

## Response of the DustTrak DRX to Aerosols of Different Materials

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The DustTrak DRX is a real-time monitor for size segregated aerosol mass concentrations. It combines photometry with single particle sizing to measure  $PM_1$ ,  $PM_{2.5}$ ,  $PM_4$  and  $PM_{10}$ . Since this instrument works on the principle of light scattering, its response depends on aerosol properties, such as particle shape, refractive index, size distribution and density. In this paper, we report the results from four sets of experiments using the DRX to measure different aerosols. Its comparison with a photometer and an optical particle counter (OPC) will be discussed, and its advantages and limitations will be addressed.

The first experiment investigates the DRX photometric response to different aerosols. The DRX was challenged with ultrafine Arizona Road Dust (A1 dust), ammonium sulfate, sodium chloride and Emery oil. The result showed that the DRX photometric response for unit aerosol mass is approximately inversely proportional to the particle density for the aerosols investigated.

The second experiment uses the DRX to measure four different aerosols: ultrafine Arizona Road Dust, coarse Arizona Road Dust (A4 dust), hematite and petroleum coke. The result showed that when the aerosol under measurement is different from the calibration aerosol, the DRX could not predict mass concentrations accurately. This experiment also showed that once calibrated with the aerosol of interest, the DRX can measure mass concentrations quite accurately. An example comparison between the DRX and the Tapered Element Oscillating Microbalance (TEOM) for measuring the light absorbing petroleum coke is shown in Figure 1.

The third experiment compares the DRX with a simple photometer, the TSI DustTrak 8520, for their sensitivities to size distribution change. Both instruments were calibrated with A1 dust. Then they were used to measure A4 dusts. It was shown that the DRX underestimated  $PM_{10}$  concentration by 7%, while the DustTrak 8520 underestimated 31%. Therefore the DRX  $PM_{10}$  measurement is less sensitive to size distribution change than a photometer due to its single particle measurement feature.

The fourth experiment compares the DRX with the TSI 8220 OPC for measuring monodisperse Emery oil particles at various concentrations. The result showed that while the OPC can accurately

measure very low concentrations ( $<0.1 \mu\text{g}/\text{m}^3$ ), it suffered coincidence losses at relatively low concentrations ( $\sim 10 \mu\text{g}/\text{m}^3$ ). On the other hand, the DRX was not so accurate at very low concentrations ( $<1 \mu\text{g}/\text{m}^3$ ) due to low signal-to-noise ratio, it can measure high concentrations without coincidence losses. Therefore the DRX is suitable for dusty environments.

In summary, we measured the DustTrak DRX response to different aerosols. It is shown that the DRX could not accurately measure mass concentration if the aerosol of interest is different from the calibration aerosol. However, once calibrated with the measurement aerosol, the DRX can measure size segregated mass concentrations quite accurately. Comparing to a simple photometer, the DRX not only provides particle size information, but also is more accurate for  $PM_{10}$  measurement and less sensitive to particle size distribution shift. Comparing an OPC, the DRX can measure higher concentrations, and is more suitable to dusty environment.

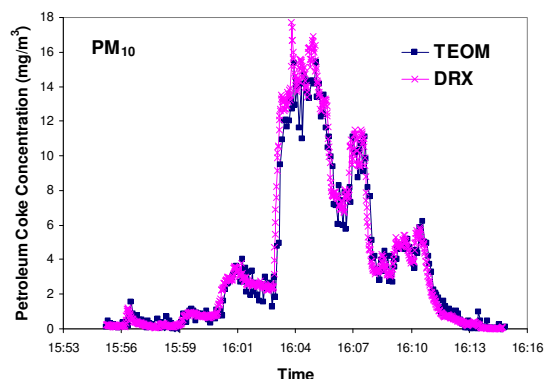


Figure 1.  $PM_{10}$  mass concentrations of petroleum coke dust measured by TEOM and DRX. The TEOM had a  $PM_{10}$  impactor on its inlet, while the DRX did not have an impactor. The DRX simultaneously measured  $PM_1$ ,  $PM_{2.5}$ ,  $PM_4$ ,  $PM_{10}$  and TPM. Only  $PM_{10}$  is plotted for the sake of clarity.