

## Passive sampler for airborne particulate matter

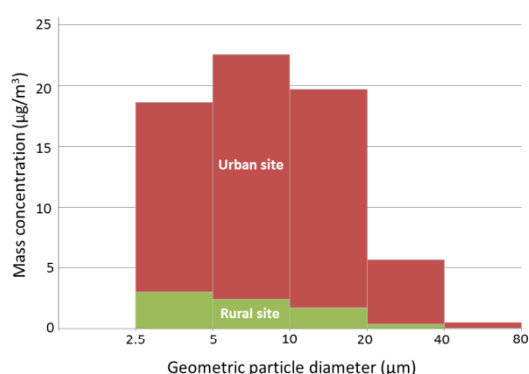
Particulate matter (PM<sub>10</sub>) is a complex mixture:

- Primary particles emitted directly as a result of combustion processes (e.g. diesel engines, wood-fired heating systems), produced by abrasion of tyres, brakes or road surfacing and resuspension, or originating from natural sources.
- Secondary particles formed in the air from gaseous precursor pollutants (sulphur dioxide, nitrogen oxides, ammonia, volatile organic compounds).

This cocktail of pollutants comprises a wide range of chemical compounds, some of them carcinogenic, e.g. diesel soot. It causes local inflammation in the respiratory tract and may thus result in serious effects on health.

The grain-size distribution of particulate airborne pollutants can differ depending on their source. The problem with performing passive sampling is that each particle size has its own diffusion coefficient which, unlike that of gaseous substances, is not well known. [zd1]

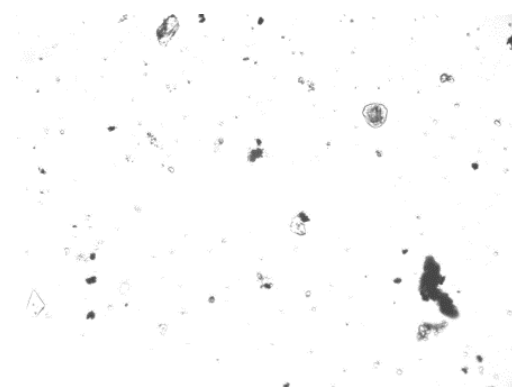
The special design of the Sigma-2 technique achieves impaction of the particle sizes by means of sedimentation in the 2.5 µm to 100 µm range. The particles are fixed on an adhesive plate and subsequently subjected to microscopic image analysis. The result of this analysis shows the grain-size distribution; together with the number of particles counted, an approximate PM<sub>10</sub> value can then be calculated.



Grain-size distribution of two contrasting sites

The benefits of this kind of passive measurement of particulate matter are as follows:

- Indicative measurements of PM<sub>10</sub> not only at a single measurement site; wide-area statements are also possible.
- Combination with other regulated pollutants such as NO<sub>2</sub>, ozone etc.
- Qualitative characterization of particles and allocation to specific sources.



Particle characterisation for source allocation

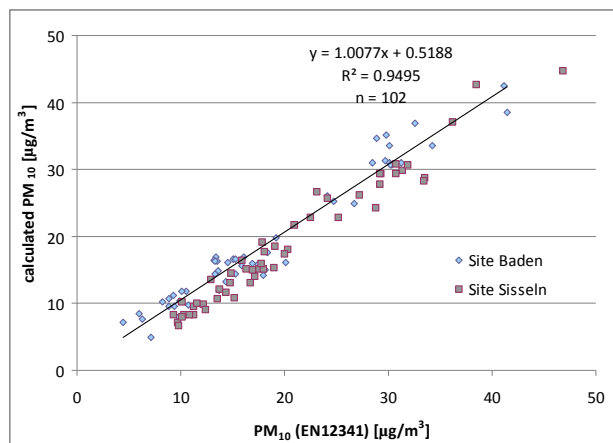
The particulate matter sampler comprises a sedimentation tube fitted with a protective cap with a diameter of 105 mm. The bottom of the tube rests on a sampling plate that can be swivelled out to enable samples to be replaced, while the top of the tube is covered by a fitted protective cap with a diameter of 155 mm.



SIGMA-2 sampler for particulate matter and adhesive plate inside the sampler

There are four air-inlet windows measuring 37 mm x 77 mm, all at the same height, in both the upper part of the coarse particulate matter sampler and in the protective cap. The windows are positioned radially at an angle of 45° to one another. All parts are made of anodized aluminium. The sampling system can additionally be combined with other passive samplers.

## Specifications



PMC<sub>tr</sub> : Particle matter coarse de la fraction transparente (2.5 – 10 µm diamètre géométrique)

$$PM_{10} = k_{PM2.5} (PMC_{tr} \cdot k_{tr} + PMC_{op} \cdot k_{op})$$

PMC<sub>tr</sub> : Particulate matter coarse of transparent particles (2.5 – 20 µm geometric diameter)

PMC<sub>op</sub> : Particulate matter coarse of opaque particles (2.5 – 20 µm geometric diameter)

K<sub>PM2.5</sub> : Correction factor for PM2.5

k<sub>tr</sub> : Conversion factor of geometric diameter into aerodynamic diameter for the transparent fraction

k<sub>op</sub> : Conversion factor of geometric diameter into aerodynamic diameter for the opaque fraction

Calculated sampling rate	Depending on grain-size distribution	
Measurement range	1 - 500 µg/m <sup>3</sup>	
Exposure time	0 - 25 µg/m <sup>3</sup>	2 weeks
	25 - 50 µg/m <sup>3</sup>	1 week
Detection limit	0.12 µg/m <sup>3</sup> for a measurement time of 7 days [1]	
Climatic effects:		
Wind speed	Wind influence < 10% up to 4.5 m/sec	
Temperature	No influence between -30°C and 40°C	
Humidity	No influence under non-condensing conditions	
Shelf life	Before use:	12 months
	After exposure:	3 months
Cross-sensitivities	None	
Measurement uncertainty	18 % in the 15 µg/m <sup>3</sup> range [1]	
Weight of collection device	800 g	

Revised 14.4.2014

## Literature

[1] VDI 2119:2013: Passive Probenahme mit einem Grobstaubsammler zur Charakterisierung von Einzelpartikeln und Berechnung der grössenfraktionierten Massenkonzentration

[2] Swiss study in the Canton of Aargau, report

# passam ag

Environmental Analytics

Schellenstrasse 44, CH-8708 Männedorf,

phone +41 44 920 46 44,

Fax +41 44 920 24 97

e-mail [passam@passam.ch](mailto:passam@passam.ch)