Going from PM10 towards the nano scale

Measuring particle mass, surface and number concentrations

Airborne particles have been identified already decades ago to be a form of air pollution that induces serious adverse health effects. Therefore governmental authorities started to regulate allowable levels of particulate pollution in the 1970's. These regulations focused on inhalable particles with a size smaller than 10 micron as a result of which the standard became known as the PM10 standard (Particulate Matter smaller than 10 micron). Because the only detection method available in the 1970's was the gravimetric method, the PM10 standard is mass based.

More recent epidemiological studies showed that the smaller fraction of the inhalable particles plays a significant role in the adverse health effects, and around the year 2000 a new standard for particles smaller than 2.5 micron (PM2.5) was set up. Also this standard is based on gravimetric measurements. In the mean time the measurement technology developed resulting in the availability of online measuring gravimetric equipment like the tapered element oscillating microbalance (TEOM).

Nowadays an increasing number of scientific studies is pointing at the role of even smaller particles, especially those at the nano scale (smaller than 100's of nanometers). Due to their size these ultrafine particles end up in the deepest parts of the lungs and are even small enough to enter the blood stream.

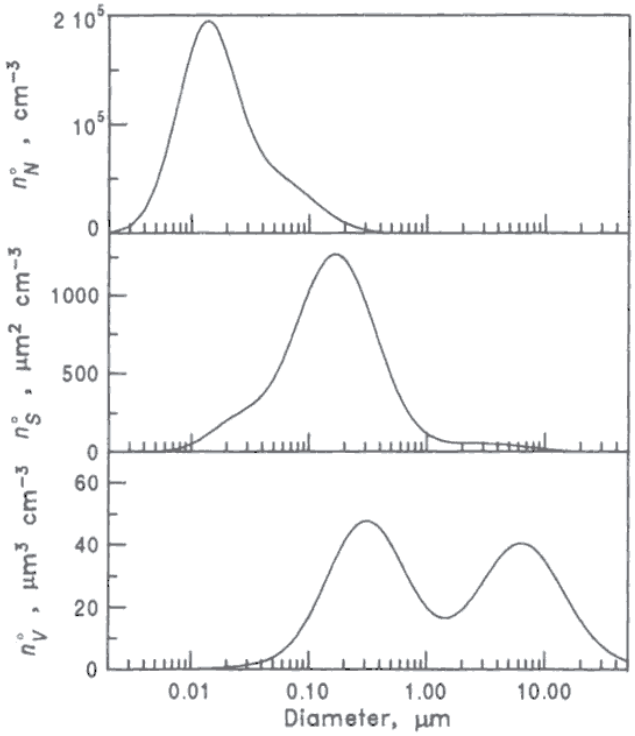

Figure 1 Number, surface and volume/mass weighted particle distributions in an (example) urban aerosol (from "Atmospheric Physics and Chemistry", Seinfeld and Pandis, 1998)

Using traditional gravimetric methods to measure airborne particles at the nano scale is a problem however. As the bottom graph of figure 1 clearly depicts, the sensitivity of a mass based measurement for nano particles is very low. Because of their small volume they are not contributing any mass. On the other hand, as the two other graphs show, number concentration and surface concentration measurement are very sensitive at the nano scale – and vice versa not at the coarse particle scale.

Furthermore, epidemiologists and toxicologists are discovering that number and surface concentration associate better with health effects than mass concentration. See for example *Respiratory effects are associated with the number of ultrafine particles, Peters et al, 1997.* The common believe is now that while gravimetric measurements of coarse and fine particles (PM10 and PM2.5) are still completely valid, a new standard, based on a number concentration measurement will arise. With the NanoTracer Philips offers the technology for this next step in air pollution control. It measures not only the number concentration of particles at the nano scale, but also determines the average particle size giving a better understanding of both health effects and particle sources.