Testing and Analysis of Brown Coal Ash Residue in Roof Cavities Report

Morwell, Victoria

Prepared for:
Department of Health and Human Services
50 Lonsdale Street
Melbourne, Victoria, 3000

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Distribution

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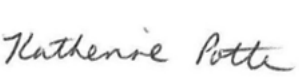
Author and Project Manager		**Technical Peer Review and Project Director**	
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Executive Summary

Background

In August 2016, Senversa was engaged by the Department of Health and Human Services (DHHS) to conduct a series of works to assess the potential for residual brown coal ash to be present in roof cavities of residential properties in the Morwell area and surrounds, as a result of the Hazelwood brown coal mine fire in 2014. The works investigated the potential for residents to be exposed to ash residue, and whether exposures could result in a potential ongoing risk to health. This report presents the scope, methodology and results of the works undertaken, and the recommendations to the Victorian government based on the results.

The works were undertaken in response to Recommendation 9 of Volume III of the Hazelwood Mine Fire Inquiry Report 2015/2016, which recommended that the State "*ensure that ash contained in roof cavities in Morwell is analysed and acted on.*" This recommendation goes on to say that the *"State should:*

- *Commission an analysis of the ash contained in roof cavities of houses in Morwell and publish the results of that analysis to the community and Latrobe Valley Health Assembly, together with clear advice about the potential known, or unknown health effects.*
- *If the analysis of the ash residue in roof cavities reveals any content that is potentially hazardous to health or of unknown impact on health, conduct an audit of the extent of the exposure to ash and develop an action plan to remove the ash from all affected houses."*

With consideration to the above, the objectives of the sampling and analysis program described within this report were to:

- identify whether brown coal ash associated with the Hazelwood mine fire in February and March 2014 is present within roof cavities of residences in Morwell;
- assess the potential human health risk from the brown coal ash; and
- provide recommendations and present the findings to key stakeholders and the community.

The scope of the works undertaken included:

- preparation of a comprehensive literature review of brown coal ash, including its chemical characteristics, potential associated contaminants, and potential health effects;
- identification of 50 properties in Morwell, and 10 properties in a control town (Rosedale) unaffected by the 2014 Hazelwood coal mine fire, for roof cavity sampling;
- sampling and laboratory analysis of dust samples from roof cavities, and of indoor dust using swabs, from the selected properties;
- collection of photograph and video records and sampling records for each property;
- review and interpretation of the data, including comparison with 'safe' levels not considered to cause adverse health effects, and assessment of whether data correlated with factors such as house location or construction type; and
- development of conclusions regarding potential ongoing risk to human health due to brown coal ash residue in roof cavities, and recommendations to the Victorian government based on the conclusions.

Literature Review

The objectives of the literature review were to:

- identify likely contaminants that may be present in brown coal ash, to inform the rationale for selecting specific contaminants for testing; and
- describe the evidence for potential health risks to the community from brown coal ash residue in roof cavities.

Limited specific information was found in the literature regarding the chemical and physical nature of brown coal ash from mine fires, or associated potential health effects. However, inferences were made from studies of coal fly ash (which is expected to have similar properties), and based on the Victorian Environment Protection Authority (EPA) testing of brown coal ash samples during the Hazelwood fire.

The key conclusions and recommendations of the literature review were the following:

- Contaminants expected to be present in coal fly ash derived from coal and/or brown coal ash from the Hazelwood fire included metals/trace elements, polycyclic aromatic hydrocarbons (PAHs), other organic compounds such as acetone and monocyclic aromatic hydrocarbons (MAHs), dioxins/furans and radionuclides. However, with the exception of some metals/trace elements and, to a lesser extent, PAHs, these compounds are not expected to be present at concentrations higher than those in background soils and/or other materials to which humans are routinely exposed. Coal fly ash is a fine grained, powdery coal combustion product produced during the burning of pulverised coal.
- The available data do not indicate that contaminant concentrations in brown coal ash from the Hazelwood fire are likely to pose a risk to human health if present in roof cavities, however sampling and analysis for key parameters (metals/trace elements and PAHs) will assist with confirming this conclusion.
- No information was identified regarding a potential link between brown coal ash from the mine fire and red mould growth on ceilings or cornices. This was reviewed in response to anecdotal reports by Morwell residents that red mould growth was observed in their house after the Hazelwood brown coal mine fire.
- Based on the above conclusions, it was recommended that roof cavity samples be analysed for PAHs and a broad suite of metals/trace elements. Analysis for other potential components of brown coal ash, including radionuclides, dioxins/furans, MAHs or other organic compounds was not considered necessary. This was because both literature and site-specific data indicated that these components were not present at concentrations higher than background levels in soil or other common materials.

Selection of Properties for Sampling

DHHS provided a list of 149 Morwell residents who volunteered to have their roof cavity tested for the project. Of these, 50 were selected for testing. The selection process aimed to provide a representation of properties with consideration of factors which could affect ash abundance in roof cavities. These included:

- Age
- Roofing material (e.g. tiles vs. metal)
- Cladding material (e.g. brick vs. weatherboard or other solid cladding)
- Distance from the fire

Ten properties were also identified for sampling in Rosedale (the control site considered to be unimpacted by the Hazelwood brown coal mine fire).

Sampling and Analysis

Roof cavity dust (including ash if present) and indoor dust samples were collected from the selected Morwell and Rosedale properties:

- Roof cavity dust was collected using a flexible spatula to transfer dust into clean jars supplied by the analytical laboratories.
- Indoor dust samples were collected using a surface wipe method, where sterile cotton swabs moistened with a solvent (water or isopropyl alcohol) were used to swab an approximate 100 cm^2 surface area.

The surface wipe samples were collected to allow assessment of the relationship between roof cavity dust and indoor dust.

All roof cavity dust samples and one half of the swab samples (30 out of 60 total samples collected in Morwell and Rosedale) were analysed for:

- A suite of metals and trace elements, including antimony, arsenic, barium, beryllium, boron, cadmium, chromium, chromium VI, cobalt, copper, lead, mercury, manganese, nickel, selenium, strontium, titanium, vanadium, and zinc.
- PAHs.

In addition, 30 of the 50 roof cavity dust samples collected from Morwell properties were submitted to a coal petrography laboratory for 'maceral' analysis. Maceral analysis quantifies the amount of coal in the dust, and the specific constituents of coal that are present.

Results and Conclusions

The data and information obtained from the investigation were reviewed and evaluated to assess:

- the amount of brown coal ash in roof cavities;
- the amount of coal dust in roof cavities;
- relationships between chemical concentrations, ash abundance and/or property characteristics which may impact on roof dust composition;
- whether identified brown coal ash and/or other constituents of roof cavity dust may pose a risk to human health.

The results and conclusions based on the collected data were the following:

- **Brown Coal Ash Abundance**: While some variability was observed across the study area, there was a general correlation between the amount of ash observed in roof cavities and the distance of the property from the fire, with more ash observed in properties closer to the fire.
- **Coal Dust Abundance**: The percentage of coal dust in roof cavity dust was relatively low, ranging from 0% to 3.4%, with an average of 0.8%. No clearly visible or statistically significant pattern or correlation was found between coal dust concentrations and property factors expected to affect coal dust accumulation. For example, the highest coal dust concentration (3.4%) was reported in a property located over 2 km from the coal mine, and many properties much closer to the mine had very low concentrations or no detectable coal dust. However, the presence or absence of sarking material within roof cavities explained more of the observed variability than other factors, and the general range of coal dust concentrations in houses with sarking was lower than that in houses without sarking.
- **Chemical Concentrations in Roof Cavity Dust, and Sources of Elevated Chemical Concentrations**: To assess whether chemicals in brown coal ash and/or roof dust may pose a risk to human health, the chemical testing results were compared to 'screening levels' considered safe if present in soil and/or dust on residential properties. These screening levels are developed and published by the National Environment Protection Council (NEPC), and allow for potential repeated and prolonged exposure to soil or dust particles. The majority of chemical concentrations reported in roof cavity dust were below these adopted screening levels, with the exception of those indicated in **Table E-1** below. **Table E-1** also summarises the inferred sources of the elevated chemicals, based on detailed review and statistical analysis of data that was undertaken.

Table E-1: Chemicals Exceeding Adopted Health-Based Screening Levels, and Their Sources

Chemical	Screening Value (mg/kg)	Number of Properties with Screening Level Exceedance	Inferred Source of Chemical in Roof Cavities
Antimony	31	Morwell: 2 out of 50 (4%) Rosedale: 1 out of 10 (10%)	Presence of roof sarking, which is used to provide thermal insulation and which can contain up to 10% antimony trioxide. All houses with antimony concentrations above the screening level were observed to have sarking, and higher antimony concentrations were generally reported in roof cavities with sarking.
Lead	300	Morwell: 14 out of 50 (28%) Rosedale: 5 out of 10 (50%)	Property age and dust associated with historical leaded petrol emissions (pre-2002) or lead paint and/or flashing. A clear and statistically significant correlation was present between lead concentrations and property age.
Zinc	7,400	Morwell: 4 out of 50 (8%) Rosedale: 1 out of 10 (10%)	Use of metal roofing materials. Many residential metal roof products are made from zinc plated steel or zinc/aluminium alloys. Zinc-containing particles may therefore be released during drilling/installation of metal roofs, or due to corrosion and degradation. Average and maximum zinc concentrations were at least one order of magnitude higher in properties with metal roofs than those with tiled roofs, and these differences were statistically significant.
PAHs (total)	300	Morwell: 0 out of 50 (0%) Rosedale: 1 out of 10 (10%)	Property age and dust associated with long-term accumulation of PAHs from combustion sources. PAHs are formed during combustion of organic matter, and sources include diesel or fuel emissions, natural gas combustion, burning of briquettes in fireplaces, meat cooking, and burning of green or domestic waste. The single property in which the screening level exceedance was reported was one of the oldest sampled houses (approximately 100 years old), and was located in Rosedale.

- **Relationship Between Roof Cavity and Indoor Results**: No clear similarities were observed between the chemical patterns in roof cavity dust and indoor dust. This suggests that roof cavity dust is not a major contributor to the dust accumulating within occupied (indoor) parts of the properties, and that indoor dust is comprised predominantly of other materials, e.g. soil or dust blown or tracked inside from outdoors, and indoor sources including carpet fibres, clothing fibres, skin flakes, etc.
- **Potential Link Between Brown Coal Ash and Mould Growth**: No evidence of a link between the presence of brown coal ash and mould growth in properties was identified during the study.
- **Potential Risks to Human Health Associated with Coal Dust or Brown Coal Ash Residue**: While some chemical concentrations exceeded adopted screening levels in some roof cavity dust samples, they were not considered likely to cause adverse health effects for occupants. This is because the health based screening levels are considered safe if present in outdoor soil and associated indoor dust, and are derived assuming that people will be continuously and regularly exposed to the soil/dust. For example the screening levels assume that residents will routinely play and/or garden in soil within their yards, and will routinely come into contact with soil-derived dust outside and within their homes. In contrast, residents are exposed to roof dust only on an occasional basis, if at all, (i.e. if wearing PPE and practising good hygiene when entering a roof cavity), thus even chemical concentrations in roof cavity dust that are much higher than the screening levels would be unlikely to result in adverse health effects.

Recommendations

The results of this study indicated that the presence of brown coal dust or brown coal ash residue in roof cavities is not associated with elevated chemical concentrations, and brown coal ash and/or coal dust is therefore not expected to pose adverse health effects to Morwell residents. On this basis, removal of ash and/or coal dust (where present) from roof cavities is not considered to be warranted or necessary to prevent health risks to property occupants.

Dust within any roof cavity may contain a range of hazardous materials and/or contaminants. Generally, it is recommended that exposure to such materials be minimised through wearing PPE and practising good hygiene when entering a roof cavity. It is noted that this recommendation applies to houses in any location within Australia (or worldwide), and is not specific to properties in Morwell or due to the potential presence of brown coal ash and/or brown coal dust.

Further information about hazards in roof cavities, and measures that can be taken to minimise risks associated with these hazards, can be found on the DHHS website (https://www2.health.vic.gov.au/public-health/environmental-health/environmental-health-in-the-home/hazards-in-roof-cavities) or by phoning 1300 761 874 during business hours.

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