Particle Morphology Related to Size Distribution during Milagro Campaign on T1 Site

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I. Abstract

Measurements of fine particles (five sizes less than 2.5 μm) were made at the Technological University of Tecamac (UTTEC), State of Mexico (T1 site of MILAGRO campaign). The university location is 19° 43' N Latitude, and 98° 58' W Longitude. The altitude of this site is 2,340 m.a.s.l.

Four three-hour periods throughout the day were sampled. The objective was to find out any differences due to time of the day and sources. Sampling was done by placing transmission electron microscope (TEM) grids on the last 5 stages of an 8-stage MOUDI cascade impactor.

TEM images of particles were obtained at different magnifications by using a CM 200 Phillips TEM at the Advanced Materials Research Center (CIMAV, Chihuahua).

Preliminary results showed that T0 site and T1 site samples of particles with aerodynamic diameter 0.18 μm have differences in border-based fractal dimension that can be attributed to the process of particle aging and secondary particle formation. This situation is observed in a day with winds coming mainly from the city of Mexico.

Figure 1. Sampling Site (Arrows Indicate MOUDI Location)

II. Experimental Method

Samples were taken every other day from March 1 to March 30. A MOUDI impactor was placed on the top of the communication building of UTTEC (Fig. 1). We placed polycarbonate foils in each stage. TEM grids were placed in the last five stages to cover sizes with the following cut-off diameters d_{50}= 0.18 μm, 0.32 μm, 0.56 μm, 1.0 μm, and 1.8 μm (Fig. 2). Samples were obtained during early morning (6:00-9:00), noon (11:00-14:00), afternoon (16:00-19:00) and evening (21:00-24:00) conditions.

The grids were stored and later analyzed with a CM 200 Phillips TEM at CIMAV. Digital images of regions of interest (ROI) were obtained for particles of different sizes by changing the magnification (Fig. 3).

Individual particle perimeter fractal dimensions [Kindratenko, 1994] were obtained for about 30 particles per TEM grid. Preliminary analysis of samples was done on March 9, 15 at T1 and 27 at T0.

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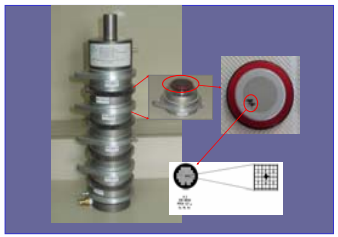

Figure 2. Sampling Method and System

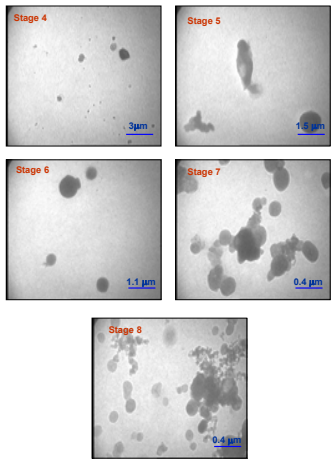

Figure 3. Aerosol TEM Digital Images of Different Stages.

III. Criteria for Selecting Analysis Dates (Mexico City Influence)

To select which days in T1 had influence from Mexico City emissions, we looked at two data sources. First, Model MM5 predictions for the campaign were reviewed [B. de Foy, 2006]. We also looked into meteorological data for T1 site (Meteorological tower, IIE). Converging data sets were then analyzed from days showing a clear influence (or not) from the city as indicated by prevalent wind direction (Fig. 4).

IV. Preliminary Results

Samples for particles with diameters 0.18 and 1.8 μm at T1 and T0 correspond to early morning conditions (6:00 to 9:00 am). March 9 had influence from Mexico City while March 15 had none. Sampling at T0 was done on March 27.

Shape distributions for large particles (d_{50} =1.8 μm) tend to be similar in Figure 4 (a, c, e). This indicates that emission sources do not have a noticeable influence on the shape of those particles.

For smaller particles (d_{50}= 0.18 μm) the behavior of the distributions is different. When we consider fresh emissions, the shape distribution tends to be more irregular (Figures 4 b, 4f).

On the other hand, it can be observed that in Fig. 4d, particles tend to have a more spherical character when there is influence from the city. This can be attributed to aerosol aging processes (p.e. BC agglomerates) [Dye et al, 2000] or new aerosol formation (p.e. sulfates).

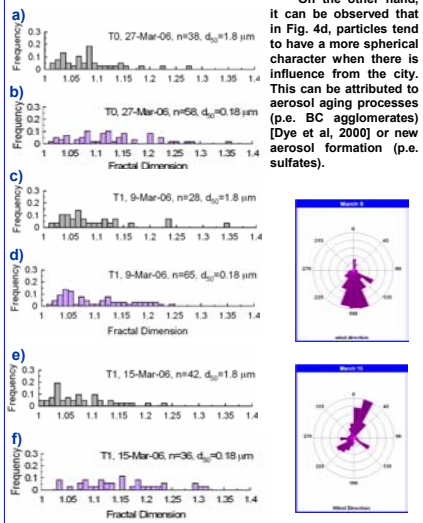

Figure 4. Shape Distributions of Different Sampling Times and Places.

V. Conclusions

Particles with d_{50}=0.18 μm sampled in T1 associated with urban influence tend to show less irregular shapes than particles sampled in T1 having local influence. In the same manner particles, in T0 have more irregular shapes due to local emissions.

Particles with d_{50} =1.8 μm sampled in T1 on days with and without Mexico city influence show no major variations in shape distributions.

Particle analysis for intermediate sizes and other sampling times are being currently conducted. Results will be provided in the future.

References

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