

The Continuous Ambient Air Pollution Monitoring in Kawasaki City

Toward the acquisition of high-precision environmental data based on preventive maintenance for the monitoring instruments and so on

1 The Purpose of Continuous Air Pollution Monitoring

*The national government enforced the Air Pollution Control Law in 1968, which made **continuous monitoring of air pollution obligatory** for local government.*

Therefore, Kawasaki-city government has been conducting **continuous monitoring of air pollution since 1964 as the statutory entrusted function** in accordance with Article 22 of the Air Pollution Control Law.

2 Monitoring Place

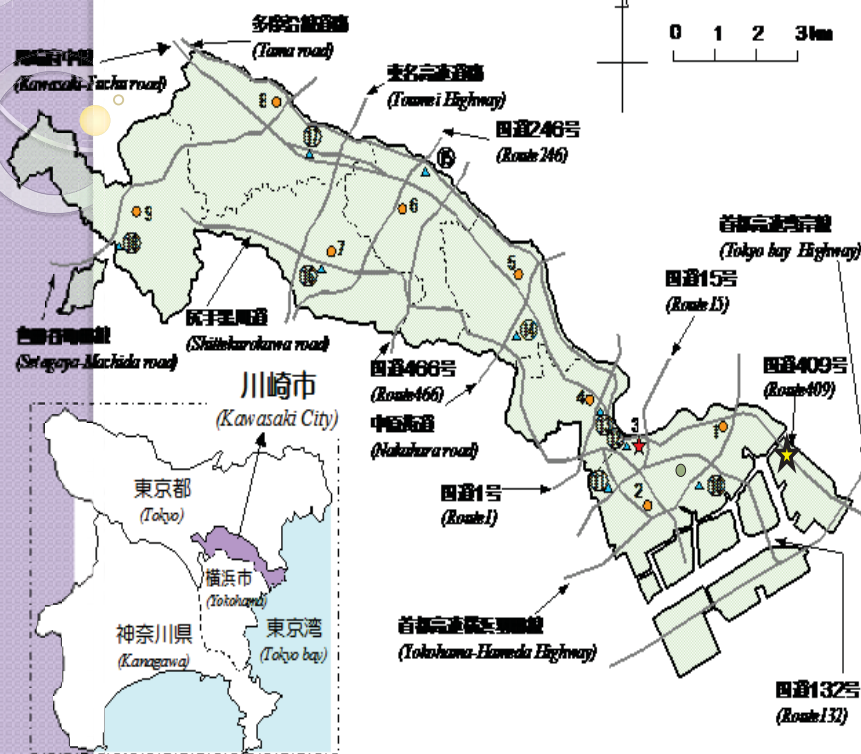


Fig.1 The installation sites of Air Pollution Monitoring Stations in Kawasaki City

Type of Station		Name of Station
General Station	1	Daishi
	2	Tajima
	3	Kawasaki
	4	Saiwai
	5	Nakahara
	6	Takatsu
	7	Miyamae
	8	Tama
	9	Asao
Roadside Station	10	Ikegami
	11	Nissincho
	12	Shiyakushomae
	13	Endocho
	14	Nakaharaheiwakoen
	15	Futago
	16	Miyamaedairaekimae
	17	Honmurabashi
	18	Kakio

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Table1 Monitoring Items

Type of Station		Name of Station	Air Monitoring Items										Meteorological Monitoring Items						Installation
			NO ₂	NO	SPM	O _x	SO ₂	CO	NMHC	CH ₄	PM _{2.5}	Acid Rain	WD	WS	TEMP	HUM	SUN	RAIN	
General Station	1	Daishi	○	○	○	○	○		○	○	○	○	○	○	○	○	○		1965
	2	Tajima	○	○	○	○	○	○	○	○	○		○	○	○	○	○	○	1967
	3	Kawasaki	○	○	○	○	○		○	○	○		○	○	○	○			1965
	4	Saiwai	○	○	○	○	○		○	○	○		○	○	○	○	○		1971
	5	Nakahara	○	○	○	○	○		○	○	○		○	○	○	○			1965
	6	Takatsu	○	○	○	○	○		○	○	○		○	○	○	○			1971
	7	Miyamae	○	○	○	○	○				○		○	○	○	○			1978
	8	Tama	○	○	○	○	○		○	○			○	○	○	○			1971
	9	Asao	○	○	○	○	○				○	○	○	○	○	○			1979
Roadside Station	⑩	Ikegami	○	○	○			○			○		○	○					1981
	⑪	Nissincho	○	○	○			○			○								1974
	⑫	Shiyakushomae	○	○	○			○											1973
	⑬	Endocho	○	○	○			○											1973
	⑭	Nakaharaheiwakoen	○	○	○														1973
	⑮	Futago	○	○	○						○								1975
	⑯	Miyamaedairaekimae	○	○	○						○								1979
	⑰	Honmurabashi	○	○	○						○								1978
	⑱	Kakio	○	○	○						○								1984

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3 The purpose of **general stations**

General stations are established to obtain data for the purposes described below

- (1) To determine if meets environmental quality standards for air pollution.
- (2) To obtain data which need to take measures for emergency due to the prevention of damage to human health and living environment by air pollution.
- (3) To establish air pollution control measures and evaluate their effects.
- (4) To check trends of air pollutant and their effects for long time.

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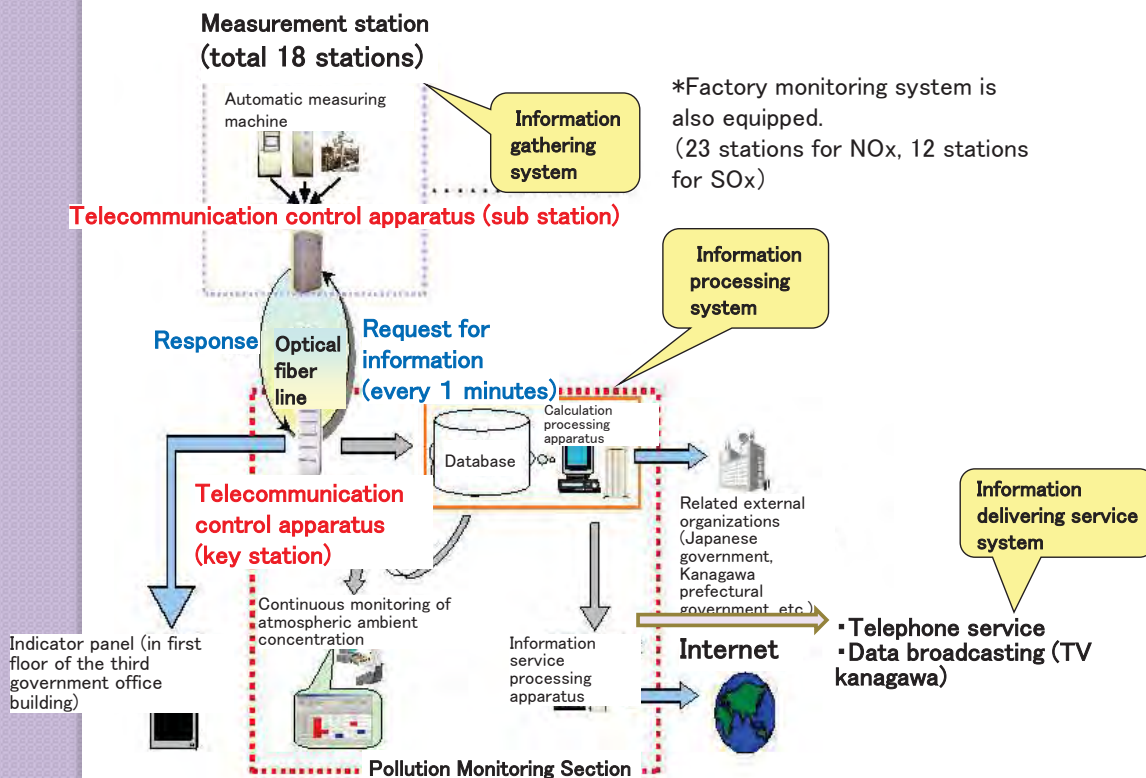


Fig.2 The schematic diagram for the Continuous Air Pollution Monitoring System of Kawasaki-city

Table 3 Guiding Principles behind Analyzing Methods for Pollutants

Pollutant	Analyzing Method	Guiding Principle
SO ₂	Fluorescence spectroscopy	A spectrofluorometer is used to excite electrons in molecules of SO ₂ compounds by shining a beam of ultraviolet light on them, which causes them to emit measurable light.
NO ₂	Chemiluminescence spectroscopy	NO ₂ is first broken down to NO and Oxygen using a converter. A beam of O ₃ is emitted at the air sample and reacts with the NO, making it excited NO ₂ . Chemiluminescence occurs as this excited NO ₂ releases energy to return to normal NO ₂ , and this light is recorded and analyzed.
SPM PM _{2.5}	Beta attenuation monitoring	According to the Beer–Lambert–Bouguer law, the amount of beta radiation absorbed by a solid matter is dependent on its mass and not any other feature, such as density or chemical composition. This method records the amount of beta radiation absorbed by a sample of air particles and thus makes clear the amount of SPM and PM _{2.5} in the sample.

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Table 4 Guiding Principles behind Analyzing Methods for Pollutants

Pollutant	Analyzing Method	Guiding Principle
Ox	Ultraviolet absorption spectroscopy	Oxidant molecules absorb ultraviolet rays of a wavelength of about 254nm when they are emitted through the sample. The amount absorbed can be used to determine the concentration of oxidants in the sample.
CO	Infrared spectroscopy	CO molecules absorb infrared light. The amount of infrared light absorbed when emitted through the sample is used to determine the amount of CO in the sample.

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9 Maintenance of the measuring instruments (1)

Maintenance management of measuring instruments, which are carried out to keep the accuracy and reliability of measured values on a continuous high level, are prescribed in the Monitoring Manual based on Administrative Processing Standard.

○ Operation and Maintenance plan

In order to properly inspect and maintain all the measuring instruments, they are maintained and managed based on the maintenance plan and **the equipment update plan** according to the inspection procedure prescribed for each measuring instruments.

Daily inspections and periodic inspections of measuring instruments are entrusted to the professional vendors.

9 Maintenance of the measuring instruments (2)

○ Maintenance – Inspection plan

Management classification	Objective	Frequency of implementation	Contents
Daily check Ordinary check Patrol check	Operate the automatic measuring instrument normally and continuously (Acquisition of data)	At least once a week	1. Confirmation of operating condition of measuring machine 2. Replacement and Supply of Consumables 3. Simple calibration, check 4. Cleaning and replacing simple parts
Periodic inspection Precise inspection Transmission accuracy check	Maintenance of equipment performance and failure prevention maintenance (Guarantee accuracy within reference width)	At least once a year	1. Inspection of flow path 2. Inspection of detection section 3. Inspection of control and transmission system 4. Inspection of amplification and recording section
Emergency inspection	Quick and emergency inspection at the occurrence of abnormality or failure (Return to normal state)	When an error occurs	1. Discovery of faults and minor repair 2. Cause investigation and repair (by manufacturer)
Performance test	Maintain continuity in maintenance or data evaluation, prevent trouble (Grasp equipment characteristics)	<ul style="list-style-type: none">When purchasing equipment (including remodeling, replacement, updating)Failure related to accuracy After repairPeriodic inspection and after overhaul	1. Equipment performance test (reference gas meter, standard gas, equivalent liquid check etc) 2. Equipment stability test (zero span drift, repeatability, linearity, flow stability) 3. Evaluation of measurement data (consistency with old measuring instruments, etc.)
Dynamic calibration	Determine the contents of accuracy width	At any time	1. Check with standard gas 2. Creating a calibration curve

10 Internal QC Activities

1. Precision and Accuracy (P & A) Checks -

These checks can be used to provide an overall assessment of measurement uncertainty;

2. Zero/Span Checks –

These checks provide an internal quality control check of proper operation of the measurement system;

3. Periodical Certifications –

A certification is the process which ensures the traceability and viability of various QC standards;

4. Calibrations –

Calibrations should be carried out at the field monitoring site by allowing the analyzer to sample test atmospheres containing known pollutant concentrations.

11 Calibrate instruments and telemeter systems

Improperly calibrated instruments frequently cause poor results.

All calibrations must also include a zero-span check covering the full range of concentrations expected during data collection.

Linearity of instrumental response must be demonstrated not assumed.

Telemeter systems, too, must be tested thoroughly, to verify that it is performing as planned.

1 2 Maintenance of the measuring instruments

○ Durable life of measuring instruments (the equipment update plan)

The durable life of the measuring instruments are roughly 5 to 7 years

- Dry type automatic measuring instruments, Suspended particulate matter (SPM) measuring instruments, PM2.5 measuring instruments
 - 7 years (at least once every 7 years)
- CO measuring instruments
 - 8 years
- Meteorological instruments
 - 5 years

1 3 Instrument Equipment Testing, Inspection and Maintenance

Preventive Maintenance

Preventive maintenance is what its name implies; maintaining the equipment within a network to prevent downtime and **costly repairs** and **data loss**.

Preventive maintenance is an ongoing element of quality control and is typically enveloped into the daily routine.

In addition to the daily routine, scheduled activities must be performed monthly, quarterly, semi-annually and annually.

14 Determination of measurement value (1)

Regarding the handling and evaluation method of the measured value, it is prescribed as follows in the administrative processing standard.

1) Evaluation of the continuous monitoring results

1-1) SO₂, CO, SPM, O_x, NO₂

As a result of continuous monitoring, short-term and long-term evaluations will be conducted for each measurement station according to environmental quality standards, and shall be as follows.

A. Short-term evaluation (SO₂, OX, SPM, CO)

In the case of short-term evaluation of the state of air pollution in light of environmental standards, the environmental standard is set as a condition for 1 hour value or 1 hour average value per day value. Evaluate the date or time on which the measurement was made according to the measurement results continuously or occasionally by the specified method.

10 Determination of measurement value (2)

B. Long-term evaluation (SO₂, CO, SPM, NO₂)

a) SO₂, CO, SPM

Evaluate by excluding those that are within 2% of the higher one of the average daily values over the year (measured values for 7 days if there are 365 days worth of measurements).

b) NO₂

Evaluate at the equivalent of 98% from the lowest one (98% of the average daily value) out of the daily average value of the 1 hour value over the year.

2-2) Suspended particulate matter (SPM)

For the evaluation on the long-term standard, the one-year average value of the measurement result is compared with the long-term standard (1 year average value).

For the evaluation on the short term standard, 98% of the average daily value of the measurement result is selected as a representative value, and it is compared with the short term standard (1 day average value).

14 Conclusion

The most important things for continuous air pollution monitoring are to continue confirming and improving the followings;

- ① **To accurately monitor** the changes according to time
- ② **To effectively place** air pollution monitoring stations from the point of the regional representation and **perform preventive maintenance of them appropriately**

The monitoring data have been utilized as a basic material of the administrative policy for the local environmental improvement.

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Thank you for listening



