Ash Development Association of Australia

COAL ASH matters

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CCPs - *a valuable resource*

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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 visit us at **www.adaa.asn.au**

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- UK Quality Ash Association www.ukqaa.org.uk
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- World Wide Coal Combustion Products Network (WWCCPN) www.wwccpn.org

Editorial

It has been an extremely busy start to 2020 for all things Coal Ash. From new and exciting projects to interesting research and re-brands.

As always, the ADAA has diligently been keeping an ear to the ground. Catching any & all relevant pieces of information to share with our Members and our readers.

Our featured article in this edition of Coal Ash Matters comes from our very own Chief Executive, Mr. Craig Heidrich. The article examines Naturally Occurring Radioactive Materials (NORM) in Coal Combustion Products. The guest editorial addresses NORM and how they are relevant to Australia. Mr Heidrich references an interesting paper written by Gordon McOrist and Sue Brown.

We also address our friends over at the Coal Combustion & Gasification Products Journal and their new look. Beginning as a partnership between University of Kentucky Center for Applied Energy Research (UK CAER) and the American Coal Ash Association (ACAA).

The April 2020 CAM looks at a very recent paper that was commissioned by the National Association of Regulatory Utility Commissioners and funded by the U.S. Department of Energy, addressing the commercialization of Coal Ash in America.

There's an exciting project coming from London, England, with an Australian twist. Toowoomba based construction company, Wagners, has been a part of the project that saw Coal Ash based Geopolymer Concrete used in the creation of a 17-storey building. We take a look at sustainable building methods integrating into the UK construction industry.

A unique article that draws a comparison between Volcanic Ash and Coal Ash as Supplementary Cementitious Materials features in this edition. This interesting piece looks at how the Philippines Government takes action against these horrifying natural disasters and how they can be transformed into a positive community outcome.

We also take a look at expert presentations on the latest coal ash findings hosted by the IEA Clean Coal Centre in their monthly webinars.

ASSESSING NORM IN AUSTRALIA

GRADIENT TRENDS
Risk Science & Application

As concerns over naturally occurring radioactive materials (NORM) in coal combustion products persist, Australia has tackled the issue head-on with promising results.

Naturally occurring radioactive materials (NORM) are ubiquitous in the environment, being widespread in sands, clays, soils, rocks, many ores and minerals, commodities, products, by-products, recycled residues, and devices used or processed by humans. Although NORM are present in all naturally occurring substances (used by humans), the literature consensus is, where materials are extracted from the earth and processed, refined or combusted, NORM can potentially be concentrated in products, by- products, or waste (residue) streams. In particular, international concerns have been raised regarding NORM in coal combustion products (CCPs), which are the mineral by-products from the combustion of thermal coal to produce electricity, and in wastewater by-products of shale gas drilling and hydraulic fracturing.

Within a circular economy, by-products are increasingly used to manufacture value-added products, e.g., construction materials containing CCPs, resulting in potential NORM exposures for both workers and members of the public. Internationally, considerable attention has focused on determining appropriate safe exemption thresholds, along with management guidelines and regulations, for clearance of NORM. The International Atomic Energy Agency (IAEA, 2004) has recommended an exemption threshold of 1 becquerel per gram (bq/g) for virgin materials (e.g., sands, clays, soils, rocks, and many ores and minerals) as well as commodities, products, by-products, recycled residues, and commercial devices. Prompted by international thresholds, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) developed a nationally consistent regulation, coupled with methods of management across all jurisdictions of Australia.

One potential consequence of the ARPANSA regulation was the re-classification of CCPs for the purposes of NORM regulation and management, which carried with it serious implications for established-end use markets and potential new applications. Regulators recommended a substantial program to update and verify the NORM characteristics of current CCPs in Australia.

In response to this changing regulatory climate, the Ash Development Association of Australia (ADAA) commissioned an independent study with the objectives of:

(1) determining radionuclides present in CCPs (including for ultra-fine size fractions <10 microns in size),

(2) determining any consistencies/inconsistencies with previous studies, and;

(3) conducting a comparison with existing natural materials and background Australian soil levels.

The results of this study (McOrist and Brown, 2009) showed that none of the CCPs analyzed would be considered radioactive from a regulatory perspective, as no single sample tested was above the international exemption limit of 1 bq/g. Furthermore, for applications where CCPs were blended for use, e.g., for concrete manufacture, the contribution of fly ash to the total gamma ray dose from the concrete was found to be negligible. In summary, key study findings included:

- the low radionuclide levels present in CCPs (including ultra- fine fractions) are well below international and Australian adopted thresholds and exempt for the purposes of regulation;
- results are consistent with previous studies, therefore demonstrating the long-term consistent nature of CCPs; and
- the comparison with Australian background soil levels showed no significant difference to natural soils.

References:
- IAEA. 2004. Safety Guide No. RS-G-1.7, Table 1, Application of the Concepts of Exclusion, Exemption and Clearance.
- McOrist, G., S. Brown. 2009. Assessment of Naturally Occurring Radionuclides in Australian Coal Combustion Products (CCPs). Lucas Heights, NSW, Australian Nuclear Science and Technology Organization: Minerals, pp. 27.

> *"Internationally, considerable attention has focused on determining appropriate safe exemption thresholds, along with management guide- lines and regulations, for clearance of NORM."*

PROGRESS FOR THE COAL COMBUSTION AND GASIFICATION PRODUCTS JOURNAL

The Coal Combustion and Gasification Products (CCGP) online journal welcomes our Chief Executive Officer, Craig Heidrich on the CCGP Editorial Board.

Coal ash research and emerging new technologies are at the forefront of the journal, a joint venture between the University of Kentucky Center for Applied Energy Research (UK CAER) and the American Coal Ash Association (ACAA).

Established in 2009 with Allen Press publishing, the CCGP journal is growly rapidly and setting new goals as it emerges into the new decade. By partnering with the publishing platform Scholastica, the journal will access the latest publishing technology to produce a more efficient paper production, rapid turnaround, increased amount of published papers and generate an Impact Factor.

The launch of the new website **www.coalcgp-journal.org** showcases a brand-new look for the free online journal and a more efficient and user-friendly site.

With a vision to bring together research encompassing the science and technology of the production, sustainable utilization, and environmentally-sound handling of the by-products of coal combustion and gasification, the journal is currently seeking papers to be actively published throughout 2020, in Volume 12 of the Coal Combustion and Gasification Product journal.

US COAL ASH STUDY

In a white paper published in January 2020, A Comprehensive Survey of Coal Ash Law and Commercialization: Its Environmental Risks, Disposal Regulation, and Beneficial Use Markets commissioned by the National Association of Regulatory Utility Commissioners under a grant from the U.S. Department of Energy, found that regulation to comply with Federal and State EPA requirements by utilities [coal fired power stations] or CFPS will be costly.

The recovery of imposed compliance costs will usually fall within the purview of state public utility commissions (State Owned and Operated faciliaties) and ultimately will likely be passed onto power customers. Compliance cost estimates for remediation of ash ponds range from the millions for individual coal ash ponds to billions for some utilities, and up to possibly hundreds of billions of dollars across the country, but true cost projections will be dependent on the closure and clean-up methods that are approved by state legislatures and/or environmental regulators.

Along with explaining coal ash, its components, and its environmental and health risks, it explores the legacy of coal ash, reviews coal ash management and challenges for regulators and stakeholders and provides an overview of events leading to the regulatory drive to address the environmental risks of coal ash. The survey includes a detailed summary of recent developments in several states, including North Carolina and Georgia, and also discusses beneficial use markets for coal ash.

The white paper concludes by suggesting that the regulation of coal ash has become a public policy priority. Disposal is not the only alternative solution. Beneficial use markets for coal ash have been developing over the same time duration as coal ash has been accumulating. In 2017, 64 percent of coal ash produced was used in a beneficial end use, and more would have been used except for the lack of quality coal ash availability. Private markets are investing in means and methodologies to improve the production of coal ash during the coal combustion process at coal burning plants. Concerned with a potential decline in the supply of coal ash byproducts as a result of the decline in coal-based electricity generation and closure of CCR units, private and public investment is also supporting research in extracting marketable byproducts from legacy coal ash. While this research continues and while new applications for coal ash become commercially deployable, there is a need for long-term storage of coal ash inventory as opposed to disposal facilities.

The paper recommends regulatory policy may need re-examination to find regulatory pathways that incentivize the conservation of coal ash as a commercial resource consistent with RCRA's conservation objectives [similar to Circular Economy Objectives]. Meanwhile, it appears certain that the next phase of litigation is commencing, as utilities attempt to recover cleanup and compliance costs from ratepayers [power customers], especially as environmentalists engage on groundwater quality issues. How these costs will be recovered will have significant impacts on the electricity customers served by public utilities.

INNOVATION & SUSTAINABILITY

EARTH FRIENDLY CONCRETE

The rising need for more housing, buildings and developments to shape our growing population is simultaneously sparking concerns of carbon emissions and its impact on future generations.

For Toowoomba based construction company, Wagners, sustainability in the construction industry is key. Transforming the industry by using innovative technology and waste materials to produce a cement-free concrete, the Australian company is becoming world-renowned, with London recently joining forces to trial Wagners Earth Friendly Concrete (EFC) in a 17-storey building.

Using a geopolymer technology to bind fly ash from coal fired power stations and slag from steel production, the by-products reduce the emissions produced by ordinary concrete by up to 90 per cent. The end result displays higher resistance to deterioration factors such as chloride ion ingress, sulphate, acid and heat, which increases the overall quality and durability of the concrete.

With these environmental and structural impacts, Wagners are aiming to shift production processes worldwide by influencing jobs and projects across the industry. In effect, the company has already used EFC in a range of successful projects including the Brisbane West Wellcamp Airport. Heavy duty pavements for turning node and taxiway areas, foundations and wall panels for the terminal and civil works including the entry bridge solely used Earth Friendly Cement. The elimination of Portland cement in this single project prevented the 8,800 tonnes of CO_2 emission that would have been produced using conventional cement-based concrete.

Currently, according to the UK Green Building Council, its estimated the UK construction industry generates about 22% of UK carbon emissions, uses 40% of drinking water, contributes 50% to climate change and over half our landfill waste, and accounts for 39% of global energy use. While Central London's adopting geopolymer concrete in its high-rises, Wagners continues to drive the movement of sustainable construction by transforming materials and methods used in the production of concrete on a local and global scale.

PHILIPPINES VOLCANIC ERUPTION BENEFICIAL FOR BRICK PRODUCTION

Communities destroyed in the blink of an eye. What little remains, buried in ash.

Last week the volcanic island Taal transformed into an ominous blanket of grey as smoke and ash smothered the air. Residents and tourists evacuated, followed by hours of threatening lava spewing over the surface of the Taal Volcano, which resides approximately 60 kilometres south of the capital Manila.

Despite the government's Philippine Institute of Volcanology and Seismology predicting a far more powerful eruption in the coming days, locals journeyed back to the aftermath. Knee-deep volcanic ash, shops and homes destroyed. Communities clinging onto what little life remained.

Residents in Biñan City are determined to transform the disaster into new life by regenerating the volcanic ash into environmentally friendly structures. What most would consider an abundance of waste from the eruption can actually be used as an effective substitute for cement and implemented globally.

Prior to the Taal Volcano eruption, Biñan used plastics in producing bricks to build facilities and classrooms. Now, the city is exploring the on-going potential of pozzolans, specifically adding volcanic ash to cement to produce not only an environmentally friendlier approach, but a stronger end-product.

According to MIT's Department of Civil and Environmental Engineering (CEE) Stephanie Chin, cement production takes a lot of energy due to the high temperatures involved and its multistage process, whereas volcanic ash forms under high heat and high pressure but the processing and chemical reactions occur naturally, thus reducing the embodied energy.

This translates into significant energy savings when creating a neighbourhood or city – a process which Biñan is currently benefiting from.

As residents have already witnessed, when the volcanic ash is in contact with water such as from the rain, the fine powder transforms into a thick black sludge resembling a cement-like paste. Due to its natural binding properties, Biñan City Mayor Arman Dimaguila says the city is sweeping the fine volcanic ash into sacks to be salvaged for production and to avoid clogging drainage.

By altering the ratio of volcanic ash, a wide range of end-products can result. Oral Buyukozturk, a professor in MIT's Department of Civil and Environmental Engineering (CEE) says it's very flexible and can be customised according to the task at hand. For example, a traffic block may not need as much strength as a high-rise building so it could be produced with much less energy by increasing the amount of volcanic ash in place of cement.

At this stage, Biñan plans to use the ash in the production of bricks that will be used in the construction of a children's facility.

On a global scale, where volcanic ash is not present, Coal Combustion Products (CCPs) are commonplace. The approach of using one industry's by-product or waste as another industry's raw material is evident in the use of fly ash, which is produced at pulverised coal power stations. In many countries, cement and concrete products are the largest market segment for fly ash. With its consistent physical and chemical properties, fly ash is a reliable raw material used in many production processes including as an additive in Portland cement. Possessing similar properties to volcanic ash, when substituting cement, fly ash avoids CO2 emissions and is beneficial in the production of bricks and concrete blocks primarily used in domestic dwellings and office building.

IMPROVED PERFORMANCE

FOR GEOPOLYMER CONCRETE MIXES

India's leading companies involved in the construction, infrastructure, and ready-mix concrete sectors have been given the green light to trial EdenCrete (a carbon nanotube enriched liquid) with geopolymer cement.

By exploring the potential of the carbon-strengthened additive, India aims to combine EdenCrete with high pozzolan (fly ash, silica fume, slag) concrete mixes to optimise performance and increase cement efficiency. In effect, this may enable an increase in the ratio of waste material such as slag, to cement during concrete production. With the assistance of EdenCrete, the percentages can be altered to create an eco-friendlier low-cost product without hindering the concrete performance characteristics.

Samples of Indian cement and fly ash were sent to Eden's Colorado laboratory for testing where after three days, the test cylinders showed significant improvement in the concrete's early strength development – a characteristic that's prevented when the proportion of pozzolanic material is too high and without the additive of EdenCrete.

Groups within the concrete industry are putting these well-received results to the test in their own concrete mixes that include fly ash or blast furnace slag. In the process of identifying suitable applications for these mixes, the advantage of EdenCrete is the carbon nanotubes providing greater bearing capacity for slabs, columns, and footings.

Generating electricity; fertiliser plants; cement furnaces and brick kilns is the non-coking coal that is mainly used in India's coal-fired thermal power stations. As non-coking coal contains high levels of silica, a significant amount of fly ash is produced. Minimising air pollution, this is captured in the smokestacks of the furnaces and sold at very low prices or given away for free.

With a population exceeding 1.3 billion and a rapidly growing concrete market, India is taking steps to reduce its carbon footprint. Large quantities of waste materials such as slag and fly ash are being repurposed into an affordable and beneficial resource that can replace a higher ratio of cement with the addition of EdenCrete, which will result in a lower overall cost of concrete, without being produced at the expense of the environment.

GEOPOLYMER CONCRETE

DEVELOPED AT SWINBOURNE UNIVERSITY

A new Geopolymer Concrete has been developed & patented by SUT Researchers Dr Behzad Nematollahi and Professor Jay Sanjayan.

Dr Nematollahi is an ARC DECRA Fellow at the Center for Smart Infrastructure and Digital Construction and also the Deputy Director of Digital Construction and Concrete Laboratories.

The concrete made predominately with fly ash sourced from Gladstone, Queensland has shown to be around 400-times more bendable when compared to conventional concrete, while retaining its regular strength.

Dr. Nematollhai outlined that his concrete technology can work with multiple types of fly ash, noting that he and his team are also utilizing Melbourne Ash, a combination of Gladstone fly ash and Calide fly ash. The concrete's enhanced strength properties are one of its most impressive aspects.

This project highlights just how important Geopolymer Concrete is for our environment. Dr. Nematollahi's concrete requires around 36% less energy to create and releases 76% less carbon dioxide when compared to conventional concrete made of cement.

The concrete's ability to bend under force - earmarked for regions that frequently suffer from natural disasters such as earthquakes, hurricanes and tsunamis.

INTERNATIONAL ENERGY AGENCY CLEAN COAL CENTRE WEBINARS

The IEA Clean Coal Centre focuses on the development of coal to become a cleaner source of energy, compatible with the UN Sustainable Development Goals.

Addressing all aspects of coal production, transport, processing and utilisation, the balance of security of supply, affordability and environmental impact are at the forefront.

WEBINAR:
Beneficial Uses of Fly Ash

Their recent webinar details how fly ash can be repurposed – from waste material to commodity. Cement that contains up to 50% fly ash provides an enhanced construction material for bricks and concrete. Other applications are explored in agriculture, as a minerals resource, and as a component of advanced materials such as metal composites, zeolites and proppants.

WATCH NOW

WEBINAR:
Current Technologies for Cofiring Biomass with Coal

Another webinar that reviews current available cofiring technologies. It covers fuel preparation and processing, such as torrefaction in detail. It also includes the impact of biomass on combustion and plant emission control technologies.

WATCH NOW

IEA CLEAN COAL CENTRE

WE WANT YOUR FEEDBACK

2020 MEMBERSHIP SURVEY REMINDER

CCPs produced from coal-fired power stations represent useful sources of raw materials for a range of applications and products. In addition to the new ash produced each year, the ash already stored (estimated to be in-excess of 400 million tonnes) in ponds and other storage sites represents shallow-lying mineral deposits that are more readily accessible than many equivalent geological materials.

The utilisation of CCPs in a variety of both high and low value add products helps to conserve natural resources such as sands and gravels. This reduces the environmental impact that would otherwise be caused by mining these resources. In addition, the need to construct additional storage facilities at the power stations can be deferred or even eliminated.

The ADAA conducts an annual survey for information regarding CCP production and sales by members and non-members for each calendar year to determine the utilisation of CCPs annually. Information provided by members and non-members is collated and then aggregated into a national set of results and include CCP production levels and nominated uses for all CCPs.

The survey results include all generators, marketers, (processing and marketing companies) and users for the total production and resulting sales by each end use. **Please download the Membership Survey** from www.adaa.asn.au and email your completed spreadsheet to info@adaa.asn.au.

WRITE FOR COAL ASH MATTERS

Coal Ash Matters is the ADAA's main educational publication that is produced twice a year for the benefit of ADAA members and readers. Before each publication is drafted, an email is sent out to all members, urging them to contribute stories that they think are of interest. The types of content we are looking for include:

- **New Developments**
- **Technological Innovations**
- **New Projects**
- **New Employees**
- **Industry Research**

If you have an idea or some content that you think should be shared with the CCP community, get in contact with the editor, Dan Webb, via 02 4228 1389 or publications@adaa.asn.au

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