Geophysical Research Abstracts
Vol. 18, EGU2016-8739, 2016
EGU General Assembly 2016
© Author(s) 2016. CC Attribution 3.0 License.

Establishing aeolian particulate 'fingerprints' in an airport environment using magnetic measurements and SEM/EDAX

Sue Jones (1,2), Stephen R Hoon (2), Nigel Richardson (1), and Michael Bennett (2)

(1) Edge Hill University, Ormskirk, United Kingdom (jonessj@edgehill.ac.uk), (2) Manchester Metropolitan University, Manchester, United Kingdom

The significant increase in global air travel which has occurred during the last fifty years has generated growing concern regarding the potential impacts associated with increasing emissions of particulate matter (PM) from aviation activity on health and the environment. PM within the airport environment, in particular, may be derived from a wide range of potential sources including aircraft; vehicles; ground support equipment and buildings. In order to investigate and remediate potential problem sources, it is important to be able to identify characteristic particulate 'fingerprints' which would allow source attribution, particularly respirable particulates. To date the identification of such 'fingerprints' has remained elusive but remains a key research priority for the aviation industry (Webb et al, 2008).

In previous PM studies, environmental magnetism has been used as a successful technique for discriminating between different emission types and particulate sources in both urban and industrial environments (e.g. Hunt et al 1984; Lecoanet et al 2003, Jones et al 2015). Environmental magnetism is a non-destructive and relatively rapid technique involving the use of non-directional, rock magnetic measurements to characterise the mineral magnetic properties of natural and anthropogenic materials.

In other studies scanning electron microscopy (SEM) has also been used as an effective characterisation technique for the investigation of grain size and morphology of PM derived from vehicle emissions (e.g. Bucko et al 2010) and fossil fuel combustion sources (Kim et al 2009).

In this study, environmental magnetic measurements and SEM/EDAX have been used to characterise dusts from specific aircraft sources including engines, brakes and tyres. Furthermore, these methods have also been applied to runway (both hard and grass covered surfaces), taxiway and apron dusts collected during extensive environmental sampling at Manchester International Airport, UK in order to investigate source attribution.

The results indicate that the dusts collected from the various aircraft sources (i.e. engines, brakes and tyres) are significantly different in terms of magnetic mineral type and grain size. Furthermore, particulates deposited at different locations on the runway surface show significant differentiation in magnetic grain size and mineralogy which when compared with the results from the different aircraft sources suggest that they may relate to emissions from different sources at various stages of the take/off landing cycle.

Results of SEM/EDAX analysis show that aircraft engine, brake and tyre dust particulates vary significantly in terms of morphology and chemical composition. All sources include respirable (sub 10 micron) particulates. Engine dusts are carbon and silicon rich dominated by angular particulates. They have a distinctive chemical composition including Chromium, Cobalt and Nickel. Tyre dusts are predominantly carbon based dominated by spherical particulates and a unique presence of Zinc. Brake dusts, carbon and oxygen dominated and trace metals, include sub-angular particulates but an absence of the characteristic engine and tyre dusts metals. By combining SEM/EDAX measurements and magnetic measurements we are establishing potential fingerprints for particulates from ground based air transport activities to enable identification of potential health hazards. This will help inform management plans for reduction of associated risks to the environment and health.

References

Bucko, M., Magiera, T., Pesonen, L., Janus, B. (2010) 'Magnetic, geochemical and microstructural characteristics of road dust on roadsides with different traffic volumes – Case study from Finland' Water, Air and Soil

Pollution 209, pp. 295-306.

Hunt, A., Jones, J. and Oldfield, F. (1984) 'Magnetic measurements and heavy metals in atmospheric particulates of anthropogenic origin' The Science of the Total Environment 33, 129-139.

Jones, S., Richardson, N., Bennett, M. and Hoon, S.R. (2015) The application of magnetic measurements for the characterization of atmospheric particulate pollution within the airport environment. Science of the Total Environment., 502 pp.385-390

Kim, W., Doh, S., Yu, Y. (2009) 'Anthropogenic contribution of magnetic particulates in urban roadside dust' Atmospheric Environment 43 (19) pp.3137-3144.

Lecoanet, H., Leveque, F. and Ambrosi, J.P. (2003) 'Combination of magnetic parameters: an efficient way to discriminate soil-contamination sources (south France)' Environmental Pollution 122, 229-234.

Webb, S., Whitefield, P.D., Miake-Lye, R.C., Timko, M.T. and Thrasher, T.G. (2008) 'ACRP Report 6: Research needs associated with particulate emissions at airports'. Transportation Research Board'.