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Application of Organic Particle Analysis in Inhalable Particulate Matter by TEM-EDS and GC-MS to Air Quality Studies

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Air pollutants can be classified according to their size as: a) fine particles of maximum 2.5 micrometers in diameter (PM2.5) which originate from power plants, industrial processes, vehicle exhaust pipes, wood stoves and forest fires, and b) coarse particles between 2.5 and 10 micrometers (PM10) from milling and grinding operations, road dust and some agricultural operations [2].

Atmospheric aerosols consist of a number of inorganic and organic chemical species, of which the organic fraction contributes 20 to 90 % of the total particulate matter in the atmosphere [1]. Because the chemical properties of organic compounds will have an influence on the effects of aerosols on radiation, as well as on the environment and human health, it is important to identify these organic species.

Despite having knowledge of the potential toxicity of many of the chemical substances that make up suspended particles, the morphological and chemical profiles of their emission sources and the way in which they are modified during their transit through the air are not known with certainty atmosphere, maintaining its size or adding to others to form larger particles of different morphology. [3].

Presently, Transmission Electron Microscope (TEM) is considered the most reliable equipment for studying of inorganic particles that can be found in our atmosphere, thus, in direct contact with population TEM can provide detailed information on the sizes, compositions, morphologies, structures, and mixing states of individual aerosol particles; and where, gas chromatography is an effective technique for the separation and analysis of the mixtures of organic compounds in the samples to be analysed.

The aim of the present study is to examine the morphology and elemental chemical composition of organic particles in PM10 samples as part of an air quality study performed by TEM-EDS and GC-MS.

The PM10 particles was collected by high-volume sampler, using a sampling flow of 1.3 m3/min. Sampling was carried for 24-h one day a week. Analysis of PM10 were performed using Transmission electron microscopy coupled with energy dispersive spectrometer, for determination of morphology and elemental composition of airborne particles. Specimens were processed by separating the collected particles from the quartz filters by means of submersing a 2 cm2 section of each filter into isopropilic alcohol within a test tube for 5 minutes. Then, an aliquot of the suspension was placed over a sample holder, and is introduced into the chamber of TEM. For the analysis of organic compounds, an Agilent Model 6890N Gas Chromatograph coupled to Mass Spectrometry (GC-MS) was used, the column used was HP5-MS for compounds with medium polarity. 50% of the filter is introduced into an extraction thimble which is placed inside the extraction tube, mounting it on the flask and the condenser tube, Dichloromethane was added to the flask through the mouth of the condenser was refluxed for 6 hours. The analysis of each compound was carried out individually by coinciding with the database used by the

software, to carry out this identification the baseline subtraction method is carried out for better identification.

In the transmission electron microscope, 72 images of particles were obtained, showing a diversity of forms, of organic compounds, present in the agglomerates in chain or mass form. (Figure 1) whose size is less than 0.2 micrometers in whose composition a variety of compounds participate, GC-MS analyzes show that the types of organic compounds found were phenol, phthalate, alkane, halogenated ester, amine; and inorganic whose composition obtained by EDS shows us a conformation of Al, Ca, P, Mg, K, Fe, Cl, Na, Si, Ti as well as S.

Figure 1. Organic conglomerates in a) Chain and in b) Mass obtained by TEM

The results to date indicate the presence of some organic compounds, which due to their size or chemical composition, have properties or characteristics of importance because they represent considerable harmful effects for the health of the population to which they may be exposed.

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