

**Date of Report:** August 30, 2002

**EPA Agreement Number:** R828771-0-01

**Center Name and Institution of Ctr. Director:** Center for Hazardous Substances in Urban Environments, Johns Hopkins University

**Identifier Used by Center for Project:** (Research Project #)

**Title of Project:** (sub-project): Single Particle Characterization of Ambient PM

**Investigator(s) and Institution(s):** Joseph J. Helble, University of Connecticut

**Type of Research:**

**Project Period:** February 2002 – August 2002

**Objectives of Research:** Understanding particle distribution functions and the particle-to-particle variations within that distribution are important for determining the potential health effects of urban aerosols. Unfortunately, there are only data on average values within the urban environment; little is known about the details of these distributions.

The objective of our project is therefore to develop an understanding of the particle to particle variation in an ambient respirable aerosol downstream of an incinerator in an urban location. Our approach is to collect aerosol samples by deposition on a cascade impactor both in an incinerator stack and in a downwind region. Samples will be analyzed for bulk composition as a function of particle size. Individual particle analysis is the most important aspect of this research and will then be used to obtain distribution functions. The morphology of individual particles will be examined by transmission electron microscopy (TEM). Images will be used to obtain measurements of perimeter, major axis, and minor axis, information that will be used to obtain fractal dimension information of each category of particle. Analysis of particle chemical composition on a particle-by-particle will then be obtained by applying surface science methods.

**Progress Summary/Accomplishments:** Our activities thus far have centered on developing the sampling methods and characterization approach that will be used to characterize particle morphology in TEM samples. We have been working with an existing sample of urban PM 2.5 collected in a local airshed by deposition on a TEM grid attached to a specific stage of a cascade impactor using the sampler depicted in Figure 1. Preliminary analysis of these images indicates that the distribution in morphology is broad, and the distribution of sizes is much broader than expected from the calculated cutoff diameter of the specific impactor stage.

Particle morphology will be determined through calculation of the surface fractal dimension. Much of our initial work has been focused on determining the minimum TEM magnification and image pixel density needed to provide a fractal dimension that is

independent of magnification. This work was completed in late August 2002. The next step is therefore collection of samples in the Baltimore airshed followed by image analysis for morphology. Selected samples will also be examined for particle-to-particle variations in chemical composition to determine whether relationships exist between particle composition and morphology type. Additional analysis will be conducted to examine the surface composition of selected particle types to determine whether significant stratification occurs. The latter analysis will by necessity be confined to relatively non-volatile materials present in the samples.



Figure 1: Impactor and housing as used for ambient particle sampling.

**Publications/Presentations:** None thus far.

**Future Activities:** Our sampling methodologies have been finalized, and we are preparing to install our low pressure impactor sampling equipment at the Ponca Street site. We will be visiting the Ponca Street site on September 10 as the final preparatory stage. An intensive two-week particulate matter sampling campaign will then follow in late September or during the month of October.

**Supplemental Keywords:** PM 2.5, morphology, chemical composition

**Relevant Web Sites:** N/A