Elemental Characterization and Speciation
CEEFI

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The Elemental Characterization and Speciation Group of the LFI (CEEFI) was born in 2003 in the sequence of a small reorganization of activities using the 2.5 MV Van de Graaff accelerator of ITN, namely in what concerns activities previously in the framework of the Atmospheric Elemental Dispersion (DEA) unit.

CEEFI carries out work of research, development and application of ion beam based nuclear analytical techniques for the characterization of samples elemental composition, aiming also at speciation methodologies. So far, the main focus is put on particle induced x-ray emission (PIXE) and airborne material. Atmospheric environment related samples like airborne particulate matter and/or biomonitoring samples are different faces of this focus. Widening of this focus is presently being undertaken in order to cover a broader but more concise focus on small mass samples as particulate like and/or thin film samples.

In complementary lines of work, the group assumes that it is important not to depend exclusively on collaborations neither for sampling nor for data handling processes. Therefore, R&D is carried out on airborne particles sampling and on data handling methods, both for spectra handling and for aerosol and biomonitor multielemental data analysis.

Taking into account that PIXE is already a matured analytical technique, services are provided to both the community in general and the scientific community in particular. In this last case, the analysis of samples other than environmental is carried out, and case studies do sometimes lead to spin offs associated to details or specific developments of the PIXE technique.

Within the organics of the Ion Beam Laboratory (LFI), CEEFI is responsible for the maintenance and improvement of the PIXE line, assuring that (at least) there are no losses on the installed capacity.
In 2005, the groups' activity was focused on preparing the launch of a large re-equipment project approved in 2004, namely the: Laboratory for Characterization and Speciation of Aerosols (LCEA). These included training of young members, testing the robustness of airborne particles sampling prototypes developed at ITN, and improvements on the existing data handling software. Still, during 2005, the major funding for this project become available only in the end of the year, therefore only the first steps of the projects could be carried out.

Research Team

Researchers (*)

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Characterization and Speciation of Aerosols

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Objectives

The characterization and speciation of aerosols, is the basis and central issue of the CEEFI group work, since it is based on this data that uptake and/or impact models are tentatively established. Each of the specific activities of the group therefore converges towards this aim, or emerges from it. During 2005, the main activity undertaken was the operation of an airborne particle sampling unit at ITN campus, and the advanced formation and renewal of members of the CEEFI team, aiming at the launching of the Laboratory for the Characterization and Speciation of Aerosols (LCEA) during 2006. LCEA will be a major demonstration unit infrastructure intended to characterize as best as possible the aerosol present at the ITN Campus, and as well as airborne particulate matter sampled in a few locations that will configure a small network spread across the country.

Results

During 2005 the monitoring protocol used was identical to that used during 2004, namely an intermittent (6 minutes on, 18 minutes off) all days sampling with filters being replaced every week. In this way an almost continuous monitoring is achieved while preserving the number of samples within reasonable limits. In parallel to this, a database structure, which includes samples historic record, was created. Presently this database is under thorough debugging of both structure and data. Publication of this database is scheduled for mid 2006.

In Fig. 1 the time series of week averages of chlorine in airborne particles determined during 2004 is presented. The comparison to the results from 2005 show that in both years events showing very high Cl concentrations in fine particles were identified essentially in the same periods of the year. Further data gathered from these samples leads to a hypothesis of a problematic situation originated from a combination of anthropogenic emissions (pollution) clear sky and strong marine influence. Still no information is yet available on the chemical species holding this chlorine although the NaCl possibility can be practically excluded based on results from XRD. Further investigation is nevertheless necessary to trace this PM2.5 chlorine origin. The results from 2005 definitely exclude the hypothesis of single occurrence that was posed when only the 2004 data was available. The unexpected nature of these results clearly shows the importance of multi-element continuous monitoring of airborne particles composition

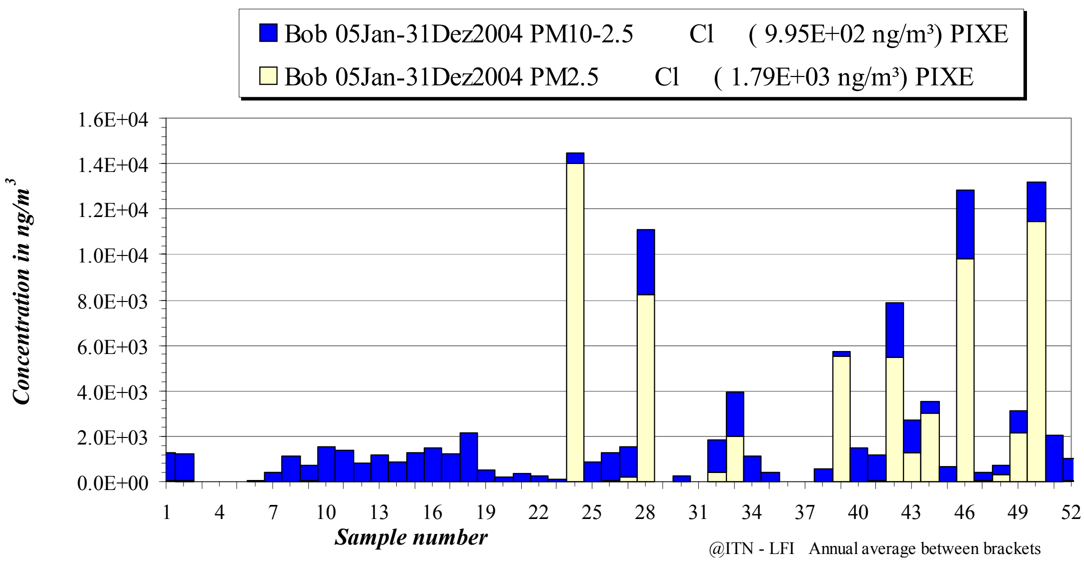

Fig. 1: Airborne chlorine week average concentration in PM10 specifying the PM2.5 component, determine at ITN during 2004.