Generating and Measuring Dust in the Laboratory from Field Samples

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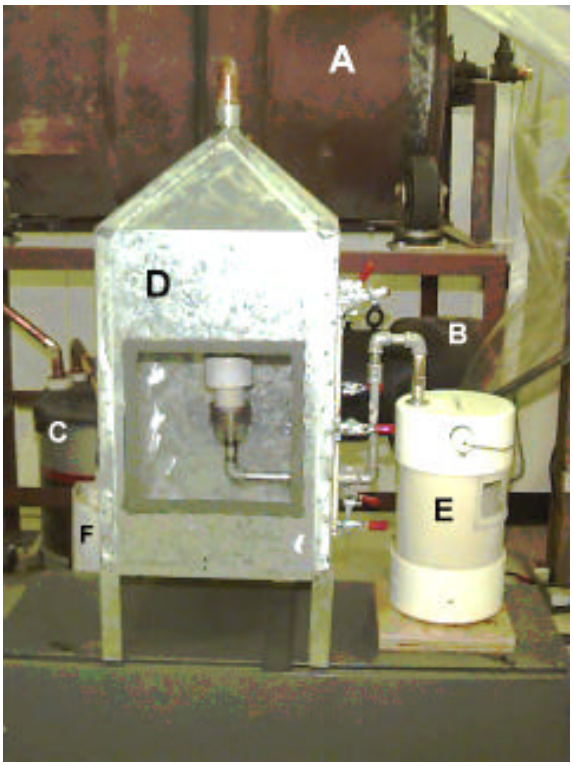

Figure 1. The rotating barrel (A) is controlled by a motor (B) to impart a specific kinetic energy to the soil sample placed inside it. Airflow provided by a vacuum (C) circulates the dust through the system, settling into a sampling chamber (D: Figure 2) where fine particles are collected into a PM_{10} sampler (E). Airflow exits the bottom of the settling chamber, and returns to the vacuum after passing through a cyclone separator (F) which collects coarse material.

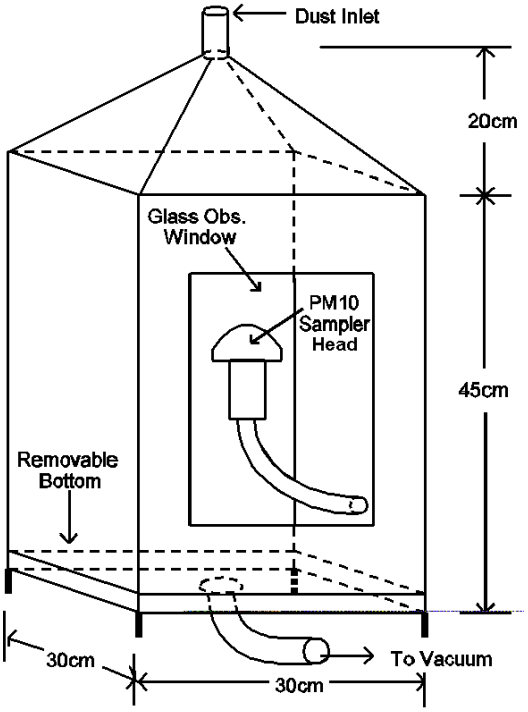

Figure 2. Airborne particles generated from the sample enter through a small conduit at top into a much larger area, where they settle and the fine aerosols are collected on 47-mm diameter poly-carbonate filters in the PM_{10} sampler; the filters can be archived and analyzed chemically and physically. Airflow returns towards the vacuum from the bottom of the settling chamber.

Dust can be transported great distances by the wind. The dust that we breathe and the dust that is trapped in airborne particle samplers may be composed of materials originating from many different sources- some generated locally, and some generated from different sites far upwind. It is important to measure dust generation and transport in the field, but careful and quantitative characterization of the amount and physical/chemical nature of the airborne particles generated by a given surface (for example, a particular soil or type of unpaved road) is difficult to control, time-consuming, and often impractical under field conditions of wind erosion. In order to determine the specific physical and chemical characteristics of dust that derives from a specific location with a specific soil type, cropping, and/or land use pattern, a sample snatched from the atmosphere may be inappropriate and difficult to properly obtain. It is also not sufficient to simply analyze a bulk soil sample taken from a given location, since a bulk sample will contain many grains that are too large to become suspended by the wind.

We have developed a laboratory system (Figure 1) to generate a dust sample by suspending only the fine particles contained within a bulk soil sample, in a closed, controlled system that eliminates contamination from other dust sources, and with energy parameters that simulate the natural dust (re)suspension process. Its main components consist of a controlled-energy rotating-barrel dust generator (described by Singh *et al*., 1994), aerosol settling/sampling chamber (Figure 2), PM_{10} sampling system, and vacuum/forced air supply which circulates the material.

Reference: Singh, U.B., Gregory, J.M., Wilson, G.R., and Zobeck, T.M., 1994. Dust emission from a controlled energy environment. Annual Meeting Paper No. 944041, American Society of Agricultural Engineers, St. Joseph, Michigan.