Issue #1. The performances of PM$_{10}$ and PM$_{2.5}$ samplers have not been clearly ascertained for particle sizes larger than 10 micrometers (µm) aerodynamic equivalent diameter (AED). (Agricultural dust emissions will typically have mass median diameters (MMD) larger than 10 µm AED.)

It is our view that while the FRM PM$_{10}$ and PM$_{2.5}$ samplers' performances for ambient particles with MMD of 10 and 2.5 µm AED, respectively have been established, the performances of these samplers with ambient PM having MMDs greater than particles sizes of interest have not been studied. Agricultural dusts have reported MMDs as large as 24 µm AED. The CAAQES faculty have published data demonstrating that use of FRM samplers to measure PM$_{10}$ concentrations of agricultural dust will result in concentrations that are as much as 300% higher than if the measured concentrations of ambient PM were characterized as having MMDs equal to or less than 10 µm AED. This phenomenon is referred to as “over-sampling” errors for dusts with larger MMD (Buser, et. al, 2002, Wang, et. al., 2004 and Capareda, et al., 2004).

EPA defines PM coarse as the difference between PM$_{10}$ and PM$_{2.5}$ sampler concentrations. PM$_{10}$ samplers will capture PM$_{2.5}$. In the presence of large PM, PM$_{2.5}$ samplers will capture significant quantities of PM course (PMc) that will be counted as PM$_{2.5}$. Therefore, merely subtracting PM$_{2.5}$ measurements from erroneous PM$_{10}$ measurements would likely misrepresent PMc concentrations.

Thus, we cannot be confident on the regulated PMc concentrations if the sampler data are based on measurement errors that are flawed. We suggest that the upper limit for the PMc National Ambient Air Quality Standard (NAAQS) should be 150 µg/m$^3$ (24-hr average).

**CAAQES Position:** If we can not measure PMc correctly, how can we establish a PMc NAAQS?
Issue #2. Overcome the Difficulty in Measuring True and Actual PM$_{10}$ and PM$_{2.5}$ concentrations.

In order to overcome the difficulty in measuring true PM$_{10}$ or PM$_{2.5}$, the EPA, research community and the industry must agree on a protocol to measure accurate PM$_{10}$ and PM$_{2.5}$ concentrations that takes into account the variability in ambient dusts characteristics for reporting and monitoring purposes. Our view is that, these PM$_{10}$ and PM$_{2.5}$ samplers will not be redesigned but in the calculation of concentrations, a method must be in place to account for (1) sampling error due to varying particles sizes, and (2) establishing the mass median diameter (MMD) and the geometric standard deviation (GSD) of various dusts encountered in ambient air.

PM$_{10}$ samplers, as defined in Appendix J - 40 Code of Federal Regulations (CFR) Part 50, collect all of the fine particles and part of coarse particles. The upper cut-point is defined as having a 50% collection efficiency ($d_{50}$) at 10±0.5 µm AED. The slope of the collection efficiency is defined in amendments to 40 CFR, Part 53. Hinds (1982) reported a slope of 1.5 µm which would mean that some particles larger than 10 µm are captured and at 50% efficiency, the amount of larger particles captured will be equal to that of smaller particles that were not captured making the weight measurements for PM$_{10}$ correct at 10 µm. But it is only the case when the PM$_{10}$ sampler exposes to PM with a 10 µm MMD. When the PM has a MMD larger than 10 µm, the amount of larger particles captured will be greater than that of smaller particles that were not captured, thus over sampling error will occur (Buser, et al. 2001). This over sampling error is the sampler inherent sampling error due to interaction between sampler performance character and particle size distribution. More over, it has been reported if the sampler is exposed to dust of larger size, the cut-point will be shifted (Wang, et al, 2003) and it will capture more large particles and thus creating a bias in concentration measurements.

The FRM PM$_{2.5}$ sampler on the other hand is assumed to have a $d_{50}$ of 2.5 µm and a slope of 1.18 (EPA, 2001). Studies by Buch (1999) and Pargman, et al. (2001) showed that there was a shift in the cut-point for FRM PM$_{2.5}$ to 2.7±0.41 µm and a slope of 1.32±.03 µm. This shift in the cut-point creates different over sampling problems.

The only way to correct this error is to establish the over sampling errors at different particle sizes including establishing the MMD and GSD of agricultural dusts. The MMD of some agricultural dust (e.g. broiler dust) is as high as 24 (Lacey, et al., 2003) and a GSD of 2.0.

**CAAQES Position:** EPA should allow the correction for errors brought about by performance of FRM samplers under varying PSD's.
Issue #3. The True PM Coarse concentrations must be based upon corrected PM$_{10}$ and PM$_{2.5}$ sampler concentration readings as affected by particles sizes and other associated errors in reporting.

If we can establish the performance of FRM PM$_{10}$ and PM$_{2.5}$ samplers by accounting for those errors and varying sampler performances, then simple differences in the reported concentration would be the true PM coarse concentrations. This value should be much less than 150 µg/m$^3$. EPA may require co-located PM$_{10}$ and PM$_{2.5}$ sampling as well as requiring occasional PSD of ambient dusts for numerous monitoring stations (i.e. providing MMD and GSD) to establish and correct over sampling errors.

CAAQES Position: Once the True PM$_{10}$ and PM$_{2.5}$ concentrations are established based upon corrections due to varying PSD, we may subtract the true concentration values of collocated PM$_{2.5}$ from PM$_{10}$ samplers.

Issue#4 There is an incorrect perception that dust with larger particles settle more readily downwind along the property line.

The popular belief that agricultural dusts having larger particles would settle immediately upon release is incorrect. It has been observed in the field that agricultural dust may travel several miles with limited decrease in particle size based upon its MMD and GSD from Coulter Counter Multisizer data. The problem is especially acute with EPA using the NAAQS as a concentration not-to-be-exceeded at the property line. Limited deposition studies have been reported and dispersion models (e.g. ISCST3) do not account deposition more accurately.

CAAQES Position: A study to investigate the variations in particle size of agricultural dusts as it moves from the source to the property line must be conducted.

References:


2. Buser, M. D.; C. B. Parnell, Jr.; R. E. Lacey, B. W. Shaw; B. W. Auvermann. 2001. Inherent biases of PM$_{10}$ and PM$_{2.5}$ samplers based on the interaction of particle size and sampler performance characteristics. ASAE Paper no. 01-1167. American Society of Agricultural Engineers; St Joseph, MI.


