

ASSOCIATION

connections

australasian slag (iron & steel) association newsletter

www.asa-inc.org.au

Conference attracts enthusiastic response



The first ASA seminar this decade was a great success. Attendees included representatives from industry, cement companies, greenhouse network, consulting engineers, roads and ports, CSIRO and Universities.

This year's seminar brought together some of the ongoing research and the ecosociopolitical and economic environments in which slag producers, marketers and users operate.

Buoyant world steel markets are mirrored in Australia, ensuring ongoing supply of slag for the construction industry. BlueScope Steel projects a 40 million tonne supply of molten iron and steel rock over the next 20 years from Port Kembla Steelworks, underlying its role as a 'renewable quarry'.

The opportunity to save 17.03 tonne of greenhouse gas, or equivalent to emissions from a four-cylinder car for 5.66 years in constructing a residential dwelling was highlighted. Research covering environmental assessment of slag enables it to be classified as inert under the NSW Waste Classification Guidelines. Experience with the use of slag products for waste water treatment points the way for more innovative uses. The HEWSO (2004) cross discipline student group from the University of Wollongong brought quite a



Delegates at ASA Conference 2005

different perspective on slag products as a resource. Recognition of molten iron and steel rock (slag) as a resource and looking for its highest use is the key to maximizing its potential for the community was a key outcome from the conference flowing directly or indirectly through each of the presentations.

Considerable research has been carried out over the past 40 years that underpins the use of slag products in particular applications, as diverse as origami concrete canoes through to the Sydney harbour Tunnel immersed tube segments, Bass Strait offshore gas platforms

Sydney's Mascot Airport Third Runway and North West Shell Gas infrastructure and many other large items of public infrastructure.

This year's conference adds to that significant body of research and experience and underpins the fact that iron rock, steel rock and BF Sand and the products that are derived from them can and do make a significant contribution to the environment and development of durable infrastructure in Australasia. C

Hewso team wins ASA annual award

University of Wollongong's 2004 Hewso Yellow Team was awarded both of the Association's 2005 Higher Education awards (\$2000 total) sponsored by Komatsu Australia. Judges considered that this cross discipline team of University students clearly demonstrated great skill and initiative in dealing with complex

issues and presenting a set of innovative solutions to their sponsoring organisation in the space of 4 weeks.

Conference organisers considered it appropriate to have the team present their findings to delegates at this year's conference, showcasing their skills and demonstrating



Association Chairperson Shani Smith presents the Annual Higher Education Awards to Hewso Team Members Luke Coombes, Djurdica (Georgia) Ivancevic, Mohammad Mamun, Claudia Perry-Beltrame & Mitchell Pirie

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Connections Editorial Team

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innovation in the solutions offered. >

The report produced by the yellow team for BlueScope Steel Limited, describes the opportunities that present for BlueScope Steel Limited to recycle its by-product streams taking into consideration market activities, environmental issues and the community.

The key recommendations were placed within the context of the need to present a

Komatsu representative Peter Calder congratulates HEWSO 2004 team members: Luke Coombes, Djurdjica (Georgia) Ivancevic, Mohammad Mamun, Claudia Perry-Beltrame and Mitchell Pirie.

positive and environmentally active image for BlueScope Steel Limited.

Each year, the Association invites University Students to enter the ASA Annual Award, details of which can be found at www.asa-inc.org.au

Award sponsor Komatsu Australia is one of the leading distributors of mining, construction and forestry equipment in Australia and New Zealand. (Komatsu Australia – www.komatsu.com.au). C

ASA AGM elects officers for 2005

The past year has seen significant change for the Association, with its focus on the slag products from the manufacture of iron and steel. Changes throughout the year have contributed that alignment, including new livery and targeted research. The new look website was launched and the appearance of Connections changed in response. Research on shrinkage in concrete and classification of slags against the EPA NSW guidelines has made significant contribution to the already large body of knowledge about the materials and their performance.

Work of the Association is carried out through the main committees of Education and Promotion, Technical and Operations, with

governance the responsibility of the Executive committee. Chairperson Shani Smith paid tribute to the work of the Executive Director and committee members in making 2004 a successful year for the Association.

For the first time, the Association's AGM and Dinner was moved to the City location of the Radisson Hotel in Darling Harbour Sydney. The decision was taken to showcase some of the work of the Association and its members at a conference immediately following the AGM and before the dinner. Effectiveness of the Association's work was evidenced by the positive responses to the Conference and Dinner that followed the AGM.

Being eligible to stand for a third year,

Shani Smith (ASMS) was unanimously elected Chairperson for 2005. Other officers elected to guide the Association through the next year are Vice Chairman International – Bill Bourke (SteelServ NZ), Vice Chairman Australia – Oscar Gregory (Bluescope Steel), Treasurer – Simon Hodsden (Multiserv), Secretary – Andrew Wilson (EcoCem), – Executive Committee Members – Rob Newman (SCE Group), Ross Johnson (Hunter Mill Services), Michael Byrne (Steel Cement), Technical Committee Chair – Tom Wauer (Steel Cement), Education and Promotion Committee Chair – Simon Hodsden (Multiserv), Operations Committee Chair – Chris Stuckey (Metserv Australia). C

Conference Presentations: Key Findings

Speakers at this year's conference came from industry, university, environmental and consulting backgrounds. Each brought some new insights into the possibilities and performance of iron and steel slag products. HEWSO Yellow Team (2004) of students from the University of Wollongong provided perspectives from "outside the square" as they tackled issues of industrial co product management in industry.

A report on each of the presentations follows the full papers and presentations being available on CD from the Association office – email info@asa-inc.org.au

World of Iron & Steel – a construction materials perspective

Presented by: Ray Peters Manager Slabmaking BlueScope Steel – Port Kembla Steelworks

Authors: Oscar Gregory – Manager Operations Services Bluescope Steel – Port Kembla Steelworks and **David Jones** Director / Consultant Principal – Damaur

Consultants, Wollongong.

World Iron & Steel Production in 2004 is said to have passed the 1 Billion tonne level. The dramatic increase has not reduced the drive for rationalisation, even a suggestion of it in Australia.

Developing and offering solutions rather than just product is BlueScope's corporate focus. As well as producing water tanks, BlueScope Water is able to offer the complete installation package including plumbing. In Vietnam, BlueScope Steel came up with an ingenious design for houses subject to flooding, with the floor being able to be raised during the wet season.

One clear message from Bluescope Steel is the ongoing viability of the Port Kembla Steelworks, with production being increased gradually over the next 20 years rising from 5 MT/A to 6 MT/A.

Port Kembla steelworks produces 2 of the around 3 million tonne of molten rock (slag) produced in Australia each year. As

such, the steelworks is an "Endless Quarry" projected to produce 40 million tonne of **Iron Rock, BF Granulate and Steel Rock** over the next 20 years.

Marketing **Iron Rock, BF Granulate and Steel Rock** has been typically focused on the low value bulk commodity end of the market other than product supplied into the cement industry where it brings significant environmental benefit. Research conducted over the years together with the material's successful use in a number of Australia's high profile infrastructure projects provides confidence for pursuing higher economic, social and environmental value uses.

Given the projected continuity of supply is time for Iron Rock, BF Granulate and Steel Rock (slag) producing and marketing organisations to become a "solutions-based" industry that changes the landscape of the country. This will require attitudinal changes on behalf of producers, processors, marketers, Government and specifiers.

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Milled Slag: Making a difference on lane cove tunnel

The Lane Cove Tunnel project, currently under construction by Thiess – John Holland Joint Venture (TJHJV), is one of the most ambitious and challenging construction projects undertaken in Australia. Almost quarter of a million cubic metres of concrete will be supplied to the project. The Lane Cove Tunnel connects the end of the M2 motorway to the Gore Hill Freeway at Artarmon, significantly reducing traffic congestion along Epping Road. The works also include road widening at Epping Road and major improvements to interchanges and traffic flows along the Gore Hill Freeway, from the Pacific Highway to Falcon Street. Given the current traffic volumes already utilising these roads, and the limited space available, the task is an enormous challenge for TJHJV, contractors and suppliers alike.

Readymix has an established plant at Marden Street in Artarmon: ideally located for the supply of concrete to the main tunnels and above ground works. Given Readymix's recent experience in supplying major road and rail infrastructure projects, combined with expertise in utilising milled slag to improve concrete performance, an opportunity was identified to use slag to the benefit of client and supplier alike.

Readymix has been using milled slag across Sydney for a number of years. Silo capacities have been increased to provide storage for the product, and it is now seen as "here to stay" in Readymix mixes. It has

provided a number of benefits, particularly in durability, heat of hydration and long-term strength gain. Its' successful use in a cut and cover tunnel section on the Parramatta Rail Link, with a design life of 100 years, has ensured that its versatility and cost-effectiveness are a major consideration in evaluating opportunities to improve mix performance on major projects.

It was observed that many bridgework sections of the Lane Cove Tunnel have challenging durability criteria, which has

previously led to the use of concrete with a characteristic strength far higher than the design strength. So, a different approach was taken. Concrete was trialed incorporating milled slag for added durability. The benefits to the client are clear: concrete with improved durability performance, at a cost saving, and an opportunity to learn for future projects. The use of slag for the benefit of client and supplier is typical of the collaborative approach being taken by Readymix on key projects. **C**



Work Compound on the Warringah Freeway Island



Tunnel works



Tunnel construction from Marden Street



Shotcreting

"Silo capacities have been increased to provide storage for the product, and it is now seen as "here to stay" in Readymix mixes."

Lane Cove River

Sirius Road

Epping Road

Driven tunnel

Pacific Highway

overpass

Cycle and pedestrian path

Photos: Lane Cove Tunnel Project www.lanecovetunnelproject.com.au

and tunnel access

Pacific Highway Interchange

EcoCem: Making a difference to the environment



Ecocem Pty Ltd specialises in processing and marketing ground granulated blast furnace slag from BHP Port Kembla.

Granulated slag when used in cement manufacture, provides significantly improved performance and durability and contributes around 0.8t/t greenhouse gas saving compared to ordinary Portland cement use.

Blue Circle Southern Cement also grinds granulated slag for the concrete industry and supplies about half of the Sydney and NSW market. Independent Cement Ltd (ICL) process Port Kembla granulate for the Victorian market.

Port Kembla granulated slag, ground with cement by Blue Circle Southern Cement was used in the Sydney Harbour Tunnel Tube segments to replace 65% of the ordinary cement

used in the concrete to provide exceptional performance in the marine environment.

A number of the large infrastructure projects around Australia have used ground granulated slag cements. One of the earlier uses during the 1970's was the North West Shelf offshore gas platform and landbased installations. Cement replacements of 25% through to 90% (grout application) were used.

Construction on the Ecocem plant started in August 1999 and was completed in July 2001. The plant was constructed using state of the art technology.

The construction process employed approximately 110 people over the construction phase. A lot of environmental innovation and creativity was incorporated into the construction.

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small towns where space is not a key constraint, being economical, simple to install and operate.

A key focus for the future is in targeting the treatment of run off from roadways. In Korea, steelmaking slags are used to restore the harbour bottom. Of particular interest and the subject of future research is the rejuvenation of aggregates used in phosphorus removal and their potential for future use in agriculture.

Latest Slag Cement research

Presented by: **Dr Jay Sanjayan** – Associate Professor in Civil Engineering at Monash University

Long term durability of major structures has always been a focus for both infrastructure owners and construction contractors or

authorities. Shrinkages is one of the factors that influences cracking in concrete impacting on durability. ASA sponsored an experimental program conducted at Monash University to distinguish the factors that affect the long-term drying shrinkages of concrete containing blended cements (Type GB).

Altogether 28 concrete mixes were tested up to 180 days for drying shrinkage and compressive strengths. The mixes were based on a typical Grade 40 concrete with 80 mm slump. The mixes included two types of cements (Type GP and SL) and four types of supplementary cementitious materials, namely, three types of slag and one type of fly ash. Type GB ratios of 35/65, 50/50 and 65/35

were tested. In addition to the standard tests, a modified shrinkage test was also carried out to measure the shrinkages between 0, 1, 3 and 7 days.

Results show very large strains occur between 0 and 1 day in all the concretes. Concretes containing slag exhibited expansion strains between 0 and 7 days. A lot of variation takes place in the first 24 hours whilst the concrete is still plastic. In this state, shrinkage can be absorbed by the creep and as such is not part of the cracking influence.

For the slag mixes as measured by Australian Standards at 7 days the level is higher but if measured from 1 day, the level is lower. Lowest shrinkage is with 65% slag. **C**

Company Members

A primary role of our Association is to bring together Slag Producers, Processors, Customers and Suppliers to the Slag industry. Our activities cover Technical Developments, Plant Operations and Processes, Education and Promotion. If you would like more information on the Association and how you can become involved, just complete the information section at the end of this newsletter. Current membership is as listed below.

Australian Steel Mill Services Pty Ltd
BlueScope Steel Ltd (Port Kembla)

Brambles Equipment Ltd
Brambles Industrial Services Ltd (Whyalla)
Concrete Institute of Australia
Concrite Pty Ltd
CSIRO CMIT
Ecocem Pty Ltd
Heckett Multiserv (UK)
HiSmelt Pty Ltd
Holcim NZ
Hunter Mill Services Pty Ltd
Komatsu Australia Ltd
Multiserv Australasia Pty Ltd
OneSteel Limited (Whyalla)
University of Newcastle – Mr Stephen Fityus

University of Wollongong – Dr Denis Montgomery
Premium Tyre Service Pty Ltd
Readymix Holdings Pty Ltd
Roads & Traffic Authority of NSW
Slag Cement Sdn Bhd, Malaysia
Smorgon Steel Ltd (Melbourne)
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Related Associations

European Slag Association (EU)
Canadian Slag Association
National Slag Association (US)
Nippon Slag Association (Japan)

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Supplementary Cementitious Materials and Greenhouse Gas Reduction Benefits

Presented by: **Craig Heidrich** – Executive Director
Australasian Slag Association

SCM's potential to lower Australia's Greenhouse gas emissions profile.

Authors: **Craig Heidrich**¹, **Dr Ihor Hinczak**², **Bridget Ryan**³, ¹HBM Group Pty Ltd, ²Cementech Pty Ltd ³Energy Supply Association of Australia.

Under the Kyoto Accounting rules, Australia's National Greenhouse Gas Inventory Report emissions for 2002 was 550.1 Mt carbon dioxide equivalent (CO₂-e) being a net increase of 1.3% on the 1990 levels. This increase is largely attributed to the stationary energy, transport and industrial process sectors, offset with reductions from reduced land clearing. Australia's rejection of Kyoto is based on economic grounds given the countries role as a supplier of raw materials to the world. Greenhouse gas production in Australia contributes just 3.3% of the world's annual total compared to 39% for USA. However, on a per capita basis it is double the per capita generation in USA.

In Australia, the manufacture of one tonne of cement results in the emission of approximately 0.82 tonne of CO₂-e or annually 6.1 Mt of CO₂-e emitted for total cement sales.

This industry has made some significant advances in its reduction program, including the

upgrading of plant and the use of SCM's (Slag and Fly Ash) as cement replacements. There is considerable environmental benefit in increasing the use of these materials in concrete.

Using data collected from member companies, life cycle analyses were conducted to demonstrate the reduced embodied energy and CO₂-e signature for one cubic meter of concrete containing various combinations fly ash, iron blast furnace slag and amorphous silica of the binder. From the resultant data a simple CO₂-e estimator has been developed to assist architects and designers in understanding and constructing eco friendly structures.

For the construction of a domestic dwelling (four bedroom home) using approximately 130 cubic metres (m³) of 25 MPa concrete containing binder ratios of 35% Portland cement and 65% ground granulated blast furnace slag cement, the total savings in CO₂-e emissions was 17.03 tonnes, or equivalent to emissions from a four-cylinder car for 5.68 years.

The increased use of supplementary cementitious materials has the benefit of further greenhouse reductions and displacing some of the forward capital investment required for the cement industry.

Phosphorus and metals removal from run off and waste water using slag filter beds

Presented by: **Bill Bourke** – Manager Marketing and

Business Development SteelServ New Zealand

New Zealand Steel produces its steel products from the refinement of iron sands. Even though the refinement processes and chemical composition differ, the products have a number of end uses and potential end uses in common. The ability of iron and steel making slag aggregates to remove phosphorous and a number of heavy metals from waste water has been well documented for many years, but for a variety of reasons the material has only been used sporadically internationally for this purpose.

The exception is New Zealand, where there are currently six waste water treatment plants using iron making aggregate from NZ Steel's unique ironsand based operation as final water polishing media, with several more in design. NZ Steel recently installed two melter aggregate filter beds at their Glenbrook mill to improve the quality of site storm water, targeting zinc and suspended solids. SteelServ and NZ Steel are undertaking further initiatives to utilize this unique aggregate's water improvement qualities.

Long term (2 year) leaching study started in the late 1980's. These confirmed the ability of melter slag to remove P and certain heavy metals detected. Performance levels achieved include suspended solids, reduced from 112 ppm to 10 ppm or over 90% and phosphorous levels reduced by 66%.

Filter beds constructed are only 0.5 m deep and are not planted. They are particularly good for

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Environmental research and classification of iron and steel slag materials

David Aynsley – Director Moeyan Management



Current testwork again confirms iron and steel slag to be inert when tested against NSW EPA Waste Guidelines.

Over the years the producers of iron and steelmaking slags have had to demonstrate to environmental authorities the potential impact of the materials properties on the environment. Notwithstanding the long history of successful use of Blast Furnace slag there is still a requirement to classify it under the NSW Waste Guidelines. Classification is the responsibility of the producer. In the 1990's this work was carried by Golder and Associates who declared the materials to be in the inert classification. From discussions with the EPA, during 2003/4 it was decided to conduct a follow up series of tests to verify these findings.

Iron and steel furnace slag's though sometimes showing elevated metals concentrations are, when assessed against



the NSW Environment Protection Authority Environmental Guidelines, able to be categorised by the generator as Inert Waste. The steelworks regularly monitors slag chemistry as part of the iron and steelmaking process control. As such the material shows very consistent chemistry at the macro level. Regulations however work at the micro level. More work at the micro level will confirm the material's consistency.

These findings and ongoing investigations will assist regulatory authorities and the ASA in providing the scientific evidence required for appropriate handling and application of iron and steel slag by-products for productive and beneficial end use applications.

Special Presentation

“Investigation of the opportunities to use or recycle iron and steel slag products taking into consideration market activities, environmental issues and community attitudes”.

Presenters: **Luke Coombes**, **Djurđjica (Georgia) Ivancevic**, **Mohammad Mamun**, **Claudia Perry-Beltrame**, **Mitchell Pirie**

The team from the University of Wollongong, worked with Bluescope Steel, on a problem related to economically and environmentally viable means of recycling by-products from the Port Kembla Steelworks.

The report produced for BlueScope Steel Limited, as part of the Higher Education Workplace Skills Olympiad (HEWSO) competition in 2004 describes the opportunities to recycle its by-product streams taking into consideration market activities, environmental issues and the community.

The key recommendations are placed within the context of the need to present a positive and environmentally active image for BlueScope Steel Limited.

Solutions that appear to be most economically viable include the use of slag for a variety of marine applications, water filter medium and fertiliser as well as the creation of sulphur pools.

Members of the team also evaluated the public perception of Bluescope Steel.

Bluescope commented that “we are already starting to use the work in discussions with our contractors”.

Vale – Chris Francis – The Association extends its sympathy to the family and friends of Chris Francis, former RTA General Manager Technical Services NSW who passed away on Friday 8th April 2005. Chris spent a considerable part of his working life in the Hunter Region of NSW and was instrumental in the development of Steelstone Mix 3, a slag blend road base used extensively throughout the Hunter. Chris' life and work were recognized at a packed service at Christ Church Cathedral Newcastle on Monday 11th April 2005.

ASA Website – Executive Director Craig Heidrich stated in response to a question from the floor at the Association's AGM that the website attracts around 3,000 – 4,000 hits per month. This is believed to indicate a good response to the material presented, with the Library section attracting most interest. Hit rates tend to increase around the time a new issue of Connections is issued or one of the University educational Seminars is conducted.

Connections Newsletter – With a circulation of 2000 copies per issue, Connections reaches into the offices of architects, engineers, designers, Government departments and agencies as well as customers and member

companies of the Association each quarter. Through Connections and the website, the Association is able to provide information on current projects, research and applications for slag products as well as insight into the activities of the Association and its members. Find the website at www.asa-inc.org.au

Change of name for ASA Operations Committee – Focused mainly in the Port Kembla and Southern Highlands, this group provides a valuable forum for operators from the various slag processes to compare notes on Safety and Environmental performance and best practice. A suggestion from the floor of the AGM that there be a name change to better reflect the scope of the committees work has been forwarded to them for consideration.

Transit New Zealand approves melter slag as skid resistance aggregate – International Vice President Bill Bourke reports growing support for slag products from authorities in New Zealand. Acceptance as skid resistance aggregate and greater interest in using melter slag as filter material to remove solids and phosphorus are examples of this.

BlueScope Steel name change for iron and steelmaking slags – Ray Peters, in his

presentation of World of Iron and Steel – "A construction materials perspective" by Oscar Gregory and David Jones – identified changes to the thinking about production of iron and steelmaking slags, referring to them as iron rock, BF granulate and steel rock. This is consistent with BlueScope's policy of being a solutions based rather than materials production company.

ICL builds new plant at Port Kembla – Victorian based producer ICL is currently constructing a blending and bagging facility at Kembla Grange. The plant will supply bagged cement and concrete products to major hardware chains in NSW. It is proposed that slag products will be used in the production of both the cement and packaged dry mixes.

ICL Ecoblend specified for Council pavements
Maribyrnong City Council has specified the Ecoblend range (30-50% slag content) for pavements in its Maribyrnong River Trail – Chifley Drive – Stage 2 Landscape Specification. This is a clear recognition of the environmental benefits from the use of slag cements and supports the Victorian Government Greenhouse Strategy.

[Source: James Howard ICL – jhoward@independentcement.com]

Slag – "The ultimate renewable mineral resource"

The video has proved to be very useful to many members. New additional footage has been incorporated demonstrating the beneficial properties of slag in various large-scale projects completed in recent years. The video (15mins duration) outlines slag's historical beginnings through to the various types of slag produced in a modern production process today.

Copies are available to members at a cost of \$15.00 each, non-members \$20.00 plus postage and handling. Just complete and fax back the subscription/order form indicating your requirements.

CD Technical Resources

ASA produces a number of high quality technical guides (i.e. the new – "A Guide to the use of Iron and Steel Slag in Roads" and the "Guide to the Use of Steel Furnace Slag in Asphalt and Thin Bituminous Surfacing") bulletins, newsletters and general industry information on current issues. The Education and Promotion Committee has developed a Technical Compendium on CD; an invaluable readily accessible reference tool for engineers, specifiers, consultants, government authorities, and slag users. *A limited number of hard copies are also available.* Copies are available to members at a cost of \$15.00 each, non members \$20.00 — plus postage and handling. Updated CD's will be available for registered users as new material is added. Stay up to date! Complete and fax back the subscription/order form today.



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