THERMAL ANALYSES OF AEROSOLS

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Thermal analysis as an analytical tool has been applied to the study of suspended liquid and solid matter in air. The aerosol is heated in a glass pipe, and the light scattering coefficient is used for the \textit{in situ} detection of aerosol. Results of thermal analysis of the Los Angeles smog, and of St. Louis aerosol on dry and humid days, are presented, all indicating distinctly different thermo-nephelograms. On polluted days in St. Louis, over 50\% of the light scattering coefficient is lost at about 100\°C, which indicates the presence of $\text{H}_2\text{SO}_4$.

Suspended liquid or solid matter in air, commonly referred to as aerosols, are receiving increasing attention because of their important role as health hazards, their effects on the global climate and weather, damage to buildings and vegetation, and other environmental effects. Because of these effects, aerosols, in particular atmospheric aerosols, constitute one of the most damaging components of the current air pollution problem.

In recent years much has been learned about the physical and chemical characteristics of atmospheric aerosols. Unfortunately, chemical analyses of aerosol samples deposited on filter or other substrates could only yield partial information regarding the aerosol which is suspended in air. A major uncertainty about the suspended aerosol concentrations exists due to inadequate data on the content of water and other volatile matter such as light organics in the ambient aerosols [1]. The present study was initiated with the purpose to elucidate the volatile aerosol fraction and, if possible, derive quantitative data on the volatility, i.e. under what conditions (mainly temperature) and how much of the ambient aerosol is driven from the aerosol to gas phase. For this purpose, we adapted thermal analysis as the analytical tool.

Results of controlled thermal exposure and analyses of urban aerosols were first reported by Goetz, Preining and Kallai [2]. They showed that deposited marine aerosol changes insignificantly after exposure to 80\°C air, i.e. it is not volatile at that temperature. On the other hand, about 80\% of the Los Angeles smog aerosol in the size range below 0.5 $\mu$m volatilized at 80\°C. They found that at this temperature the subrange between 0.5 and 1.3 $\mu$m did not change substantially.

Thermal analysis, i.e. aerosol analysis as a continuous function of temperature has been used by other investigators to study the behavior of natural aerosols.
In the present work, the light scattering component (0.2 – 0.6 μm) of urban aerosols was thermally analyzed using an *in situ* detection technique, nephelometry.

**Experimental setup**

*Description of the equipment*

The experimental setup used for thermal analyses of aerosols is shown schematically in Fig. 1. It consists of three major components, the heater, the aerosol sensor and the data recorder. Aerosol is heated by a pyrex glass heating pipe before it enters the nephelometer. Fin-like obstructions extending from the inner wall to the center of the pyrex pipe insure the mixing and uniform heating of the aerosol sample. The first section of the pipe is wrapped with a heating strip, and the aerosol passing through this section can be heated up to 300°. The rate of heating is controlled by the power input, and the air flow rate. A timer turns the power on or off, and hence it controls the heating time. The aerosol flow rate through the heater is set at 500 cm³/s. After heating, the aerosol passes through the other half of the pyrex pipe and cools down to about 30°, and then enters the nephelometer.

The temperature of the heated aerosol is measured by a thermocouple which is placed in a teflon radiation shield and rests at the end of the heating section of the pipe. Hence it measures the maximum temperature that the aerosol has been heated to.

There are several convenient devices available for the monitoring of aerosol properties. Optical devices, using the light scattering by aerosols as the signal, can provide a simple means for the continuous and *in situ* measurement of particles in the 0.20 – 5 μm particle diameter range.

In the present work, the aerosol is monitored by a nephelometer [5] which measures the total light scattering coefficient, $b_{scat}$, in the visible wave length...