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QUARTERLY
2003

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ASA ASSOCIATION connections

THE AUSTRALASIAN SLAG ASSOCIATION NEWSLETTER

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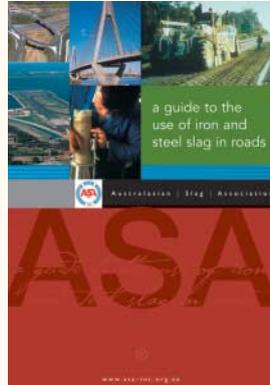
Editorial comment

SUSTAINABILITY of our environment confronts us at the global local and personal level. The choices we make about transport, building materials, energy use all contribute either positively or negatively. The words recycling and rebirthing have come to be associated with getting more than one use from a product or appliance. Such are the technological advances available to us that we are able to use materials that have previously been part of another process with confidence, saving valuable raw materials, resources and our environment. Since the commencement of commercial use of slag in Australia as binder in blended cements and associated applications, over 9 million tonnes of GHG (Greenhouse Gases) have been abated ... a significant and over looked contribution .

In this issue of *Connections* we have featured a number of articles that point to the role slags can and do play in conserving natural resources

and reducing greenhouse gas emissions. The term Slag is used to cover the non metallic co products of reducing a metal from its ore. It is Iron and Steel making slag that is covered in this issue. Much is known about these materials, their environmental contribution and impact and technical applications and performance.

Slags ain't slags highlights the variety of slag materials produced in Australia and serves as a guide to selecting appropriate material for use. Research into use of Iron and Steel making slags in Agriculture is reviewed. Each year, the Association has challenged students to research further applications for slag. Winners for 2002 Christopher Wing and Steve Dalley have



added to our knowledge of Iron Blast Furnace slag performance properties in Concrete. Iron making slag has a significant potential to reduce green house gas generation directly in cementitious applications and as a silico-aluminates source in the production of Geopolymers.

Education remains a key driver for change. The seminars launching of the new technical publication *A Guide to the Use of Iron and Steel Slag in Roads*

provided opportunity to support end users with up to date performance and usage data. Industrial plant and process operators met in Port Kembla in December to reinforce the industry's commitment to Safety and Environment. ■

High calibre leader... sorely missed

PETER TAYLOR Association Chairman Peter Taylor retired from the position co incident with his departure from ASMS. During his term as Chairman, Peter has shown great leadership, guiding the association through a period of significant change. His election as Chairman came soon after the appointment of Craig Heidrich as the new Executive Director for the Association. During Peter's term, restructuring within member companies meant significant changes in representation and in some cases reduction in member contributions. To set the association on a firm footing for the second decade of its existence, a review was carried out during 2002. Peter's contributions and guidance offered to each of its committee's has been significant in both support and involvement, accordingly leading to the Association's objectives being met. We at Australasian Slag Association wish Peter and his family well as he returns to the Gold Coast to undertake some Property Development and spend more time with his family.

Deputy Chairman Michael Byrne from Independent Cement and Lime Victoria has stepped

up to take on the challenges of Chairman of the Association. This is the first time the Association has had a Chairman from beyond NSW. ■



Connections Editorial

Connections is published by ASA
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Wollongong NSW 2500 Australia
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Email: info@asa-inc.org.au
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Publisher	ASA inc.
Executive Director	Craig Heidrich
Art Director	Martin Costanzo
Pre-Press/Print	In-House Graphics www.ihgdesign.com

Contributors:

ASMS, David E. Jones, Craig Heidrich & Batelle
Institute & Stuart Thompson.

Quarterly Publication
Circulation: 2,000

Views expressed in *Connections* newsletter do not necessarily reflect the opinion of the Australasian Slag Association. All contributions are welcomed, though the publisher reserves the right to decline, to publish or edit for style, grammar, length and legal reasons. ©2003

Dalley showed that “the type of slag as well as the % in the binder do affect both the plastic and hardened properties of the hardened concrete”.

Students win cash awards for slag research work

EACH YEAR, the Association holds a competition for University Students to encourage investigation into the innovative use of slag products in construction. Komatsu Australia came on board as the major sponsor for this award in 2002. Students prepare a research paper detailing their work and conclusions including recommendations for future work and demonstrated merit for increased slag utilisation. Papers are reviewed by an expert panel and winners selected. The 2002 awards of \$1000 each were made at the Associations Annual meeting in March to Mr Christopher Robert Wing and Mr Steve Dalley, both students of the University of Wollongong.

Wing's paper was entitled *Early Strength Development of Slag Concretes*. In his research, he examined “concrete mixes containing slag blended cements, slag aggregates and natural aggregates under different curing conditions”. Dalley showed that “the type of slag as well as the % in the binder do affect both the plastic and hardened properties of the hardened concrete”. The ability to alter these properties increased the potential of blended cements as construction material”. His paper was titled *The effect of Slags at varying ratios in the binder on the plastic and hardened properties of the concrete*.

Both papers contribute to our knowledge of slag properties and performance enabling more



Ian MacCowan from major sponsor Komatsu Australia presents Steve Dalley with his award at the AGM.

confident use of the products. They can be viewed on along with over 1400 other reference articles at www.asa-inc.org.au Increased slag utilisation, contributes to lowering the environmental footprint of industry and construction by use of renewable resources and lowering of greenhouse emissions. ■

Iron and Steel Slag use in agriculture – the facts

AT THE start of the 1980's BHP at Port Kembla commenced work to investigate ways of generating a growing media or 'soil' to be used in its revegetation work, topsoil being both expensive and in short supply. With scientific support from the BHP Shortland laboratories, various bulk solid by products streams from the steelworks were evaluated and classified. Outputs from this work included the development of *BHP Soilmix* as a growing matrix and research into broader agricultural applications.

In the mid 1980's, pasture improvement trials

using steel furnace slag fines were carried out by the Pastures Research unit at Berry in NSW. This work was aimed at addressing the acid soils environment of southern NSW. Given the encouraging plant growth results and University of Wollongong hot house trials, broad acre trials were proposed. The broad acre work did not proceed for lack of financial resources to complete it.

At the commencement of the 1990's the Australasian Slag Association convened a group including Australian Steel Mill Services, BHP Steel

and the EPA to agree on a testing regime to classify the potential environmental impact of Iron and Steel making slags. In May 1993, the Golder Associates report *Ecotoxicity and Chemical Characterisation of Experimentally Generated Leachate from Unbound Rock Blast Furnace Slag* was published. Subsequent assessments for Steel making slag and Electric Arc Furnace slag were carried out and reported by Golder Associates. The pH or liming effect of Steel making slags was the reason they were selected for the Pastures Research Unit trials. ■

Geopolymers – the next wave

INTERNATIONAL CONFERENCE Geopolymer 2002 — *Turn potential into Profit*, is evidence of the ongoing research and development aimed at producing new materials and lowering the environmental impact of the construction industry. Institut Geopolymere (www.geopolymer.org) states that Geopolymerization is a geosynthesis (a reaction that chemically integrates minerals) that involves naturally occurring silico-aluminates. The silicon (Si) and aluminium (Al) atoms react to form molecules that are chemically and structurally comparable to

those binding natural rock. The Battelle report *Towards a Sustainable Cement Industry: Substudy 8 — Climate Change* lists Geopolymers as one of the potential alternates to production of cement by the clinker route that could assist in reducing CO₂ generation.

Whilst a great deal of research has been undertaken and products developed over more than two decades, the applications to date have tended to be in the smaller volume higher value markets. Geopolymers, one form of mineral polymers made from inorganic aluminosilicate

compounds, were originally developed to create non-flammable plastic material and have subsequently been used in the automobile and aeronautic industries and in certain niche cement markets (e.g. for waste encapsulation) (Battelle 2002 sub study 8). Iron Blast Furnace Slag has been used in product development as a source of aluminosilicate for creating Geopolymers. As with any new product, there is need to overcome user resistance as well as learn new placement and application techniques and supply at a cost the construction market perceives to yield value. ■





www.battelle.org

SCM's – reduce CO₂ emission... maybe



BATTELLE MEMORIAL Institute issued a report in March 2002 titled *Towards a Sustainable Cement Industry: Substudy 8 — Climate Change*. The report was prepared as a part of large project carried out for the World Business Council for Sustainable Development for the global cement industry. It is “one of a series of member-sponsored projects aimed at converting sustainable development concepts into action.” The final report and sub studies were released in May 2002.

Two important factors that drive unit based CO₂ emissions for the Cement Industry are energy intensity and the “clinker factor”. The report states that cement industry currently emits 0.73 to 0.99 kilograms of CO₂ for every kilogram of cement produced.

The report concludes that Australia/New Zealand has one of the lowest energy intensities (kJ/kg) for the production of clinker of the Cement regions of the world.

It states that the use of pozzolans such as “blast furnace slag, fly ash, and natural pozzolans for clinker substantially reduces process-related CO₂ emissions.”

Battelle has reviewed the potential for the use of blast furnace slag and fly ash as a blending agent in cement to make significant reductions CO₂ emissions. They conclude the potential is high for the Australian NZ market given their 2020 projections for blast furnace slag and fly ash and demand for cement.

further information: www.wbcscd.ch and www.battelle.org



ASA Roads Guide Launched in Sydney and Regions

ONE OF THE first technical guides produced by Australasian Slag Association was "A Guide to the Use of Slag in Roads", produced with the support of the Roads and Traffic Authority of New South Wales. In late 2002, *A Guide to the Use of Iron and Steel Slag in Roads* was produced. This incorporated updated performance data and expanded guidelines for use, based on the in-field performance and research available since the first publication. The section on stabilisation has been significantly revised and expanded to include performance data.

This new edition of the guide has been

introduced to specifiers and users through a series of technical seminars in Sydney, Newcastle and Wollongong. These have attracted good attendance from sectors including; Roads and Traffic Authority of NSW, Local Government, Port Authorities, Consulting Engineers and other groups. A further seminar is being planned for 2003 in Melbourne.

Executive Director Craig Heidrich said that "significant interest has been generated by the seminars with member companies responding to the specific questions raised". ■



The section on stabilisation has been significantly revised and expanded to include performance data.

Safety and environment workshop

ASA'S OPERATIONS committee is based in Port Kembla NSW and meets regularly to review member performance in the areas of Safety and Environment and to provide an exchange of best practice operational ideas.

Safety and Environment education of employees and management alike remains a top priority focus for the member companies and their heavy industry customers to ensure these matters remain 'top of mind'.

Under the leadership of its Chairman Paul O'Kane, the committee organised a seminar at the Australia's Industry World Visitors Centre on December 12th 2002. It set out to remind

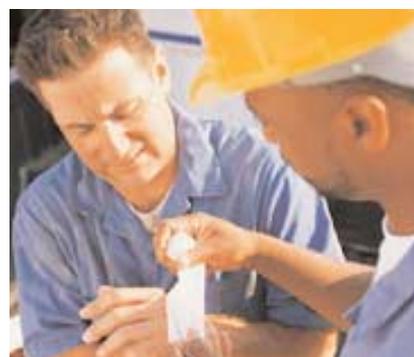
participants of "steps we all can take to protect our personal safety and also the safety of our loved ones together with the need to protect our environment". Target audience was frontline supervisors, OH&S coordinators/committee members and operator's, with 39 people attending.

Key speakers were Michael Casser (Vice President OH&S BHP Steel) and Paul O'Kane (General Manger – Operations Port Kembla Metserv and ASA Operations Committee Chairman). Case studies for the seminar were presented by, Australian Steel Mill Services, Blue Circle Southern Cement, Hunter Mill Service, Metserv, Port Kembla Copper, SCE Group.

Participant feedback showed that for 76% of respondents, the seminar exceeded their expectations, with the balance indicating the seminar met their expectations. most participants supported more case study analysis, learning from

other organisations experiences, and more external company communication. There are good indications of support for future seminars.

Committee chairman (Paul O'Kane) extended his personal thanks to those individuals and organisations that supported the Environment and Safety Seminar. ■



For 76% of respondents, the seminar exceeded their expectations.





Slag's ain't Slag's

SLAG is a broad term covering all non metallic co products resulting from the separation of a metal from its ore. Its chemistry and morphology depends on the metal being produced and the solidification process used.

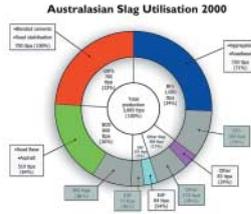
Slags can be broadly categorised as ferrous (iron/steel) and non-ferrous (copper, lead/zinc) depending on the industry from which they come. Non ferrous slags make up only 12% of the total annual production

Described below are the main types and uses of slag commercially available in Australasia,

Ferrous Slag products Iron Blast Furnace Slag (BFS)

This is the by-product from the reduction of iron ores to produce molten iron and molten slag.

1. When allowed to cool slowly to a crystalline rock form it becomes a light grey vesicular rock known as Air-Cooled Blast Furnace Slag. Principle uses include:
 - a. Uncrushed — fill and embankments (particularly areas subject to severe loading such as mainline rail systems), working platforms on difficult sites, pavements, where binding fines are produced by rolling to break the slag down to fill the voids.
 - b. graded roadbase — on its own or blended with other slags and/or with other natural rocks and sands.
 - c. Crushed and graded — for concrete aggregates, concrete sand, glass insulation wool, filter medium, and use under concrete slabs as a platform.
2. By passing the molten slag through high volume high pressure water sprays, a glassy, sand-type (granulated) material is formed, known as Granulated Blast Furnace Slag. The colour of this product is very similar to normal beach sand.
 - a. The principal use is as Cement replacement (when ground), replacing 30-50% of Portland Cement in 'normal' concrete, but can replace up to 70% in specialist applications such as marine concrete.
 - b. Other uses include; glassmaking, trace elements in agriculture, concrete block manufacture, sporting field sub-base (for drainage), filtration medium, reinforced earth embankments, and mine backfilling and grit-blasting medium requiring fine etching.



Basic Oxygen Steelmaking Slag (BOS or Steel Furnace Slag)

This slag is formed when molten iron, scrap metals and various fluxes, such as lime, are oxidised by injecting large amounts of pure oxygen into the molten iron mix to create molten steel and molten slag. Slow cooling of the molten slag produces a dense rock material. Principal uses include:

- a. Blending with many other products such as granulated slag, fly ash and lime to form pavement material
- b. Other uses include, skid resistant asphalt aggregate, rail ballast, asphaltic concrete aggregate, soil conditioner, hard stand areas and unconfined construction fill.

Electric Arc Furnace Slag (EAF or steel furnace slag)

Produced when scrap metal and fluxes are oxidised by the use of an electric current, molten slag is generally placed into ground bays for cooling. Both BOS and EAF slags are somewhat heavier than Blast Furnace Slag and most quarried rock material. Uses include:

- a. Blending with many other products such as granulated slag, fly ash and lime to form pavement material, skid resistant asphalt aggregate and unconfined construction fill.

Non Ferrous Slag products Copper Slag (CS)

Molten copper slag is produced by the reduction of ores and fluxes to liberate the copper metal. It is generally granulated to form very dark coloured glassy single-sized (about 2mm) particles. The main use for copper slag in Australia is in grit blasting, due to its sizing and strength characteristics.

Lead/Zinc Slag (LZS)

Formed from the smelting of Zinc ores, it is generally granulated to form a sand size product with a top size of about 5mm, with only a small quantity of material below 1mm. Its dark colour and has attracted the name of Black Sand. Mostly spherical in nature it has been used as concrete sand. Remember "Slags ain't Slags" ... the distinction is important, make sure the article clearly indicates just what type of slag is involved rather than assume you know. For further information on any of the above slag products, please contact the Australasian Slag Association (02 4225 8466). ■

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 Cement Holdings Pty Ltd
- Australian Steel Mill Services Pty Ltd
- BHP Flat Products – Port Kembla Ltd
- Blue Circle Southern Cement Ltd
- Boral Concrete & Quarries Ltd
- Brambles Equipment Ltd
- Brambles Industrial Services (Whyalla) Ltd
- Cleary Bros (Bombo) Pty Ltd
- Comsteel – Newcastle Ltd
- CSIRO CMIT
- CSR Readymix Group Ltd
- University of Wollongong – Dr Denis Montgomery
- Gough & Gilmour Pty Ltd
- Heckett Multiserv (UK)
- HBL (Heggies Bulkhaul Ltd)
- Hunter Mill Services Pty Ltd
- Mahaffey Associates Pty Ltd
- Metserv Australasia Pty Ltd
- Milburn New Zealand Ltd
- University of Newcastle – Mr Stephen Fityus
- NS Komatsu Ltd
- Pioneer Construction Materials Ltd
- Port Kembla Copper Pty Ltd
- Premium Tyre Service Pty Ltd
- Queensland Cement Ltd
- Roads & Traffic Authority of NSW
- Slag Cement Sdn Bhd, Malaysia
- Smorgon Steel Ltd
- Steel Cement Ltd
- SteelServ Ltd (NZ)
- Steelstone Services (Aust) Pty Ltd
- Sunstate Cement Ltd
- Wormald Fire Systems Ltd

Personal Members

- Anderson, L
- Dobson, G
- Gregory, G
- Jones, D E (Hon.)
- Heaton, B (Hon.)
- Maric, M
- Prosser, S D (Hon.)
- Venour, M (Hon.)

Related Associations

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



NEWS in BRIEF...



Peter Taylor General Manager ASMS departed in November 2002. After 4 years at the helm, Peter has returned to Queensland to take up property development and spend more time with his family.

Greg McAlister has moved to Boral in Wollongong as the new Area Manager Concrete and Quarries. His appointment in the Illawarra region provides opportunity to further develop the manufactured sands market.

Shani Smith commenced with ASMS on 1st September 2002 as the new Manager Sales and Marketing, replacing Greg McAlister. Prior to this, Shani worked for Holcim in the USA, introducing and marketing Slag Cement to the Atlanta Cement and Concrete markets. Previously, Shani worked for QCL with responsibilities including Chemical Admixtures Company Euco, and earlier for Pioneer Concrete and Cement Products. Shani is representing ASMS on the Associations Executive Committee.

Proposed Merger of Australian Cement and Queensland Cement — On November 26th 2002, CSR Limited, Hanson Plc and Holcim Ltd announced that they have agreed to merge their Australian cement businesses to form the leading cement supplier in Australia. The merged entity will produce over 3 million tonnes of cement per annum from three main plants: Gladstone (Qld); Kandos (NSW) and Railton (Tas). The proposed merger is subject to final documentation being agreed, regulatory approval and final due diligence.

Standards – CE – 030 Guidelines for the design of Marine Structures — In line with

our main charter the Association continues to seek representation on standards of relevance to the use of slag in construction. Our response to the committee draft is to affirm the use of a minimum of 65% slag in the binder for concrete structures in marine environments based on research and performance data available.

Adam Kelly departs for O/S — After 5 years with Steel stone services, Adam has departed with his wife Kate, to spend 2 years travelling overseas. Adam, an Engineering graduate of the University of Newcastle, joined Steelstone Services in the Hunter Valley as a Cadet. He has worked on product development with the RTA and major customers, and has undertaken a brief assignment in China. As operations and Pavements Engineer, Adam has made a real contribution to ASA and his company in the preparation and delivery of a number of technical papers and presentations. Adam and Kate keep in contact with their friends at Steelstone and have already spent time in Switzerland and Scotland.

Wayne James — has resigned from ASA as Chairman of the Technical Committee, coincident with leaving ASMS. Wayne has made a considerable contribution to the Association over the past 4 years in this role and over a number of years as the Associations representative on various standards committees.

Graeme Weston — former Executive Committee member of the Association has moved from his role at ACH to pursue private interests. The Association acknowledges Graeme's support for the Association, his contribution to the Executive Committee and wishes him well for the future. ■

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.

Technical Resources on CD

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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