Ash Development Association of Australia

NOV 07

COAL ASH matters

ash - a valuable resource

this issue

CCPs: A Greener & Innovative Future

Recovered resources, including coal combustion products (CCPs) like fly ash and furnace bottom ash, have a significant role to play in advancing the 21st century's quest for a greener environment.

Incorporating fly ash into concrete mixtures over the past 30 years has proven to significantly improve the environmental footprint of concrete, thus making concrete a more desirable construction material. As a co-product of coal used to provide energy to more than 85% of Australians, the use of fly ash alleviates the consumption of additional energy and resources to process virgin materials, thus reducing the resultant greenhouse gas emissions.

Fly ash's environmental edge is well acknowledged by the concrete industry. In fact, the industry, in partnership with the Commonwealth Government, recently announced a commitment to double its use of fly ash and other supplementary cementitious materials (SCMs) by 2012.

CCPs, including fly ash, have also recently proven to have a range of benefits as a soil amendment. Building on previous ADAA funded research by University of Western Australia and the University of Technology in Sydney, interim reports have confirmed fly ash's water saving benefits and improved capacity for nutrient retention properties. Furthermore, the researchers have shown increased crop yields with amended soils and a capacity to modify soil pH to good effect. Future work will be focused on the potential to increase soil carbon levels, which is extremely topical given recent greenhouse policy announcements.

These are just some of the reasons behind the ADAA's activity in advocating for appropriate and scientifically sound legislation and regulations for the reclassification of CCPs for beneficial reuse.

Building on the recent exemption granted in NSW by the Department for Environment and Climate Change for CCP use in land, the ADAA has been engaged in discussion with the Queensland Government seeking a similar outcome. If successful, any exemption would provide industry members and researchers in Queensland with legal assurance that further investments into product development and research could potentially lead to substantial new reuse opportunities.

On top of these environmental benefits, CCPs are today being incorporated into a range of products, some which feature in this edition of Coal Ash Matters. From fertilisers, to high-strength concretes, to building blocks, this issue focuses on the diversity of CCP uses today.

In contrast, this issue's insert provides a brief flashback on the history of CCP use in New South Wales. This comparison of history and the present highlights the innovative development of the industry over the past 50 years.

For more information on the ADAA, its members and the industry, or to download an electronic copy of this newsletter, please visit our website: www.adaa.asn.au.>

High Strength Concrete for Tower Buildings

Solidflow, a special grade, ultra-fine, processed fly ash, has been used as a high strength concrete additive in numerous major buildings in Sydney, including the luxurious Regent Place development.

Designed by Fosters and Partners Architects and built by Multiplex Constructions, this $330 million, 56 level development combines leisure, retail, commercial and residential apartments in two tower buildings.

Boral Concrete was the concrete supplier for the project, utilising the properties and benefits of Solidflow in their high strength 80 MPa concrete. Applications included columns, beams, blade walls and a central core. The mean compressive strength at 28 days for the project was 92 MPa.

Solidflow provided increased strength while also reducing the internal heat of hydration of the concrete. Reduced shrinkage was achieved and durability performance was enhanced. The use of Solidflow also improved the workability and slump retention properties.

In other projects, Solidflow has also been incorporated in the design of concrete requiring super workable self-compacting concrete, shotcrete and other high performance concrete works.

Solidflow is manufactured by Flyash Australia at its new manufacturing facility at Bayswater Power Station, NSW.

Acknowledgements David Hocking - Boral Concrete, DeMartin & Gasparini, Multiplex Constructions

Solidflow was used as a high strength concrete additive in the Regent Place development, Sydney

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Coal Ash Matters is a bi-annual publication **Circulation:** 2000

Membership>

Company Members

A primary role of the Association 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, and a forum for the exchange and publication of CCP information. If you would like more information on the Association and how you can become involved, please complete the information section at the end of this newsletter. Current membership is listed below.

Adelaide Brighton Cement Ltd
Blue Circle Ash
Cement Australia
CS Energy
CSIRO (CMIT)
Delta Electricity
EFA Technologies Pty Ltd
Energy Supply Association of Australia
Eraring Energy
Flinders Power
Flyash Australia Pty Ltd
Golden Bay Cement Ltd
Heeleys Consulting
HRL Technology Pty Ltd
Hyrock Pty Ltd
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Macquarie Generation
Pozzolanic Enterprises Pty Ltd
Readymix Ltd
Rio Tinto
RTA NSW
Tarong Energy Corporation Ltd
Tarong North Power Station
TRUenergy
Loy Yang Power
Verve Energy

Personal Members

Barry Butler
Peter Heeley
Ron McLaren
Peter Nelson

Related Associations

American Coal Ash Association
www.acaa-usa.org

CCSD (CRC for Coal in Sustainable Development)
www.ccsd.biz

Curtin University (WA)
www.che.curtin.edu.au

Energy Supply Association of Australia
www.esaa.org.au

Institute for Water and Environmental Resource Management University of Technology, Sydney
www.iwerm.uts.edu.au

UK Quality Ash Association
www.ukqaa.org.uk

Furnace >>> Bottom Ash

In pulverised, coal-fired power stations, fine ground coal is burned in large boilers to raise steam for power generation. Approximately 85 percent of the burnt coal passes through the boiler and is collected as fly ash. The remaining 15 percent either agglomerates and falls from the air stream or adheres to the boiler water heater tubes and on cleaning, falls to the bottom of the boiler. This material is furnace bottom ash (FBA).

Furnace bottom ash is a glassy, inert material and is generally collected and removed from the bottom of the boiler by wet sluicing. After de-watering, furnace bottom ash can be transported in a moist state and, if kept in this condition, dust nuisance can be readily controlled.

Furnace bottom ash has proven to be a valuable material for the construction industry, being the material of choice in building block manufacture overseas, and recently, in Australia. Furnace bottom ash blocks are lighter and have superior thermal and acoustic properties compared with denser natural aggregate blocks.

In many Australian states, applications of furnace bottom ash are widespread, ranging from small agricultural uses such as its inclusion in potting mixes, to significant projects, which, in one case, used over 300,000 cubic metres in a lightweight road embankment bridging a sensitive wetland area.

Furnace bottom ash has also been proposed and approved for use as a bedding material in a major pipeline for the Western Corridor Recycled Water Project in Queensland, thus replacing the need to mine value natural sand deposits.

Given recent water shortages in Queensland, the construction of several new pipelines is underway. With pipelines terminating at Tarong Power Station, a natural synergy was evident. It was proposed that furnace bottom ash from Tarong North Power Station be used as the bedding material.

Bedding sand is normally used in this application and the challenge was to convince the Queensland Environmental Protection Agency (EPA) that sand could be replaced with furnace bottom ash with no adverse environmental consequences and significant positives.

The ADAA has been instrumental in providing advice and walking the parties through the legislative process to apply for the EPA's consent to use power station ash. A small site trial was conducted by Tarong Energy and the Western Pipeline Alliance to prove furnace bottom ash would be suitable as a pipe bedding material. The site trial verified that furnace bottom ash performed well in "flowing" around and moulding to the pipe shape with minimal compaction effort required.

The success of these efforts has resulted in the saving of over 20,000 tonnes of natural sand for other uses and with the superior properties of furnace bottom ash, should result in better pipe support and protection over the years.

A furnace bottom ash emplacement at Tarong North Power Station.

Concrete

a contributor to improving our environment?

Ash Development Association of Australia

From the earliest of times, humans have had an innate desire to master and improve their environment. This has been evident in structures created by early civilisations including the Great Pyramids of Egypt, the Inca Temples, Greek and Roman cities, monuments, roads and more, through to structures in the modern ages. Much of this construction has been aimed at improving the shelters in which we live and work, as well as aiding communication, trade and the construction of places of religious and spiritual significance. The cost of these great advances, it has been argued, is the depletion of the Earth's resources, which results in some cost to our environment. This includes the degradation of the earth's air and scarce potable water resources, among other natural resources.

The realisation of the finiteness of the Earth's resources dawned at the end of the 1960s, with U Thant, then Secretary-General of the United Nations concluding in 1969: '…members of the United Nations have perhaps 10 years left in which to subordinate their ancient quarrels and launch a global partnership to curb the arms race, to improve the human environment, to defuse the population explosion and to supply required momentum to development efforts'.

Now, just under 40 years from U Thant's call to action, the global community is beginning to take seriously the finiteness of the Earth's resources including its air and water supply and their quality. The APEC summit held in Sydney at the beginning of September 2007, for example, sought to address greenhouse gas reduction through an agreement with a broader group of nations than the Kyoto signatories.

Cement and concrete have been key components in the construction sector over the centuries. Due to population pressures and the demand on the earth's mineral and food resources, populations are moving to more extreme climates. As developed countries have progressed, the focus has moved from the mere utility of structures, to the aesthetic components of structures, which modify and control the internal environment of offices in particular, as well as commercial spaces and residences, regardless of location. This shift, particularly over the last century, has increased demand for material and greater use of energy in the construction and operation of structures. The structures and their long-term operation along with global development have contributed to the significant rise in atmospheric CO2 from 330ppm in 1975 to 380ppm in 2007, with levels projected to increase by around 2% annually to a critical tipping point of around 450 ppm by 2040.

Assistant NSW Government Architect, Peter Poulet, recently reported on a joint project between industry, the Cement Concrete and Aggregates Association and the Government Architects office. Using concrete as the major structural and design element material, a typical project home was redesigned, applying a lifecycle assessment model with the aim of maintaining comfort levels within the limits of 18-27ºC, whilst avoiding air conditioning. Poulet pointed out that the revised design provided the same amenity and size for approximately the same construction cost as the current design, but with potentially significant, ongoing energy savings. He stressed the importance of matching climate zones to building design and confirmed that mass leads to energy performance improvement.

Concrete, as a material, is able to span many construction applications and because of its mass, it has the capability of adding to the thermal stability of structures – potentially moderating the operational energy consumption. Whilst production of ordinary Portland cement has been argued as a significant greenhouse gas generator, its impact in concrete can be lessened significantly by the use of supplementary cementitious materials (SCM's).

The use of these materials has been recognised, in limited fashion, in construction practice and in environmental ratings systems such as Greenstar. Modern buildings, such as the recently constructed Melbourne City Council House 2 building, have used concrete to good effect. This building achieved a benchmark rating of 6 under this code. It is designed to reduce lifetime environmental impact, thus moving us towards a more sustainable use of finite resources.

Albrecht describes sustainability as the master concept of the twenty first century. The challenge is for architects, designers and engineers (gatekeepers of the built environment) to achieve sustainable design and consider materials (such as SCMs and recovered resources) which can contribute towards more sustainable outcomes. This includes lowering concrete's environmental footprint and potentially improving durability and energy performance of the built environment.

In this way, the concrete industry, and moreover concrete technology, can make a significant contribution to global sustainability now and in the future.

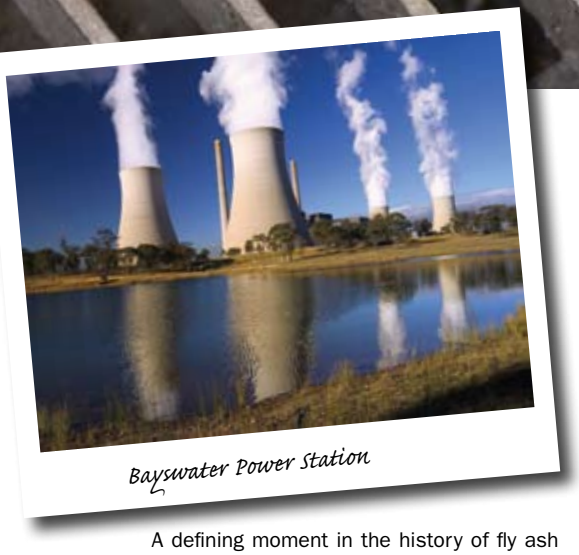
Acknowledgements:

Peter Poulet –
Assistant NSW Government Architect

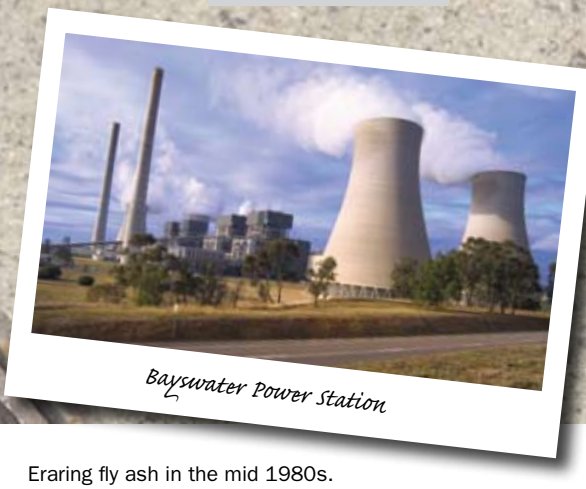
Glenn Albrecht –
University of Newcastle.

Fly Ash
through the decades

The use of fly ash in New South Wales began in the early 1960s when some material from Wangi Power Station was taken in bulker bags and used without much success in concrete.



Bayswater Power Station



Bayswater Power Station

A defining moment in the history of fly ash came when Gerry Peabody took a trip to Europe and viewed the 2000 year old ash/lime structures in Italy, made from volcanic ash from Mt Vesuvius near Pozzuoli. When flying back into Sydney, Gerry saw ash in the stacks at the Tallawarra Power Station and an idea was born. Urban myth or not, it's a great story.

From there, Gerry negotiated the rights to commercially use Tallawarra fly ash. He formed a company, Pozzolanic, with the familiar volcano as a trademark. Tallawarra Power Station, now demolished, comprised of four smaller boilers and two 120MW boilers fitted with fabric filters for ash collection. The fly ash from the 120MW units was useful in concrete but was deemed to partially agglomerate into "ropey chains". Intergrinding fly ash with cement clinker therefore proved beneficial.

The early days proved difficult for Pozzolanic. Most concrete batch plants did not have the silo capacity for another product. To counter this, Pozzolanic started buying cement, blending it with fly ash and marketing a blended product with moderate sales success.

The cement companies at the time, while seeing fly ash as a sales threat, bought in on the action. They purchased fly ash from Pozzolanic, intergrinded it with cement clinker, and marketed the hybrid product as "Pozzoment".

To increase the use of fly ash in concrete, Pozzolanic needed someone who could see the benefits that fly ash would bring to concrete. Mick Ryan and John Ashby both worked for Blue Metal Industries (BMI) and had substantial laboratory back up with emphasis on research and development. Mick and John used these facilities to carry out exhaustive testing of fly ash concretes culminating in paper with their findings, which they presented to the Institution of Engineers.

With the greater acceptance of fly ash concrete by specifiers and rapid increases in the volumes of pumped concrete and value fly ash, BMI elected to purchase Pozzolanic's NSW operations in the late 1960s. The Peabody family, ever the entrepreneurs, saw a similar opportunity in Queensland and launched the fly ash industry there.

The early 1970s saw fly ash use take off. It was specified in many prestigious projects including the 80-storey MLC tower, Tallawarra Dam and others.

At this time, all major power stations were State-owned and run by Pacific Power. They were quick to see the benefits of fly ash concrete with their chief engineer, Peter Nelson, authorising test panels in the Munmorah Power Station inlet canals. The success of these trials resulted in fly ash being specified for concrete in all future power stations.

Monier Concrete, now known as Rocla, recognised the benefits of fly ash for their pipe, concrete and other uses. In the early 1970s, they obtained rights to supply fly ash from Vales Point Power Station.

The demand for ever-increasing quantities of quality fly ash in the late 1970s was satisfied by the introduction of a classification plant to extract, in a controlled fashion, the finer fly ash particles. Rocla used a Buell unit and BMI Pozzolanic, a Sturtevant unit.

The 1970s saw steady growth in fly ash utilisation in the concrete industry with marketers turning their attention to new uses, concrete roads, mine backfill and so on.

In 1981, Pacific Power commissioned the first of 4 state-of-the-art 660MW generating units at Eraring. Being the major base load station, Eraring had the potential to dominate the fly ash market.

Rocla and BMI took a pragmatic approach and formed Flyash NSW (later Flyash Australia) and won the rights to market Eraring fly ash in the mid 1980s.

New power stations like Eraring generally required fly ash marketers to locate processing and distribution facilities outside the main power station boundaries. The Flyash Australia (FAA) plant had to be located some 900 metres from the power station fabric filter collection plant. Pneumatic dense phase conveying of fly ash over this distance proved a challenge, but with the difficulties overcome, sales volumes rapidly grew to approach a half million tonne per annum or 50 percent of the total fly ash produced.

The 1990s saw the commissioning of Mt Piper Power Station with two 660 MW generating units. In the mid 1990s, FAA won the contract to market fly ash. A plant was installed with a Sturtevant classifier. With an ability to service its natural geographic market, sales volumes were assured. Mt Piper was one of the first power stations to follow the trend from wet sluicing of unused fly ash to "dry disposal". Conditioned unused fly ash was carried on closed belt conveyors to final compaction in an adjacent exhausted open cut mine.

The early 2000s brought a new entrant to the fly ash industry with Hyrock winning the rights to install plant at the 4x660 MW Bayswater power station. The large quantities of material available allowed a very fine fly ash to be produced through a Sturtevant classifier.

Introduction of silica fume, a very fine silica product, to the concrete industry was the catalyst for Rocla to develop a ground fly ash product primarily for use in performance concretes and Shotcrete mixes. By the mid 2000s, the process was refined and a grinding facility installed at the Bayswater power station. This facility has been acquired by FAA.

Over the past 50 years the industry has moved along with many twists and turns. With global warming, clean coal and other factors, it will be most interesting to see what the future holds.

This article was compiled from Ron McLaren's memory and from stories told to him over the years. If any readers wish to contribute feedback via the ADAA, it would be welcomed.

New Bio-Ash Fertiliser

QLD-based company, Nutri-Tech Solutions (NTS), have recently developed a new bio-fertiliser based upon carbon, minerals and micro-organisms. NTS have been researching biological techniques to solubilise humic and fulvic acid from brown coal while maximising the mineral punch of coal ash. The solution is a unique blend of micro-organisms that thrive in a specific ratio of carbon and minerals (brown coal and ash). The new product, called Life-Force® will be manufactured on site at Hazelwood Powerstation which boasts the best analysis ash for agricultural purposes. The special Life-Force® inoculum includes beneficial fungi which boost carbon sequestration in the soil and a range of task-specific bacteria species. These inocula contain nitrogen fixers, phosphate solubilisers and predatory organisms, which together can boost both the productive and protective qualities of soils. Life-Force® from NTS features luxury levels of plant-available calcium, magnesium, sulphur and silica. It also contains over 70 other minerals, many of which have been linked to plant health and crop quality.

Coal ash in Life-Force®, has a huge role to play in the essential soil remineralising that is required to produce superb food quality.

The Life-Force® blend contains several species of bacillus for plant growth stimulation and protection.

Calcium is the most common deficiency in Australian agriculture and Life-Force® is designed to increase the uptake of this important mineral. There have been several published papers on the capacity of humic and fulvic acid (found in Life-Force®) to increase calcium uptake. The calcium found in coal ash (a combination of calcium oxide and hydroxide) is much more soluble and plant-available than calcium in limestone (calcium carbonate). In fact, limestone contains just 5 kilograms of soluble calcium per tonne while coal ash contains over ten times that amount. There are also micro-organisms included in the Life-Force® blend which aid in the retention and availability of calcium.

For more information about Life-Force® phone 1800 425 663.

Around the power stations

Delta Electricity – Munmorah Power Station

Munmorah Power Station, owned by Delta Electricity, is situated on the New South Wales central coast, some 110 km north of Sydney. While the power station is no longer a commercial source for ash sales, it was central in developing methods to select and process fly ash for sale and earlier marketing development.

The power station was commissioned in 1967, with Pozzolanic (the BMI owned company) winning a tender for fly ash sales in the early 1970s. The power station is comprised of four 350MW generating units originally fitted with electrostatic precipitators (EP).

Units 1 and 2 of the station were fitted with three stage EPs while units 3 and 4 were fitted with two stage EPs.

Extensive testing has shown that Munmorah's Zone 2 fly ash gave excellent performance in concrete and was marketed as "secondary fly ash". Zone 1 fly ash was marketed mainly for non-concrete uses as "primary fly ash".

Munmorah Power Station

The Munmorah EPs followed the typical pattern, with 80 percent of fly ash presenting to the Zone 1 hoppers, 16 percent to Zone 2 and four percent to Zone 3. With only 16-20 percent of total fly ash available for concrete use as secondary fly ash, and with a rapid increase of demand from the concrete industry, product shortages occurred (particularly at times of boiler outages).

Testing of the Zone 1 material found that it contained fine particles similar to those found in Zone 2 fly ash. The problem with this material was that it also contained coarse particles. If the coarse fraction could be removed, a material similar to Zone 2 fly ash would result.

To achieve the splitting of the fine and coarse particles, two ten foot Sturtevant Whirlwind classifiers were used. The fine material was blended with Zone 2 fly ash and marketed as "Munmorah classified fly ash". With greater availability, this quickly became a material of choice for the concrete industry.

Curiously, with the current emphasis on ultra fine and milled fly ashes, the opportunity to develop ultra fine fly ash from Zone 3 hoppers was passed over. The material was deemed to cause cracking in concrete, presumably added at traditional volumes of 100 kilograms per cubic metre and before the days of high range water reducers.

In later years, larger classifiers were employed but, with the commissioning of Eraring Power Station, Munmorah slipped into a peak load station and a fly ash industry became unviable. Today, only units 3 and 4 are used and are now fitted with fabric filters.

Regardless of what the future holds for Munmorah as a fly ash source, it will retain its place as the birthplace of quality fly ash for the concrete industry. >

NEWS BRIEFS

AUSTRALIAN NEWS

Queensland - Beneficial Reuse Application – The ADAA is in the final stages of negotiation on the consent approval for it submitted a Beneficial Reuse Application to the Queensland Environment Protection Agency submitted in June. Once consent from the QLD EPA is granted, significant regulatory barriers on the beneficial use of coal combustion products will be removed.

Hyrock has renewed its contract with Macquarie Generation to process and distribute classified fly ash from Bayswater Power Station. Hyrock plans to expand their classification capacity to keep pace with increasing demand for this high quality product that Hyrock produces at Bayswater Power Station.

Concrete 07 – Presentations on ash featured prominently at the Concrete Institute of Australia's (Concrete 07) 23rd Biennial Conference in Adelaide last month. The theme for the conference focused on design, materials and concrete for construction in the built environment.

Chief Executive Officer of the ADAA, Craig Heidrich, presented a paper on CCP applications with the greatest potential in Australia, as well as shifts in the regulatory framework surrounding CCP use, including an update on the evolving greenhouse debate and likely impacts for concrete use in construction.

The programme also covered a diverse range of other thematic areas, appealing to anyone who worked in any aspect of the concrete industry, from concrete technology and application to design and construction.

Further information on the CIA's Conference, Design, Materials and Construction – Concrete for the Future, can be found at: http://www.plevin.com.au/concrete2007/

INTERNATIONAL NEWS

WOCA – The world's largest coal ash convergence was a success last May, attracting 530 participants from over 20 countries. There was equally a strong Australian contingent, presenting some 12 papers over the duration of the conference

Organisers of the World of Coal Ash (WOCA) Conference, the University of Kentucky Centre for Applied Energy Research and the American Coal Ash Association, said the event surpassed the success of their inaugural 2005 Conference, acting as both an educational and networking event.

Presentations at the Conference covered a wide range of topics including ash utilisation, sustainability, emerging technologies, ash management, research, international activities and regulation, amongst others.

WOCA conference CDs can be purchased from the Conference website: www.worldofcoalash.org

The American Coal Ash Association (ACAA) publishes a biannual publication reporting on the application, science and sustainability of Coal Ash in the United States. This publication, Ash at Work, is now available for download from the ACAA's website: http://www.acaa-usa.org/ASHatWork.htm. You can also subscribe to receive hardcopies of the magazine through this website.

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