



BOTTOM ASH

WHAT IS BOTTOM ASH?

Bottom ash is by-product of coal combustion in power plants. When coal is combusted in the furnace, the coarse particles that fall to the bottom are called bottom ash and make up about 10% of the total generated ash. Bottom ash has a well-graded particle size distribution, ranging from gravel (40 mm) down to silt and clay (smaller than 75 µm). Bottom ash can vary in composition, dependent on its source. Other sources of bottom ash include waste-to-energy (WtE) incineration facilities, where bottom ash comprises 70–90% generated ash. WtE is an emerging waste management technology in Australia, with very little market maturity.

WHAT ARE THE BENEFITS OF USING BOTTOM ASH?

The benefits of using bottom ash in road and rail infrastructure are as follows:

- **Environmental benefits**
 - Using bottom ash in place of natural aggregates including gravels and sandy soils can offer environmental benefits, such as reduced use of virgin materials and reduced landfilling.
- **Performance benefits**
 - Compared to sand and gravel, bottom ash is reported to have higher shear strengths and to be a suitable material for road base, though may have a lower abrasion resistance. The light weight, as well as drainage and bearing capacities of bottom ash, makes it ideal as an embankment fill material.
- **Cost benefits**
 - Cost reductions from using bottom ash in place of quarried materials.

WHERE IS IT USED?

Bottom ash can be used as both unbound and bound aggregate. Examples include as an unbound aggregate in embankment fill, subbase layer and the capping layer of pavements over expansive soils, or abutment fill for heavy vehicle access and rail bridges to replace quarried materials. Other applications for bottom ash are as aggregate for concrete works and in bituminous bound road base. In combination with Portland cement, or other binders such as lime and fly ash, bottom ash can be used in stabilised subbase and base layers of roads.

HOW MUCH CAN BE USED?

There are few standards and/or specifications in Australia, currently, specifying the use or any requirements for bottom ash. The only road agency that does is Transport for New South Wales (TfNSW), which allows 10% by mass of bottom ash to be used in base and subbase as granular material. TfNSW also allows using bottom ash in public road related activities (road construction and maintenance; installation of road infrastructure facilities) but does not specify any limits or requirements. Queensland's Department of Transport and Main Roads (TMR) does not have any specifications, though it is looking at the use of bottom ash in earthworks, drainage and concrete applications.

WHAT OPPORTUNITIES ARE THERE FOR IMPROVING ADOPTION?

Bottom ash has not been used much in Australia and there is little guidance on its use in transport infrastructure from road agencies. Based on international studies, bottom ash could be used as a granular fill or embankment material, with up to 100% of natural aggregates replaced with bottom ash. In lower layers of roads, such as subbase, up to 100% of natural aggregates too can be replaced with bottom ash. In base layers, lower contents should be used; road base course containing up to 60% bottom ash and stabilised with bitumen have been reported to perform well.

Further investigation into these options and their feasibility within an Australian context will be key to enhancing the adoption of bottom ash. Additionally, with several WtE facilities planned for construction, it will be valuable to build upon early research and investigate possible avenues for this emerging material stream.



BOTTOM ASH: KANGY ANGY, NSW



In June 2018, construction of a fleet maintenance facility commenced in the regional area of Kangy Angy, on the NSW Central Coast. The facility was required for the adequate maintenance of the New Intercity Fleet (NIF). The NIF is a fleet of new trains transporting passengers between Newcastle, the South Coast (including Sydney) and the Blue Mountains.

As part of the project's sustainability plan, recycled materials, including bottom ash, were used in the construction of various sections of the facility. In total, 85,000 tonnes of bottom ash, sourced from Eraring Power Station in NSW, were used as an alternative fill material. This replaced quarried material in abutment fill for both vehicle access bridges and rail bridges. It was also used for backfill of utility trenches, in embankment under the facility and the lay-down area for construction materials. Bottom ash was selected due to specific ground conditions, groundwater and restricted access to site.

At a density of 1.25 t/m³, it is lighter than general fill, at a density of 2.0 t/m³. This meant less materials usage (85,000 tonnes of bottom ash as opposed to 149,000 tonnes of virgin material). It also meant less consumption of natural resources, lighter fill and embankments (less applied load to the ground) and fewer truck movements for transporting materials. Using bottom ash resulted in a free-draining working layer that reduced the drainage time following a wet weather event. With performance similar to that of virgin material, using bottom ash resulted in a 15% cost saving.



Sustainability Report 2019



LOCATIONS

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