Estimation of Non-Exhaust Emissions in PM_{10} Road Dust in Birmingham, UK

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Non-exhaust emissions constitute an important fraction of total road traffic emissions and becoming increasingly important to achieve air quality targets (Denier van der Gon *et al.*, 2013). Road dust consists of primarily coarse-sized particles derived from different sources such as wear and tear of vehicle components (brakes, tyres and clutches) and road surface, engine corrosion, tailpipe emissions, crustal dust and other emissions sources. The aim of this study was to characterize the metal concentrations in road dust in a busy traffic tunnel in UK.

Sampling of PM_{10} road dust was conducted in the Queensway Tunnel in Birmingham, UK in September 2012 using the dust resuspension chamber (Amato *et al.*, 2009). The samples were collected using 47mm PTFE filters and extracted using reverse aqua regia. A total of 14 elements were analysed including Si, Al, S and Fe with energy-dispersive x-ray fluorescence (EDXRF) and Zn, Cu, Ba, Sb, Mn, Cd, Ni, using inductively coupled plasma mass spectrometry (ICP-MS). Details of the chemical analysis methodology are presented in Gietl et al. (2010).

Based on Pearson correlation analysis, two major groups of elements were identified, each with statistically significant correlations among the elements in the group: crustal elements including Al, Si and Fe ($r^2>0.99$) and traffic-related elements such as Cu, Zn, Sb, Ba and Mn. Interestingly, while Ti was found to be correlated to traffic-related elements, Ni was not found to be correlated to either group. S showed higher correlation to the crustal elements ($r^2>0.91$) compared to traffic-related elements ($r^2>0.60$-0.64). The traffic-related elements could not be subdivided into tyre/brake wear categories based on correlation analysis.

Table 1: Elemental Ratios for PM_{10}

	Si/Al	Fe/(Al+Si)	Cu/Sb
Average	3.91	0.21	7.44

A diagnostic ratio of 7.0 ±1.9 has been proposed for brake wear particles (Amato *et al.*, 2009) and in the current study, a Cu/Sb value of 7.5 was observed indicating the contribution of brake wear particles. The Si/Al ratio was also observed to be corresponding to previously reported values in the literature.

Using Ba and Zn as markers for brake wear and tyre wear and the conversion ratios reported in Harrison et al. (2012), contributions of brake dust and tyre dust to PM_{10} were calculated to be 6.6% and 15.6% respectively. However, the percentage of tyre dust might be an over-estimate owing to the several different sources of Zn.

Similar measurements are currently being made in roads with different traffic loads to estimate the contribution of traffic emissions to PM_{10} under different traffic conditions.

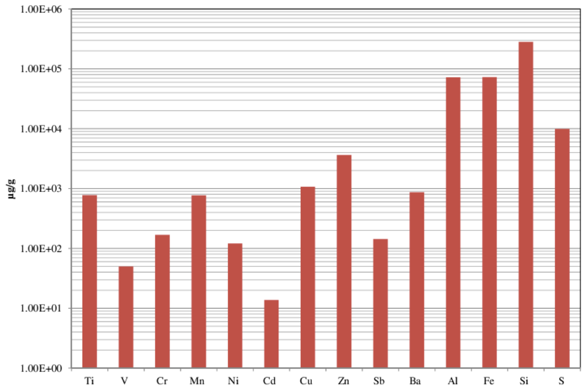

Figure 1: Average concentrations of trace metals in PM_{10} road dust

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