

Measuring Air Quality in Rural Areas

Russell McGee and Saqib Mukhtar*

A research study has found that some equipment used to measure air pollution can overestimate it by as much as 70 percent. The problem occurs when certain equipment is used in atmospheric conditions like those near crop fields and cattle feedyards, and it can lead to unwarranted regulation.

The results of the study can help regulators and agricultural producers to adjust the readings from specific air pollution samplers to enable them to produce accurate results, particularly for air quality near agricultural operations.

Dust and other small particles in the air are called particulate matter (PM). The US Environmental Protection Agency (EPA) regulates particulate matter as a pollutant because it can cause health problems when inhaled.

These particles can be emitted directly into the atmosphere from sources such as combustion engines, or they can form when gases from power plants, industries, and automobiles react in the air.

Particulate matter is measured in micrometers: 1 micrometer is 1 millionth of 1 meter; a meter is about 3.28 feet. The average diameter of a human hair is about 70 micrometers.

PM is regulated in two categories—fine and coarse:

- **Fine PM** is typically found in smoke and



Figure 1. A high-volume particulate matter sampler. Air is pulled through a filter under the rain hood using a vacuum fan at 40 to 60 cubic feet per minute (cfm).



Figure 2. Low-volume PM sampler. The air flow is about 1 cfm.

haze and is generally associated with urban areas. It is 2.5 micrometers and smaller in diameter.

- **Coarse PM** is typically found near roadways and dusty operations. It is between 2.5 and 10 micrometers in diameter. Most particles in rural areas are larger than 10 micrometers.

The federally approved method for determining the total amount of particulate matter suspended in the air is the gravimetric method. Gravimetric samplers collect PM by pulling air through a filter at a specific flow rate. The filter is weighed before and after sampling, and the amount of PM on the filter is calculated and divided by the volume of air sampled.

High-volume samplers (Fig. 1) are used to measure particulates ranging up to 100 μ in

* Assistant Research Scientist, Texas AgriLife Research;
Associate Department Head and Extension Program Leader for Biological and
Agricultural Engineering, Texas AgriLife Extension Service;
The Texas A&M University System



Figure 3. A TEOM 1400 series sampler.

diameter. Low-volume samplers (Fig. 2) can be calibrated to collect a range of particle sizes. Low-volume gravimetric samplers have been used more widely because their filters cost less than those for other samplers.

The EPA has approved an alternative to the gravimetric sampler for measuring particulate matter: It is the tapered element oscillating microbalance (TEOM) sampler (Fig. 3).

Many state air pollution regulatory agencies have installed TEOM monitors at community-oriented monitoring sites. Although the National Ambient Air Quality Standards (NAAQS) were implemented to set air quality standards for a given area, many states require that PM sources maintain emissions at or below the NAAQS at their own property line. Monitors may be placed along property lines for permit enforcement.

The two types of samplers were the focus of a 2-year study conducted by Texas A&M University System researchers. The study was funded by Texas AgriLife Research and the US Department of Agriculture's National Institute of Food and Agriculture.

The samplers were used to measure particulate matter concentrations near cattle feedyards. The study found very little differences between the results from TEOM and gravimetric samplers when the PM concentrations were low.

However, the results differed dramatically when PM was measured downwind of a site where the concentrations were more than 100 micrograms per cubic meter and the average particle diameter was larger than 10 micrometers. Under those conditions, the TEOM sampler's measurements were 70 percent higher than those found by the gravimetric sampler.

Accordingly, when the concentration of particulate matter is high, TEOM measurements of large-diameter particulates should be adjusted to prevent improper regulation of the emissions source. The TEOM measurements made outside the design limitations for the instrument must be corrected to prevent improper regulation. More research is needed to continue to study the variation of TEOM measurements in varying environmental and physical conditions.

Reference

Vanderlick, F., R. McGee, C. Parnell Jr., B. Auvermann, B. Lambeth, and S. Skloss. 2008. *Comparison of TEOM and Gravimetric Methods of Measuring PM Concentrations*. Center for Agricultural Air Quality Engineering and Science, Texas A&M University. College Station, TX.

Produced by Texas A&M AgriLife Communications
Extension publications can be found on the Web at AgriLifeBookstore.org

Visit the Texas AgriLife Extension Service at AgriLifeExtension.tamu.edu

Educational programs of the Texas AgriLife Extension Service are open to all people without regard to race, color, sex, disability, religion, age, or national origin.

Issued in furtherance of Cooperative Extension Work in Agriculture and Home Economics, Acts of Congress of May 8, 1914, as amended, and June 30, 1914, in cooperation with the United States Department of Agriculture. Edward G. Smith, Director, Texas AgriLife Extension Service, The Texas A&M University System.

New