

aerosol *n.* a colloidal dispersion of solid or liquid particles in a gas (air).

National Study Produces Results on Fine Particles

Australian and worldwide studies into the health effects of air pollution found that ambient levels of PM₁₀ and PM_{2.5} are associated with adverse health effects such as increases in premature deaths, hospital admissions and emergency attendances for respiratory and cardiovascular disease and exacerbation of asthma. Australian studies have shown significant variability in the size and strength of the associations between these effects. This raises the question as to what is different about the composition of particles in each of these cities that gives rise to the different health effects when particle mass levels in each of these cities are similar.

The Commonwealth Government initiated Air Pollution in Major Cities Program, which was funded under the Natural Heritage Trust. Part of this Program was Particle Composition in Four Major Australian Cities – a consultancy undertaken by Environment Protection Authority Victoria, Griffith University and the University of the Sunshine Coast. The major project investigators were ANSTO (elemental composition of particles by accelerator-based ion beam analyses), Griffith University (ionic composition by Ion Chromatography) and Queensland Health Scientific services (analyses of VOCs and PAHs). Four State EPAs supported data collection at the chosen sites.

PM _{2.5}	Adelaide	Brisbane	Melbourne	Sydney
Average±STD	5.2±2.3	5.2±2.8	6.3±4.0	6.0±3.2
Median	4.8	4.4	5.2	5.5
Maximum	13.8	16.3	29.2	19.0
N ₂ > NEPM	0	0	1	0
PM _{2.5-10}	Adelaide	Brisbane	Melbourne	Sydney
Average± TD	12.9±7.1	7.5±3.7	9.6±8.4	9.8±6.5
Median	12.0	7.1	7.7	8.6
Maximum	44.2	18.1	77.2	36.8

Table 1. Conc. of PM_{2.5} and PM_{2.5-10} in four Australian cities.

collected on VOCs and PAHs at these locations. The sites were, Alphington and Footscray/Paisley (Melbourne), Earlwood and Richmond (Sydney), Rocklea and Springwood (Brisbane), and Netley and Northfield (Adelaide). 24-hr PM₁₀ samples for PAH analysis were collected on glass fibre filters. PM_{2.5} and PM_{2.5-10} samples for elemental (carbon and elements from fluorine to bromine in the Periodic Table) and ionic composition analyses were collected using dichotomous samplers, VOC samples were collected in sorbent tubes.

The results showed that the levels of particles in Australia differed from city to city. The mass of PM_{2.5} and PM_{2.5-10} in each city is shown in Table 1 and in Figures 1 (a and b). ANSTO's accelerator-based IBA techniques provided quantitative information on a range of elements from fluorine to lead allowing determination of elemental composition of particle samples and chemical composition by source components. These components served as indicators of contributions from the major sources of particles, namely crustal matter, sea spray, secondary sulfate (Figure 2a), secondary nitrate, soot from combustion of fossil fuels (Figure 2b), biomass burning and estimated organic compounds.

The results indicated that the composition of PM_{2.5} varied from city to city (Figures 4 a, b, c and d). Sea salt was a major component of this size fraction in all cities. The composition of PM_{2.5} in Sydney and Brisbane was very similar and had a much higher contribution of soot (an indicator of combustion processes) than either Melbourne or Adelaide. The contribution from estimated organic components was higher in Melbourne than in the other cities. The significant contribution of crustal matter to the PM_{2.5} indicated that windblown dust in Australian cities comprised a significant proportion of fine particles.

The study was to collect information on the composition of particles in the PM_{2.5} and PM_{2.5-10} fractions at two sites in Melbourne, Sydney, Brisbane and Adelaide over a 12-month period to gain information on the variation of the composition of particles with season and location. Information was also

collected on VOCs and PAHs at these locations. The sites were, Alphington and Footscray/Paisley (Melbourne), Earlwood and Richmond (Sydney), Rocklea and Springwood (Brisbane), and Netley and Northfield (Adelaide). 24-hr PM₁₀ samples for PAH analysis were collected on glass fibre filters. PM_{2.5} and PM_{2.5-10} samples for elemental (carbon and elements from fluorine to bromine in the Periodic Table) and ionic composition analyses were collected using dichotomous samplers, VOC samples were collected in sorbent tubes.

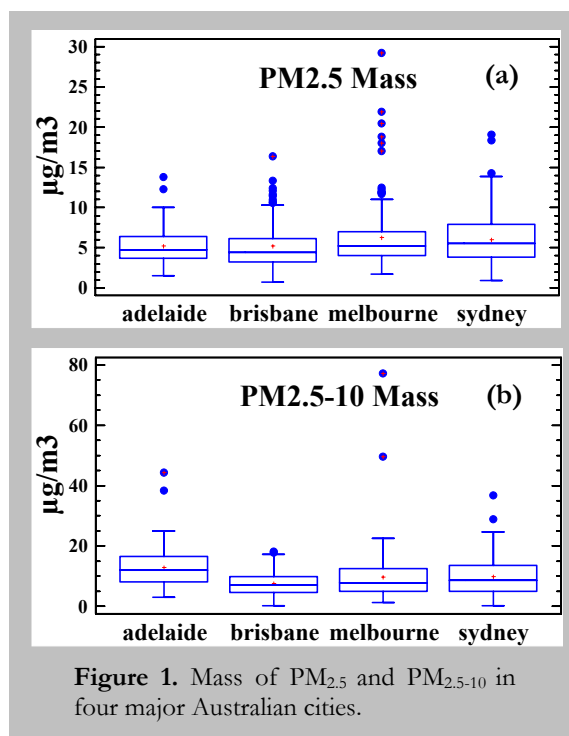


Figure 1. Mass of PM_{2.5} and PM_{2.5-10} in four major Australian cities.

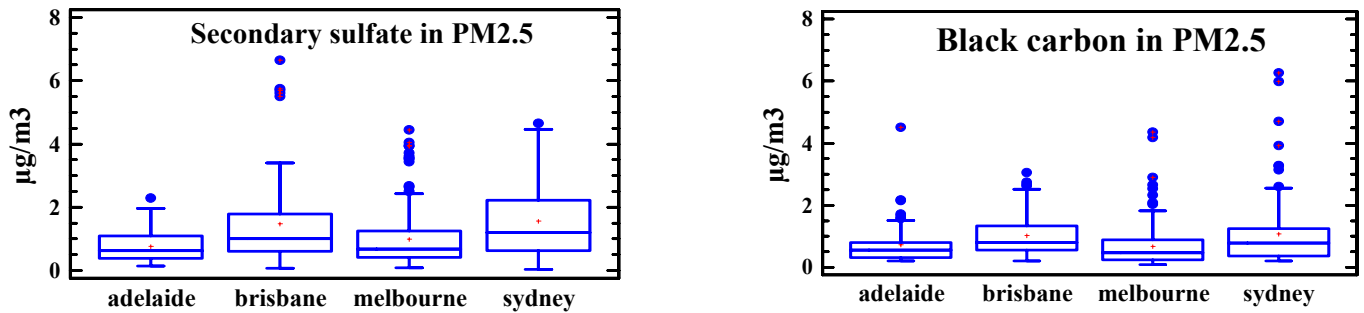


Figure 2. Contributions of secondary sulfates and black carbon to PM_{2.5}.

In the PM_{2.5-10} fraction the variability between cities was not as marked. Crustal material, sea-salt and estimated organic compounds dominated the PM_{2.5-10} fraction. These three components accounted for 80 to 90% of the total coarse mass in cities studied.

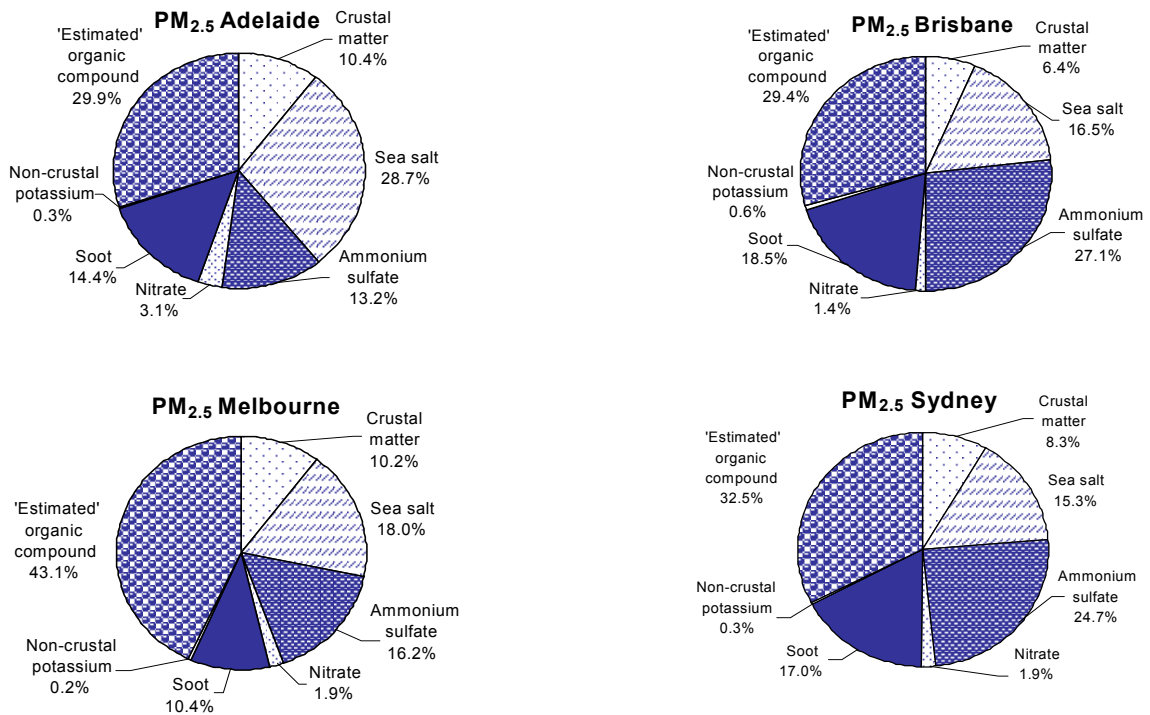


Figure 3. Composition of PM_{2.5} particles in four Australian cities.

The results showed that within each city there was significant seasonal variability in the composition of particles in both the fine and coarse fractions. The contribution of secondary particles was higher in the warmer months while organic carbon was higher in the cooler months. The contribution from wood smoke and biomass burning (as indicated by non-crustal K) was much lower in this study at all sites than found in previous studies. Similar seasonal variations were observed for PAHs and VOCs with higher levels observed during the winter.

The results of this study provided useful information to aid in the understanding of the sources of particles in Australian cities and to guide the development of management strategies to reduce levels of particles. Further source apportionment work is required to fully characterise the sources and to allow statistical analysis of the health data to determine the components that are most strongly linked to adverse health outcomes.

Short Term US EPA NAAQS Standards for Airborne Particulate Matter

Index (NAAQS)	TSP (µg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	Air Quality
0 to 50	0 - 75	0 - 50	0 - 15	Good
51 to 100	76 - 260	51 - 150	16 - 65	Moderate
101 to 200	261 - 375	151 - 350	66 - 150	Unhealthy
201 to 300	376 - 625	351 - 420	151 - 250	V/Unhealthy
> 300	> 626	> 421	> 251	Hazardous

Source : US EPA July 1997 Documents.



Want more information on how ANSTO can help you with your Fine Particle air sampling and characterisation?

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