asa connections
australasian (iron & steel) slag association
Vol 11 | Issue 2 | November 2013
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www.asa-inc.org.au

Editorial

Members of the Australasian (iron & steel) Slag Association (ASA) could be characterised as resilient, stout, irrepressible and a number of other adjectives but in general, they are pretty hardy. In this issue we celebrate a number of incremental achievements made in the second half of 2013. We have had something to celebrate with a series of amendments to the NSW EPA Exemptions for various iron and steel slags gazetted on 1 July 2013, which further attest the beneficial and safe applications of slag. These important amendments provide further certainty to industry members in support of their economic pursuits as an increasingly predominant aspect in today's competitive environment.

The CRC for Low Carbon Living (http://www.lowcarbonlivingcrc.com.au/) provides an alternative lens in which to perceive Association members where instead of comparing ourselves to other mainstream competitors, perhaps we should take a different approach and look to how we can distinguish ourselves from the majority, as innovators running our own race.

In this edition, we focus on two individuals that highlight the diversity of participants within the slag industry. Eliot Weiner, Business Development Manager for Australian Steel Mill Services (ASMS) provides an insight into his involvement in the family business and moving from the US to Australia. Artist Jamie North talks about his sculptures which are made from slag materials and the way in which they seek to demonstrate the built environment. Both of these stakeholders demonstrate the varied applications of slag and the types of business participants who seek to continually innovate.

The Roads Guide Review project has been progressing well with the first Quick Reference Guide: Roads Guide Supplement on General Applications included in this edition of Connections. Authors continue to work hard to produce these documents with the next expected for completion in mid-2014. The contribution of other members during the Member Review process is also much appreciated as this adds to the technical validity of the documents.

In terms of industry events, the Australasian (iron & steel) Slag Association has sponsored and attended the Concrete 2013 (http://www.concreteinstitute.com.au) and the Australian Society of Concrete Pavements (http://www.concretepavements.com.au) conferences, both providing beneficial networking and member generation opportunities for the Association network. There are also future events to look forward to with the Construction Materials Industry Conference (CMIC) 2014 scheduled for 3-6 September 2014 with a focus on 'Building Productivity'. Members are encouraged to attend and support their industry advocate in action and detailed Conference Reports are provided later in this edition.

Finally, it seems to come around faster every year but the Australasian (iron & steel) Slag Association would again like to wish its members a safe and happy Christmas holiday period and we look forward to working with you to further iron and steel slag utilisation in 2014.

THIS ISSUE

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CONNECTIONS EDITORIAL TEAM
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Connections is a quarterly publication with an online circulation of 1,500 copies

ELIOT WEINER

Eliot Weiner, Business Development Manager for Australian Steel Mill Services (ASMS) provides a brief insight into his experiences of the family business, life in the US and moving to Australia with his family.

How did you get involved with ASMS?

My family has been officially involved in the slag business since 1922 when Ed Levy Sr. struck a handshake deal with Henry Ford to begin trucking slag from the Rouge Steel Mill. My Father, Evan Weiner, helped start ASMS nearly 25 years ago and I am honoured to join ASMS and our strong tradition as leaders of the slag industry. While I am learning more about the business every day, you could say my family's history is as old as the industry itself.

Where else have you been employed?

After graduation, I joined a Fortune 500 distribution company as the General Manager of a new Business Development Group focused on helping our clients win large public sector contracts. As a team we were able to grow this start up to $100 million per annum in just a few years.

Prior to Levy, I worked for Oldcastle Materials in quarries and road construction, learning the foundational elements of crushing, screening and project management. After completing Oldcastle's Management Development Program, I elected to get an MBA at the Tippie School of Management, where I was the MBA President.

I first joined the Levy Group of Companies as the Director of Flame and Technological Services running Indiana Flame Service (IFS), which provide patented slab cutting and conditioning to the steel industry. This was my introduction to the steel industry and to the steel mill service business and it was a rewarding one. Through this experience, I learned that our people are the pillar of our business and I enjoyed supporting the IFS team in providing world class services to the largest steel mills in the USA.

What is you role with ASMS?

I moved with my wife from Chicago in July 2013 to manage business and development for ASMS. The role will be accountable for growing and creating markets for slag products and improving the quality and delivery of our products in order to exceed customer expectations.

Roads Guide Supplement on General Applications

1. INTRODUCTION

The continuing need to preserve diminishing natural resources and increase sustainable practices is a fundamental tenet in business today. This has predominantly occurred through the promotion of increased reuse, recycling and reprocessing. Here, disposal has become the last resort and is an issue of great importance in our society.

This focus on the importance of preservation and resource recovery is supported by international, federal, state and local Governments with respective regulating authorities empowered to ensure these sustainable goals are met through effective policy implementation.

The use of iron and steel slags (ISS), being a co-product of iron and steel production, are predominant in road construction and maintenance applications. These large-scale applications provide for the large-scale recovery of an abundant product which demonstrates the goals of sustainability.

With the formation of the Australasian (iron & steel) Slag Association in 1990, there has been a number of significant changes and advances in the effective utilisation of slag materials. Effective utilisation is the use of slag materials in a productive or economically beneficial way which does not require disposal as landfill. The vast majority of ISS produced in Australia is sold for use in today's market.[1] For example, in 2010, 88% percent of the 2.67 million tonnes (Mt) of ISS produced was effectively utilised within various value added civil and construction material applications throughout Australasia. The key results include:

- 33% consumed in high value add cementitious applications
- 50% delivered into road construction and civil works

During the 1990s, effective utilisation of ISS remained at 30-40%. However, current utilization rests at around 85%, illustrating changing paradigms in the active reuse of these products.

Collaborating through the Association in 'doing together what we could not do alone', we have broadened both stakeholder and community understanding. This now extends to material users, specifically those in road construction which has led to further increases in effective utilisation.

Slag co-products are the result of highly controlled steel-making processes. Therefore, these materials carry the same level of quality as the result of these process controls, which ensure the consistency of slag chemistry and quality.

The types of slag covered in this guide are:

1) Blast Furnace Slag (BFS)
   i. Granulated Blast Furnace Slag (GBFS)
   ii. Ground Granulated Blast Furnace Slag (GGBFS)
2) Steel Furnace Slag (SFS)
3) Electric Arc Furnace Slag (EAFS)
4) Ladle Furnace Slag (LFS)

Table 1 - Typical values for the physical properties of iron and steelmaking slags.[2]

Physical Property - Aggregate	Blast Furnace Slag	Steel Slag		Test Method
	Rock Slag	BOS Slag	EAF Slag	
Bulk Density (t/m^3) (loose)	1.2	1.7	1.7	(AS 1141.4)
Dry Strength (kN)	100	250	250	(AS 1141.22)
Wet Strength (kN)	90	220	220	(AS 1141.22)
Wet/Dry Variation (%)	10	12	12	(AS 1141.22)
Water Absorption (%)	5	fine - 3.0 coarse - 2.0	fine - 3.0 coarse - 2.0	(AS 1141.5/6)
LA Abrasion	40	15	16	(AS 1141.23)
Polished Aggregate Friction Value (PAFV)	50	55	60	(AS 1141.41/42)
Sodium Sulfate Soundness (%)	<1.0	<1.0	<4	(AS 1141.24)
Physical Property- 20mm Road base				
Maximum Dry Density (kg/m^3)	2,200	2,200	2,250	(AS 1289.5.1.1)
Optimum Moisture Content (%)	10	11.0	10	(AS 1189.5.1.1 & AS 1289.2.1.1)

Note: - [1]OMC depends on the components of the mix.

2. METHOD OF MANUFACTURE

Slag is a co-product of all common steel production methods. Here it forms either through the addition of fluxes such as lime or as the oxide portion of iron ore. There are a number of different slag types produced which is dependent on the steel-making process used. Table 1 outlines typical physical properties of ferrous slag produced in Australia.

2.1 BLAST FURNACE SLAG (BFS)

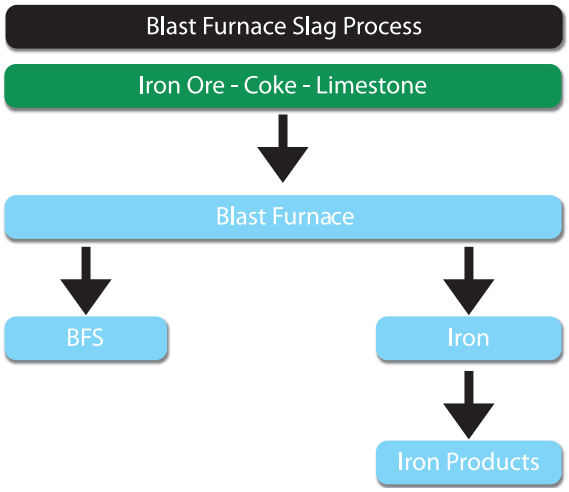

Figure 2.1 - BFS Manufacturing Process.

BFS is produced when iron ore is reduced to iron in a blast furnace. Molten slag from the furnace is poured into pits and allowed to cool in air. Rock like minerals are formed which are then crushed and screened to separate them into aggregates and sands.

Air cooled blast furnace slag materials are grey, vesicular rocks slightly lighter in weight than natural materials like basalt.

2.2 GRANULATED BLAST FURNACE SLAG (GBFS)

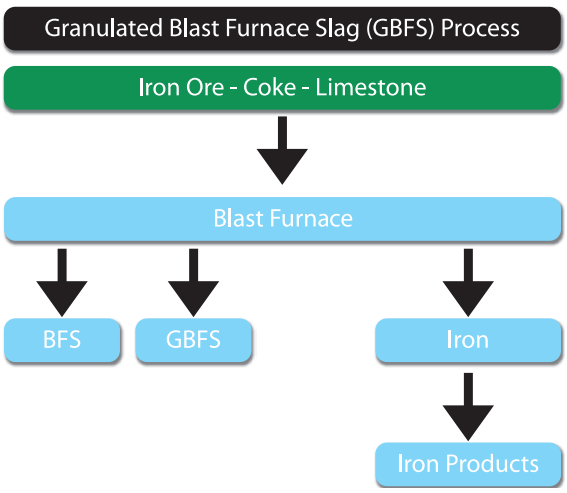

Figure 2.2 - GBFS Manufacturing Process.

GBFS is produced when molten BFS is rapidly quenched by a series of high pressure/high volume water sprays. These conditions cause the slag to solidify before crystallisation is able to occur, creating a glassy material.

GBFS is similar in appearance to river sand with a density of 60-70% that of natural sand.

2.3 GROUND GRANULATED BLAST FURNACE SLAG (GGBFS)

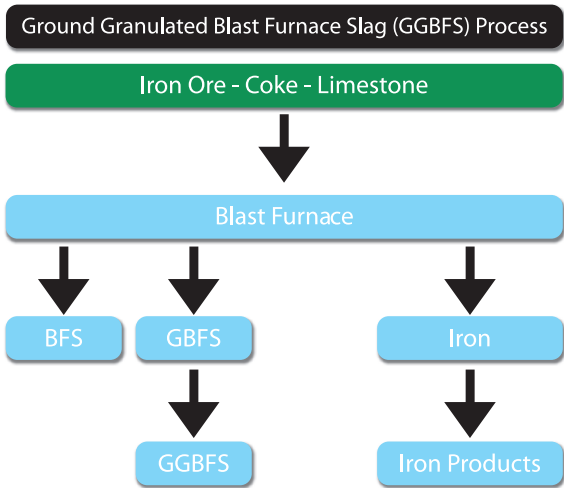

Figure 2.3 - GGBFS Manufacturing Process.

GGBFS is produced when GBFS is ground to cement powder fineness in a ball or vertical roller mill and has an off-white colouration.

2.4 STEEL FURNACE SLAG (SFS)

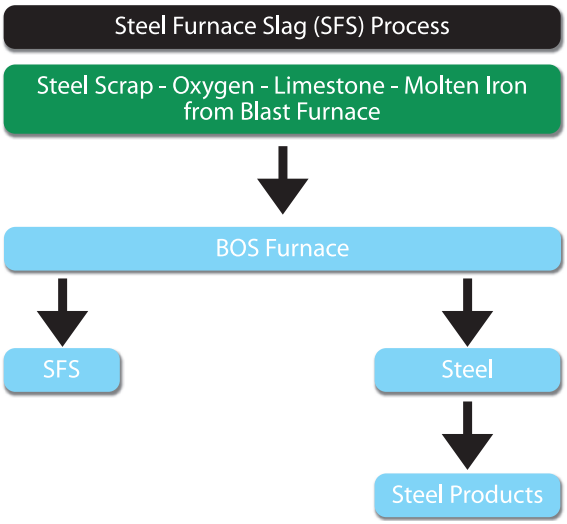

Figure 2.4 - SFS Manufacturing Process.

SFS is a co-product of the conversion process of molten iron to steel in a basic oxygen steelmaking shop within an integrated steelworks. Where the violent reaction occurs within the vessel after the oxygen lance is lowered, a protective slag layer forms with the addition of lime. When the reaction has been completed, the steel and slag are separated and molten slag is poured into pits where the slag is cooled with waters sprays after initial solidification.

SFS has a dark grey colour, with a particle density that is 20% greater than basalt and is definitively harder than BFS. This product crushes into a cubical shape and has the potential for expansion if not adequately weathered.

Weathering is typically achieved by periodic watering, monitoring and internal stockpile management procedures.

2.5 ELECTRIC ARC FURNACE SLAG (EAFS)

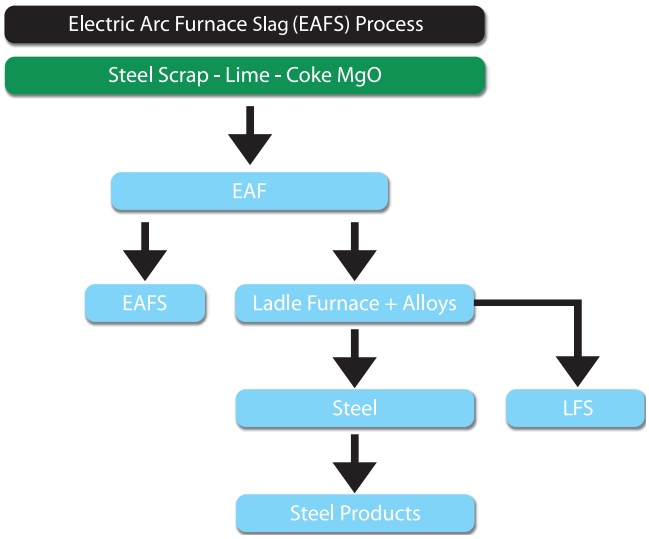

Figure 2.5 - EAFS Manufacturing Process.

As the molten slag is produced, it is tapped directly into adjacent pits and begins to solidify in air. This product then undergoes a further refinement process to remove the residual metallics and remaining slag, which is then separated into various product streams.

As a co-product of the steel making process, EAFS is produced in an electric arc furnace. In terms of its physical appearance, the slag is dark grey in colour and harder than BFS with a particle density of 20-25% greater than basalt. This product crushes into a cubical shape and has the potential for expansion if not adequately weathered. Weathering is typically achieved by periodic watering, monitoring and internal stockpile management procedures.

2.6 LADLE FURNACE SLAG (LFS)

Refer to Figure 2.5 for the diagram of the manufacturing process.

LFS is a co-product of the Ladle Metallurgy Furnace (LMF) process which is the refining process of liquid steel sourced from the EAF, but prior to casting. After the EAFS process has occurred (see Figure 2.5) and most of the EAFS removed, the liquid steel is tapped from the EAF into a ladle. The ladle of liquid steel is then alloyed at the LMF to achieve the required chemical specifications. After specification is achieved, the liquid steel is poured out during casting and the remaining LFS is retained to be poured out separately, cooled, and then reprocessed to recover metallics.

The composition of LFS varies depending on the EAF, ladle furnace processing conditions and the type of steel grade being produced.

2.7 CURRENT STANDARDS

Quality assurance principles, as seen in Table 2, are in place to ensure the supply of high quality, safe, reliable and uniform ISS products to the market place. Under these standards, slag products are used to substitute or supplement naturally won materials to maximize natural resource sustainability, minimise waste to landfill and improve construction and manufacturing processes.

Table 2 - Quality Assurance Principles.[3, 4, 5, 6, 7]

Application	Principle
Road Base	Heavily Bound: NSW RMS R73 and various Council specifications
	Unbound: RMS 3051 Austroads, ARRB SR41 and various Council Specifications
Fill	Select Fill: NSW RMS 3071 and various Council specifications
	General Fill: RMS R44 and various Council specifications

3. TYPICAL CHEMICAL

The typical chemistry of BFS, SFS, EAFS and LFS after appropriate conditioning and weathering is shown in Table 3 below. All ISS comply with the necessary guidelines for their chemical composition.

Table 3 - Typical Chemical Characteristics.[8]

Constituents as Oxides	Symbol	BFS (%)	SFS (%)	EAFS (%)
Calcium Oxide	(CaO)	41	40	35
% Free Lime		0	2	1
Silicon Oxide	(SiO_2)	35	12	14
Iron Oxide	(Fe_2O_3)	0.7	20	29
Magnesium Oxide	(MgO)	6.5	9	9
Magnesium Oxide	(MnO)	0.5	5	6
Aluminum Oxide	(Al_2O_3)	14	3	6
Titanium Oxide	(TiO_2)	1	1	0.5
Potassium Oxide	(K_2O)	0.3	<0.5	0.1
Chromium Oxide	(Cr_2O_3)	<0.005	0.1	1
Vanadium Oxide	(V_2O_5)	<0.05	1.4	0.3
Sulphur	(S)	O.6	<0.1	0.1

4. ENVIRONMENTAL

Australia's adopted environmental policy holds closely to the precautionary principle without regard or recognition of the considerable scientific evidence gathered over the past 30 years.[8]

National environmental legislators and regulators have been hesitant in adopting more progressive and modern international approaches that incorporate sustainability objectives. Despite definitions and traditional categorisations which have kept slag labeled as a 'waste' material,[9] our members have explored and developed innovative, value-adding options for ISS to rebut these restrictions.

In recent years, National and State Environmental Departments and Agencies, as part of an overall review of the classifications of 'wastes' have progressively implemented changes to simplify and streamline the current waste classification systems.

Through these systems, the Association has been instrumental in negotiating and securing various exemptions or approval pathways for ISS materials including:

- Blast Furnace Slag including, Granulated Blast Furnace Slag
- Steel Furnace Slag
- Electric Arc Furnace Slag
- Ladle Furnace Slag

These exemptions represent a significant and important step towards creating greater investment certainty for our industry members.

Exemptions may be used by anyone, without seeking approval from the EPA, provided the generators, processors and consumers fully comply with the conditions of the exemption. However, these exemptions do not excuse those using them from complying with relevant planning consent requirements and it is their responsibility to seek any necessary development consents from the appropriate regulatory authority.

General exemptions are developed and published by NSW EPA with input from industry groups for materials which can be recovered, reprocessed or reused. These exemptions can be used without notifying the granting authority provided that the conditions of the Exemption are met. For example, conditions that are prescribed in the General Exemption give guidance for end use applications 'such as' concrete. This is not to mean only concrete but applications that result in bound matrices, for example, bound pavement products like slag road base.

General exemptions are gazetted as they become available or when the exemption is amended or revoked. Resource Recovery Exemptions can be amended from time to time and generators, processors or consumers of waste derived materials should reference the website for the latest versions.

Copies of NSW EPA exemptions gazzetted for iron and steel slags can be downloaded from: http://www.epa.nsw.gov.au/waste/generalrre.htm

In recent years, increasing awareness of environmental issues in our society has improved utilisation of slag. For example, carbon reduction opportunities through the use of slag have been tried and tested as a sustainable alternative which gives preference to this material in comparison to the use of traditional cement and quarried resources.[10, 11] When coupled with member companies identifying new opportunities for slag products, investment will continue to ensure these markets are further developed.

5. CASE STUDIES

There are numerous case studies, which demonstrate the effective utilisation of slag. The following case studies are a selection of recent projects where ISS provided solutions for the project contractor, proponent or client.

Table 4 - Case Studies in NSW.

Application	Amount of Slag Used (kt)
North Kiama By-Pass	165
Lake Macquarie City Council various projects	80
Princes Highway Realignment Oak Flats	70
Hunter Expressway NSW	68
Wollongong Northern Distributor Extension	40
RTA/RMS various projects Greater Newcastle NSW	31
Gosford City Council various projects	22
New England Highway, Harpers Hill NSW	16

5.1 CASE STUDY 1: NORTHERN DISTRIBUTOR EXTENSION, BULLI NSW

In 2009, construction commenced on the Princes Highway Northern Distributor Extension linking Wollongong to the northern Bulli area.

The main slag product used was an 80:20 ratio of air-cooled BFS:GBFS with 2% binder. In addition, 300 mm of BFS select fill and a 600 mm fines layer of air cooled BFS was used in the sub base.

BFS road base was the preferred material proposed under tender. This material was preferred over natural equivalents because of its reduced compactive effort and increased life expectancy as a result of strength gain over time.

Over the period of March 2009 until November 2009, 40 kt of BFS material supplied to the project. This material complied with RMS specifications R73 and 3051.

Figure 5.1 - Northern Distributor heading north.

5.2 CASE STUDY 2: NORTH KIAMA BY-PASS, SOUTH COAST NSW

The Kiama by-pass commenced construction in 2005 with a significant amount of slag used over a large area.

Figure 5.2 - Truck unloading slag material at site.

The types of slag used depended on the specific area on which the road traversed. In one section, 75 mm of air cooled BFS was used as a drainage layer. The area closest to Bombo beach required 300 mm of modified road base with an 80:20 ratio of air cooled BFS:GBFS with 2% binder.

Figure 5.3 - Aerial view of completed project.

Once again, BFS was the preferred material and from January 2005 until October 2007, 165 kt of BFS stabilized road base was supplied which complied with RMS specifications R73 and 3051.

5.3 CASE STUDY 3: HUNTER EXPRESSWAY HEA, NEWCASTLE NSW

In 2011, 67 kt of slag material was supplied to the Hunter Expressway in the form of heavily bound pavement and heavily bound, high load bearing hardstand material.

During this process, the Specific RMS specification RN73 “Ed 6 Bound Pavement Course (Slag or Ash based)” and the relevant EPA waste regulation specific exemptions have been conformed to.

The SFS and EAF slags are sourced from the Port Kembla, Rooty Hill and Newcastle steel-making operations.

Once delivered to the manufacturing facility, the SFS and EAFS is blended with other constituent materials in a computer controlled process to produce a heavily bound pavement material.

The stabilised road base material is placed and compacted using a combination of proven civil construction methodologies and ongoing best practice in the use of slag based materials for civil construction purposes.

This material has been used in a number of applications including:

- Heavily Bound Pavement: Construction of new heavily bound traffic pavements meeting RMS specification RN73 Ed6.

Figure 5.4 - Heavily Bound Pavement.

- Mine Void Platforms: Existing mining voids underneath the Hunter Expressway alignment required filling to minimize the risk of mine subsidence. Slag material is a preferred material to the emplacement of unbound road base due to the increased production capacity, a safer working environment for personnel on the ground due to a stable ground covering and a decreased program due to weather tolerance.

- Access Tracks and Platforms for Bridge Works: Most of the 23 bridges used a 200-300 mm thick layer of BFS and SFS stabilised road base as a piling platform. The advantages of using this material include decreased run off and erosion and minimal costly piling delays.

Figure 5.5 - Hunter Express way piling works at bridge BW13 on a layer of stabilized road base.

In summary, the slag materials used added to the overall efficiency of the Hunter Valley Expressway project.

6. CONCLUSIONS

In terms of its competitive advantages in relation to other materials, ISS products have been proven for use in various types of applications including: cement and concrete manufacture, civil works, road construction, rehabilitation and stabilisation of existing roads, car parks and pavements.

Economically, ISS are comparative to other traditional resources, but should be assessed on a case by case basis given the other performance and environmental advantages.

The Australasian (iron & steel) Slag Association will continue to advocate for the current and potential uses of slag products as well as improving regulatory understanding of the benefits arising from slag use.

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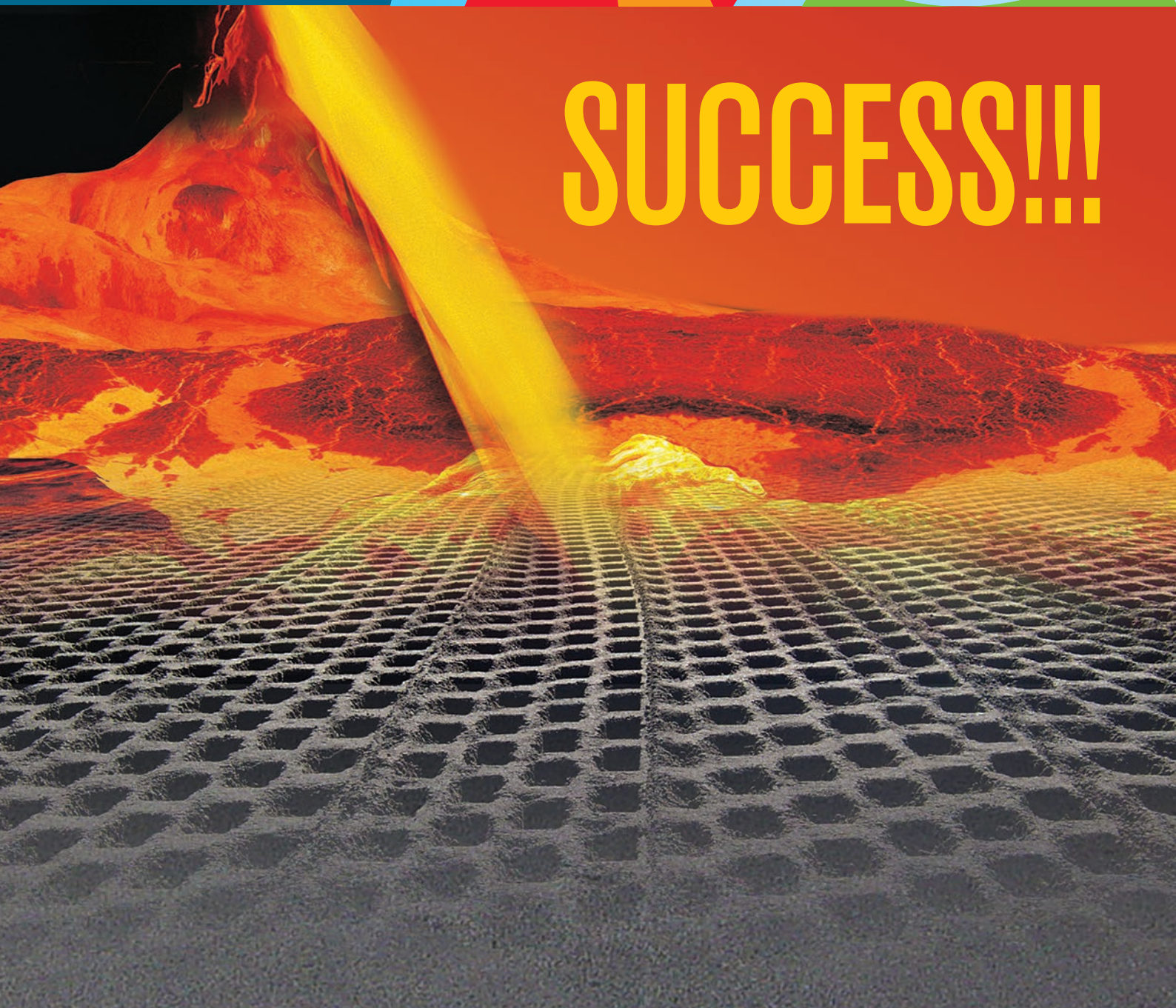
Update: CRC for Low Carbon Living.

Slag based geopolymer is a low carbon alternative to conventional Portland cement concrete however, it is yet to enter the mainstream commercial applications of concrete construction.

The Cooperative Research Centre for Low Carbon Living (CRC-LCL) project on low carbon materials is aimed at identifying the barriers to the widespread adoption of slag based geopolymer in industry. The main barrier identified and presented recently at Concrete 2013 (http://www.concrete2013.com.au/technical-program/ :Prof Marita L. Berndt: Overcoming Barriers to Implementation of Geopolymer Concrete) was the lack of standard specifications that included this material. Indeed, design of plain, reinforced and prestressed concrete in codes and standards such as AS 3600 implicitly assume that the concrete is based on Portland cement. Therefore is has been determined that the pathway to overcome this barrier is to develop a Standard Test Methods Handbook for Low Carbon Concrete Mix Design through Standards Australia to assist engineers and end-users in specifying and using geopolymer concrete with greater confidence and less risk.

Indeed, the rapid depletion of quality natural aggregate quarry sources close to most major metropolitan regions of Australia has emphasised the need to explore alternative economic sources to support increasing vital infrastructure development, including housing, roads, bridges, schools and hospitals.

For more information on the CRC for Low Carbon living, please visit: http://www.lowcarbonlivingcrc.com.au



SUCCESS!!!

Recent changes to the NSW EPA General Exemption for Iron and Steel Slags for Civil and Construction Purposes.

With over 20 months of negotiation with key industry stakeholders, amendments were gazetted and approved for the NSW EPA General Exemption for Iron and Steel Slags and their use in Civil and Construction purposes.

The main amendments are as follows:

- Definition for cementitious applications incorporated, with significantly reduced restrictions and reporting requirements
- Definition for non-cementitious applications incorporated
- Restrictions for use of iron and steel slags in water have been removed for cementitious applications
- Other minor amendments for test methods and LOD which reduces testing costs

All other conditions from the 2010 Exemption remain the same.

The Association would like to thank our members for their commitment to the drafting and review process. This is yet another example of 'Doing Together What We Could Not Do Alone'.

To view the Exemption, visit: http://www.epa.nsw.gov.au/waste/generalrre.htm

Guide to the Use of Iron and Steel Slag in Roads Review: Introducing the QRG.

The review of the Guide to the Use of Iron and Steel Slag in Roads is well underway. Since its commencement in mid-2012, authors have been working tirelessly in the design and completion of drafts for each of the four Quick Reference Guides (QRGs). This review is designed to produce summary documents for the key areas of the 2002 edition, not to replace this original publication as it still holds significant value.

The first of the documents, QRG 1, focuses on the general aspects of different slag types and applications as the basis for the coming documents which will focus specifically on Stabilisation, SFS and EAFS. QRG 1 and other published documents are available on the ASA website at: http://www.asa-inc.org.au/knowledge.php

We will continue to keep members updated on the progress of this project through the National Technical and Education Committee meetings held every 3 months - http://www.asa-inc.org.au/committee-meeting-schedule.php - as we continue to add to our library of technical literature which benefits stakeholders and the general community alike.

asa australasian iron & steel slag association

QUICK REFERENCE GUIDE 1 - 2013

Roads Guide Supplement on General Applications

1. INTRODUCTION

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4) Ladle Furnace Slag (LFS)

Table 1 - Typical values for the physical properties of iron and steelmaking slags.[1]

Physical Property - Aggregate	Blast Furnace Slag	Steel Slag		Test Method
	Rock Slag	BOS Slag	EAF Slag	
Bulk Density (t/m³) (loose)	1.2	1.7	1.7	(AS 1141.4)
Dry Strength (kN)	100	250	250	(AS 1141.22)
Wet Strength (kN)	90	220	220	(AS 1141.22)
Wet/Dry Variation (%)	10	12	12	(AS 1141.22)
Water Absorption (%)	5	fine - 3.0 coarse - 2.0	fine - 3.0 coarse - 2.0	(AS 1141.5/6)
LA Abrasion	40	15	16	(AS 1141.23)
Polished Aggregate Friction Value (PAFV)	50	55	60	(AS 1141.41/42)
Sodium Sulfate Soundness (%)	<1.0	<1.0	<4	(AS 1141.24)
Physical Property- 20mm Road base				
Maximum Dry Density (kg/m³)	2,200	2,200	2,250	(AS 1289.5.1.1)
Optimum Moisture Content (%)	10	11.0	10	(AS 1189.5.1.1 & AS 1289.2.1.1)

Note: - *OMC depends on the components of the mix.

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A CHAT WITH JAMIE NORTH

Jamie North, a Sydney based artist talks about his use of slag as a medium in sculpture and representations of the built environment in his 'Innerrouter' and 'Slag Bowls" exhibitions at the Sarah Cottier Gallery.

What kind of work do you do?

I do sculpture and photography that to date have involved indigenous plants in states of transformation.

How did you get involved in sculpture?

I started to get involved in sculpture as a way to work through some ideas that I was having. I used to make sculptures when I was in school though left it behind, and have come back to it in the past 6 years.

What kinds of materials have you used before?

I have used mostly concrete as a medium, with various mixes and aggregates. The concrete sculpture becomes a housing for the native plants that I use in my works.

What led you to have an interest in industrial by-products/co-products, specifically the use of fly ash and slag as materials?

I guess many roads led to this. Fly ash and slag have traditionally been used in concrete manufacture, so I was eager to try both of these in blends to achieve desired outcomes in terms of final concrete composition, though also environmental outcomes.

What aspects of slag do you find favourable to work with?

I have never been able to get enough slag to use as the primary aggregate in my work, though from what I have experienced it seems to perform well. My primary attraction to slag is both aesthetic and conceptual. I use slag as an exposed aggregate as I find it attractive and intriguing. Conceptually, I am interested in the idea of slag being a man made pyroclastic substance, and a by-product of human activity.

Different types of slag will have a variation in colour and consistency, did this effect your selection of the material?

Absolutely. I have primarily worked with slag sourced from ASMS in Wollongong and I always favour slag with lots of gas bubbles. This is for visual interest, though I also believe that there is a chance that plant life will take to this porous slag. I am also very interested in slag with a high silica content for its glassy appearance though do not currently have a source for this. If anyone can help out in terms of supplying this, or other types of interesting slag or coarse ash I would be very grateful.

Did you have any difficulties when working with slag?

No real difficulty.

What kind of inspiration or message are you portraying in your work? Is there a sustainability element?

I think art is best when direct messages are avoided as it allows the viewer room to have their own thoughts about the work. However, my original motivations in making these sculptures was to emulate the way in which some species of native plants grow out of the mortar of city buildings, which is a testimony to their resilience.

Your exhibition, 'Innerouter' used cast concrete and native plants, what kinds of manipulation techniques did you use?

The plants used are those that would naturally occur growing on rock, though they must be established on some other growing medium included in the sculpture, before they can spread to concrete. This is the primary manipulation technique.

What were your reasons for incorporating various native plant species into your work?

I'm personally very interested in native plants and the possibilities around them. I do think they are greatly under-appreciated and they have a lot to tell us about the place in which we live. I wanted to celebrate them and grow them in a way that was unconventional and challenging.

Was there any particular reason for showing both the external and internal surfaces of the cast concrete?

Yes. I like the contrast between the smooth lifeless outer and the coarse, more organic inner concrete. Also, as the plants grow inside the work, they are more likely to adhere to the coarsely finished concrete rather than the smooth.

Your work was described as a 'series of idiosyncratic concrete jungles… pulled from the fabric of the local urban environment – reminding the viewer of those moments when you come across some plant life pushing through a broken bit of footpath.' What is your response to this critique?

I think this is a good introduction to the work.

For more information on Jamie North and his use of slag materials, visit: http://www.jamienorth.com

Since this article went to publication, North has been awarded the NSW Visual Arts Fellowship for Emerging Artists Exhibition and intends to study slag in the US next year. Congratulations Jamie!

PIANC AUSTRALIA WORKSHOP SUSTAINABLE PORTS 9-10 SEPTEMBER 2013

PIANC is the global organisation which provides guidance and encourages the use of sustainable waterborne transport in ports and waterways. This organisation is both non-political and non-profit and brings together leading international experts on technical, economic and environmental issues in this field.

PIANC Australia's vision is to be the recognised leader in establishing best practice and standards of excellence in the sustainable development of infrastructure and operations of Australian ports and waterways.

The PIANC Australia Workshop- Sustainable Ports continued again this year on the 9-10 September 2013. With considerable success since the introduction of this initiative, this workshop attracted international and national speakers to discuss current topical issues.

In terms of the relevance of iron and steel slags, the NSW Port Authority attended the conference to share their experiences of utilisation of slag products, as demonstrated in the Port Kembla Expansion. Key characteristics such as little to no settlement, cost efficiency and an interlocking angle of repose supported the use of over 3.5 million tonnes of slag products, making it preferable over other naturally derived products.

Conference topics included:

- WG150 Report- Sustainable Ports: A practical guide for port authorities
- Dredging for Sustainable ports
- Beneficial use of dredged material
- Beneficial use for reclamation of alternative materials
- WG143 Report- Initial Assessment of Environmental Effects of Navigation and Infrastructure projects
- Regulatory Considerations: Approvals, Licences and Conditions
- Offsets and Ecological Restoration
- Climate Change (Impacts, Adaption and Mitigation)

For more information on PIANC Australia, please visit: http://pianc.org.au

US National Slag Association: REGIONAL MEETING AT CATERPILLAR VISITOR CENTRE.

The US National Slag Association held its regional meeting at the new Caterpillar Visitor Center in Peoria on March 19-20, with attendees representing a cross-section of steel producers, slag processors, equipment manufacturers and service providers gathering to discuss safety innovations, environmental issues, regulatory trends and new equipment. Among the topics were industry governing bodies, best practices, a review of EPA legislation and fugitive dust management. Most discussions were dominated by safety and environmental content.

The event was attended by over 50 active and allied NSA members, including organizations that are actively engaged in iron and steel slag processing, refining and/or the marketing of these slags, as well as those involved in related activities, such as manufacturers and users of iron and steel slags.

Sponsored and hosted by NSA member Dust Control Technology, the meeting was held at the expansive Caterpillar Visitor Center on the Illinois River. The facility provides a fascinating look at the company, equipment and people making sustainable progress possible around the world. Featured projects included Caterpillar's role in building San Francisco's famed cable car system, construction of the Three Gorges Dam in China and the widening of the Panama Canal.

DCT Vice President Aaron Valencic pointed out that safety was always a primary topic at the meetings. "The steel industry doesn't have a governing body such as the mining industry has in MSHA," he explained. "And OSHA really isn't comprehensive enough to cover all steel industry activity." For that reason, NSA considers part of its mission to be forming groups to develop best practices and reduce workplace hazards.

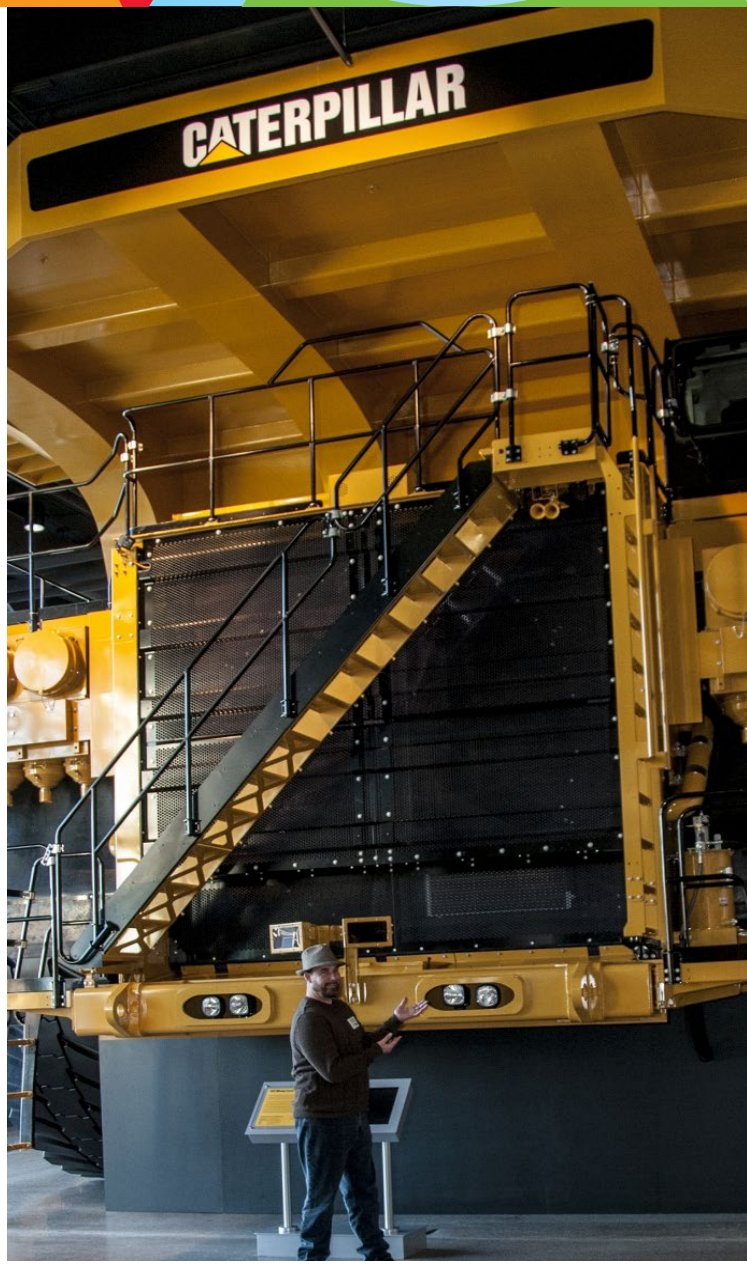
Working closely with sister Associations across the globe over the past few years, NSA has also entered into an official alliance with these associations under the 'World of Iron and Steel Slag - Network' or WoISS. Network members include:

- Australasian (iron and steel) Slag Association (ASA)
- Brazilian Steel Co-Products Center (CCA)
- Canadian Slag Association (CSA)
- EUROSLAG
- National Slag Association (NSA)
- Nippon Slag Association (JSA)

The organization currently hosted by the Australasian (iron & steel) Slag Association conducts six monthly conference calls as part of annual meetings hosted by member associations.

Visit the ASA website for more information on this alliance:
http://www.asa-inc.org.au/membership-woiss.php

For more information on the US National Slag Association (NSA), visit: http://www.nationalslag.org



Conference Report: Concrete 2013

The Concrete Institute of Australia's Biennial National Conference, Concrete 2013 was held at the Gold Coast Convention and Exhibition Centre, Gold Coast, Queensland from 16 to 18 October, 2013.

Conference highlights included

- 5 keynote speakers, 75 sessions, 15 award posters
- 480 registrants networking, listening and learning from the best in the field
- 44 exhibiting companies, 11 sponsors

The broad theme of the conference was 'Understanding Concrete', covering materials, research, design, construction and innovation. The conference provided a forum for the sharing of ideas and experience through formal presentations, industry displays and informal contact between delegates. It was the concrete industry's pre-eminent technical and social event in the Southern Hemisphere for 2013.

The technical program was of value to practicing Civil and Structural Engineers, Engineering Academics, Concrete Product Manufacturers, Civil and Building Contractors, Developers, Government Departments covering Transport, Roads, Railways and Public Works and Local Government Shires and Councils.

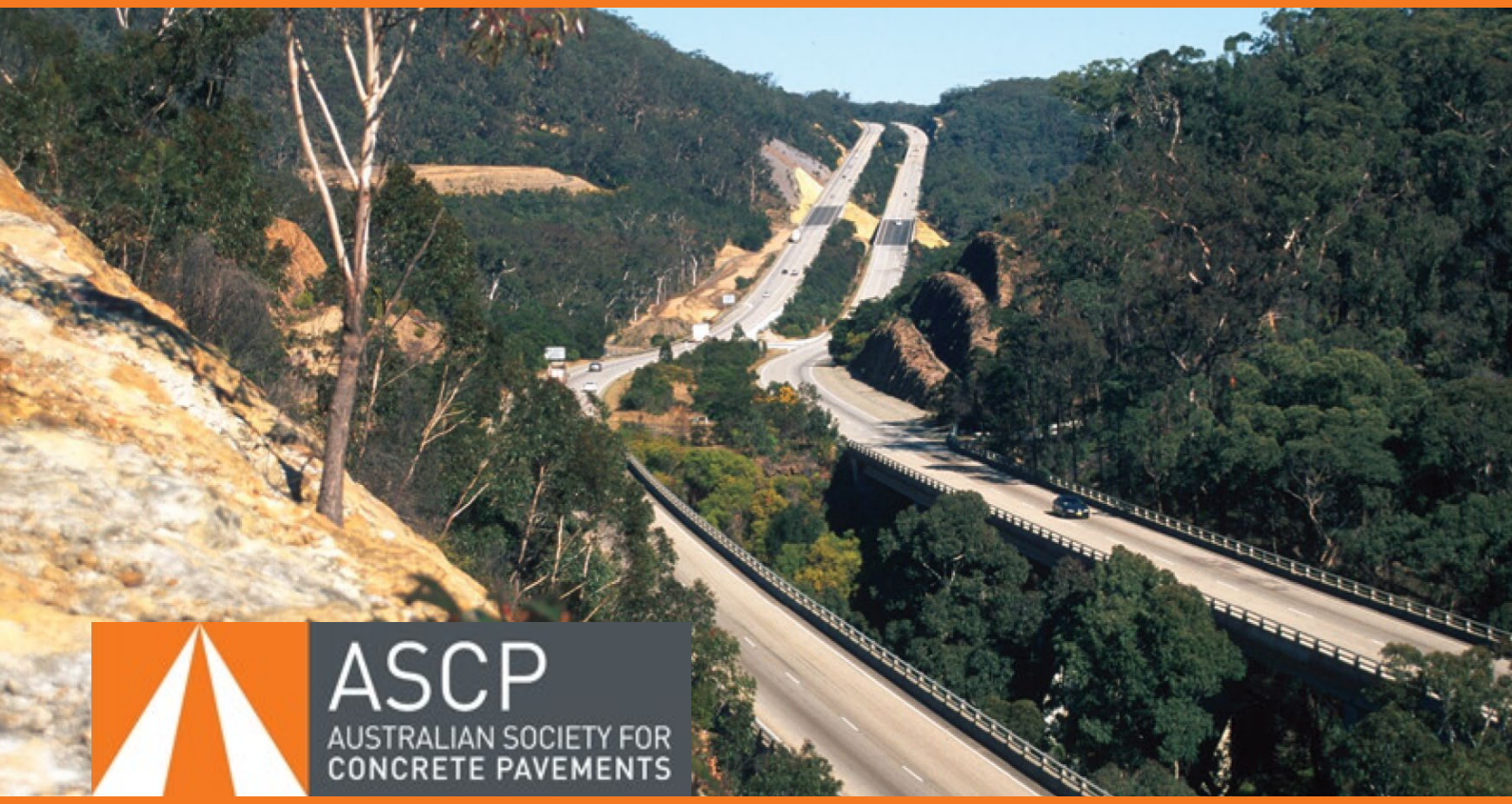
One of the main themes that arose from this conference was the growing popularity of slag materials and their use in geopolymers. This product was represented in a number of sessions including Structures Research and Applications (5 Sessions), Concrete Materials and Performance (3 Sessions) and Geopolymer Concrete (3 Sessions). This indicates yet another innovative field for the continued beneficial utilisation of iron and steel slag products.

The Association received a positive response from Conference delegates and fellow exhibitors. There were a number of enquiries ranging from membership interest, obtaining samples for research programs to general interest in our aims and activities. These events are important to the education and technical foundations of the Association because it brings members together with other industry stakeholders to encourage knowledge transfer.

Concrete 2015 will be held from 30 August until 2 September 2015 at the Pullman, Albert Park, Melbourne.

For more information, visit: http://concrete2015.com.au

Conference Report: Australian Society of Concrete Pavements (ASCP)



Back in August, the Australasian (iron & steel) Slag Association attended the ASCP 2013: Concrete Pavements Conference at the Australian National Maritime Museum, Darling Harbour, Sydney.

This one day technical event aimed to provide the industry with current and relevant information about concrete pavement design, construction, materials and equipment from within Australia and internationally. Additionally, the Museum location provided an interesting venue with access to a large number of maritime historical artifacts.

With 10 international and domestic technical presentations, coupled with a number of discussion sessions, this Conference offered delegates tailored information on specific topics and the opportunity to discuss concepts and ideas with presenters and colleagues alike.

The Association encourages members to attend such events as they afford a valuable technical and professional networking opportunity in industry related fields. We look forward to the next ASCP conference in 2015.

For more information on the ASCP,
please visit: http://www.concretepavements.com.au/Default.aspx