Environmental Monitoring Systems

SPM and Gas Monitoring

Air Quality Monitor
AQM

for Determination of PM_{10} and $PM_{2.5}$
and Gaseous Pollutants
(SO_2, NO_2, O_3, CO)

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Air Quality Monitor AQM

Particulate matter and gas monitor for continuous real-time monitoring of particulate matter ($PM_{2.5}$ and PM_{10}) concentrations and gaseous pollutants

- Real-time monitoring system for $PM_{2.5}$ and PM_{10}
- Parallel measurement of gaseous pollutants (SO_2, NO_2, O_3, CO)
- Photometer and virtual impactor technology
- Advanced semiconductor and electrochemical gas sensors
- Large color touchscreen
- Interfaces: USB, RS-232, mobile communications, LAN, SD card drive
- Localization via GPS
- Remote access for data retrieval and remote control
- Compact lightweight device

The method applied by the AQM uses light scattered by tiny particles (nephelometry) to determine the PM_{10} and $PM_{2.5}$ concentration in the ambient air directly and continuously. After performing a qualification test, TÜV Rheinland certified the procedure as equivalent to the customary gravimetric method. Simultaneously, the AQM monitors gaseous pollutants, using advanced electrochemical and seminconductor gas sensors. All measurement values are shown in the display, and can also be accessed remotely. Additionally, measurement data can be exported via USB or stored on an SD card.

Design

The AQM consists of the following principal components:

- Stainless steel cabinet
- Control unit with touchscreen and interfaces
- Vacuum pump
- Intake tube and impactor inlet
- Virtual impactor
- Scattered light photometer
- 4 gas sensors for SO_2, O_3, NO_2 and CO
- Temperature and humidity sensor
- GPS module for independent localization
- Mobile communications modem (GPRS/3G/4G)

In order to protect the photometer signal against the effects of changing temperatures, the photometer is installed in a thermally insulated, temperature-controlled housing.

Operating Principle

Before measuring begins, the desired parameters (e.g. the desired particulate matter fraction $PM_{2.5}$, PM_{10} or combined) are entered at the color touchscreen or via remote access.

During operation, the device takes in ambient air through a PM_{10} impactor inlet at a volumetric flow rate of 3.3 l/min. The design of the impactor inlet follows the same technical principles as standard inlets for gravimetric measurement methods which are specified in EN 12341:2014; its separation characteristics have been verified by the Institute of Energy and Environmental Technology (IUTA) and surpass the requirements of DIN 481. In the downstream virtual impactor, the aspirated air is separated into an auxiliary (enrichment) stream and a primary (normal) stream. A switching device (peristaltic valve) then diverts one of these two streams to the scattered light photometer. In the photometer, the aerosol is illuminated by a laser. The light scattered by the particles is captured by a photodetector and converted into an amplified output signal. This output signal is a direct measure of the airborne particulate matter concentration. The photometer measures the PM_{10} concentration in the enrichment mode, and the $PM_{2.5}$ concentration in the normal mode.

For zero point adjustment purposes, the photometer is periodically supplied with filtered air by way of the switching device.

The measurement of gaseous pollutants by way of sensor modules is executed simultaneously with SPM (suspended particulate matter) monitoring. Semiconductor sensors determine the concentrations of NO_2, O_3 and CO. The concentration of SO_2 is determined by an electrochemical sensor.

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The sensor modules are located in a separate housing, which is screwed to the main housing. This sensor box, as well as the external temperature and humidity sensor, can by installed separated from the main housing, in case of using the AQM within a measurement container, for example. Interferences of the sensors are computationally compensated on an external server or in the cloud.

All measurement values are shown as absolute values and progressive graph. The device software features an alarm function which indicates the transgression of threshold values specified by the customer for each single measured value.

The captured data is saved in the internal memory and transmitted to the cloud via mobile communications modem. All measurement values are always available in the cloud. Additionally, data export is possible using a USB drive, an SD card or the RS-232 interface. The touch panel or remote access enable updates or system control.

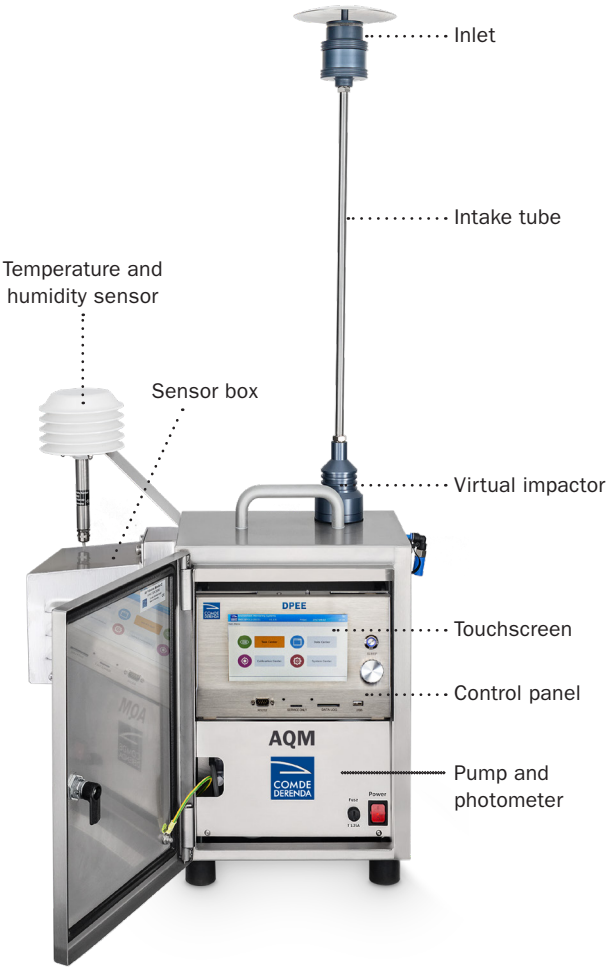
The AQM has a service life of more than 10 years and low maintenance requirements.

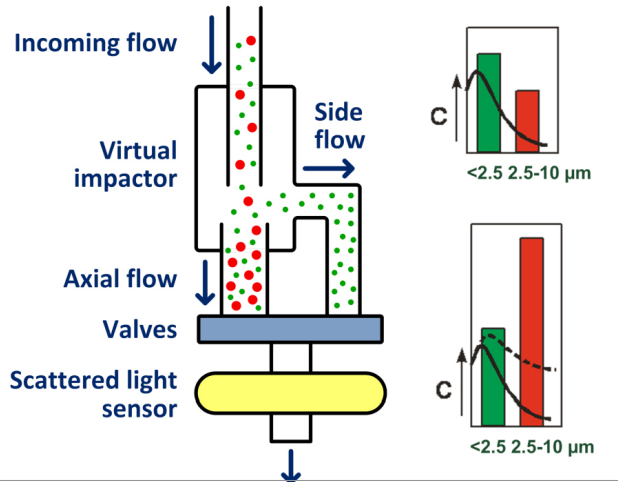
Details of the Measurement Method

A highly sensitive scattered light sensor lies at the heart of the applied method. The light emitted by an intensity-stabilized laser diode illuminates a measuring space defined by the optical path. The light scattered by all the aerosol particles inside this measuring space is captured by a semiconductor photodetector, positioned at an angle of 90°. After amplification, the outcome of this measurement is made available as a voltage signal (0 ... 5 V). The signal is directly proportional to the mass concentration of the aerosol in the measuring space (measuring range 0 ... 1000 µg/m³).

The wavelength of 650 nm applied by the system is most sensitive to particles in the size range from 0.5 to 1 µm. To improve the sensitivity of the coarse fraction PM2.5 to PM10, the AQM uses its virtual impactor, situated upstream of the photometer, which selectively enriches the concentration of the coarse fraction. This enrichment effectively increases the sensitivity of the photometric equipment for the particle size range PM2.5 to PM10.

Design / Operating principle of the virtual impactor





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Air Quality Monitor AQM

Scope of Delivery:
Basis device AQM, intake tube Ø 12 mm,
Sampling inlet PM_{10} for 3.3 l/min,
2 × USB drive, 1 × USB transfer cable,
Calibration protocol,
Key and instruction manual

Ordering Information Consumables:

D100101	Zero air filter
D100101	Photometer outlet filter
D100058	Pump outlet filter
D101247	Bypass filter
D100096	Sinter filter

Technical Data AQM

Volumetric flow rate	3.3 l/min
Measurement duration	Continuous*
Power supply	230 V, 50/60 Hz 110 V, 60 Hz (optional on request)
Power consumption	approx. 100 VA
Connectivity	LAN, USB, RS-232, mobile communications (GPRS/3G/4G), SD card reader

Measurement	
Measuring range SPM	0 ... 1000 µg/m³
Resolution SPM	1 µg/m³
Measuring range SO_2	5 ... 10,000 ppb
Detection limit** SO_2	20 ppb
Resolution SO_2	1 ppb
Measuring range NO_2	10 ... 250 ppb
Detection limit** NO_2	10 ppb
Resolution NO_2	1 ppb
Measuring range O_3	10 ... 250 ppb
Detection limit** O_3	10 ppb
Resolution O_3	1 ppb
Measuring range CO	0.1 ... 80 ppm
Detection limit** CO	0.2 ppm
Resolution CO	0.1 ppm

Dimensions (without inlet, intake tube, temperature and humidity sensor and antenna)	
Width	approx. 330 mm (approx. 500 mm incl. sensor box)
Height	approx. 545 mm (incl. virtual impactor)
Depth	approx. 290 mm (incl. lock)

Weight	approx. 16 kg
IP classification	IP 55
Sound pressure level acc. EN 3744:2010 in 8 m distance	< 19 dB(A)
Operating temperature range	–20 ... +50 °C
Operating humidity range	5 ... 95 % rF

* According to alternating measurement of the two fractions $PM_{2.5}$ and PM_{10} in intervals of at least 2 minutes. Longer intervals can be parameterized. A limitation on one fraction is possible. A zero point calibration (duration 2 minutes) automatically takes place after 60 minutes of measurement.

** Information on detection limit at an averaging time of 10 minutes.

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