Continuous Ambient Mass Monitoring System CAMMS

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Environmental Monitoring
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new Continuous Ambient Mass Monitoring System PM-2.5 : CAMMS

The CAMM System is used for continuous measurement of the mass concentration (µg/m³) of suspended particulate matter smaller than PM2.5 microns in the air. Public air quality networks can use it for continuous measurement / surveillance of the pollutant component suspended particulate. The CAMM System is operating at ambient temperature. That prevents from loosing volatile particles with high vapor pressure. To avoid humidity effects the measurement air is dried by a diffusion membrane.

The CAMM System uses the simple fact that a filter loaded with dust increases its pressure drop in the air stream. Two virtual impactors linearize the particulate size dependence up to 2.5 microns.

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CAMM System features:

- new technology: first continuous on-line monitor working at ambient conditions
- no lost of volatile particles caused by short sample intervals and no heater required
- low detection limit, high accuracy and very good resolution
- accurate mechanical operation
- control and data exchange over 2 serial interfaces possible
- well considerated status management
- Storage of half average concentrations over 2 years (opt.)
- operating air flow rate at the inlet or norm m^3/h
- two serial interfaces for simultaneous connection of the network connector and a printer or maintenance - PC.
- the following languages set up for the menu and LCD/Soft-Keys are possible: German, English (optional: French, Italian, Spanish).
- built-in diagnostics and status storage for quality ensured measurement.
- Processor controlled calibration of all sensors.

Principle of Operation

When dust is sampled on a filter tape, the flow resistance is increasing because the filter is blocked by the dust particles. If the particles are monodispersive, the increasing of the flow resistance is linear to the mass loading up to a certain value.
To compensate the effect of diameter dependence of the pressure drop response two Virtual Impactor stages are inserted.
In a „real“ impactor the air stream is curved at a plate and particles with larger than a certain aerodynamic diameter, the cutpoint, impact on that plate. A Virtual Impactor has a second outlet instead of a impactor plate.

The major flow (80 %) goes out in the horizontal outlet. The remaining 20 % of the incoming air flows straight through the Virtual Impactor. Instead of sticking on the impactor plate larger particles do not follow the curvature of the major air stream but they pass the orifice and reach the vertical outlet.
The fine particles are not touched by the mechanism of the Virtual Impaction and so 20 % of the fine particles appear at the vertical outlet.
The result is: The number of coarse particles on the filter is the same as at the Virtual Impactor inlet. The number of finer particles is reduced in a way, that the sensitivity of the filter tape now is linear with the diameter of the particles. The higher sensitivity of the filter tape on smaller particles is equalized by a reduction of their number.
To get a real linear behavior two stages are necessary.
The so preconditioned air stream passes a diffusion dryer. Because only 36 l/h are left, the dryer can be a simple and small one. The reached relative humidity is 40 % even if the inlet air has 100 % like on rainy days.

Now the air stream is divided into two paths by a flow splitter. It is a isokinetic separation with straight way for the measurement path. The other part is going to the reference path.
If air passes a filter membrane a certain pressure drop occurs. The Flouropore™ filter tape the CAMMS uses has about 10 hPa at 18 l/h and a spot diameter of 6.35 mm. If the air contains dust the particulates are kept by the filter. If the filter surface is small and the dust concentration high enough, after a certain time the pressure drop is noticeably higher, in the CAMM System about 1 hPa for 500 µg of dust.
Because the pressure drop is highly sensitive to all variations of operating conditions like temperature or flow variation the system has two paths. One measurement path and a reference path. In the measurement path the air goes immediately through the measurement filter. The filter is blocked by the sampled dust and the pressure drop through the filter is increasing. In the reference path in front of the filter spot the dust is sampled by a low pressure drop HEPA-filter. For symmetry reasons one is also included after the measurement filter spot

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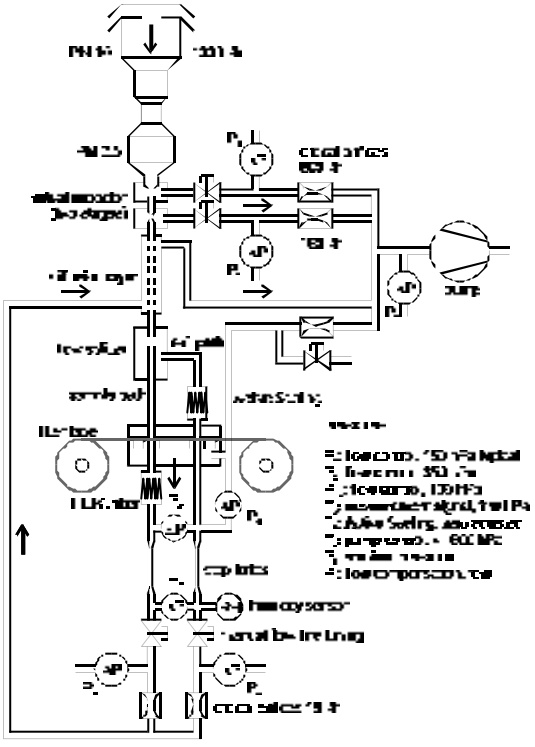

Principle of the CAMMS

The measurement is performed by a highly sensitive pressure transducer that measures the differential pressure between measurement path and reference path below the filter spots (P_5). If dust is sampled by the system, the differential pressure is increasing. Other influences to the pressure drop of the measurement filter spot also concerns to the reference filter spot. So the differential pressure between the two paths is not affected.
After the two filter spots a capillary in each path makes a little pressure drop. A second sensor of equal specification is added also to measure the differential pressure between the paths (P_9). If there is any flow fluctuation in one path (asymmetric!) not caused by the blocked measurement filter, with the pressure signal (P_9) a flow compensation value can be calculated.