Multi-wavelength characterization of carbonaceous aerosol

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Carbonaceous aerosol is a major component of the urban PM. It mainly consists of organic carbon (OC) and elemental carbon (EC) although a minor fraction of carbonate carbon could be also present. Elemental carbon is mainly found in the finer PM fractions (PM2.5 and PM1) and it is strongly light absorbing. When determined by optical methods, it is usually called black carbon (BC). The two quantities, EC and BC, even if both related to the refractory components of carbonaceous aerosols, do not exactly define the same PM component (Bond and Bergstrom, 2006; and references therein). Moreover, another fraction of light-absorbing carbon exists which is not black and it is generally called brown carbon (Andreae and Gelencsér, 2006).

We introduce a simple, fully automatic, multi-wavelength and non-destructive optical system, actually a Multi-Wavelength Absorbance Analyzer, MWAA, to measure off-line the light absorption in Particulate Matter (PM) collected on filters and hence to derive the black and brown carbon content in the PM (Figure 1)

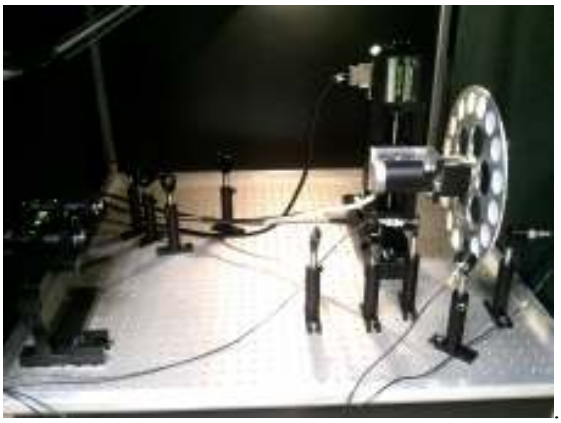

Figure 1: Set-up of the MWAA

This gives the opportunity to measure in the same sample the concentration of total PM by gravimetric analysis, black and brown carbon, metals by, for instance, X Ray Fluorescence, and finally ions by Ion Chromatography. Up to 16 samples can be analyzed in sequence and in an automatic and controlled way within a few hours. The filter absorbance measured by MWAA was successfully validated both against a MAAP, Multi Angle Absorption Photometer (Petzold and Schönlinner, 2004), and the polar photometer of the University of Milan.

The measurement of sample absorbance at three wavelengths gives the possibility to apportion different sources of carbonaceous PM, for instance fossil fuels and wood combustion. This has been done following the so called "aethalometer method" (Sandradewi et al., 2008;) but with some significant upgrades that will be discussed together the results of a field campaign presently on going in a mountain site in the Ligurian Appennines. The apportionemnt of the combustion source derived from the optical analysis, will be compared with the results of other techniques (i.e chemical characterization of biomass burning tracers and radiocarbon determination by Accelerator Mass Spectrometry).

Results of the application of the MWAA to the analysis of collecting stages of cascade impactors will be also also shown.

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Andreae, M.O, and Gelencsér, A. (2006). *Black Carbon or Brown Carbon? The nature of light-absorbing carbonaceous aerosol.* Atmospheric Chemistry and Physics, 6, 3131-3148.

Bond, T., Bergstrom, R. W. (2006*). Light absorption by carbonaceous particles: an investigative review.* Aerosol Science and Technology, 40, 27-67.

Petzold, A., Schölinner, M. (2004). *Multi-angle absorption photometry—a new method for the measurement of aerosol light absorption and atmospheric black carbon.* Journal of Aerosol Science, 35, 421-441.

Sandradewi, J., Prevot, A.H., Zidat, S., Perron, N., Rami Alfarra, M., Lanz, V., Weingartner, E., Baltensperger, U. (2008). *Using Aerosol Light Absorption Measurements for the Quantitative Determination of Wood Burning and Traffic emission Contributions to Particulate Matter.* Environmental Science & Technology, 42, 3316-3323.