Fuji Electric

Innovating Energy Technology

Quantitative measurement of aerosol (PM2.5)

Aerosol Analyzer

< Type: ZSF >

Contributes to inferring PM2.5 formation mechanism and source of PM2.5

FEATURES

1 Simultaneous measurement of 3 components

A combination of light diffusion method, laser-induced incandescence method, and mass spectrometry enables simultaneous measurement of nitrate, sulfate, and black carbon.

2 Real-time monitoring

Takes only 15 minutes for aerosol composition analysis, which used to take more than 8 hours by filter analysis.

3 Quantitative analysis

The particle trap which uses MEMS (Micro Electro Mechanical Systems) technology is highly efficient in collecting PM2.5, enabling quantitative analysis which has been difficult.

4 Easy-to-use touch screen

From the front touch screen you can perform major operations such as indication of measured value and alarms, monitoring of operating status.

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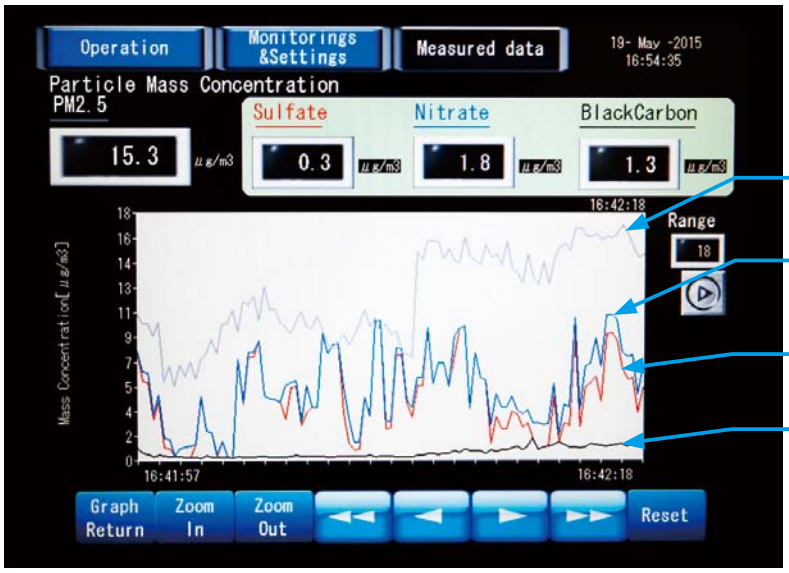
Real-time monitoring

Measurement result screen



Mass concentration of aerosol (PM2.5)

Mass concentration of nitrate in aerosol

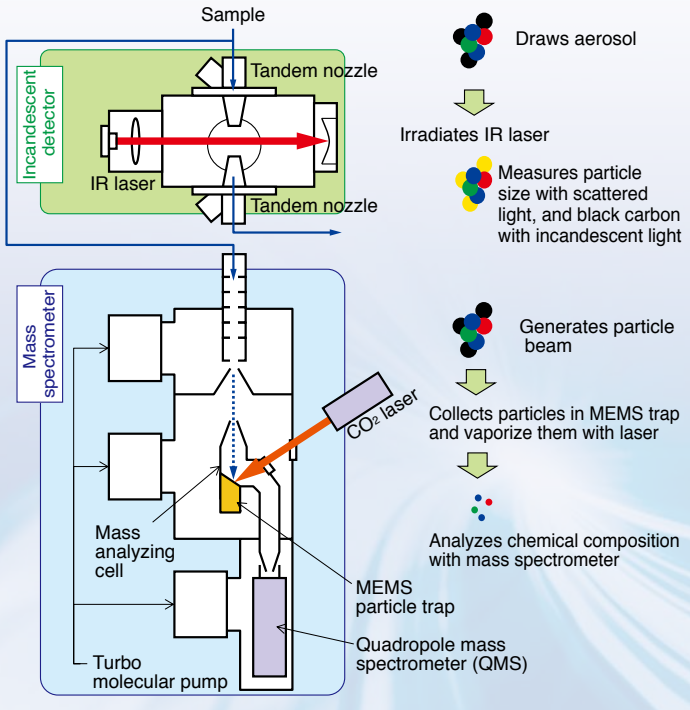
Mass concentration of sulfate in aerosol

Mass concentration of black carbon

Display function

Display type		Touchscreen
Language		English
Operation screens	Operation screen	Mode setting button, incandescent detector calibration button, start button, status indication
	Mass spectrometer status screen	Flow rate monitor, backup pump pressure indication, Vacuum chamber pressure indication, turbo molecular pump operation status, CO_2 laser status
	Incandescent detector status screen	Flow rate setting and monitor, diode laser status, temperature error
	Measurement result screen	•Previous measurements (PM2.5, black carbon, sulfate, and nitrate) •Graph (transition of measured values of each component) •Graph operation (changing time width, moving graph position, specifying mass concentration display range)
Error indication		Incandescent detector : flow rate error, temperature error, error of diode laser setpoint Mass spectrometer : flow rate error, CO_2 laser output setting error, mass spectrometer error, turbo molecular pump error, backup pump pressure error
Data export		USB port Data format: CSV Data: measured values (mass concentration of PM2.5, black carbon, sulfate, and nitrate)

Principle



Aerosol analyzer consists of an incandescent detector and a mass spectrometer.

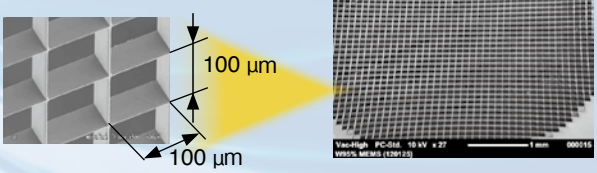
■ Incandescent detector

The incandescent detector measures aerosol (PM2.5) and black carbon.
It irradiates sample air with high-power IR laser, and detects scattered light and incandescent light emitted from particles in the sample air.
Based on the intensity and frequency of the scattered light, the detector analyzes particle size and the number of particles to derive mass concentration of PM2.5.
In the same manner, based on the intensity and frequency of incandescent light, the detector analyzes particle size and the number of black carbon particles to derive mass concentration of black carbon.

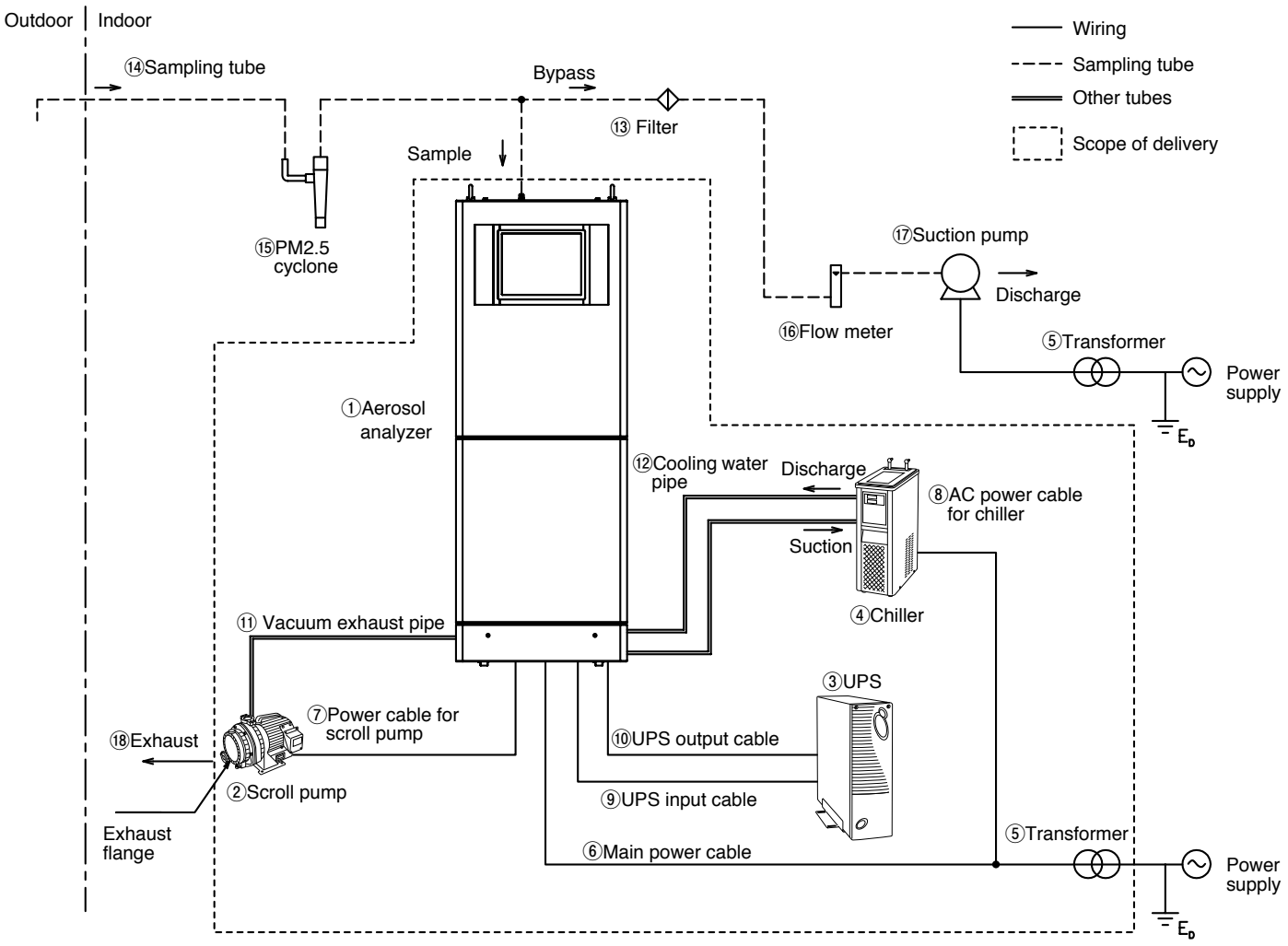
■ Mass spectrometer

Mass spectrometer measures sulfate and nitrate which are ion components of aerosol (PM2.5).
Aerosol particles are drawn into the vacuum area, and then collected in the MEMS particle trap in the mass spectrometer.
The aerosol particles caught in the trap are heated with high-power CO_2 laser until they vaporize. Then, the quadrupole mass spectrometer (QMS) carries out quantitative analysis of sulfate and nitrate.

MEMS particle trap



System configuration diagram



System configuration

Scope of delivery

No.	Name	Q'ty
1	Aerosol analyzer main unit	1
2	Scroll pump	1
3	UPS	1
4	Chiller	1
5	Transformer	1
6	Main power cable	1
7	Power cable for scroll pump	1
8	AC power cable for chiller	1
9	UPS input cable	1
10	UPS output cable	1
11	Vacuum exhaust pipe	1
12	Cooling water pipe	1

Optional Items

No.	Name	Q'ty
13	Filter	1
14	Sampling tube	1 set
15	PM2.5 cyclone	1
16	Flowmeter	1
17	Suction pump	1
18	Exhaust pipe	1

Code symbols

Digit	1	2	3	4	5	6	7	8		9	10	11	12	13
	Z	S	F	1	L	1	1	1	-	1	1	E		A

Digit	Item	SPECIFICATIONS	Code
1 to 3	Base model	–	ZSF
4	Measurement items	Aerosol and black carbon: size distribution, number concentration, mass concentration Sulfate and nitrate: mass concentration	1
5	Measurement range	PM2.5 : 0 to 100 μg/m³, each component : 0 to 30 μg/m³	L
6	Structure	Cubicle type (integrated)	1
7	Environmental resistance	For indoor installation (with air conditioner)	1
8	Revision code	–	1
9	–	–	1
10	–	–	1
11	Language	English	E
12	Power supply voltage	100 V AC, 50/60 Hz	1
		220 V AC, 50Hz	2
13	Interface	4 analog outputs, Ethernet communication, USB memory port, 1 alarm output	A

General specifications

Power supply voltage	100 V AC ±10%, 50/60 Hz ±5% or 220 V AC ±10%, 50 Hz±5%
Power consumption	Approx. 1 kVA (Max. 1.5 kVA)
Ambient temperature	15 to 30°C
Ambient humidity	30 to 75% RH
Dimensions (W x H x D)	640 x 1740 x 828 mm
Weight	Approx. 350 kg
Cubicle structure	Indoor installation (with casters), single-swing front/rear door, panel thickness 1.6 mm SECC
Cubicle finish color	Front cover : silver (dark), Mansell N6.7 equivalent Rear cover and side panels : black, Mansell N1.5 equivalent
Sampling port	Port connector SS-401-PC (Swagelok), on the top surface of the main body
Exhaust port	KF16 flange (scroll pump DIS-90)

Measurement

Target	· Mass concentration of aerosol · Mass concentration of black carbon in aerosol · Mass concentration of sulfate in aerosol · Mass concentration of nitrate in aerosol
Principle	· Light diffusion method : mass concentration of aerosol · Laser-induced incandescence method : mass concentration of black carbon · Quadrupole mass spectrometry : mass concentration of sulfate and nitrate
Measurement range	· Aerosol : 0 to 100 µg/m³ · Black carbon : 0 to 30 µg/m³ · Sulfate : 0 to 30 µg/m³ · Nitrate : 0 to 30 µg/m³
Particle detection range	Light diffusion method : 0.12 to 2.5 µm (aerosol)
Sampling amount	Approx. 2.0 L/min

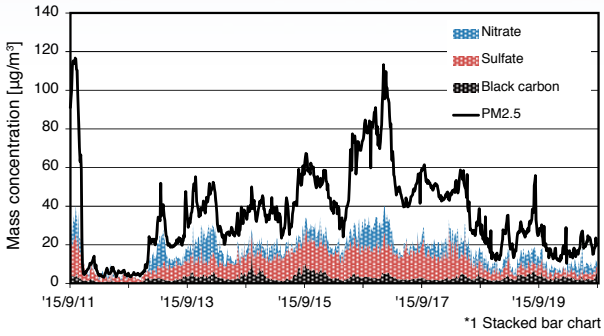
Output signal

Analog output signal	4 points: 4 to 20 mA DC (insulated by photocoupler), allowable load resistance : 600Ω or less ① Mass concentration of aerosol ② Mass concentration of black carbon ③ Mass concentration of sulfate ④ Mass concentration of nitrate
Ethernet communication	· Number of channel : 1 · Interface : 10BASE-T/100BASE-TX · Media control : IEEE802.3u · Interface switching method : autonegotiation · Connector : D-sub9P × 1 · AUTO MD1/MD1X : supported · Transmission protocol : TCP/IP, ICPM, APP · Data type : measured values (mass concentration of aerosol, black carbon, sulfate, and nitrate) Error information
Alarm output	· 1 point · Contact output: Open during error, close during normal · Rated load and rated voltage current: 24 V DC, 2 A

Installation conditions

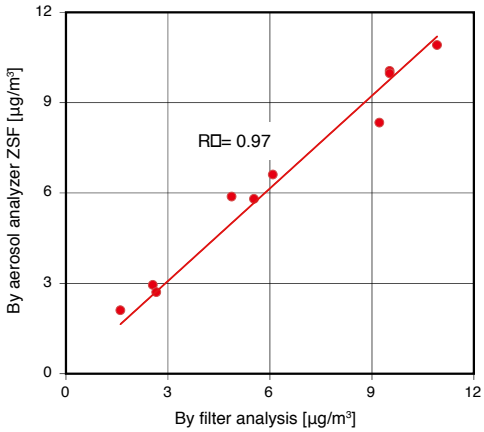
Air-conditioned room where :
- no radiation heat from high-temperature matter
- receives no heavy vibration.
- with clean atmosphere.

Real-time analysis of aerosol composition*1



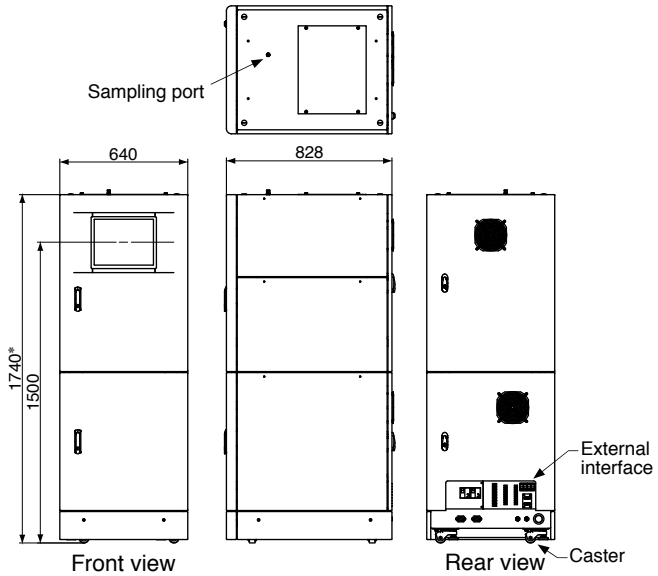
*1 Stacked bar chart

Comparison of daily mean concentration of sulfate measured by ZSF and by filter analysis*2



*2 Conforms to the Federal Reference Method (FRM) defined by the U.S. Environmental Protection Agency (EPA).

OUTLINE DIAGRAM(unit: mm)



*Dimensions of eye bolts are not included.

⚠ Caution on Safety

* Before using products in this catalog, be sure to read their instruction manuals in advance.

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