Airborne Coal Particles

Findings from the Lower Hunter Particle Characterisation Study Supplementary Report – Quantification of the Coal Particle Component of Airborne Particulate Matter at Stockton

An important concern for the Newcastle community is about how much coal particles contribute to air particle pollution. The Lower Hunter Particle Characterisation Study (LHPCS) completed in 2016 identified the composition and sources of fine ($PM_{2.5}$) and coarse ($PM_{2.5-10}$) air particles in the Lower Hunter. Despite delivering a range of evidence to inform air policies and programs, this study did not specifically identify coal particles. The LHPCS inferred the upper limit of coal particles in particulate matter based on the quantity of elemental and light-absorbing carbon identified.

This coal quantification study focused on measuring how much coal was in particulate matter measured at Stockton Air Quality Monitoring (AQM) station, using a new imaging technique called Coal Grain Analysis or CGA. This technique, developed and applied by CSIRO, accurately distinguishes coal particles from other particles and provides information on particle size from about 1–50 micrometres (µm).

Total suspended particles were sampled at Stockton in winter 2015. Coal particle analysis was done on samples taken on days with no rainfall, high levels of particulate matter and frequent north-westerly winds. Under these conditions coal particles were more likely to be generated and transported over the Stockton monitoring site from coal operations on Kooragang Island and nearby areas at the Port of Newcastle.

What did the study find?

The study provided information on the upper limit of the amount of coal particles in the particulate matter in areas downwind of Newcastle coal operations.

Coal particles in TSP (total suspended particles)

Coal particles accounted for 25% of the mass of *insoluble* TSP in the samples analysed. When both *insoluble and soluble* (including salt) particles were considered, on average 12% of TSP were coal particles. This proportion of coal particles in TSP was consistent with the 10% coal (range 0–25%) in deposited dust reported in the *Lower Hunter Dust Deposition Study*.

Coal particles in $PM_{2.5-10}$ (particles sized between 2.5 and 10 micrometres in diameter)

Coal particles made up 63% of the mass of *insoluble* $PM_{2.5-10}$ in the samples analysed. When both *insoluble and soluble* particles were considered, on average 10% of $PM_{2.5-10}$ were coal particles. This was consistent with the findings of the LHPCS that on average 10% of the $PM_{2.5-10}$ was "light-absorbing carbon" and that most of this was probably coal particles.

Coal particles in $PM_{2.5}$ (particles less than 2.5 micrometres in diameter)

The coal grain technique was only able to identify particles greater than about 1 µm in size. Coal particles were found to make up on average 83% of the mass of *insoluble* particles in the 1–2.5 µm size fraction (or $PM_{1-2.5}$). When both *insoluble and soluble* particles are considered, on average 1.8% of $PM_{1-2.5}$ were found to be coal particles.

$PM_{1\text{-}2.5}$ typically makes up 30% of total $PM_{2.5}$ in urban samples. If all coal particles are assumed to be larger than 1 µm, then the results indicate that coal particles make up on average about 0.5% of $PM_{2.5}$. This upper limit of 0.5% further refines the estimate of an upper limit of 4% of coal particles in $PM_{2.5}$ in the LHPCS, based on the amount of carbon in the soil factor fingerprint.

Possible sources of coal particles

When winds blow from the north-west, the likely sources of coal particles are the coal export facilities located to the west and north-west of Stockton. Another possible source is the re-suspension of previously deposited coal particles in the ambient environment around Stockton.

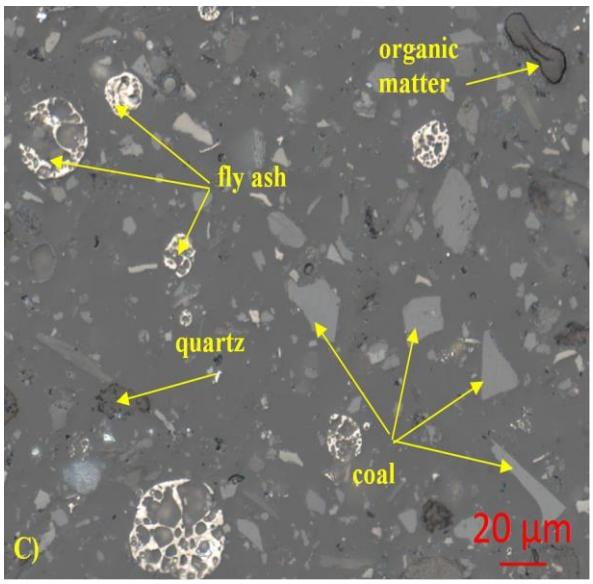
Fly ash and similar materials

Fly ash and similar materials were found to be significant components of the samples analysed, comprising up to 42% of TSP. Fly ash is generated by the high temperature combustion of coal and heavy oil, and also sold commercially for use in concrete products. Fly ash particles were generally found to have large diameters indicating local sources rather than airborne transport from distant power station stacks. The NSW Environment Protection Authority is working actively with industrial premises on Kooragang Island and around the port of Newcastle to improve handling and dust control of fly ash and similar bulk materials, such as alumina.

How was the study conducted?

Office of Environment and Heritage staff used high volume air samplers to collect 24-hour TSP samples at the Stockton Air Quality Monitoring Station. Sampling was done from 15 June to 17 September 2015, with the 95 samples collected sent to CSIRO for selection and analysis.

CSIRO selected nine samples for Coal Grain Analysis, focusing on samples taken on days when coal particles were more likely to be generated and transported over the Stockton monitoring site from nearby coal operations.



Water soluble particles were removed (e.g. sulfate, nitrate, ammonium, sea salt), leaving only insoluble particles including coal and non-coal particles (e.g. quartz, fly ash and organic matter). Insoluble particles were dried, set in resin, and a surface of the resin block polished to expose the particles for analysis.

Coal Grain Analysis is an optical reflected light imaging and analysis system which provides detailed information on an average of 6,000 particles in each sample, including the size (area, particle length, width) and reflectance fingerprint of each individual particle. Based on the reflectance fingerprint, the particle can be classified as a coal or non-coal particle, allowing CSIRO to count the number of coal particles and estimate the mass of coal particles in each size range.

More information
www.environment.nsw.gov.au/aqms/lowhunterparticle.htm

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