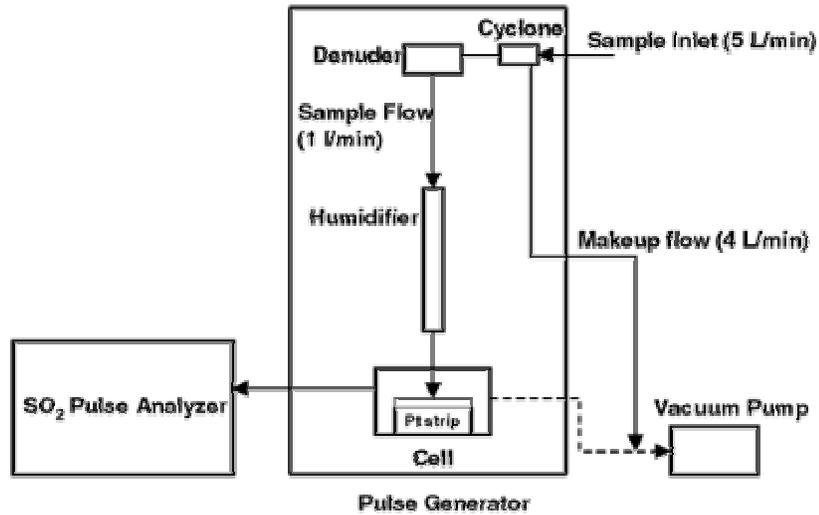


R&P Ambient Particulate Sulfate Monitor (8400S)



- Design of a 8400S Ambient Particulate Sulfate Monitor (manufactured by Rupprecht and Patashnick Co., Inc.) is very similar a prototype nitrate monitor described in (Stolzenburg, M.R., Hering, S.V., 2000. A New Method for the Automated Measurement of Atmospheric Fine Particle Nitrate. *Environmental Science and Technology*, 34, 907-914).
- The 8400S consists of a Pulse Generator, where sample conditioning, collection and flash vaporization takes place, and a SO₂ Pulse Analyzer (API Inc. Model 100A), where sulfur oxides evolved from flash vaporization and sulfate reduction are quantified.
- Solid state temperature sensor is used to measure the ambient temperature.
- Inlet consists of a raincap, PM-2.5 sharp-cut cyclone and an activated carbon denuder
- Ambient air is drawn through the cyclone at 5 l min⁻¹. This flow is split into a 1 l min⁻¹ sample flow for sulfate analysis, and a makeup flow.
- The sample flow passes through a honeycomb activated carbon denuder to remove potential gaseous interferences, and then through a Nafion humidifier, where the humidity of the sample air stream is raised to greater than 90%.
- Wetted particles are collected by impaction onto a Platinum flashing strip, which is mounted in a collection and vaporization cell.



- A full operational cycle of the instrument (typically 10-minutes long, but adjustable by the user) consists of a sampling and analysis periods. For Summer 2001 and Summer 2002 campaigns, the sampling period was 485 sec.
- During the analysis period the sample flow bypasses the collection cell and the cell is purged with 99.9% clean air from a cylinder. The air flows through the cell and into the Pulse Analyzer, yielding a baseline signal value. The strip with collected material is then heated by an electric current (~ 100 Amperes) from a battery, until an infrared cutoff is reached. Typical heating times are 10-14 msec. Collected particulate matter is flash-volatilized. Sulfate is reduced, and evolved SO_2 is carried into the Pulse Analyzer.
- The SO_2 signal from the gas analyzer is integrated and converted to the mass concentration of particulate sulfate, using the pressure, temperature, sample time, sample flow, conversion factors and the baseline signal. The mass concentration of particulate sulfate, as well as the parameters needed to calculate the sulfate concentrations are stored in an internal 8400S data logger.
- Data post-processing included corrections for the aqueous calibration, analyzer audit results and dynamic filter blank measurements.
- The instrument performed an audit of the gas analyzer every other day, using a 0.750 ppm (Summer 2001, Queens College and Summer 2002, Whiteface Mountain campaigns) and 1.068 ppm (Winter 2004 campaign, Queens College) standard SO_2 gas (*Scott-Marrin*) from a cylinder.
- The complete system was calibrated manually with aqueous standards, which were applied directly to the Platinum strip with a microliter syringe. An aqueous solution of ammonium sulfate was used for the calibrations (300 ng SO_4 / 1 μL solution). The calibration solution also contained oxalic acid. Scheduled aqueous calibrations were performed bi-weekly (Summer 2001 campaign, Queens College) or weekly (Summer 2002 campaign, Whiteface Mountain and Winter 2004, Queens College). Unscheduled calibrations were performed after each strip replacement. The resulting values of the “coefficient of theoretical conversion” were used for calculation of the particulate sulfate mass concentration.
- Dynamic filter blanks were measured by placing a Teflon (Summer 2001 campaign, Queens College), and Nylon (Summer 2002 campaign, Whiteface Mountain) filter between the cyclone and the carbon



denuder. During Winter 2004 campaign (Queens College) several types of filters (Teflon, Nylon, Zefluor, HEPA, HEPA + Na₂CO₃ denuder) were used to measure blanks (not simultaneously). An average filter blank (calculated excluding obvious outliers) for the whole campaign was used for data adjustments.

- Operational parameters of the 8400S were checked daily.

