the 4th Sustainable Development Indicators in the Minerals Industry (SDIMI) 2009 conference. The conference is being held from **6-8 July 2009** on the Gold Coast in Queensland.

The objectives of the forum are to present **actual case studies on implementing sustainability initiatives**, discuss the learnings from these case studies and elicit potentially feasible methods for putting sustainability initiatives into practice.

Panel members (representatives from engineering, industry, mining and research) will give a brief presentation on a sustainability initiative they have been involved with. The initiative will not necessarily have been successful, as a key aim of the forum is to better understand the barriers, as well as the drivers, for getting sustainability initiatives implemented. Stevan Green has been asked to chair the forum.

The proposed format is to run the case study presentations at the beginning of the forum and then use the presented information to engage the audience in an insightful discussion about the critical factors for realising successful sustainability outcomes. Given the diverse audience expected at the conference, it is anticipated that new and innovative ideas to promote sustainability initiatives would emerge. These ideas could form the basis for an action agenda which would be re-visited at the next SDIMI conference in 2011.

Visit www.ausimm.com.au/sdimi2009 to register. Discounts apply for AusIMM members, or contact Lisa Laurie by email lisa.laurie@csrp.com.au for a CSRP staff rate.

Grinding ore without steel



Photographs © M. Powell, JKMR

CSRP researchers from the JKMR at the University of Queensland recently visited LKAB, a mining company in Sweden. The LKAB site is an iron ore mine in the far north of Sweden within the Arctic Circle. When the researchers visited in May, the middle of spring, there was still occasional snow and temperatures around zero at night, accompanied by all-night light.

What is particularly interesting about the LKAB plant is that they do not use any steel grinding media in the mills, with an autogenous mill followed by a pebble mill. In 2008, the work of two CSRP researchers at the JKMR (Zeljka Pokrajcic and Rob Morrison) showed that the embodied energy of producing steel grinding media accounts for up to 50 percent of the total energy costs of milling ore. As such, the data from the LKAB site work will be used to further back up these studies.

The ore body is a massive slab of Magnetite (an iron oxide) extending deep underground at a 70 degree angle. LKAB use a mining technique known as sub-level caving, which involves undermining the ore body and collapsing it in a controlled manner.

The research team was lead by Prof Malcolm Powell from the JKMR and Prof Hakan Benzer (with two students) from our

partner researchers at Hacettepe University in Turkey. With the considerable assistance and enthusiasm of the site personnel, the team conducted nine surveys of the comminution circuit in seven days. They worked for 12 to 20 hours each day and processed 7.5 tonnes of samples at the site – with lots more to be processed back in Queensland. However, the team did manage one afternoon off for a fascinating drive up to the very north of Sweden.

By the time the team left site, the site personnel had learnt a great deal about their mill operation – completely shifting the operation of the pebble mill and shedding light on the grinding response and control options for the autogenous mill. All this was prior to processing the data and modelling the circuit, so we look forward to a useful contribution to our sponsor and high quality data for our research and modelling of autogenous milling.

Site work was conducted as part of the sponsor technology transfer within the AMIRA P9 project. The understanding gained from this data will be used to address specific site operational issues and forms a critical part of CSRP research in collecting full-scale experimental data for applied models.

Constructing roads without needing a quarry

CSRP, in collaboration with Alcoa, has supplied approximately **2,500 cubic metres of ReSand®** to Main Roads Western Australia for trial use in the widening of a road near Pinjarra, south of Perth. ReSand® is sourced from the minerals industry and can be used as a replacement for virgin sand mined in a conventional quarry – with a significantly reduced ecological footprint.

Looking much like any other sand, ReSand® has little if any dust, has great drainage and wetting properties, requires only light grading and compacts well. The construction crew have all been pleasantly surprised by this innovative product. The road trial will undergo monitoring over the coming months and further trials have been suggested.



Photographs © E. Jamieson, Alcoa

From waste to paste: Fireproof concrete that has risen from the ashes

Imagine reducing greenhouse gas emissions while developing a strong construction material designed to insulate against fire! Researchers from CSRP are using fly ash (a waste product produced from burning coal in power plants) to make concretes, called **geopolymers**, for use in high temperature applications such as fireproofing and building insulation.

The global community has accepted as real the threat of man made climate change and the negative impact of unsustainable resource consumption. Geopolymers have attracted the interest of many scientists and engineers eager to develop sustainable construction materials without sacrificing engineering performance. Geopolymers are not a plastic as their name might suggest. They are cementitious material formed by dissolving materials that contain silicon and aluminium, such as clay, in a highly alkaline solution.

A major advantage of geopolymers is that they can be **produced from waste material** such as fly ash, which reduces the source material cost and prevents the waste from being dumped in landfill. Furthermore, the production of geopolymers produces up to 80 percent less greenhouse gas

emissions than ordinary Portland cement, the common cement used in everyday construction. Cement manufacture currently contributes around 5-8 percent of the world's greenhouse gas emissions.

Now, you might think that an environmentally friendly cement made from waste ash cannot possibly be able to compete with the engineering performance of conventional fireproof concrete. Well, recent research by William Rickard and other team members at Curtin University of Technology are proving otherwise. They have shown that **fly ash based geopolymers exhibit remarkable fire resistance whilst also maintaining a high degree of mechanical strength.**

Geopolymers are an exciting construction material which offers economic, environmental and social benefits. The utilisation of fly ash geopolymers as a fireproofing material not only provides an economical solution to fire protection, but also has a suite of benefits for the environment and community. William Rickard's research on fireproof fly ash geopolymers was presented at the annual CRC Association conference on 26 May in Canberra.

Student research

PhD student **Alberto Melgoza**, studying at the University of Queensland, had his paper on "*Subtle sexism: Re-informing intergroup bias and regulating emotion in an Australian Organisation*" accepted by the Journal of Management and Organisation, due to be published in September. Alberto has also had a paper entitled "*Prejudice and Experience of Aggression at Work: The Role of Gender, Emotion and Climate*" accepted for presentation at the 2009 Academy of Management annual meeting being held on 7-11 August in Chicago. Alberto is supervised by Prof Neal Ashkanasy from the Business School at the University of Queensland.

Ross Williams, studying under the supervision of Prof Arie van Riessen at Curtin University of Technology, will represent both Curtin and CSRP at two international conferences during June. Ross's paper entitled "*Evaluation of the effectiveness of amorphous composition for fly ash geopolymer mix design*" will be presented at the 8th Pacific Rim Conference on Ceramic and Glass Technology in Vancouver, Canada. His paper on the "*Determination of the reactive component of fly ashes for geopolymer production – a comparison between leach data and QXRD*" will be presented at the 11th Conference of the European Ceramic Society in Krakow, Poland.

Ailar Hajimohammadi is a doctoral student at the University of Melbourne and is supervised by Prof Jannie van Deventer and Dr John Provis. Ailar will travel to Venice, Italy, to participate in the 2nd International Congress on Green Process Engineering (GPE 2009) in June. She will present her paper on "*Using synchrotron radiation Fourier transform infrared microscopy to investigate the effect of timed release of aluminate during geopolymer gel formation*".

PhD student, **Di Nichols**, will present her paper on "*Increasing teachers' content knowledge by developing partnerships with scientists*" at the annual conference of the Australasian Science Education Research Association (ASERA) to be held in Geelong, Victoria in July.

Two new undergraduate research students began their work at Curtin University of Technology this quarter. **Berlin Ciputra's** research on "*Geopolymer concrete using Bayer liquor as a binding agent in place of Portland cement*" and **Darryl Hole's** research on "*Mix design development of geopolymer concrete*" are being supervised by Dr Natalie Lloyd. Both students are working within our Geopolymer program with support from Alcoa.

Geopolymer Alliance open for membership

The Geopolymer Alliance is an initiative proposed by CSRP that aims to cooperatively develop mutually beneficial applications for geopolymer technology by bringing together research institutes, the engineering fraternity, Government authorities, industrial by-product generators, cement manufacturers, chemicals suppliers, concrete aggregate suppliers, concrete manufacturers, infrastructure owners and industry regulators.

The **prospectus** was issued in May and can be downloaded from the Geopolymer Alliance www.geopolymers.com.au or CSRP www.csrp.com.au/projects/ga.html websites. For further information please contact Dr Terry Gourley at the Geopolymer Alliance by email jtgourley@bigpond.com.

Collaboration in South Korea

A small delegation from Australia spent the week of 24 May in South Korea for a joint symposium, visits to industry and research organisations, and various technical discussions. **Dr Terry Gourley**, representing CSRP and the Geopolymer Alliance, along with delegates from CSIRO attended a day of presentations for the 3rd Korea-Australia Joint Symposium on the Technology for Sustainable Development of Mineral and Energy Resources.

The Korean hosts were very interested in geopolymers and asked Dr Gourley to give a second, extended version of his talk on "*Fly ash binders for geopolymer concrete*" to staff and students from the Korea Institute of Geoscience and Mineral Resources (KIGAM). These international gatherings help strengthen the relationships and networks between CSRP and Korean research organisations, help raise our profile and provide opportunities for future collaborative projects.