

Interpretation of the Results of the Chemical Characterisation of Size Fractionated Particulate Matter Collected at a Semi rural site in the UK

A contribution to subproject SATURN

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Summary

Previous work on chemical characterisation of fine atmospheric particles has continued as part of SATURN contribution for the year 2000. Further sampling campaigns to collect particulate pollutants were carried from 06-03-2001 to 21-03-2001. The particle samples were collected in 10 size fractions using MOUDI from the same site of University of Hertfordshire, a semi rural, in the UK. The collected samples were analysed for gravimetric mass, and metals (Pb, Zn, Fe, Ni and Cu) using ICPAES. The meteorological data for the sampling period was obtained from the BADC (British Atmospheric Data Centre). The results from this campaign are presented here and also compared with the previous campaign that was carried in the summer of 2000 (from 17/08/2000 to 04/09/2000).

Aim of the research

Particulate matter in the atmosphere is present in different size ranges from a few nanometer to tens of micrometer, with various shapes (McMurry, 2000). The environmental impact of these particles, such as, health hazards, acid rain, global albedo and visibility degradation as well as their fate and transport is basically determined by factors including the size of the particles and their chemical composition in addition to other environmental variables (McMurry, 2000). Therefore, to understand the environmental and health impact of ambient particles it is important to study their chemical composition as a function of their size. As different sources emit particles in different size range such a study can also assist to understand the source receptor relationships.

Activities during the year

- Field campaign in the Spring of 2001 to sample PM₁₀ and size fractionated aerosol using MOUDI
- Analysis of size fractionated aerosol for mass and metal species

Principal results

The results of the chemical characterisation are given in figures 1-3. Figure 1 shows the particle mass concentration in various size fractions during two campaigns. Figure 2 shows same for metal species for the March 2001 campaign. Figure 3 A and B show the percentage concentrations of the analysed species in terms of Coarse (2.5-10 μ m), Fine (PM_{2.5}) and PM₁ during Aug-Sep 2000 and March 2001 campaigns respectively.

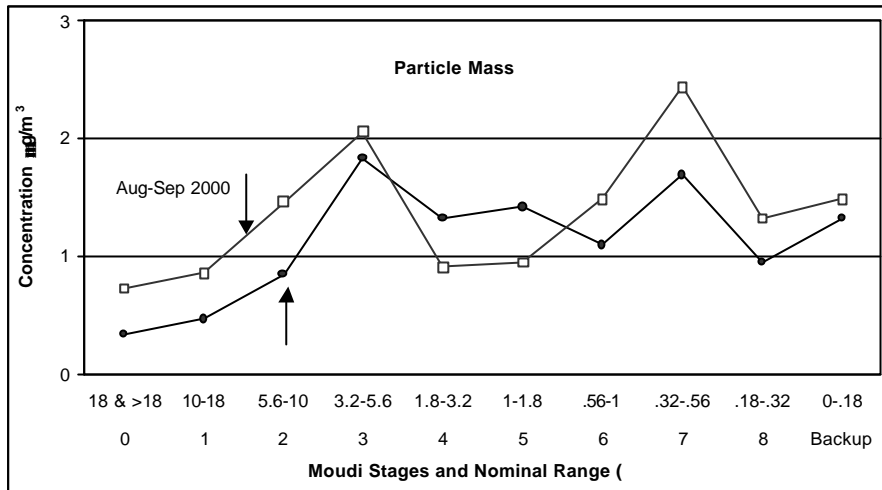


Figure 1. Concentration of particle mass in various size fractions.

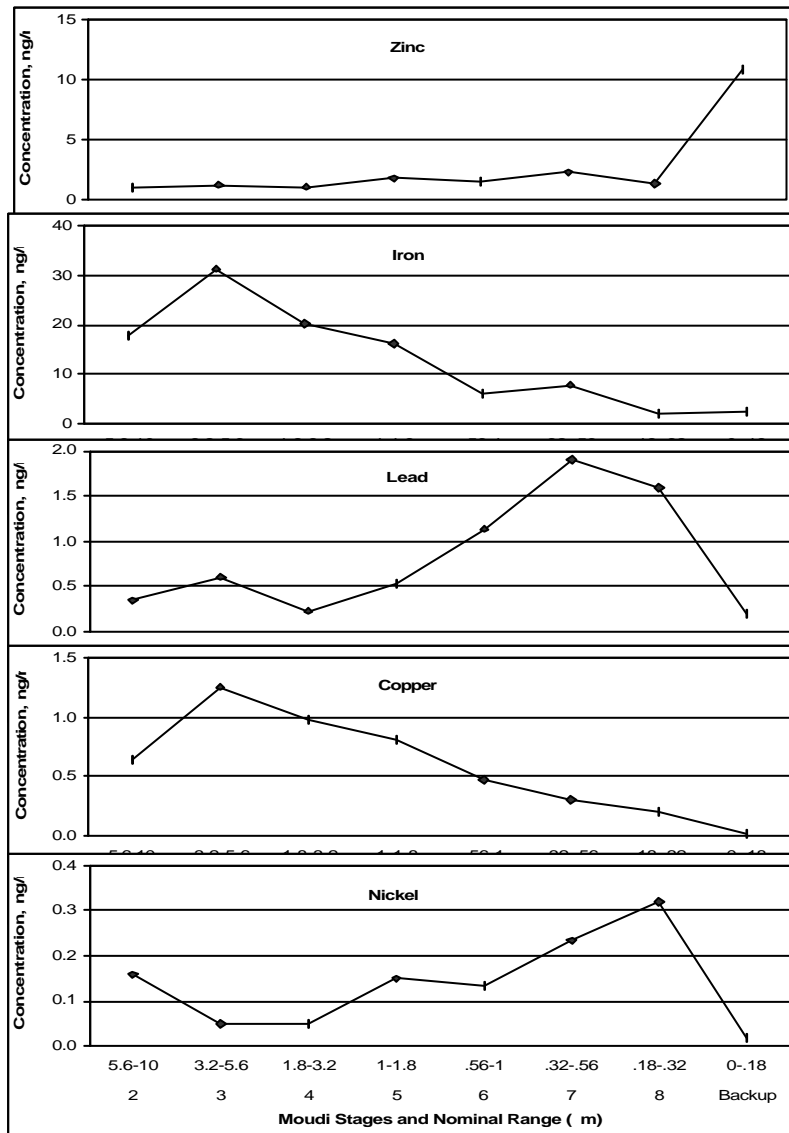


Figure 2. Size fractionated concentration of various metals – March 2001 campaign.

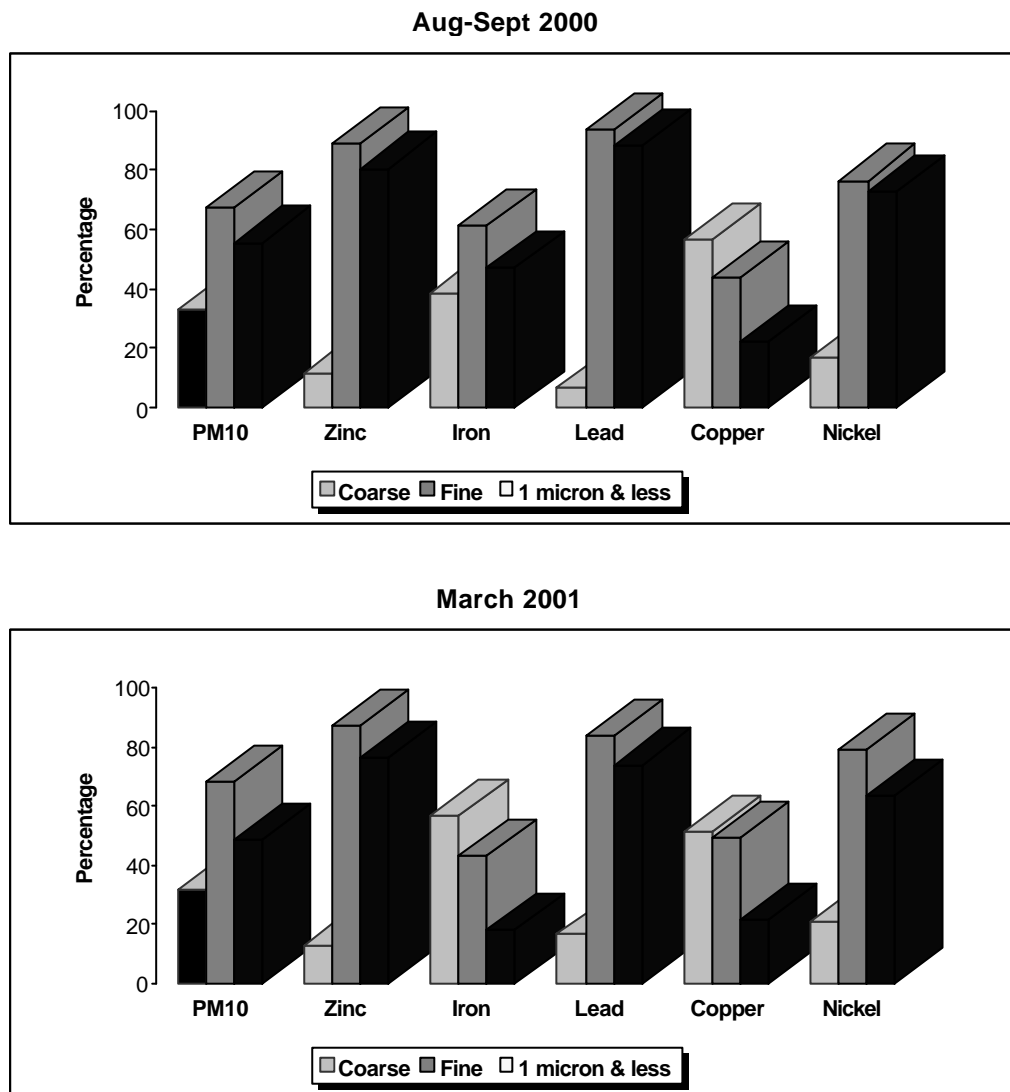


Figure 3 A & B. Percentage fraction of coarse, fine and PM1 fractions in the metal species and particulate mass during two campaigns.

Main Conclusions

- The size distribution pattern exhibited by the particulate mass is quite similar during both the campaigns.
- The mass concentration during the campaign of march 2001 is slightly lower compared to the Aug-Sep campaign that can be explained when the overall meteorological conditions during sampling campaigns are taken into account. During the March campaign the average wind speed was higher and had more rainy spells.
- The PM10 mass and all but iron of the analysed species are dominated by the fine fraction. More than twothird of PM10 mass and over 80% of zinc and lead are in fine fraction (particles of 2.5 micron and less)

- The contribution of particles of 1 micron and less is also significant in the march campaign as it was in the previous campaign.
- The percentage distribution in the three preselected size ranges during the two campaigns show quite a similar pattern
- The dominance of the fine fraction in the particle mass and the analysed species point towards the influence of anthropogenic activities on the suspended particulate matter at the site
- The concentration of lead in the March campaign was quite low and well comparable with the previous campaign (6.6 and 8.0 ng/m³ respectively)
- The concentrations of the particle mass and other species can be termed as low that are characterised by the site type which being apart from asemirural site is also at a height of about 30 feet

Aims for the coming year

- Carry out winter sampling campaign at the same site
- Use other size fractionating aerosol sampling equipment (PARTISOL-Starnet)
- Use semi quantitative particle number counting equipment (Grimm)
- Chemical analysis
- Analysis of the results including seasonal variation

References

McMurry P H, A review of atmospheric aerosol measurements, 2000, Atmospheric Environment, 34, p 1959-1999