Dust Measurement
&
SIBATA Products

Sibata Scientific Technology Ltd.

Content

- Conditions of Dust Measurement in Japan
- Mass Concentration Method & SIBATA Products
- Relative Concentration Method & SIBATA Products
- Beta-ray Mass Concentration Method & SIBATA Products
- Q&A

Dust Measurement
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～Conditions of Dust Measurement in Japan～

Items of the Environmental Measurement

- ***Air Environment Measurement***
  - *Dust Measurement*
  - *Gas (Component) Measurement*
  - *Temperature, Humidity, Wind Direction & Speed*
- ***Water Analysis***
- ***Soil Analysis***
- ***Other***
  - *Sound (Noise)*
  - *Vibration*
  - *Illuminance*

etc...

Why do we need Aerosol Measurement?

- ***Risks*** *from Dust exposure*
  - *Harmful effects for Animal and Plant*
  - *Health Damage (Labor, Resident, Neighborhood, Citizen)*
  - *Traffic Disturbance caused by Visibility Degradation*
  - *Decreasing productivity*

- ***Purpose*** *of the Dust Measurement*

  Reducing risks*, which are listed above, by investigating dust variation with time and space, pursuing the cause, taking an action, evaluating, and controlling of maintenance*

  Cause→Action→Evaluation→Maintenance

To perform this procedure, they need measuring instrument which is able to measure a spatial distribution and a time variation with high accuracy.

SIBATA products are well used in Japanese field.

Fields of the Environmental Measurement

- ***Ambient Air***

  Health Effect on human & Weather effect in the open air

- ***Indoor Air Quality (IAQ)***

  Health Effect on human in a building

- ***Industrial Hygiene (Working Environment)***

  Health Effect on human during a production process and a operation process

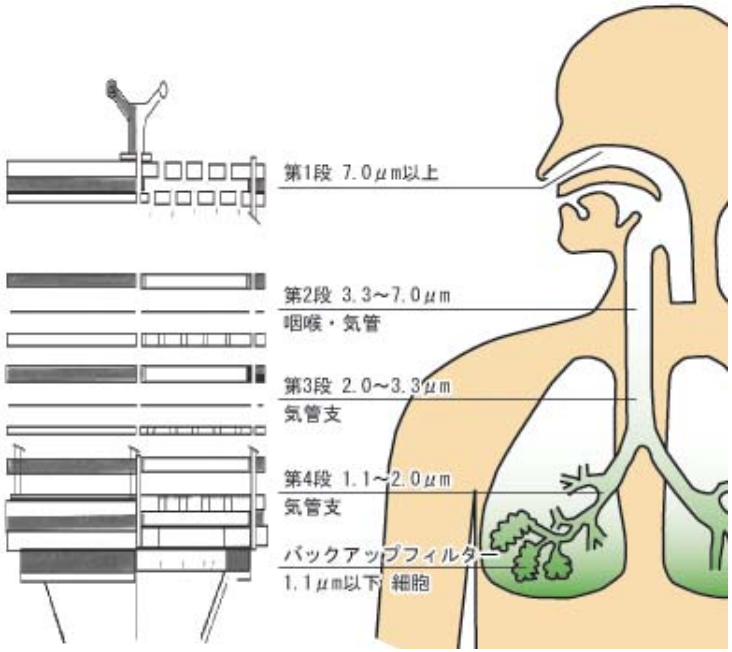
- ***Production Control***

  Effect on products in a semiconductor factory, a pharmaceutical factory, and a food factory

Considering the effects, Regulations and Standard values are set for each item in each field.

Human Impact of Dust depending on Size

- Dust goes into the human body through the respiratory airway system, and has various impacts.
- Most of the tiny particles (0.2～0.3μm, tobacco smoke for example）reach the alveori of the lung.



Suspending Dust endanger the health of People.

Standard of Dust Concentration in Japan

- For the protection of people's health, various regulation state the standard of Dust Concentration.

■Dust Concentration Standard in Japan

Standard related to Suspending Dust	Concentration mg/m3	Size
Building Maintenance Law(Indoor Air Quality)	0.15	10μm100%CUT ＝ＳＰＭ
Health Standard for office in construction site	0.15	10μm100%CUT ＝ＳＰＭ
Workplace Assessment Standard (Work Environment)	2.9	４μm　50%CUT ＝ＰＭ４
Air Pollution Control Law(Ambient Air)	0.1	10μm100%CUT ＝ＳＰＭ

Dust Measurement Method

- ***Mass Concentration Method (Filter Sampling)***

Measure a mass concentration (an absolute value) directly to actually sample dust(particle) on a filter, and weigh the filter

- ***Relative concentration method***

Measuring a relative concentration using a instrument which is able to measure a physical quantity which is one-one relation to a mass concentration of certain dust(sampled particle).

*→Evaluating a relationship between a Relative concentration and a mass concentration (**K factor**) in advance enables to get a mass concentration (an absolute value) with a Relative concentration method (without any filter sampling).*

You will have a result without any filter sampling by the Relative concentration method.

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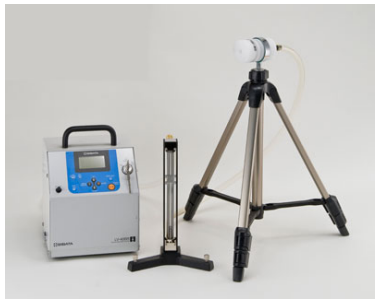
Mass Concentraion Method



Relative Concentraion Method

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～Mass Concentration Method & SIBATA Products～

Mass Concentration Method

Sample suspending dust on a filter using a suction pump, weigh the filter, and divide weight of the sampled dust by mass flow volume to calculate a concentration of suspending dust.

- **Features**
  - Result will be an absolute value by weighing dust on a filter directly.
  - A Basic Method for Dust Measurement

- **Types**

  Types are classified depend on the flow rate.
  - Low Volume Type
  - High Volume Type

Mass Concentration Method

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Low Volume Type

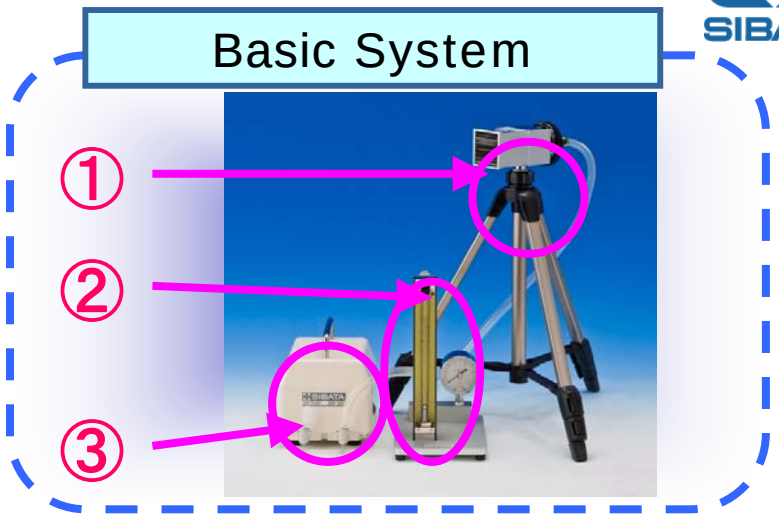
High Volume Type

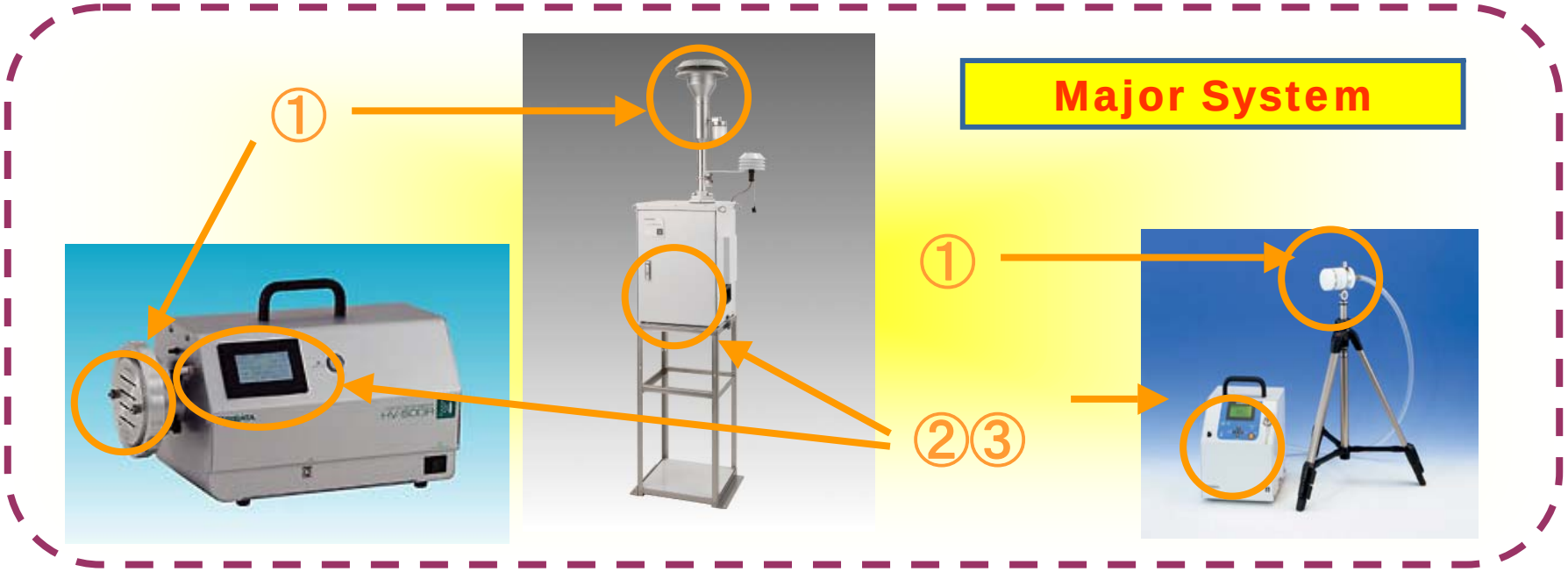
Composition

① Dust Separator

② Flow Meter

③ Suction Pump



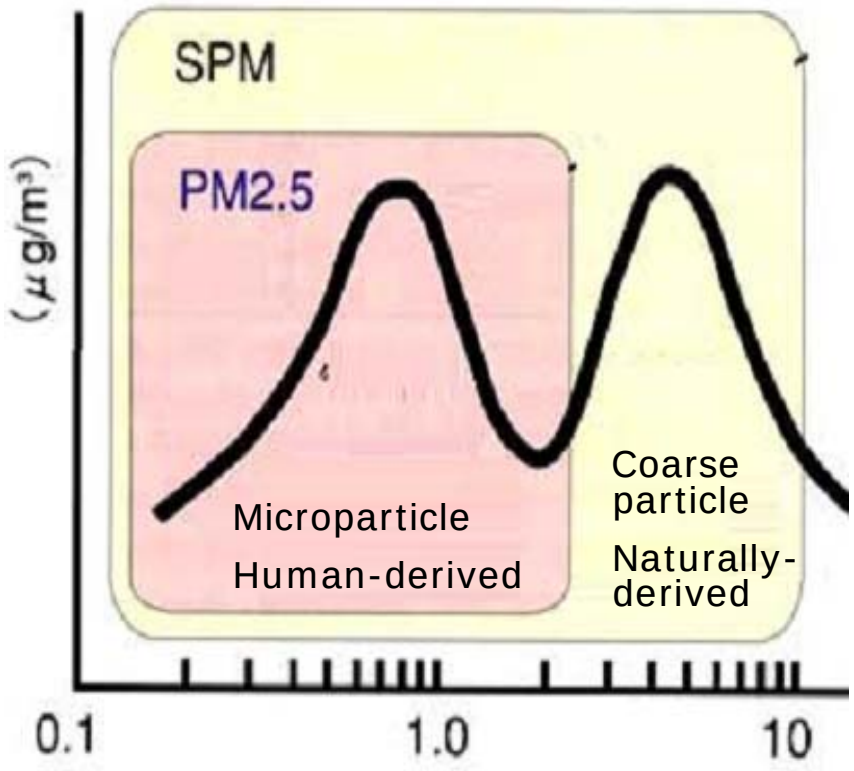


Dust as a Sampling Object

Dust differ in type according to its source, and also differ in Physical Character and Health Effect.

Therefore, Size of Controlled Particle vary depend on Measurement Site.

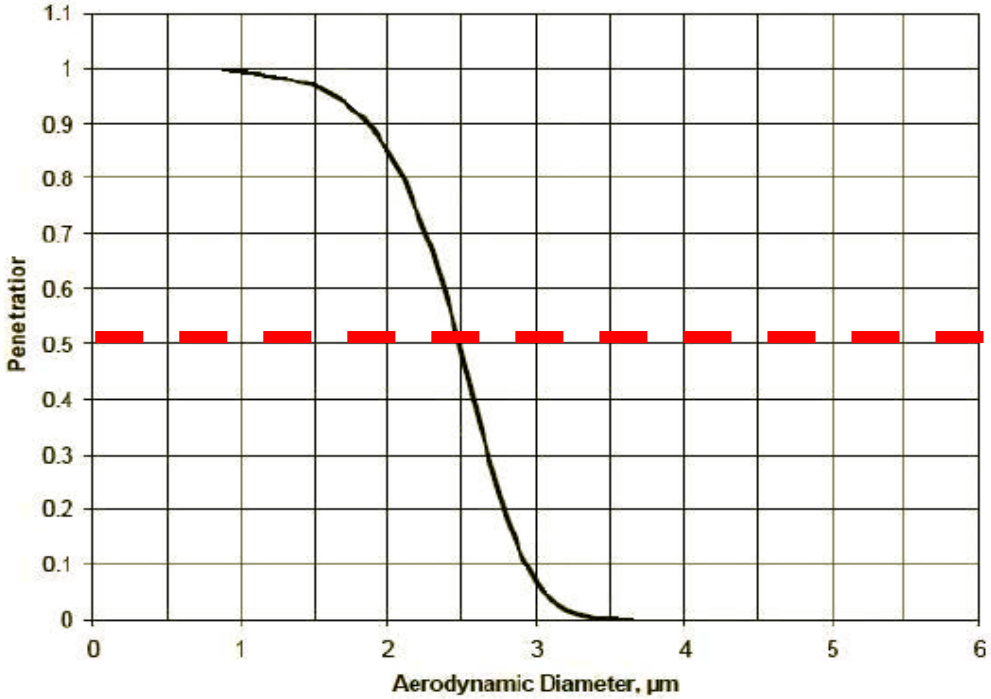
Particle Size Distribution in Ambient Air



Controlled Particle Size in each country

- The particle size at a site, which is considered the most harmful size for human body, will be controlled.
  PM△＝Cut 50% of particle of △μm

Example：PM2.5＝2.5μm50%CUT(USEPA)



Controlled Particle Size in each country

■Controlled Particle Size in each country

Country	Field	Size	Title
Japan	Ambient	10μm 100%CUT 2.5μm 50%CUT	SPM PM2.5※1
	Work Environment	4 μm 50%CUT	PM4
The United States	Ambient	10μm 50%CUT 2.5μm 50%CUT	PM10 PM2.5
	Work Environment	4 μm 50%CUT	PM4
EU	Ambient	10μm 50%CUT 2.5μm 50%CUT	PM10 PM2.5
	Work Environment	4 μm 50%CUT	PM4

※1 : Under Consideration

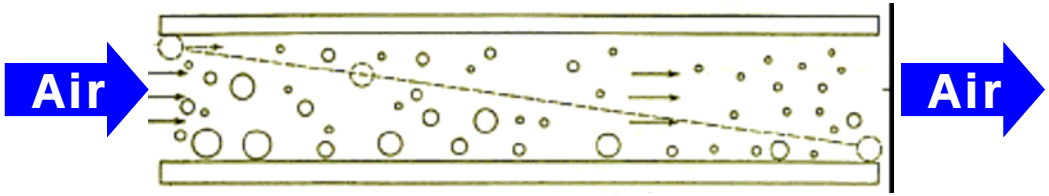
Dust Sampling Method for specified particle size

- Sample the size-specified particle on a filter using Gravity, Inertia force, or Centrifugal force.
  - Multistage Dust Separator ⇒ Gravitational Deposition
  - Impactor type Dust Separator ⇒ Inertia force
  - Cyclone ⇒ Centrifugal force

- Conditions to ensure the performance of Dust Separator
  - Keep design-time shape & dimentions
  - Keep constant flow rate for sampling
  - No depression of flow rate caused by deposition of sampled dust on a filter

SIBATA Dust Separator

☐Multistage Dust Separator (Gravitational deposition type)

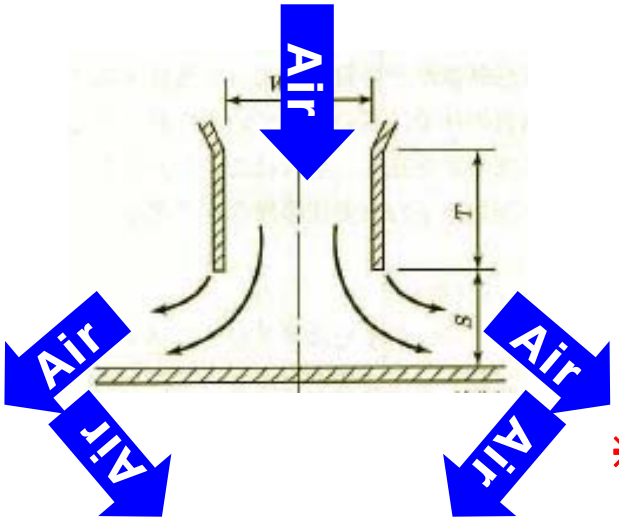


Constant Flow Rate is required!

Dust Separation：

PM4、**PM2.5、PM10、SPM**※1

☐Impactor Type



※1：**PM2.5 & PM10 are theoretically estimated.**

Required Performance of Instrument used

- Suction Pump perform Constant Flow Rate & Pressure
- Settable Flow Rate
- Prevent significant decrease of Flow Rate caused by Deposition of sampled dust on a filter

  ＝It is favored to use a Pump has Constant Flow Rate Control System.
- Suction Flow Rate through a Dust Separator should be constant.

  ＝For Ambient Air Measurement, it is favored to use a Sampling Pump which has Correction System for Temperature and Atmospheric Pressure to correct its flow rate.

SIBATA Sampling Pumps

- Low Volume Air Sampler, LV-40BR
  - Usable in AC/DC Environment
  - Display (LCD) Instant Flow Rate, Integration Flow, Pressure Loss, Atmospheric Pressure, Temperature
  - Timer Function
  - Constant Flow Rate System prevent Flow Rate Decrease caused by Deposition of sampled dust on a filter.
  - Mass Flow Rate or Volumetric Flow Rate is displayed.
  - Brushless Motor is utilized for low generation of dust.

Flow Rate:

8～40L/min

Control actual flow rate.

Used for Industrial Hygiene, IAQ, and Ambient Environment field.

SIBATA Sampling Pumps

- Low Volume Air Sampler, LV-250R
  - WINS(FPM specification) Impactor
  - Constant Flow Rate System enables to keep Suction Flow Rate and performance of Dust Separation (Impactor).
  - Suction Flow Rate is automatically corrected for the Ambient Temperature and Atmospheric Pressure
  - Constant Flow Rate System keeps stable Suction Flow Rate.
  - Display Flow Rate, Time, Temperature, and Pressure.
  - Data Logging
  - Record the time of occurrence of Temporary pause from a blackout, Temperature anomaly of filter or flow rate anomaly

Flow Rate:

16.7L/min

Control Actual Flow Rate.

PM2.5 Measurement

SIBATA Sampling Pumps

- High Volume Air Sampler, HV-500R
  - Constant Flow Rate System prevent Flow Rate Decrease caused by Deposition of sampled dust on a filter.
  - Display (LCD) Integration Flow, Suction Pressure, Instant Flow Rate.
  - Brushless Motor is utilized for low generation of dust.
  - Low noise
  - PM2.5, PM4, PM10, SPM, and Dioxin Sampling for Options

Flow Rate:

500L/min

For Industrial Hygiene, IAQ, etc...

High Volume Flow Rate, Short Sampling Time!

SIBATA Sampling Pumps

- Mini Pump, MP-ΣN Series
  - Equipped Flow Sensor enables to measure its Suction Flow Rate directly, and display Instant Flow Rate and Integrate Flow.
  - Constant Flow Rate System prevent Flow Rate Decrease caused by Deposition of sampled dust on a filter.
  - Operate Timer Sampling by four modes（Manual Mode, Down Timer Mode, Volume Timer Mode, Clock Timer Mode）
  - Low noise

Flow Rate:

0.05～5L/min

4 models

Industrial Hygiene, IAQ, and Ambient Air Sampling

Summary (Mass Concentration Method)

- Basic and Absolute Method for Dust Measurement
- High Volume Air Sampler makes Sampling Time much shorter than Low Volume Air Sampler.
- Constant Flow Rate System is necessary for Dust Measurement.
- Correction System for Ambient Temperature and Atmospheric Pressure is necessary for PM2.5 Measurement
- Mass Flow System is effective to calculate Concentration
- Precise handling (weighing, filter handling, etc...) often provides individual difference.
- To ensure Measurement Accuracy, certain amount of time will be needed for one measurement.

Dust Measurement
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~Relative Concentration Method & SIBATA Products~

Relative Concentration Method

- *Features*

  ・***Short Time Measurement*** *(1 – 2 min. per Measurement point)*

  →Multipoint Measurement in limited time.

  ・***Easy operating***

  →Individual Difference of the result is smaller.

  ・***Light and Small size***

  →Easy carrying

  ・***Easily figure out a time variation & a spatial distribution***

  →Enable to specify the generation source & time

- *Method*

  ・***Light Scattering Method (Aerosol Photometer)***

  ・*Light Absorption Method*

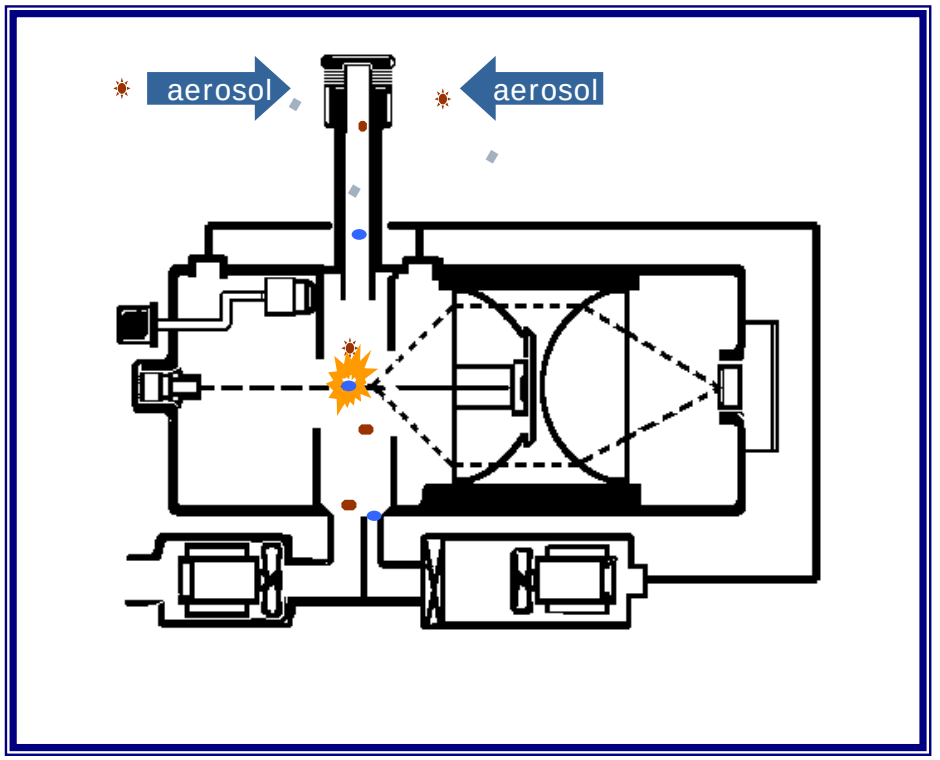
  ・*Piezoelectric Balance Method*

  ・*β -ray absorption Method*

Light Scattering Method (Relative Concentration Method)
Dust Indicator (Aerosol Photometer)

Principle

Particle emit a scattered light when it is exposed to light in a darkroom. If all particles at a site have the same physical character, amount of the scattered light is proportional to a mass concentration. With this principle, a mass concentration of suspended dust is measured and shown as an amount of scattered light.



Unit：CPM(count per minute)

Light Scattering Method (Relative Concentration Method)
Dust Indicator (Aerosol Photometer)

- Points to consider for use of Light Scattering Dust Indicator
  - Since every measurement site has different type of dust, displayed number is not always shown as an actual concentration.
  - For above reason, we should calculate a factor (K factor) from a result of Mass Concentration Method (Air Sampling) to adjust the result from Dust Indicator.
- Advantages of Light Scattering Dust Indicator
  - Easy Handling, Short time measurement, findable a concentration variation, prevent Individual difference. For these advantages, a Light Scattering Dust Indicator is well applied as a standard method of many regulations in Japan.
  - Since it has a high correlation with Mass Concentration Method, result from the Dust Indicator (Relative result) can be rated as a Mass concentration (Absolute result) by using the K factor.

    ⇒To get the K factor, a Comparison Measurement should be done.

* Comparison Measurement: Simultaneously carry on a Relative Concentration Method and a Mass Concentration Method over the same measurement time.

Comparison Measurement

- What is a Comparison Measurement？

A measurement to determine a Mass Concentration Conversion Factor (K factor) ($mg/m^3/CPM$)

* K factor is the factor to calculate a Mass Concentration from a result from Relative Concentration Method.

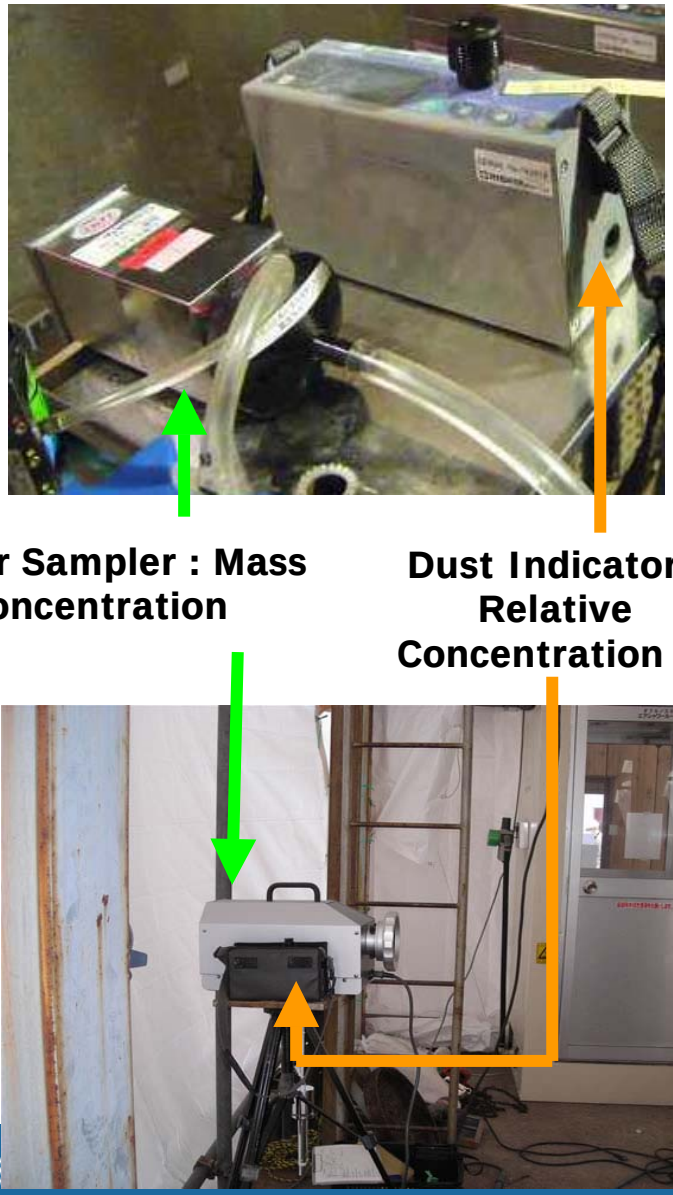
⇒This is to say...

Simultaneously carry on a Relative Concentration Method and a Mass Concentration Method over the same measurement time.

How to get a K factor (mg/m3/CPM)

1. Start Mass Concentration Measurement (Air Sampler) and Relative Concentration Measurement (Dust Indicator) at a same position and time. (See picture right)
2. Divide a result from Mass Concentration Measurement (Air Sampler, C:mg/m3) by a result from Relative concentration Measurement (Dust Indicator, R:CPM) to get a K factor (Mass Concentration Conversion Factor) ($mg/m^3/CPM$)

$K=C(mg/m^3) / R(CPM)$



How to get Mass Concentration from Relative Concentration

- Steps

①Measure at a site by Relative Concentration Method (Dust Indicator)

→Result as Relative Concentration

②Multiply the result by K factor(mg/m^3/CPM).

→Calculate Mass Concentration.

- Example

Average value of results from Relative Concentration Measurement

35cpm（cpm＝count／min)

K factor (mg/m3/CPM)※The value is different depending on a site

K＝0.013mg／m^3／cpm

⇒Mass Concentration

35cpm×0.013mg／m^3／cpm ≒0.046mg／m^3

SIBATA Dust Indicators

LD－3B

General Environment

PDS－2

Personal Exposure

LD－5D

High Concentration

SIBATA Dust Indicator (Relative Concentration Method)

Digital Dust Indicator, LD-3B

- LCD with backlighting. Logging measurement, Software for control data in PC to find a concentration variation.
- Input K factor to convert result to Mass Concentration（mg/m3）.
- Automatically adjust result with Scattering Plate Value and Back Ground Value.
- USB output, Voltage output（0～1V）, No-voltage puls output

LD-3B

Industrial Hygiene, IAQ, Ambient Environment

SIBATA Dust Indicator (Relative Concentration Method)

- High Concentration Digital Dust Indicator, LD-5D
  - The Sheath Air mechanism cut a pollution of optical system, and provide a stable measurement at a high concentration site.
  - A large type filter enables a Long-Term Measurement at a high concentration site.
  - Filter is clearly visible, and easy to know the time for replacement.
  - Light body and easy to carry

For Industrial Hygiene, IAQ, Ambient Air

Stable measurement at high concentration site

SIBATA Dust Indicator (Relative Concentration Method)

- Digital Dust Indicator, LD-2/LD-6N
  - Small & Light body. Measuring Range: 0.000～100.0[mg/m³] World's Smallest Dust Indicator
  - Built-in Nickel-hydrogen battery
  - AC Adopter for its Option
  - The LD-6N for a Personal Exposure. Easy to carry for Worker.

LD-2

LD-6N

For Industrial Hygiene

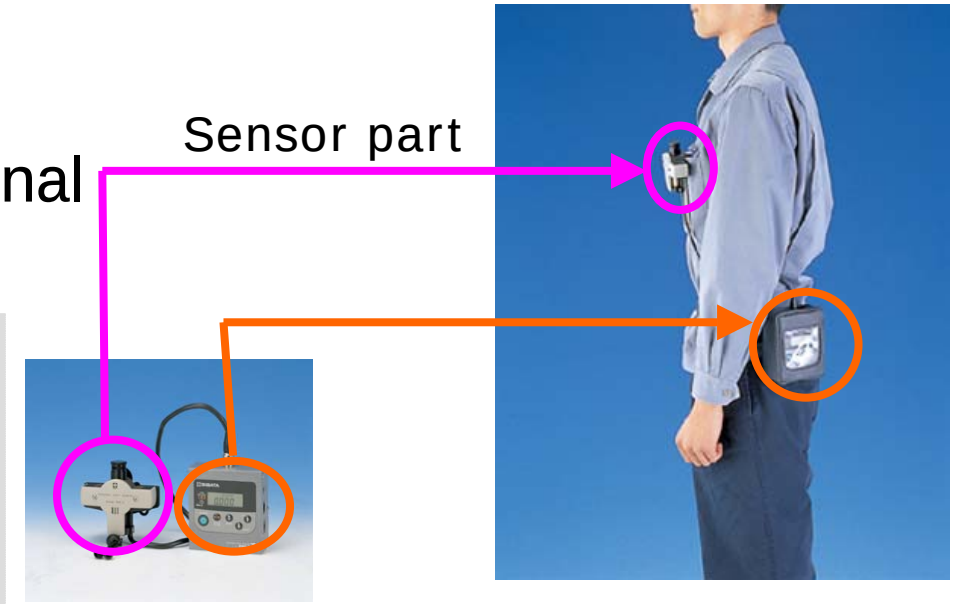
IAQ

Ambient Air

SIBATA Dust Indicator (Relative Concentration Method)

Application of LD-6N

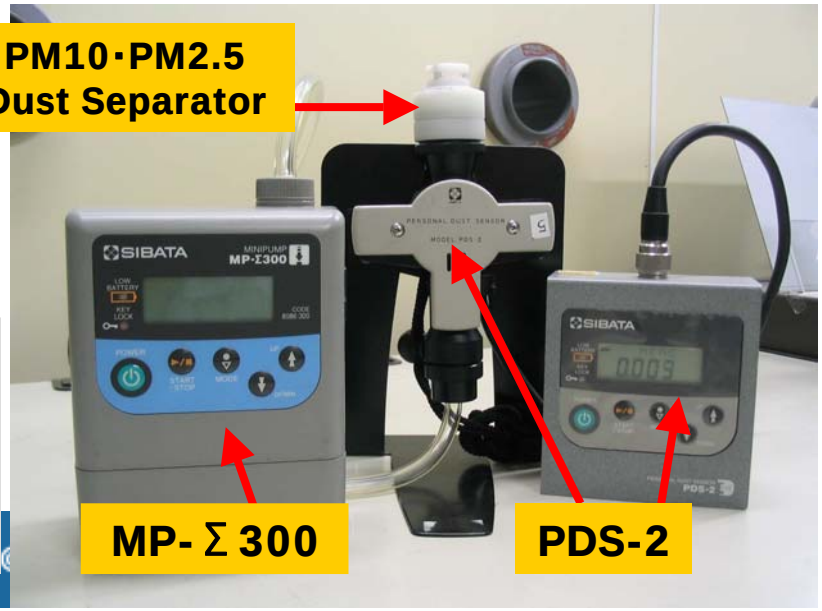
- Measurement for Personal Exposure



Personal Exposure for human body is measurable.

Logging system enables an analysis of the measuring data.

- Comparison Measurement
  - LD-6N + Dust Separator + Mini Pump



Directly weigh the dust which is actually measured by the Dust Indicator, and provide more precise calculation to get a K factor.

Application of LD-6N & LD-2

Dust Separator

PM4

PM10+2.5

SPM+PM2.5

+

Dust Indicator for Personal Exposure

+

?

+

Constant Flow Pump

Relative Concentration Method

- Summary
  - The K factor (Mass Concentration Conversion Factor) (mg/m3/CPM) enables to convert a Relative concentration to a Mass Concentration.

  →Simplify a Repeat Measurement and a Measurement at similar circumstances.
  - Enable an Analysis of Concentration Lever (High or Low?) and an Analysis of variation with time, even the K factor at the site is unknown.

    →Relative Comparison (Screening)
  - Light Weight & Easy Handling. Measureable at every site without an Individual Difference.
  - Result will be shown in about 1 min or more.
  - The Logging System provides a Graph of Concentration Variation with Time.
  - LD-6N + Dust Separator + Mini Pump → Easy Comparison Measurement