

QUARTERLY PROGRESS REPORT

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Title: The Pittsburgh PM Supersite Program: A Multidisciplinary Consortium for Atmospheric Aerosol Research

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Institution: Carnegie Mellon University

Project Period: July 15, 2000 - October 14, 2000

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Objectives: Characterization of the atmospheric aerosol in the Pittsburgh region. Development and evaluation current and next generation atmospheric aerosol monitoring techniques. Quantification of the impact of the various sources to the PM concentrations in the area. Elucidation of the links between PM characteristics and their health impacts. Quantification of the relationship between indoor and outdoor concentrations. Study of the responses of the PM characteristics to changes in emissions.

Work Status: The CMU team has received the approval by the Pittsburgh City Planning Department for the construction of the sampling site in Schenley Park. Construction is expected to start in the first week of February 2001 and the site should be ready by the end of March 2001. The arrangements with Duquesne Light to provide the necessary power to the site have been completed. Power should be available to the site at the time of the completion of its construction.

The Department of Energy (DOE/NETL) has announced that they will contribute \$3.4 million to the project enhancing the ambient measurements, and supporting the source characterization and

modeling component (http://www.fetc.doe.gov/publications/press/2000/tl_pm25_cmu.html). The focus of the study will be the quantification of the current and future contribution of coal-fired powered plants to the atmospheric PM problem. The overall program consisting of the EPA funded Supersite project, the DOE funded source characterization work, and the planned health study have been named the Pittsburgh Air Quality Study (PAQS). Ambient measurements supported by DOE/NETL include ultrafine aerosol concentrations, surface area (epiphaniometer), in-situ OC/EC, use of the PC-BOSS samplers, further development of the single particle mass spectrometers, semi-continuous metal concentrations, and single particle metal concentrations by Laser Induced Breakdown Spectrometry (LIBS). The modeling components will include applications of both 3D chemical transport models and also statistical source receptor techniques (by Phil Hopke and his group). In the source characterization components, the PAQS team will obtain fingerprints of the main sources in the area including both traditional filter based techniques but also the state-of-the-art techniques that will be used in the ambient measurements (single particle spectrometer, continuous monitors, speciated organics, etc.). For the last piece of PAQS, the health study, a proposal has been submitted by the Johns Hopkins to team to EPA and is currently under review.

The construction of the new CMU Air Quality Laboratory continued during this period. A number of small problems with the existing floor (a new floor had to be installed) caused a small delay in the construction. The laboratory will be ready in the end of February of 2001 and the two clean rooms should be operational during the first week of March. This should allow us two months before the beginning of the Supersite operations for the installation and testing of the various instruments.

The CMU team continues the preliminary measurements in the area testing the various instruments and techniques and also to learn more about the atmospheric aerosol in the area. A mini-sampling campaign will be performed during February to check the performance of the various technologies under low temperatures and adverse weather conditions (snow, freezing rain, etc.).

The Supersite team has received a number of additional instruments. They include a nephelometer, a VOC pre-concentrator, a second IC, two MOUDI impactors, a TEOM, an FRM sampler, an ultra-high sensitivity microbalance and the associated relative humidity controlled box, data acquisition hardware and software, etc. All the necessary instrumentation is therefore in place and will be tested in the CMU aerosol laboratories and in the subsequent mini-sampling campaigns.

Preparation for sampling and analysis of inorganic species in aerosols has been proceeding, focusing on ionic species and trace metals. In the first category, a new Dionex 120 ion chromatograph was purchased and tested. The IC is equipped with an anion column that will permit quantification of organic acids as well as major species like sulfate and nitrate, and with a cation column for monovalent cations. Filter sample preparation and extraction procedures were tested for the anions and cations. In the second category, a Microwave Digestion System for extracting trace metals was purchased from CEM and the unit was tested. Procedures for working with the filters to be analyzed for trace metals are currently being tested.

The UC Davis/U. Delaware team has started the construction of the single particle mass spectrometer that will be used in the Pittsburgh Supersite project. Version 1 of the data acquisition software was completed and tested at the Houston Supersite. Version 2 of the software, with complete laser control, is underway and the first tests have been completed successfully. A new nozzle design has been built. Pressure tests show that we will be able to reduce power consumption below our original estimates if the nozzle is able to transmit particles successfully.

CSU investigators have been testing methods for automated sampling of cloud/fog and gaseous hydroperoxides. During the fall tests were performed on new reagent pumps for the continuous flow peroxide analyzer. The intent is to reduce operator maintenance by replacing a peristaltic pumping system (where tubing must be replaced weekly) with a series of small diaphragm pumps requiring much less frequent maintenance. A stand-alone Labview data acquisition system has also been prepared for the single channel version of the analyzer. During December and January a new automated fog/cloud sampling system was field tested as part of the California Regional Particulate

Air Quality Study (CRPAQS). A modified version of this system will be prepared later this year for use in the Pittsburgh winter intensive. In addition to equipment design and evaluation, CSU prepared SOP's for field operation of the peroxide analyzer and fog/cloud sampling system. These will be updated later to reflect changes to the final designs of these two systems.

A number of additional measurement approaches are under development and will be used during the Supersite operations. The first is a steam-based sampler for the semi-continuous measurement of the inorganic ions. A version of this sampler will be coupled by an ammonium detector to create a semi-continuous ammonium monitor. The CMU team together with DOE/NETL are exploring the use of thermal mass desorption spectrometry as an efficient approach to obtain speciated organic aerosol information. This new technique will be compared and evaluated against the more traditional extraction procedure used by the Rogge group.

The overall project is proceeding according to the original schedule and the reported progress is consistent with the goals and objectives for the period of the report. The aims of the project have not changed from the original application.

Changes in Key Personnel Involved in the Project: Dr. Beth Wittig has joined the Pittsburgh Supersite team. Dr. Wittig spent the last two years working with Sonoma Technology Inc. as a Senior Air Quality Analyst designing and coordinating air quality field studies (California Regional PM Air Quality Study, Central California Ozone Study). She will be responsible for the coordination of the satellite site measurements, the health study, and the gas-phase measurements of PAQS.

Expenditures to Date: During the first nine months of the project the Supersite team has used approximately 90% of the budget for the corresponding period.

Quality Assurance Requirements: The Quality Assurance/Quality Control plans for the project are coordinated with the other six Supersites and EPA. The QAPP for the project will be sent to

EPA in the winter of 2000. Drs. Suzanne Hering and Cliff Davidson are currently managing the QA/QC activities of the project.

Planned Activity for the Subsequent Reporting Period: Major activities planned for the fourth quarter of the project include:

- Continuation of the central sampling site preparation.
- Completion of the construction of the Air Quality Laboratory and the corresponding clean rooms.
- Completion of the construction of the single particle mass spectrometer by the Wexler group using the lessons learned during the Houston Supersite activities this summer.
- Field-testing of the relative humidity control systems for the real time particle sizing instruments, of the steam sampler, and the semi-continuous ammonium monitor.
- Multi-day pilot study in the central sampling location to test the particle sizing instrumentation, the organic and inorganic samplers and the gas-phase instruments.

Supplemental Key Words: Airborne particulate matter, aerosol, size distribution, ultrafine, fine and coarse particles, atmospheric chemistry, source-receptor, measurement error, study design, epidemiology, regional modeling, source/receptor analysis, Pittsburgh, Ohio River Valley, Western Pennsylvania, photochemistry, meteorology, trajectory modeling, peroxides.

Relevant Web Sites: homer.cheme.cmu.edu