Ash Development Association of Australia

COAL ASH matters

12 OCTOBER

THIS ISSUE - OCTOBER 12

CCPs - *a valuable resource* www.adaa.asn.au

Editorial:

The Ash Development Association of Australia and its associated industries have experienced a productive yet often challenging year. Further challenges in the operating environment of the coal-fired power generation sector will continue to impact on CCP production, physical and chemical characteristics, and environmental legislation. These challenges include; the increasingly common practice of co-firing coal with other fuels, especially biomass; modifications to coal-fired power generation plant to reduce emissions (in-boiler and post combustion); the development of more fuel-efficient and more operationally flexible boiler plant; fundamental changes to the basic combustion process to prepare for carbon-capture technologies (for example oxyfuel combustion); and a changing legislative operating environment with the imposition of a carbon tax and renewable energy targets which alone or together, impact on base load demand.

This edition explores the wide ranging activities of the Association and its interactions on both a domestic and international level. Domestically, from technical knowledge updates to conferences, our members continue to advocate for the beneficial use of coal combustion products (CCPs). There have also been a number of exciting project developments outside of the Association specifically with the London 2012 Olympic Games and KOSPO's Samcheok Green power Plant, each of which seeks to advance the current application margins for CCP utilisation.

The woes of the economic climate have not restricted the growth of membership and the encumbered knowledge transfer seen in the continued production of updated technical information. In particular, a number of Technical Notes (TN) and Reference Data Sheets (RDS) originally proposed for review at the end of 2011 have been published with the remaining close to completion. Additionally, the CCP Handbook Review continues to steam ahead with four draft chapters soon to be published on the ADAA website for member comment, explained in depth later in this edition.

Reference Data Sheet 13 (Modified and Stabilised CCPs) has been included as an insert in this edition and is also published on our website. This RDS demonstrates the wide ranging applications for the use of CCPs in binding and pavement materials including Sydney's M4 Motorway and the Eyre Highway in South Australia. By examining these practical examples in conjunction with the long established research behind the use of these materials, it is clear that CCPs will continue to be an advantageous product in the modification and stabilisation of pavements.

In this edition we welcome some eight (8) new members to the Association in the past few months. Please see the Members list on the ADAA website for further information. This edition features Wagners Cement, with others to be featured in future editions.

Lastly, the Ash Development Association of Australia were excited to attend the Construction Materials Industry Conference 2012 at the Melbourne Exhibition Centre during September. Attendance at these conferences are a valuable source for networking with like-minded industry representatives and offer potential membership opportunities to the Association. Our team enjoyed all that the Conference and its city had to offer and have reported back on their experience.

From everyone at the Ash Development Association of Australia, we wish you all the best over the holiday period and look forward to bringing you the next edition of Coal Ash Matters in 2013.

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Membership

COMPANY MEMBERS

A primary role of the ADAA is to bring together producers and marketers of coal combustion products (CCPs). Our activities cover research and development into CCP usage, advocacy and technical assistance to CCP producers and users, as well as a forum for the exchange and publication of CCP information.

For more information on the Association, visit us at **www.adaa.asn.au**

- Adbri Masonry
- Adbri Resources
- Alinta Energy Group Ltd
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- CS Energy Ltd
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RELATED ASSOCIATIONS

- CSIRO www.smit.csiro.au
- Association of Canadian Industries Recycling Coal Ash (CIRCA) www.circainfo.ca
- UK Quality Ash Association www.ukqaa.org.uk
- American Coal Ash Association www.acaa-usa.org
- World Wide Coal Combustion Products Network (WWCCPN) www.wwccpn.org

A Quick Note!

The Natioanal Technical Committee has continued to push forward on the update of technical literature produced by the Association in past years. Of the nine documents identified for review, several have been published with considerable assistance from the ADAA member base. Our member base is crucial to the review of these documents in providing a current, industry leading perspective on present and future applications of CCPs.

A number of technical documents have recently been published and uploaded to the ADAA website. These include Technical Note 5, *'Pavement Construction and the Role of Coal Combustion Products'* and Technical Note 6, *'Structural Fills and the Role of Coal Combustion Products'* as well as the insert in this edition, Reference Data Sheet 13, *'Modified and Stabilised Construction Materials Incorporating Coal Combustion Products'*.

In terms of upcoming technical materials awaiting the final stages of publication, various topics relating to CCPs will be addressed. With the growing trend for CCP use in the reduction of carbon usage especially carbon emissions, Technical Note 12, *'CO_2 Benefits of Using CCPs'* has outlined the significant contribution of fly ash to the reduction of carbon emissions in cement production. Another area of research has been in the revision of the research project undertaken by Craig Heidrich in 2009 relating to Naturally Occurring Radionuclide Materials (NORMS) in CCPs outlined in Technical Note 13, *'NORMS in Australian CCPs'*.

Once again, it is important to reiterate that the contribution of our members to the collaborative draft and design of these documents is crucial to their success and ensures that the information published is timely and relevant to the current industry position.

Title	Status
Pavement Construction and the Role of Coal Combustion Products (TN 5)	**Published**
Structural Fills and the Role of Coal Combustion products (TN 6)	**Published**
Use of Fly Ash to Achieve Enhanced Sustainability in Construction (TN 11)	**Published**
CO_2 Benefits Using CCPs (TN 12)	**Drafting**
NORMS (TN 13)	**Drafting**
Other Uses and Applications of CCPs (RDS 3)	**Drafting**
Coal Combustion Products in Roller Compacted Concrete (RDS 10)	**Published**
CCPs for Soil Applications, Horticultural and Agricultural Assessment (RDS 11)	**Scope**
CCPs for Soil Applications, Horticultural and Agricultural Applications (RDS 12)	**Scope**
Modified and Stabilised Coal Combustion Products (RDS 13)	**Published**

Ash Development Association of Australia

MODIFIED AND STABILISED CONSTRUCTION MATERIALS INCORPORATING COAL COMBUSTION PRODUCTS

Fly Ash Reference Data Sheet NO. 13
2012

1. INTRODUCTION

The use of stabilised materials in road construction and maintenance has gained considerable acceptance as a result of:

- Scarcity of high quality quarry materials
- The ability to successfully recycle pavements insitu gaining economic and environmental benefits
- The development of a wide range of binders
- The development of pavement and materials design protocols

Some work on the use of fly ash in modified and bound road construction materials is available including descriptions of applications.[1] Stabilised materials can be classified in one of three ways:

i. Mechanically stabilised materials where inert materials are added to improve the grading of unbound materials
ii. Modified materials where small amounts of binder are added to unbound materials to improve material characteristics while maintaining the materials' unbound performance characteristics
iii. Bound (stabilised) materials where sufficient binder is added to significantly increase the tensile strength of the material[3]

Coal combustion products (CCPs) cover a range of materials and are used in all of the situations described above. CCPs can be broadly classified as follows:

- Furnace Bottom Ash (FBA)
- Fly Ash (FA) conforming to AS 3582.1 Fine, Medium or Coarse grades,[3] and
- Fly Ash not conforming to AS 3582.1 (often termed Run of Station ash or ROS ash)

CCPs fulfil a key role in binder design as a slow-setting binder, improving binder characteristics and reducing costs.

2. PAVEMENT MATERIALS

Stabilised pavement materials can be classified as:

- Plant mixed stabilised materials
- Insitu stabilised materials
- Sub grade stabilised materials

Further information on the use of these types of materials in a range of pavement types as well as binder types suggested for various applications are provided in Austroads 2012.[2]

3. PAVEMENT DESIGN: THE ROLE OF STABILISATION

Pavement materials include a combination of coarse and fine aggregates with a proportion of smaller clay/silt sized particles. The objective is to ensure a final grading matrix that will allow maximum compaction of the product with the least voids present. This is to achieve a solid layer that is in part impervious to water infiltration. Pavement materials can be used in different layers of the pavement and the requirements of such layers will be determined by applied load and pavement composition selected by the designer.

Typical pavement configurations for pavements incorporating stabilised materials are illustrated in Figure 1.

The design of pavements with stabilised layers is covered in detail in the Austroads Guide for Pavement Structural Design.[2]

For pavements containing mechanically stabilised materials and/or modified materials, the limiting design criterion is the vertical strain at the top of the sub grade. For stabilised and higher binder content materials, the vertical strain at the top of the sub grade is not the only design criterion as the fatigue life of the cemented material must also be considered. The fatigue life of the cemented material is usually the governing criterion.

High performance quarried materials will likely be obtained from the nearest possible source in order to minimise transport costs. Often, however, imported material may not be sufficiently strong to satisfy the pavement design requirements. In such cases, the solution is found in the design of either stronger pavement layers or a reduction in the stress requirement for the layer. One of the most cost effective ways to make the pavement stronger is to modify or stabilise the pavement material. As an alternative, it is possible to reduce the stress requirement by stiffening the foundation. Again, this can be done by either modifying or stabilising the foundation.

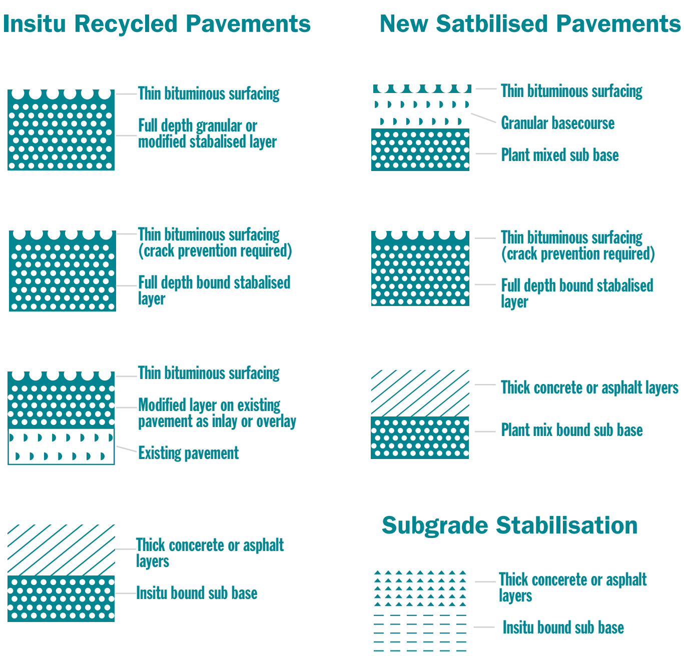

Fig. 1: Typical Pavement Configurations Incorporating Stabilised Materials (Adapted from 2)

4. BINDING PROCESS

By combining the available materials with a small percentage of binder, physical and mechanical properties of the layer can be improved. The binder may act as a glue or it may simply modify the pavement layer properties to allow easier access by construction traffic. In pavement construction where heavy duty performance is required, or where pavement materials (base and sub base) require improvement, these can be either modified and/or stabilised, depending on the needs of the pavement design. The requirement for modification or stabilisation is based on the specified material stiffness.

The material binding process utilises specialised machinery that mixes the binder evenly through the pavement material. Machines such as that shown in Figure 2 are commonly used for pavement stabilisation. Machines used are capable of mixing up to 450 mm depth in pavement.

Fig. 2 Example of a Deep Lift Stabilise[7]

The binding agents used can vary significantly in type and performance. Trialling is considered essential to confirm the likely properties of the pavement materials and stabilising agents. Commonly used stabilising materials include cement, FA, slag and lime. Apart from cement, such materials rely on a pozzolanic reaction for their binding properties. Both FA and slag react with free lime to form cementitious compounds that are forms of calcium silicate hydrates. There are also other products such as polymers which can be used as binders. Austroads Guide to Pavement Technology – Part 4L – Stabilising Binders (2009) provides detailed information on available binder types.

5. MECHANICAL, MODIFIED OR STABILISED BINDING

5.1 SELECTION OF BINDERS

Depending on the nature of the host road base material, a combination of stabilising agents may be used including cement, slag, FA or lime. In some cases a triple blend may be applied to produce a slow setting binder that gains stiffness and strength over a longer time frame. Through testing and trialling, combinations of binder materials are developed and then specified.

This improvement in the strength and stiffness as a result of stabilisation also results in a subsequent reduction in pavement permeability.

In addition, there are a number of construction advantages resulting from increased stiffness with a thinner pavement required and the ability to compact thicker layers following placement. This reduces construction time through a reduction in the number of layers requiring placement and compaction. In design, excessive strength development is to be avoided. High strength gain can result in a loss of pavement flexibility and leads to cracking in response to applied stress. The differences between Granular (Mechanical), Modified and Bound materials are illustrated in Table 1.

5.2 CCPS AND BINDERS

Either FA as defined in AS 3582.1[3] or ROS ash that has properties outside those noted in that standard can be used with lime or cement for the modification of road base materials.

General Purpose (GP) cement on its own can be used as a binder, but requires care with the limited working time to ensure compaction and ride quality are achieved prior to initial setting.

FA and lime have much slower reaction rates and result in a slower strength development and more appropriate material working times. Chapman and Youdale[5] evaluated FBA based pavements in 1982. The residual strength of the material was found to be stronger than that of conventional base course material that was re-compacted up to six days after placement.[5]

5.3 LIME STABILISATION

Lime stabilisation or modification is used in road construction to improve the quality of existing material within the construction project. Lime is an effective additive for plastic soils, improving both workability and strength.[4] Lime stabilisation can be used to:

- Modify marginal material to bring it within specification or for performance requirements
- Increase strength as an alternative to cementitious stabilisation
- Enhance volumetric stability for various layers of select material
- Improve surface stability of unsealed roads

5.4 CEMENTITIOUS STABILISATION

When stabilising with cement, the working time of the resultant material can be critical. The time available to deliver, incorporate and compact a pavement layer needs to be well understood before project commencement. With cement as the only binder, the time for performing placement and compaction processes is limited to approximately two hours from the incorporation of the cement into the moistened pavement material. No rework time is normally provided for. This can create a very demanding schedule with little opportunity for error management on site.

Cement as the only binder is not often used due to these working time restrictions. In addition, higher shrinkage rates can result in an increased cracking tendency. Addition of FA to the binder extends the working life of the stabilised material, allows more time placement in compaction of the material and mitigates risks typically associated with a single cement binder.

Category of stabilisation	Indicative laboratory strength after stabilisation	Common binders adopted	Anticipated performance attributes
Granular (Mechanical)	40% < CBR1 < +100% (sub base and base course)	• Blending other granular materials which are classified as binders	• Improved pavement stiffness • Improved shear strength • Improved resistance to aggregate breakdown
Modified	0.7MPa < UCS2 < 1.03 MPa (base course)	• Addition of small amounts of cementitious binders • Addition of lime • Addition of chemical binder	• Improved pavement stiffness • Improved shear strength • Reduced moisture sensitivity • At low binder contents can be subject to erosion where cracking is present
Bound	UCS2 > 1.0 MPa (base course)	• Addition of greater quantities of cementitious binder • Addition of a combination of cementitious and bituminous binders	• Increased pavement stiffness to provide tensile resistance • Some binders induce transverse shrinkage cracking • At low binder contents can be subject to erosion where cracking is present
Sub grade	CBR1 > 5% (sub grade and formation)	• Addition of lime • Addition of chemical binder	• Improved sub grade stiffness • Improved shear strength • Reduced heave and shrinkage

Table 1 Types of Stabilisation[2]

Notes:

1. Four day soaked CBR
2. Values determined from test specimens stabilised with GP cement and prepared using standard compactive effort, normal curing for 28 days and 4 hour soak conditioning
3. It is vital that this value is not exceeded or the pavement design will be invalid and premature failure as a result of cracking is likely

6. APPLICATION OF CCPS IN PAVEMENTS

6.1 FLY ASH

FA is light to mid-grey in colour and similar but often paler in appearance to cement. Particle sizes range typically between less than 1 micrometre (μm) to 200 μm and are irregular to spherical in shape depending on the material source and formation. FA tends to be pozzolanic in nature, reacting with calcium hydroxide in the presence of water to form cementitious compounds.[6,7,8]

6.2 FURNACE BOTTOM ASH

FBA is formed when ash adheres as hot particles to the furnace walls at coal fired power stations, agglomerates and then falls to the base of the furnace where it is collected and transferred to the storage facility. FBA can comprise 10-20% of the CCPs produced from a power station and ranges in grain size from fine sand to coarse particles up to 5 mm in size. It has a chemical composition similar to FA but may contain greater proportions of carbon (Loss on Ignition or LOI) and is relatively inert because it is coarser and more highly fused than FA.

The coarse particles make an excellent free draining material and are very beneficial as a drainage layer. FBA has a role in granular stabilisation for improving the grading of crusher run materials. Given the coarser nature of FBA particles, it is not as highly pozzolanic as FA.[8]

7. SPECIFICATION REQUIREMENTS

Selection of the most appropriate FA for stabilisation purposes requires a different approach when compared with the selection of FA as a supplementary cementitious material. Australian Standard AS 3582.1[3] describes the general requirements for FA as a supplementary cementitious material for use with GP and blended cements. The accepted practice to date has been for specifiers to stipulate the use of FA that meets the requirements of AS 3582.1 when selecting material suitable for stabilisation work. It is often also assumed that the finest grade (with the lowest LOI) of FA is the best for application to modified and stabilised materials. That assumption would lead to an expectation that fine grades would perform better in a stabilisation role than the coarser concrete grades covered by the standard. This is not the case.

The test requirements of AS 3582.1 are set out in Table 2. It is apparent from a review of the available power station data that a wider acceptable tolerance would be useful in giving flexibility to the specifier. The inclusion of an additional grade for FA is currently being considered for inclusion in the next update of AS 3582.1.

In addition to those listed in Table 1 there are a number of other reportable properties including:

- Available alkali content
- Relative density
- Relative water requirement
- Relative strength
- Chloride ion content

Most Australian coal fired power stations have capability to produce fine grade FA through various processing techniques. Air classification is the most common and known as classified FA. Unclassified FA is known as ROS ash. The major difference between ROS ash and classified FA is the fineness.

Chemically there are no differences between classified and unclassified ash, however fineness related properties such as relative density, relative strength and relative water requirement will vary. A typical ROS ash would have fineness of at least 40% under 45 µm. The LOI is usually less than 6% however a few stations have higher LOI. The major impact of LOI in concrete applications relates to the entrainment of air. There are numerous other applications. For example, pavement stabilisation has no requirement for entrainment of air. Therefore, high or variable LOI is less important.

Grade	Fineness by mass % passing 45 µm sieve	Loss on ignition, % maximum	Moisture content % maximum	SO_3 content, % maximum
Fine	75	4.0	1.0	3.0
Medium	65	5.0	1.0	3.0
Coarse	55	6.0	1.0	3.0
Test Method	AS 3583.1	AS 3583.3	AS 3583.2	AS 3583.8

Table 2 Fly Ash Defined in AS 3582.1(3)

ROS ash is worthy of consideration for stabilisation uses. Based on the findings of Chapman and Youdale,(5) lime stabilisation of FBA produced an outstanding pavement material. Clearly FBA does not comply with the fineness requirements for AS 3582.1 but its other chemical properties are similar to FA. Research and testing is required to confirm the ability of ROS ash to improve the performance of the quarry materials in the same way that FBA performs. This is a worthwhile area for further investigation as the cost of ROS ash could be less than material specified in AS 3582.1.(3)

FA is captured, stored and delivered in a dry state in dedicated binder tankers whereas FBA tends to contain higher levels of moisture which needs to be considered during transport and further use. CCPs retrieved from storage (ie. ash dam) can have variable properties and need to undergo trialling and relevant testing prior to use.

8. APPLICATIONS

Stabilisation or modification can change some of the following attributes of pavement materials depending on the binder and quantity used. It may:

- Reduce plasticity
- Improve workability
- Increase strength gain
- Change particle size distribution
- Reduce the material moisture sensitivity
- Reduce permeability
- Alter the compaction properties
- Reduce required pavement thickness
- Dry out wet materials
- Improve work platforms

9 FIELD PERFORMANCE

9.1 M4 MOTORWAY

The Sydney M4 Motorway was widened from Prospect to Penrith over 15 months in 1997-98. The existing two lanes in each direction were widened to three lanes with the additional lane constructed along the shoulder using insitu stabilisation.(9) Insitu stabilisation was chosen because of the ability to achieve high production rates adjacent to one of Sydney's busiest motorways. The existing pavement material was recycled (asphalt and the original road base) which reduced the need to quarry virgin materials and the dispose of existing material.

Compared to conventional methods of pavement construction, an estimated 50,000 tonnes of road base material was recycled rather than going to landfill. This reduced both the cost and additional truck traffic that might otherwise have had to use the existing road. The binder used was 50% FA, 25% lime and 25% slag. The required 28 day strength of 2 MPa was achieved with only 3% binder by weight. The binder provided an extended working time to allow time to correct levels and improve compaction. Ongoing performance of the pavement has been reported to be satisfactory.(9)

9.2 EYRE HIGHWAY, SOUTH AUSTRALIA

In 1997, as part of a long term upgrade of the Eyre Highway between Port Augusta and Ceduna, a 33 km section of the highway near Kimba was widened.(10) The poor quality (high plasticity) of the locally available material meant it needed to be stabilised with a lime FA blend. Various mixes containing FA and lime were utilised and blended at a rate of 3% of the aggregate. The majority of the 33 km section utilised 2.5% FA and 0.5% lime. Figure 3 illustrates spreading of the binder before incorporation.

Port Augusta supplied the FA whilst the lime was obtained from Adelaide. The binder was selected to improve material stiffness and reduce moisture sensitivity (i.e. loss of strength due to seasonal wetting). In addition, it was desired to minimise shrinkage by using the blend in preference to GP cement as the binder.

Fig. 3 FA and lime blend, South Australia(10)

Transport SA lab tested potential shrinkage rates and found much reduced shrinkage from the lime and FA blend compared to GP cement. In addition, Transport SA reported that for the same binder contents, a 1:1 lime FA binder will provide an equivalent long term strength to cement.(11) Pavement performance was extensively monitored to verify the design approach. Falling

Weight Deflectometer testing over following years demonstrated that the performance of the stabilised blend was superior to the unmodified pavement.[11]

10. CONCLUSIONS

When unbound construction materials do not have sufficient strength or stiffness for a given application, modification or stabilisation of these materials with a small addition of binder can significantly improve performance and reduce costs.

The addition of binder increases the shear capacity of the pavement material and allows thinner pavements to be constructed. Layer thicknesses for compaction can usually be increased to provide further economy during pavement construction. The addition of binders to quarry materials can change the mechanical and physical properties of the blend.

The performance of the combined blend of source material plus the binder needs to be well understood before placement into a pavement structure.

CCPs, particularly FA, play a key role in binders chosen for stabilisation projects. Most importantly, they succeed by improving binder performance and reducing project cost. The choice of CCP should not be limited to the grades covered by Australian Standard AS 3582.1. Modification and stabilisation of road base pavement layers can be successfully carried out using ROS ash that has properties outside those specified in AS 3582.1.

Establishment of ROS ash as a modification and stabilisation aid will involve suitable trialling and testing to confirm the properties of the material. Long term tests will also be able to provide an indication of the likely load bearing capacity of the pavement and hence expected service lives. ROS ash thus can have a major impact on reducing costs of pavement construction where modification or stabilisation of existing material is required.

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Member Profile: Wagners Cement

Wagners is a family owned Australian Company with a reputation for delivering high quality products and services internationally. Their focus is on cement, reinforcing steel, contract crushing and bulk transport, as well as lightweight composite fibre products. With this focus, Wagners strives to find innovative, effective and economic solutions for their clients.

Wagners has access to the finest Australian and international cementitious materials for the manufacture of their quality cement products. The Wagners team of professional cement experts utilise state of the art manufacturing and laboratory facilities in order to produce cement that exceeds Australian Industry Standards. All Wagners' cement conforms to the requirements of Australian Standards AS 3972, AS 3582.1, AS 3582.2, AS 3582.3, MRTS70 and Specification SP 43.

The Wagners Cement Plant at Pinkenba in Brisbane is a grinding plant producing:

- General Purpose (GP) cement: The most commonly used cement in Australia, predominantly used in construction applications.
- General Blended (GB) cement: Product containing 75% Portland cement blended with 25% fly ash used to increase durability whilst retaining strength. GB cement is most commonly used in road stabilisation and general construction. The adaptability of this material allows for varied blend ratios on specification to the plant with fly ash sourced from the Millmerran Power Station, some 230 kilometres west of Pinkenba.

The plant is certified under ISO 9001 and operates a fully accredited NATA laboratory on site. Wagners' cements are registered with ATIC (Australian Technical Infrastructure Committee), listed with Queensland Main Roads Registered Supplier List and have been accepted for use by Roads and Maritime Services, New South Wales and VicRoads in Victoria.

Wagners in 2011 received the *Premier's ClimateSmart Sustainability Award*, for the development of new, low emission concrete consisting of industrial waste products known as Earth Friendly Concrete (EFC). This blended cement achieves an 80-90% reduction in emissions when compared to Portland cement through its incorporation of blast furnace slag and fly ash as a geopolymer binder. Despite large ratios of substitution, performance characteristics are comparative, if not better to that of GP.

An interesting project linked to the development and use of EFC has been in the contracting for the supply of EFC geopolymer concrete. This concrete will be used for the production of 33 large floor beams as the foundation for 3 suspended floor plates at the University of Queensland's new Global Change Institute 'Sustainable Building' at their St Lucia Campus. This project marks a milestone as the first use of EFC in a fully structural building. For more information, please visit: http://www.wagner.com.au/news/

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International Outlook: Samcheok Green Power Plant

At the recent ADAA National Technical Committee Meeting in September, Association members were given the opportunity to listen and contribute to a presentation given by delegates from Korean organisations Mireco and Kospo. This visit sought to extend ties between the ADAA and these organisations in the exchange of knowledge on current utilisation technologies and the policy and regulations that regulate them in Australia.

Mireco is a specialised mine reclamation institution which seeks to actively contribute to green growth and economic development through the prevention of mining and related damage from abandoned mines. Their technology re-uses CCPs to stabilise abandoned mined areas subject to ground subsidence in order to reclaim land for other applications. On the other hand, Kospo or Korean Southern Power is a substantial power generator in South Korea, producing 11.6% of gross power from a range of generation types, including coal.

In brief, South Korea recycles 67.8% of the 8.64 million tonnes of fly ash produced. Activities such as:

- Rehabilitation of waste dumps
- Mine backfill
- Soil improvement

all contribute to the reuse of this material for which Mireco participates.

A particular project undertaken by Mireco in conjunction with Kospo, proposes to recycle 100% of all CCPs produced from the newly approved Samcheok Green Power Plant. Specifically, there is no provision for ash storage onsite due to the immediate transportation of the material to a nearby mine reclamation site on production. This in conjunction with no water discharge and indoor coal storage will revolutionise power production to extend the parameters for CCP use as a yardstick for international green power development.

mireco

KOSPO

Australia's Tennis Come Back based on Ash

Dr Geoff Cresswell of Irrigation and Water Technologies (IWT) NSW has revolutionized the renowned terra cotta surface used in Italy by making it water efficient and low maintenance. The likes of Roger Federer and Rafael Nadal who are known for their use of spin and graceful sliding, developed these skills on the famous red clay courts of Europe and South America. Australia's champions of the past dominated the sport because they also had these skills. However the present generation of Australian players find it difficult to develop these specific techniques because of their dominant play on synthetic courts which are much easier to maintain. Tennis Australia now recognises that Australian players must have access to clay courts.

The KISSS Italian clay court currently being trialled at Macquarie University solves the three main problems of clay courts - high maintenance, high water use and incompatibility to wet weather. Furnace bottom ash is therefore part of the solution to these problems. The KISSS system has a layer of graded ash directly under the Italian clay surface. This houses the KISSS subsurface textile irrigation system and acts both as a reservoir for water preventing the surface from drying too rapidly as well as an efficient drainage layer by drawing the rainwater from the surface. The exceptional capillary properties of the ash evens out the distribution of irrigation water. This uniformity of wetting combined with a system that will only irrigate when soil moisture sensors in the court allow it to, means that only a third of the water is used compared to that required by a traditional court.

Aside from tennis courts, Cresswell has also conducted promising research and field trialling on furnace bottom ash as a growing medium in agricultural applications. His experience with alkaline ash has been that the high pH has not produced the expected range of micronutrient deficiencies.

Furnace bottom ash usage in the KISSS Italian Clay Court is yet another innovative use of CCPs. If you would like to know more, please contact geoff@cresswell.com.au

Learning Legacy: Sustainability at London Olympic Park 2012

The 2012 London Olympics has been and gone, bringing the greatest athletes from around the world to one place to compete. Despite the conclusion of this world-class event, the infrastructures left behind have a longer lasting effect in terms of the materials used in their construction.

With sustainability goals in the sights of the Olympic Delivery Authority (ODA), a number of targets were met and surpassed in the reduction of carbon emissions and embodied carbon held within these super-structures.

To illustrate these reductions, a number of statistics are available:

- Average 32% cement substitution across Park which resulted in an 11.6% reduction in embodied carbon or 14,200 tonnes
- 40% substitution of Portland cement with fly ash in most areas of the Park. Despite a number of constraints relating to finish uniformity in visible concrete, the majority of substitution occurred in non-visible areas and all highway structures where the material was relied upon as being technically sound and not requiring high-performance aesthetics

The material used for cement substitution in the UK is typically ground granulated blast furnace slag, with the fly ash produced from coal-fired power stations reserved for land fill. The ODA recognised this resource for its substitution potential and took an active role in promoting the material for future uses.The sustainable targets set for the Olympics opened the minds of designers and contractors to be proactive in their use of substitutes with a number of projects undertaken to test various substitution levels that surpassed current domestic standards in the UK. One particular recommendation was a change of typical industry practices to accommodate for the use of sustainable materials in terms of setting times and strength characteristics.

The ODA has produced a number of documents as part of a "Learning Legacy", that seeks to outline the innovative methods and planning mechanisms used to orchestrate the project. These are available online: http://learninglegacy.london2012.com/index.php

Coal Combustion Handbook Review Update

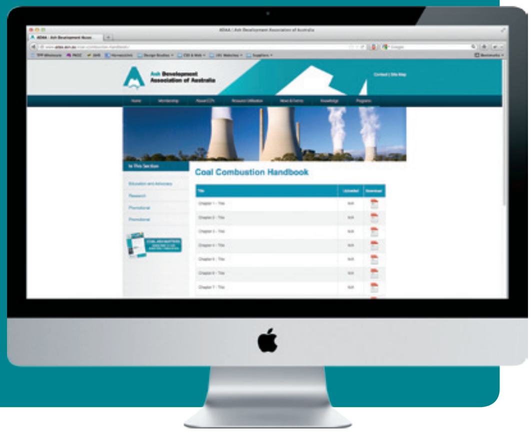
The review of the original Coal Combustion Products Handbook is underway. Since the proposal for the update and production of the *Coal Combustion Products Handbook: Second Edition*, authors and contributors have been working tirelessly in the design and completion of drafts for each chapter.

To reiterate the original aims of the update, the purpose of this project was to update existing and new information with research for application in market developments and the distillation of trends. This new research also calls for legislative changes which are incorporative of the changing face of CCP application.

With the completion of some draft chapters, future progress requires:

- Completion of all working drafts
- Revision and confirmation of data to meet current standards
- Final sign-off on content
- Proofing and publication

With the publication of several working drafts to the ADAA website, we encourage our members to review documents and provide any valuable contributions by email to cheidrich@adaa.asn.com.au. Working drafts will be available in PDF format in the Programs Section of the ADAA website as shown below. Updates on new chapter releases will also be advised by email and the Association's Twitter Feed.



Construction Materials Industry Conference 2012: Run and Done

Kicking off on Wednesday 19 and concluding on Saturday 22 September 2012, Craig, Melissa and Olivia supported by Association members attended the Construction Materials Industry Conference 2012 (CMIC12), hosted at the Melbourne Exhibition Centre.

This event offered a great opportunity for the Association and its members to network with other industry-related organisations in both a business and relaxed setting. Many of our Association members visited the stand and we thank those who gave their time and technical expertise when enquiries were made.

Delegates were enlightened and challenged by a series of keynote speakers including Paul Clitheroe and Saul Eslake who offered a unique perspective on the world in which the construction industry now operates, the changing face of consumption and global competition. Participants attended a number of networking events including the Komatsu sponsored dinner held at the Melbourne Cricket Ground where individuals were honoured to be able to walk on the renowned turf of the cricket ground so close to the AFL final. Fantastic entertainment and dining ensued, including Tim Watson MC who carried the program throughout the evening with a lovely night had by all.

The Association's stand did receive a number of technical enquiries regarding the use of CCPs in traditional applications, given increased scrutiny on the non-sustainable use of 100% virgin quarried resources. A number of membership enquires will be followed up in due course.

Conferences such as this promote CCPs, the Association and its activities to a broader audience and serve as a valuable membership generation source. Often perceived as a by-product, CCPs can be disregarded for their utilisation opportunities and it is therefore important to continue to promote current applications as well as advocating for continued beneficial regulation to allow for use innovation.We continue to encourage our members to participate in these events as a well-rounded networking experience with the next CMIC held in 2014.

Thanks should also be given to the conference organisers who ensured that the event ran professionally and smoothly.

Coal Ash Asia 2012

CCP handling, utilization technologies and techniques are underdeveloped in most Asian markets. This includes two of the worlds largest users of coal power - China and India. In other markets, such as Japan, some of the industry's most advanced technologies and highest utilization rates are being realized.

Regulatory and commercial developments in China, India and other Asian markets are increasing the demand for new solutions. Asia accounts for more than 50% of global coal power generation, and the total coal power generate is expected to increase by 30% by 2020.

Coal Ash Asia 2012 is the leading conference for Asia's CCP utilisation industries scheduled for November 6-9 2012. This year the conference will take place in Nanjing, China, with its focus placed on all things coal ash, gasification products and by-products. Coal Ash Asia 2012 is an opportunity to meet and interact with industry stakeholders, including power generators, building material manufacturers, equipment manufacturers, academics and government representatives from China, India, Australia, Japan and other markets.

The ADAA continues to extend their international relationships past Australian borders which is especially beneficial for the transfer of knowledge surrounding both current and potential utilisation methods as well as regulatory mechanisms for their expanded use. This conference will be hosted by the Asian Coal Ash Association, a body that operates similarly to the ADAA in seeking to represent the interests of its members and their product.

For more information, please refer to the Asian Coal Ash Association website: http://www.asiancoalash.org/

AsianCAA
Asian Coal Ash Association
Facilitating knowledge and collaboration.

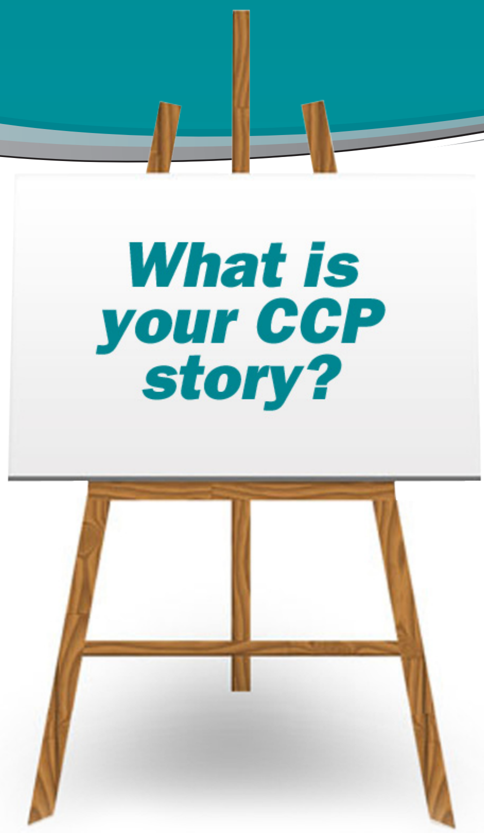
World of Coal Ash 2013: Lexington, Kentucky

The fifth biennial World of Coal Ash(WOCA) Conference is fast approaching in 2013. This popular international event, under the organisation of the American Coal Ash Association (ACAA) and the University of Kentucky's Center for Applied Energy Research (CAER), will focus on the sustainability of coal ash and its applications worldwide from a scientific perspective.

The conference will be held in April 2013 in Lexington, Kentucky with paper submissions closing at the beginning of November later this year. This conference, as an international forum, brings industry leading members and Associations together to discuss and promote further use of CCPs and gasification products. With organizers looking to improve on previous participant numbers, the presentation schedule will cover a wider-ranging number of CCB/CCP related topics including:

- Utilisation of coal ash and flue gas desulfurization materials
- Sustainable projects using CCPs
- Emerging technologies
- General ash management (including disposal)
- Mercury related topics
- Recent research and specific case studies
- International activities
- Regulatory topics from local, State and Federal perspectives

WOCA 2013 will provide an excellent opportunity to continue working with other countries in incorporating CCPs further in industry-related fields and we encourage our members to make the journey. For further information, please visit: http://www.worldofcoalash.org/index.html



A Blank Canvas

Coal Ash Matters is an ADAA publication produced to serve the interests of its members. We are continually looking for new content on industry developments such as:

- **Upcoming projects using CCPs related to the ADAA and the industry**
- **Recent developments and innovations in the use of CCPs**
- **New Member Profiles**
- **Recent appointments, key people of interest**
- **Industry related conferences and events**

If you have an article in mind or simply the bare details requiring further expansion, please contact the ADAA Office.

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