Fine PM Source Test Method

Ron Myers/Tom Logan
Emissions Measurement Center
Project Goals

- Quantify Course & Fine PM
  - Use Dilution Sampling to Mimic Atmospheric Physics
  - Operationally Simple
  - Minimal Sample Location Limitations

- Speciation of Particulate

- Minimize Pseudo Particulate Formation
Description

- In Stack Particle Sizing
  - Large Cyclone Separates PM >10μM
  - Smaller Cyclone Separates PM >2.5μM
- Air Dilution Condenses Vaporous PM
  - Air is Filtered & Dehumidified
  - Sample is Diluted up to 40 to 1
- PM2.5 is collected on multiple filters
Competing Methodologies

- **U.S. EPA Test Methods**
  - Preliminary Method 004 (M201A +2.5)
  - Method 202

- **State Test Methods**
  - More Than Four Variants
  - Similar to Method 202

- **Research Methods**
  - More Than Six Variants
  - All Based on Dilution Sampling
EPA Reference Methods

- EPA Pre Method 4 & Method 202
- Strengths
  - Compact
  - Uses Existing Sampling Systems
  - Applicable to Almost All Sources
- Weaknesses
  - Optional Procedures Allowed
  - Potential Biases
Existing Dilution Methods

- More than Six Variants
  - With/Without Stack Particle Sizing
  - Different Residence Times
  - Dilution Ratios

- Strengths
  - Condense Particulate by Dilution

- Weaknesses
  - Heavy, Bulky, Complex
Typical Research Test Method

Dilution Air Inlet
HEPA Filter

Activated Charcoal Filter w/ Glass Wool Back-up

Hi-Vol Pump & Flow Sensor
18 in Dia x 6 ft H
Residence Chamber
80 sec Res Time
@ 226 LPM

Turbulent Dilution Tunnel
Residence Time 2.4 Sec @
1200 LPM
Dilution Ratio 25X - 50X
6 in dia x 9 ft Long

Sample Inlet and Temperature Sensor
Stack

S Type Pilot Tube

0 - 5 in H₂O
Magnehelic Gage
Heated Venturi w/ Temp Sensor
Heated Sample Line w/ Temp Sensor
½ in x 2 M long SS

20 - 30 LPM

Temp Controller

0 - ½ in H₂O
Pressure XDCR

To Sampler (113 LPM)

2.5 μM Cyclones

To Sampler (113 LPM)
Typical Research Test Method
Existing Sampler
In Stack Particle Sizers

PM$_{2.5}$ Cyclone

Nozzle

PM$_{10}$ Cyclone
Heated Sample Venturi
Dehumidifier / HEPA Filter
Mixing Chamber

- Sample Gas Inlet
- Mixing Zone
- Dilution Air Inlet
Dilution Air Mixer

Static Mixer
Major Components

- Heated Sample Venturi Box
- Dilution Air Venturi
- Dilution Chamber
- Mixing Area
- Extraction Port for Speciation Samples
- Filter Holder
Aliquot of diluted sample extracted for speciation analysis

Denuders used to remove potentially reactive gases
Schedule

● Expected Need in FY 2004

Development Phase

Evaluation Phase

Standardization
Current Status

- Completing Hardware Development
  - Hardware Operates as Expected
    - Sample Rate Maintained
    - Isokinetics Maintained
    - Dilution Ratios Maintained
    - Temperatures Maintained
  - Have Final Results from 2\textsuperscript{nd} Hardware Shakedown Test

- Completed Two Comparison Tests
  - Modified URG Dilution Sampler
  - Pre M4 & Method 202
Preliminary Results of Second Test

Hardware Evaluation
Coal Fired Utility
M17/202 Performed Previous Year
ESP Rebuild Before EPA Test

Concentration (gr/dscf)

Sampling Method & Process Operation

- Dilution Sampling System (7ppm SO3)
- Method 17/202 9ppm SO3
- Method 17/202 15 – 18 ppm SO3

DST
PM <2.5
PM >2.5
M17/202
Ps PM
ICPM
OCPM
FPM
Preliminary Results of Third Test

- Oil Fired Boiler – At <20% Load
- Poor Test Location – Expanding Duct – In 90° Turn
- Very Complex Speciation Concentration (mg/dscm)

Test Method and Run number:
- ORD DST OAQPS DST

Graph showing concentration (mg/dscm) with test methods and run numbers:
- ORD DST 1, 2, 3
- OAQPS DST 1, 2, 3
Preliminary Results of Fourth Test

Portland Cement Plant

20 to 130 ppm NH\(_3\)

500 ppm SO\(_2\)

500 ppm NO\(_x\)

R 1, R 2, R 3

PM (mg/dscm)

Mill Off, Mill On

CPM (ACT), CPM (M202), CPM (EPA), FPM2.5, PM >2.5
Operating OAQPS Sample Train
QUESTIONS