

Abstracts

【Special Issues: Toward Environmental Sound Management of Mercury】

1. An Overview of the Minamata Convention on Mercury and Relevant Discussions

Hitoshi Yoshizaki

Office of Mercury Management, Environmental Health Department, Ministry of the Environment

(Godochosha No.5, 1-2-2 Kasumigaseki, Chiyoda-ku, Tokyo 100-8975 Japan)

Abstract

The Minamata Convention on Mercury, which was adopted in 2013 and came into effect in 2017, regulates the overall life cycle of mercury, from its supply to waste disposal. In Japan, the Act on Preventing Environmental Pollution of Mercury and other relevant laws were enforced to implement more stringent measures than those specified by the Convention. The Conference of the Parties has adopted certain documents for guidance, etc., which are required for the implementation of the Convention. The main agenda for coming meetings includes how to evaluate the effectiveness of the Convention in light of protection of human health and the environment. The first effectiveness evaluation of the Convention is set to be conducted within 6 years of the entry-into force of the Convention, details of which are currently under discussion. Japan strives to not only make efforts to be an active participant in these international discussions but also to lead in the discussions.

Keywords: mercury, Minamata Convention on Mercury, Act on Preventing Environmental Pollution of Mercury, effectiveness evaluation

2. Current Status of Mercury Abatement Technologies

Taketoshi Kusakabe* and Masaki Takaoka*

* Department of Environmental Engineering, Graduate School of Engineering, Kyoto University

† Correspondence should be addressed to Masaki Takaoka: Department of Environmental Engineering, Graduate School of Engineering, Kyoto University (C-1-3-461, Nishikyo-ku, Kyoto 615-8540 Japan)

Abstract

The steady implementations of the obligations under the Minamata Convention on Mercury will function effectively to reduce atmospheric mercury emissions. This paper summarizes the current status of emission factors, abatement technologies, and countermeasures for five source categories listed in Annex D of the Convention. For stationary coal combustion, the co-benefits of climate change measures such as higher efficiency, carbon capture, shift to non-fossil fuels are significant. The replacement of the electrostatic precipitator to a fabric filter and activated carbon injection can significantly heighten mercury removal efficiency. The main mercury-specific abatement technologies in non-ferrous metals production are the Boliden-Norzink process and activated carbon adsorption, and a shift to the hydrometallurgical process is also seen to reduce mercury emissions. In cement clinker production plants, a key question is how to remove mercury circulating in kilns, so in the future manufacturers will be forced to decide between extraction to mercury-enriched kiln dusts or wastewater. With regard to the best available techniques (BAT) for the flue gas treatment of waste incineration plants, the combination of fabric filters, activated carbon adsorption and wet scrubbers will become mainstream for the future, although wet scrubbers have a disadvantage in terms of energy recovery. Cost estimation including measures for not only atmospheric emissions, but also releases to land and water, and waste disposal and management will also play an important role for technology selection.

Keywords: Minamata Convention, mercury, atmospheric mercury emissions, emission factor, abatement technologies

3. Mercury Measurement Technologies for Flue Gases

Naoki Noda

Energy Chemistry Division, Energy Transformation Research Laboratory, Central Research Institute of Electric Power Industry
(2-6-1 Nagasaka, Yokosuka-shi, Kanagawa 240-0196 Japan)

Abstract

With the revision to the Air Pollution Control Law, mercury emission facilities are obliged to measure mercury in flue gas on a regular basis. Although gaseous and particulate mercury in flue gas is sampled separately using the measurement method as specified in the law, Japan's Ministry of the Environment is authorizing the addition of a method that collects particulate and gaseous mercury using one device. In addition to the method, various methods such as a dry measurement method using a sorbent trap and a continuous measurement method using sampling have been specified by JIS, the US EPA, and other countries. Many factors must be taken into consideration in order to determine measurements with a high level of accuracy.

This paper presents the characteristics of various mercury measurement technologies for flue gas as specified in Japan and overseas. It also outlines the revised contents of the JIS K 0222 measurement method, which is being reviewed.

Keywords: measurement method of mercury in a flue gas, sampling technology, revision of the Japanese Industrial Standards

4. Mercury Emissions from Artisanal Small-scale Gold Mining (ASGM), Primary Iron and Steel Production, and Techniques for Countermeasures

Eiji Yamasue*, Shoki Kosai* and Shunsuke Kashiwakura*

* College of Science and Engineering, Ritsumeikan University

† Correspondence should be addressed to Eiji Yamasue: College of Science and Engineering, Ritsumeikan University
(1-1-1, Noji-Higashi, Kusatsu-city, Shiga 525-8577 Japan)

Abstract

Throughout the world, artisanal and small-scale gold mining (ASGM) accounts for the most dominant mercury emissions and in particular, it occupies from about 70% - and even up to 80% - of the total emissions from South America and Sub-Saharan Africa, respectively. Although no ASGM is being operated in Japan, emissions from iron and steel industries are higher than that from non-ferrous metal productions. Close adherence to the Minamata Convention on Mercury is therefore of great significance, as is developing countermeasure technologies in such sectors among the ratifying countries. In this paper, we introduce literature review summaries on mercury emissions from the various sectors and discuss some of the related countermeasure techniques.

Keywords: Minamata Convention on Mercury, artisanal and small-scale gold mining (ASGM), primary iron and steel making, mercury emission, countermeasure techniques

5. Actual Conditions and Treatment Technologies for Mercury-containing Wastes

Kazuki Kido

Itomuka Plant, Nomura Kohsan Co.

(217-1 Fujimi, Rubeshibe-cho, Kitami-shi, Hokkaido 091-0162 Japan)

Abstract

In light of the fact that environmental pollution and health hazards caused by mercury have now been confirmed worldwide, there has been an international demand for appropriate management of mercury and prevention of its environmental pollution and health hazards. In response to this development, the Minamata Convention on Mercury was imposed in 2017. Nomura Kohsan is a mercury management company that has been treating and processing the various types of mercury waste since its establishment in 1973. This paper provides an overview of the mercury waste treatment business undertaken by Nomura Kohsan and introduces treatment technologies being used by the Company, including roasting and the mercury stabilization and solidification process. It also describes how Nomura Kohsan is making contributions to the international mercury waste management effort.

Key words: mercury, waste, roasting, stabilization, solidification

6. The Impacts and Fate of Anthropogenic Mercury on Environmental Mercury Cycling

Akinori Takeuchi* and Kohji Marumoto**

* Strategic Risk Management Research Section, Health and Environmental Risk Division,
National Institute for Environmental Studies

** Environmental Chemistry Section, Department of Environment and Public Health,
National Institute for Minamata Disease

† Correspondence should be addressed to Akinori Takeuchi:

Strategic Risk Management Research Section, Health and Environmental Risk Division,
National Institute for Environmental Studies

(16-2 Onogawa, Tsukuba, Ibaraki 305-8506 Japan)

Abstract

Mercury (Hg) is a global pollutant. In order to estimate the global Hg budget and assess how effective the Minamata Convention on Mercury has been so far, it is critical that the dynamics of global Hg cycling is fully understood. This study compiles information on global mercury content and flux in different environments and compares residence times. It indicates that the atmosphere and ocean surface are environments with relatively low mercury content, but which are particularly affected by anthropogenic mercury emitted after the Industrial Revolution. On the other hand, Hg existing in the land and deep marine environments is mostly naturally-derived Hg accumulated throughout the long history of the earth, and anthropogenic Hg is gradually accumulating. In addition, the residence time of the highly toxic methylated mercury feared to accumulate in living organisms, is relatively long in marine environments, and will require medium- to long-term management and monitoring in order to evaluate the effect of emission reduction.

Keywords: mercury, global pollutant, global mercury content, residence time, marine methylmercury content

7. Baseline Scenarios for Global Atmospheric Mercury Emissions from Anthropogenic Activities and Issues surrounding Emissions Reduction

Kenichi Nakajima^{*,**}, Tatsuya Hanaoka^{***}, Keisuke Nansai^{*} and Yingchao Cheng^{*}

^{*} Material Cycles Division, National Institute for Environmental Studies

^{**} Department of Environment Systems Graduate School of Frontier Sciences, The University of Tokyo

^{***} Social Systems Division, National Institute for Environmental Studies

† Correspondence should be addressed to Kenichi Nakajima:

Material Cycles Division, National Institute for Environmental Studies

(16-2 Onogawa, Tsukuba, Ibaraki 305-8506 Japan)

Abstract

The United Nations Environment Programme has specifically identified the main causes of mercury accumulation in surface soils and the oceans to be closely linked to anthropogenic mercury emissions and releases. While appropriate implementation of the Minamata Convention on Mercury (effective since 16 August 2017) is expected to reduce global supply and demand for mercury, along with anthropogenic mercury emissions and releases to the environment, there are still concerns that the future socio-economic situation and the implementation status of its measures will result in significant increases in mercury emissions from major sectors such as coal combustion, artisanal small-scale gold mining, and cement production. For countries that have ratified the Minamata Convention, it is particularly desirable to closely adhere to the Convention, including conducting effectiveness evaluations and further strengthening mercury reduction measures. This paper examines the global supply and demand for mercury, historical mercury emissions and future prospects in relation to anthropogenic activities. In addition, it introduces the progress being made on the global scenario model for anthropogenic mercury emissions in order to develop effective evaluation methods for the Minamata Convention.

Keywords: Minamata Convention on Mercury, effectiveness evaluation, scenario analysis, material flow, mercury emission

8. Development of a Method for Calculating the Health Risks of Mercury using a Global Mercury Model

Takehiko I. Hayashi* and Toru Kawai**

* Environmental Policy Section, Social Systems Division, National Institute for Environmental Studies

** Strategic Risk Management Research Section, Health and Environmental Risk Division, National Institute for Environmental Studies

† Correspondence should be addressed to Takehiko I. Hayashi:
Environmental Policy Section, Social Systems Division, National Institute for Environmental Studies
(16-2 Onogawa, Tsukuba, Ibaraki 305-8506 Japan)

Abstract

One of the major outcomes in assessing the effectiveness of the Minamata Convention is changes in the impact of mercury on human health. It is necessary to estimate mercury exposure to predict the human health effects of mercury, taking into account the effects of anthropogenic activities and mercury control measures, as well as mercury movement at the global level and mercury behavior in the natural environment subject to various physical, chemical and biological reactions. The first part of this paper summarizes existing knowledge on human health effects and exposure pathways of mercury, and selects exposure scenarios and a range of health outcomes that should be prioritized for evaluation in this research program. It goes on to describe the development of a method for estimating mercury exposure via ingestion of marine products using a global model, which has been carried out to date. In the second part of the paper, the development of a method for estimating mercury exposure via seafood consumption using a global model is explained. The direction of this future development is introduced, together with the results of calculating the average mercury exposure in each region using the method.

Keywords: health risk, epidemiology, exposure assessment, global fate model, methylmercury