

Consultation on Coarse Particle ($PM_{10-2.5}$) Speciation Monitoring

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Presented to the CASAC AAMMS

February 11, 2009

PM_{10-2.5} Speciation Outline

- Monitoring Requirements
- Monitoring Objectives
- Measurement Issues
- Proposed Species and Analysis Methods
- Network Design

PM_{10-2.5} Monitoring Requirements

- In October 2006, EPA issued the final rule to revise both the primary and secondary NAAQS for PM
- The final rule established ambient air monitoring requirements for a PM_{10-2.5} indicator of thoracic coarse particles to support research on particle distribution, sources, and health effects
 - A new Federal Reference Method (FRM) was promulgated for PM_{10-2.5} mass in ambient air
 - PM_{10-2.5} speciation monitoring was required at NCore multi-pollutant monitoring stations by January 1, 2011
 - Speciation samplers must operate on at least a 1-in-3 day schedule and be collocated with PM_{2.5} speciation

PM_{10-2.5} Speciation Monitoring Objectives

- The primary objective for PM_{10-2.5} speciation data is to support further research in understanding the chemical composition and sources of PM₁₀, PM_{2.5}, and PM_{10-2.5}
- In addition, other PM_{10-2.5} data uses include:
 - Advancement of speciation monitoring methods in anticipation of wider use
 - Collection of composition data to inform health effect research studies
 - Use of speciation data to promote advancement of source attribution methods
 - Determination of spatial and temporal concentration variations in urban and rural environments

PM_{10-2.5} Speciation Measurements

- Several issues need to be addressed in order to develop a long-term PM_{10-2.5} speciation monitoring plan
- To support long-term PM_{10-2.5} speciation monitoring planning, EPA is developing a small pilot network
- Selection of target species, analysis methods, and sampling systems is a critical first step
- PM_{10-2.5} speciation measurements to date are limited and mostly done as part of research efforts using PM_{2.5} speciation analysis methods
- ORD research studies have uncovered issues with reconstructed mass using measured species
 - 10-50% of the mass was unaccounted for or unidentified in some locations

PM_{10-2.5} Speciation Measurements

- The current filter-based samplers are logical choices for PM_{10-2.5} speciation sampler design
- Possible filter-based sampler types include:
 - PM_{10-2.5} by difference using FRMs
 - Identical PM₁₀/PM_{2.5} FRMs at 16.7 Lpm
 - Dichotomous
 - One sampler with fine and coarse flows of 15 and 1.7 Lpm
 - MetOne SASS/SuperSASS PM_{2.5} speciation
 - One sampler with PM₁₀/PM_{2.5} inlets at 6.7 Lpm
 - URG3000N PM_{2.5} carbon
 - Identical PM₁₀/PM_{2.5} samplers at 22 Lpm

PM_{10-2.5} Speciation Measurement Charge Questions

- *Are there additional PM_{10-2.5} target species or sampling methods that can be used to help identify the source of unidentified mass in order to obtain better mass closure?*
- *Which sampler types should be included or excluded from the pilot network design? Are there other sampling devices not listed here that should be considered?*
- *What are the sampling artifacts that may be encountered and how should they be addressed?*

PM_{10-2.5} Speciation Measurement Charge Questions (cont'd)

- Is speciation by the difference method problematic and if so what specific issues make it problematic?*
- The current and most widely used PM_{2.5} speciation sampler is the MetOne SASS with a flow rate of 6.7 Lpm. If this sampler was configured for PM_{10-2.5} by difference, would the flow rate be problematic, especially if the need to compare reconstructed mass to the mass collected by the PM_{10-2.5} FRM is important?*

PM_{10-2.5} Proposed Species and Analysis Methods

Table 1. List of Proposed Filter Types, Species, and Analysis Methods		
Filter Type and Species		Analysis Method
Teflon	Mass	Gravimetric
	Elements	Vacuum XRF
	Ions (Na, Ca, Cl, K, SO ₄ , NH ₄ , NO ₃) *	Water extraction with Ion Chromatography (IC)
	Total Protein (Surrogate for total biological)	Protein assay (NanoOrange®) of IC extract above with Fluorometry and/or SEM
Quartz	Organic and Elemental Carbon	Thermal Optical Analysis (IMPROVE_A TOT/TOR)
	Carbonate Carbon	Acidification followed by TOA
* Any volatile species present will be compromised by vacuum XRF		

PM_{10-2.5} Proposed Species and Analysis Methods

- Nitrate and sulfate ions have been identified as only minor components of PM_{10-2.5} in some locations
 - It is not clear whether ions are needed to support research or data use needs for PM_{10-2.5} speciation
- Potential issues with the XRF measurement of particles have been identified
 - Large or coarse particle size effects may be problematic for multi-element analysis by XRF
- PM_{10-2.5} organic and elemental carbon (OC and EC) species can be measured using the same thermal-optical analysis (TOA) as used for PM_{2.5}; however, the soil component of PM_{10-2.5} is expected to be significant where interference by metal oxides (e.g., iron oxides) may be of concern
- Biological materials were listed as target species of importance in the 2004 Criteria Document for the last PM NAAQS review
 - It is not clear if these biological materials should be measured and how they should be quantified

PM_{10-2.5} Species and Analysis Charge Questions

- *Table 1 provides a list of proposed PM_{10-2.5} species. Which of these species are most important? Are there important PM_{10-2.5} species or components missing from this list?*
- *If ions are important PM_{10-2.5} species to measure, what ions should be on the target list? Are nitrate or ammonium ions important?*
- *Of the proposed analysis methods in Table 1, which methods should be excluded or included? Are there important analysis methods missing from the list?*

PM_{10-2.5} Species and Analysis Charge Questions (cont'd)

- *If biological materials are important, is scanning electron microscopy (SEM) on Teflon filters sufficient to quantify and identify these species? Is a total protein assay technique (or something similar) important to obtain a quantitative indicator of the total biological material present?*
- *Can the complication of particle size and absorption effects in XRF be resolved using absorption correction factors? If not, what other analysis methods should be considered for PM_{10-2.5} elements?*
- *Are metal oxides a significant source of interference in thermal-optical analysis (TOA) of PM_{10-2.5} for OC and EC? If so, how should the interference be addressed?*

Network Design

- The final monitoring rule contains a requirement for $PM_{10-2.5}$ speciation at NCore
- The NCore will have about 75 sites mostly in urban areas, with a subset of about 20 rural sites
- NCore design was based on representative monitoring to provide community-wide characterization of exposure and leveraging with other measurement systems
- The appropriateness and representativeness of the NCore sites for long-term $PM_{10-2.5}$ speciation monitoring needs to be determined



Proposed NCore as of October 2007

Network Design Charge Questions

- *Are sites with high PM_{10} and low $PM_{2.5}$ good candidate sites for $PM_{10-2.5}$ speciation? Given that there will be some urban and rural NCore monitoring sites with $PM_{10-2.5}$ speciation, are there other factors to consider in selecting the pilot monitoring and long-term sites or locations?*
- *If there is an opportunity to modify the NCore $PM_{10-2.5}$ speciation monitoring requirements during a future rulemaking, should changes to the network design be considered? For example, changing the total number of required monitors and/or the required locations?*