Monitoring of Mercury in Ambient Air

Background

Mercury is emitted to the atmosphere from both natural and anthropogenic sources. In order to make the necessary policy decisions and develop specific strategies for the reduction of anthropogenic emission of mercury from various sources, the information on the level of mercury in the ambient air is necessary. Article 19 of the Minamata Convention also calls on the Parties to endeavor to cooperate with each other and to develop and improve the monitoring of levels of mercury and its compounds.

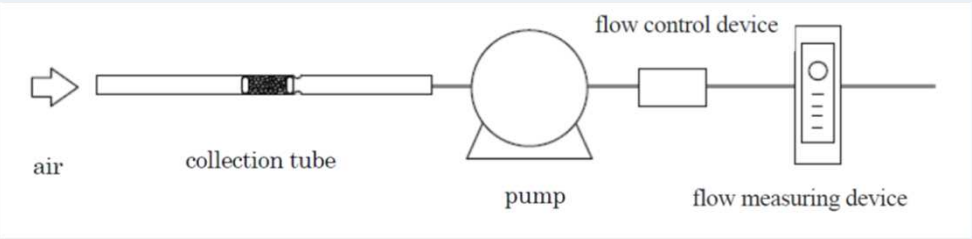
Japan has developed a reliable method for the measurement of mercury in the ambient air and published it as a part of the *"Manual of Measurement Method of Hazardous Air Pollutants"*. This manual will be a useful tool for countries to prepare a monitoring system for atmospheric mercury.

Overview of the Technology

The measurement method for mercury in the ambient air, as described in the *"Manual of Measurement Method of Hazardous Air Pollutants"* comprises of Gold Amalgamation Trap, Thermal Desorption and Cold Vapor Atomic Absorption Spectrometry.

Mercury in the ambient air is collected at a constant flow rate by using a collection tube (inner diameter 4mm) filled with mercury trap particles (80 mg of particles capped on both sides with quartz wool) . The particles are composed of diatomaceous earth particles (thermostable earth particles of 500 – 600 µm in diameter) with gold bake-coated on their surfaces.

Overview of mercury sampling device

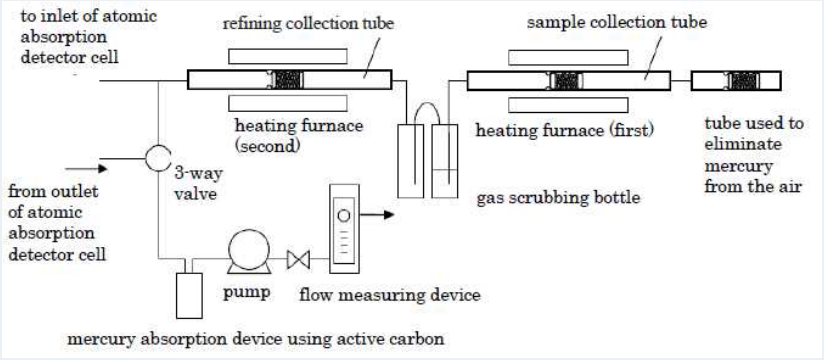


Source : Manual of measurement method of hazardous air pollutants

Generally, the flow rate of air sample collection is 0.5-1 mL per minute and sample is collected for 24 hours for ambient monitoring. As the flow rate is not very high, the collection of air sample can be done by a small pump. The necessary electrical power is also small.

During sampling, the surfaces of the particles may adsorb interfering gas other than mercury vapor that could compromise the measured values of mercury. The collected air sample tube is sealed and sent to the laboratory for measurement. On measurement of the CVAAS (Cold Vapor Atomic Absorption Spectrometry), in order to eliminate the influence of interfering gas, the collection tube is connected to a thermal desorption device whereby the generated mercury vapor is re-trapped by a refining collection tube. Then desorbed atomic mercury from secondary collection tube is led to the absorption detector cell of the atomic absorption spectrometer to determine the quantity of mercury by measuring the atomic absorption at a wavelength of 253.7nm. Measuring instruments specific to this type of collection tube are commercially available, but generic Atomic Absorption Spectrometer can be used for measurement by setting up the device to introduce mercury into the spectrometer from heater or pump.

Thermal Desorption Device



Source : Manual of measurement method of hazardous air pollutants

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Advantages/Strengths

Data accuracy

This method of measuring the concentration of mercury in the ambient air using Gold Amalgamation Trap, Thermal Desorption and Cold Vapor Atomic Absorption Spectrometry is the official method for atmospheric mercury monitoring in Japan.

It is a proven method commonly used in Japan and is widely considered to provide accurate and reliable data. If the clearly defined procedures for measurement are followed, very little difference in measured value, irrespective of which entity is carrying out the measurement, is observed. This ensures comparability of various different data sets obtained through measurement using this technique.

Decent tool for policy making and concrete action

Measurement of ambient air concentration of mercury can be a useful tool to help decision makers to formulate policies, and take concrete actions to protect the population from mercury exposure. The method can be used for formulation of monitoring system by policy makers. As the device used for sample collection is small and inexpensive, this method can be applied for the monitoring of local mercury usage and emission.

Example of sampling setup

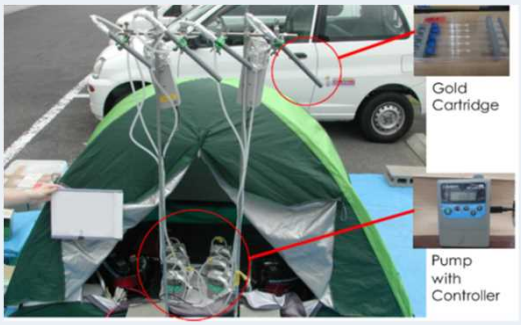

Photo provided by IDEA Consultants, Inc.

Applicability

With this method, analysis and collection of gaseous elemental mercury in the ambient air is possible. Measurement accuracy and sampling efficiency of the other chemical forms of mercury is partly uncertain. However, as the majority of mercury in ambient air exists as gaseous elemental form, the measured value determined by this method is considered as measured value for mercury concentration in the ambient air.

In order to ensure the reliability of the measured value, it is necessary to implement a strict measurement quality control. The Japanese government, through Japan International Cooperation Agency (JICA), has started a training programme since 2017 entitled “Capacity strengthening for multi-media mercury monitoring (4M) ” aimed at laboratory technicians from developing countries on monitoring of mercury. The goal of this program is to enhance the capacity of analytical techniques and laboratory management necessary for more functional mercury monitoring.

Training of participants from developing countries

Further Reading

MOEJ, Manual of measurement method of hazardous air pollutants – Monitoring of mercury in the Ambient Air (Japanese only)
(http://www.env.go.jp/air/osen/manual2/pdf/01_chpt6.pdf)

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