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A method for estimating the carbon fraction in atmospheric particles produced by gasoline and diesel combustion

O. Peralta, D. Baumgardner, G. B. Raga

Universidad Nacional Autónoma de México, Mexico City, Mexico
(oscar@atmosfera.unam.mx / Tel: 5255-56224248, Fax: 5255-56224396)

The thermograms produced by the Evolved Gas Analysis (EGA) method not only are useful for evaluating the mass of organic and black carbon (OC and BC), but the shapes of the thermograms contain additional information that is related to the types and sources of the carbon compounds. More specifically, analysis of size differentiated filter samples of emissions from gasoline and diesel engines show distinctive features we use to evaluate ambient particle samples collected in Mexico City.

The particles from gasoline and diesel motor emissions were collected directly from the exhaust of cars, trucks and heavy equipment using a Micro Orifice Uniform Impactor (MOUDI), with eight stages, ranging from 10 - 0.18μm. The samples were subsequently analyzed with EGA using a ramped temperature at 35˚C per minute, from 50˚C to 800˚C, while passing O_2 past the sample. The evolved CO_2 was measured with a Licor model 6252 analyzer. The fraction of semi volatile organics from the gasoline exhaust particles, i.e. those that evolve at a temperature between 200˚C and 400˚C, is higher than those emitted from diesel engines. Only a very small fraction of the carbon from gasoline particles evolves at temperatures above 500˚C, i.e. BC. On the other hand, in the diesel emissions, BC dominates the carbon. The shapes of the thermograms are very different for the samples from the two sources and were evaluated with a Gaussian peak fitting program that deconvolves the thermogram shapes into distinctive curves that were then compared with a similar analysis of particles collected from three representative areas in Mexico City. We find that the shapes of the thermograms from the ambient samples can be partially reproduced using combinations of the diesel and gasoline thermograms. The degree of reproducibility and

the residual difference between original and reproduced thermogram provides an estimate of what fraction of the carbon in a sample can be attributable to gasoline or diesel emissions.

The comparison of the urban samples with this fingerprinting technique reveals clear differences among the three areas of the city with respect to the fraction of gasoline and diesel carbon found in the samples. An analysis based only on the absolute mass fraction of OC and BC, however, shows no difference highlighting the potential usefulness of this technique for identifying the sources and possibly age of aerosol particles.

Keywords: EGA, thermogram, diesel and gasoline exhaust particles, MOUDI