AIRBORNE PARTICLES
Continuous monitoring

Airborne particles
A wide range of processes produce airborne particles, both naturally and as a result of human activity. In South East Queensland bushfires, hazard-reduction burning in forests and the combustion of fossil fuels (for example power stations and motor vehicles) are the major contributors.

Scientific evidence has increasingly linked airborne particles to health effects and, while the respiratory tract can deal adequately with normal airborne particle loads without any long-term effect, they may cause concern when concentrations or exposure times become excessive, or the chemical nature of the particles causes physiological effects.

Smaller particles of less than 10 micron (µm) (PM$_{10}$) or less than 2.5 µm (PM$_{2.5}$) in diameter pose the greater hazard to human health because they are not removed in the upper respiratory tract.

The measurement of particulate matter
Until relatively recently the measurement of PM$_{10}$ particulate matter has been carried out using a high-volume air sampler drawing air through a size-selective inlet, providing a 24-hour average concentration with sampling taking place at six-day intervals.

Now continuous monitoring methods are available and have the advantage of providing more comprehensive information, particularly on shorter-term particle concentrations, and the time of day that these peak concentrations occurred.

The advantage of continuous monitoring
The graph (at left) compares the data collected from a high-volume air sampler and a continuous measurement sampler in Gladstone in October 2002 when the region experienced both a major dust storm and bushfire events. Had only high-volume air samplers been operating, these events would have been missed.

Continuous data may also be used in conjunction with meteorological data to help identify the source of the particles.

How does it work?
The department’s continuous measurement equipment uses a tapered element oscillating microbalance (TEOM) technique that calculates the mass of particles collected on a filter by monitoring the corresponding frequency changes of a vibrating tapered element.

Sample air is drawn into the instrument through an inlet designed to allow only particles of PM$_{10}$ or less to pass through. The air stream is split so that a portion of the sample is directed to the sensor unit while the remainder is sent to exhaust.

The sensor unit consists of a replaceable teflon-coated glass filter cartridge mounted at the tip of a tapered glass tube. This tube (the tapered element) is fixed at the base, while the tip is free to vibrate at its natural frequency.

Electronic circuitry senses and maintains the vibration at constant amplitude. Instrument temperatures and flow rates are strictly maintained, and readings smoothed electronically to reduce noise.

As particles accumulate on the filter cartridge, the natural frequency of oscillation of the tube decreases. The mass rate is computed from the direct relationship that exists between the glass tube's change in frequency and the mass on the filter. This mass rate is divided by the total flow rate through the inlet to provide a continuous output of the mass concentration of particles in the air.

For more information about air quality in Queensland, visit <http://www.qld.gov.au/environment/pollution/monitoring/air> or email: <air.sciences@dsiti.qld.gov.au>