Particulate Matter

Where is it found?

Particles are emitted from a wide range of man-made sources. The most significant are road transport, non-combustion processes, industrial combustion plants and processes, commercial and residential combustion and power plants. Natural sources are less important and include volcanoes and dust storms.

Why is it harmful?

Particles may be seen as ones of the most critical of all pollutants. Particulate matter is the generic term to classify air pollutants comprising of suspended particles in the air. The size, surface, number and composition of particles play an important role in human health effects. The upper respiratory tract is affected by PM_{10} while lung alveoli is affected by ultrafine particles (<0.1 µm diameter).

Particles can cause premature mortality in patients suffering from lung or heart disease, provocate heart attacks, aggravate asthma, reduced lung functionality, irritation in airways, coughing, difficult breathing, etc.

PM sensor

The Particulate Matter sensor consists on an Optical Particle Counter (OPC). To cover different applications, two particle sensors are available:

- **Type A** (specific for Kunak AIR Pro stations): an OPC capable of measuring particles from 0.3 µm up to 40 µm. Then, the PM_1, $PM_{2.5}$, PM_4, PM_{10}, Total Suspended Particles (TSP) and Total Particle Counter (TPC) are calculated assuming a particle density profile. Field co-location studies have shown that the expected field performance is comparable to Palas Fidas 200 equivalent instrument.

- **Type B** (specific for Kunak AIR Lite stations): sensor with a range of measurement from 0.3 µm up to 10 µm. The sensor monitors accurately PM_1 and $PM_{2.5}$ concentration, while the expected error for PM_{10} is higher in presence of coarse particles.

The effect of humidity is perfectly corrected with the embedded algorithm achiving high accuracy at any environmental conditions except under foggy days or condensation, where the data is automatically invalidated by the software KunakCloud. Further calibrations can be applied at a specific site to match the mass concentrations. Also, the particle size distributions are available on Kunak Cloud.

Technical specifications

Type A	
(only for Kunak AIR Pro)	

Type	Optical particle counter	**Limit of Detection (LOD)[7]**	0.5 µg/m³ (PM1) 0.5 µg/m³ (PM2.5) 1 µg/m³ (PM10)
Unit of measurement	µg/m³		
Measurement range[1]	0 - 1,000 µg/m³ (PM1) 0 - 1,500 µg/m³ (PM2.5) 0 - 2,000 µg/m³ (PM10)	**Typical accuracy (MAE)[10]**	± 2 µg/m³ (PM1) ± 3 µg/m³ (PM2.5) ± 4 µg/m³ (PM10)
Resolution[2]	1 µg/m³	**Typical precision R² [10]**	> 0.9 (PM1) > 0.8 (PM2.5) > 0.7 (PM10)
Operating temperature range[3]	-10 to 50 ºC		
Operating RH range[4]	0 to 99 %RH	**Typical slope[10]**	0.85 - 1.18
Recommended RH range[4]	0 to 95 %RH	**Typical intercept (a)[10]**	-1.8 µg/m³ ≤ a ≤ +1.8 µg/m³ (PM1) -2 µg/m³ ≤ a ≤ +2 µg/m³ (PM2.5) -3 µg/m³ ≤ a ≤ +3 µg/m³ (PM10)
Operating life[5]	> 24 months		
Repeteability[8]	2 µg/m³ (PM1) 3 µg/m³ (PM2.5) 5 µg/m³ (PM10)	**DQO - Typical U(exp)[11]**	< 50%
		Typical Intra-model variability[12]	< 2 µg/m³
Response time[9]	< 10 sec		

Type B	
(only for Kunak AIR Lite)	

Type	Optical particle counter
Unit of measurement	µg/m³
Measurement range[1]	0 - 1,000 µg/m³
Resolution[2]	1 µg/m³
Operating temperature range[3]	-10 to 60 ºC
Operating RH range[4]	0 to 99 %RH
Operating life[5]	> 24 months
Response time[9]	< 10 sec

* See notes on page 28