Size Segregated Characterization of Fine Particulate Matter in a Triple Site Experiment - Leipzig-City, Leipzig-Outskirts, and Melpitz

A Contribution to subproject AEROSOL

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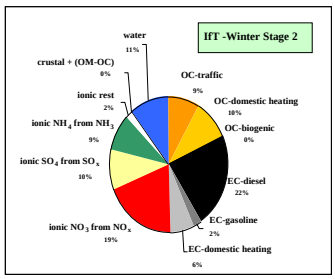
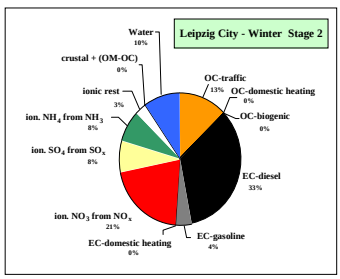
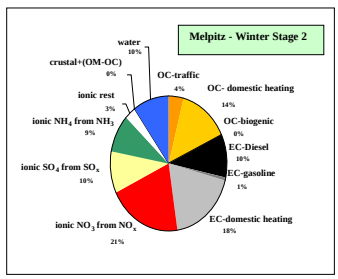
Motivation

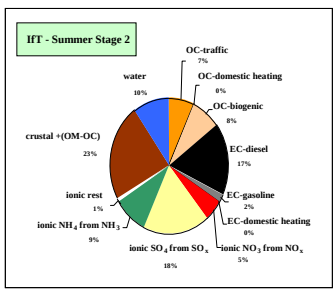
The new European standard will lead to strict regulations for PM_{10} and later on for $PM_{2.5}$. For Saxonian cities the observance of these new regulations will be problematically. So the SLUG charged the IfT to identify sources of anthropogenically produced small PM. Using three identical BERNER-type cascade impactors and three DHA-80 $PM_{2.5}$ high volume filter samplers particles were collected during two measurement campaigns (in winter 1999/2000 and in summer 2000). Nine typical dry winter days and eight typical dry summer days were selected for 24h sampling. Using all meteorological and chemical informations the sources of the small PM have been identified under some important hypotheses: 1. Industrial output does not exist in the region. 2. Biogenic sources exist only during the summer. 3.Emissions from domestic heating sources have an effect during the winter only.

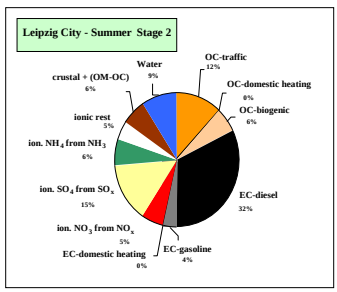
The sampling sites:

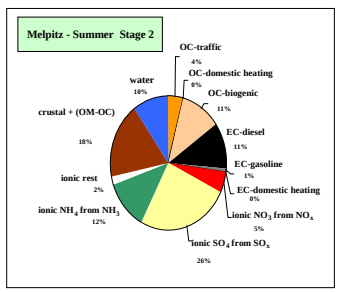






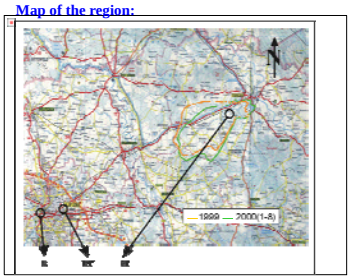






Comparison of impactor stage 2 constituents and their sources at all sites during both seasons:

Map of the region:



Analytical Methods:

OC-EC analyses:

After weighing the Al foils (1/3 of the impactor stage) were analysed in the C-mat 5500 (Ströhlein) at 650 °C under N_2 for the organic fraction and than under O_2 for the elemental carbon. After catalytic oxidation the CO_2 was analysed by NDIR spectrometry. Our laboratory was involved in the (*Schmid et al., 2001*).

Ionic content:

The TEDLAR foil part was extracted by high purity water and than analysed by ion chromatography (cations) and capillary electrophoresis (anions). The filter samples were analysed by a DX100 (Dionex Inc.) ion chromatograph after extraction in the eluent of the IC-system (*Müller, 1999*).

Organic single species:

A piece of a Curie point foil (5% of the stage area) was used for direct thermal desorption GC-MS analysis. Alkanes, PAH and o-PAH were determined.

Water determination:

The water content was estimated after *Neususess, 2000*.

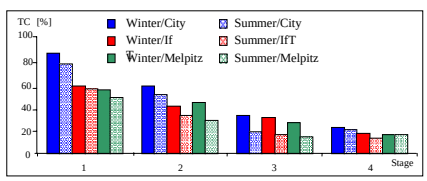
In further investigations the content of 10 important metals was determined by ICP-MS and the particle morphology was analysed by REM including EDX analyses for the elemental content of selected particles.

Main Results:

The comparison of the measurements obtained from three sampling points at two seasons under selected weather conditions was directed to separate influences of specific sources of PM in the region of Leipzig:

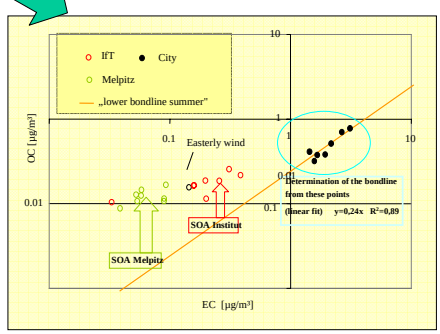
The size segregated investigation and the environmental influences on the three sampling points lead to the following main interpretations:

1. The mean particle mass increases from Melpitz via IfT to Leipzig-City.
2. The carbon content of the smallest particles (<140 nm) is mainly from traffic emissions. The diesel soot is the most important fraction. In greater particles (140 nm – 1.2 µm) the carbon content is related to household emissions and biogenic sources, the summer/winter differences are noticeably in these particle size classes.
3. From PAH analyses the importance of the domestic heating in the region during the winters is nothworthy.
4. The alkane fraction and their distribution between particle size classes is an indication for the domestic heating/traffic relation during the winter and for the biogenic/traffic sources during the summer.
5. In the smallest particles the formation of secondary organic aerosol was detected.
6. The history of the air mass is important for the ionic constitution. For the ionic content between winter and summer significant changes have been observed. The ionic fraction of winter samples is greater than of summer samples. The nitrate is the main ionic component during the winter sampling period whereas the sulfate during the summer dominates.
7. In comparison of filter and impactor measurements the filter overestimates the ammonium content and underestimates the nitrate content during the summer measurements.



Mean percentage of total carbon of the four stages at all sampling sites during the both seasons

Sampling Station	Winter PAH [ng m-3]	Summer PAH [ng m-3]
Leipzig City	16.41	2.82
IfT	15.56	0.49
Melpitz	15.51	0.13



References:

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H. Schmid et al. (2001). Results of the "carbon conference" international carbon round robin test stage I. Atmos Environ. 35, 2111-2121.

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Acknowledgements:

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