



United States Department of State

*Bureau of Oceans and International
Environmental and Scientific Affairs*

*Office of Environmental Quality
and Transboundary Issues*

Comments from the United States of America on draft guidance on Best Available Techniques and Best Environmental Practices (BAT/BEP) for controlling and where feasible reducing mercury emissions to the atmosphere, as set out in Article 8 of the Minamata Convention on Mercury

The United States of America appreciates the opportunity to submit these comments pursuant to the request from the co-chairs of the group of technical experts on air emissions under the Minamata Convention on Mercury.

Introduction and Summary Chapter

P5, Section 1.7.2, Wet Scrubbers – This section presents wet scrubbers only in the context of a “dust” scrubber. Yet wet scrubbers as used for removal of acid gases (e.g., SO₂) from the flue gas seems to also be a theme throughout the source category chapters. Suggest adding the acid gas scrubbers in as well.

P7, Section 1.8, Mercury Emissions Monitoring – Suggest renaming section “Mercury Measurement” or “Mercury Characterization”. We suggest adding a more thorough discussion on the differences between the concepts of measurement and monitoring.

P7, Section 1.8, Mercury Emissions Monitoring, Overview – Suggest including measurement location, the type and number of facilities, fuel types in the “representative” discussion. Also, suggest including a short description of the concept of “Measurement Fit for Purpose”, which should identify as a starting point what a source wants to accomplish with Hg monitoring so it can select the most appropriate measurement or monitoring approaches.

We believe there is a need to draw a clear distinction between mercury emissions measurement, versus mercury emissions monitoring. The former is testing using a discrete methodology over a discrete period of time to determine a source’s potential to emit. The latter is a continuous measurement over an extended period of time to observe long term emissions trends. It is an ongoing effort to quantify mercury emissions from a source in real time or near real time. This document uses these two interchangeably, and that is entirely inappropriate. Furthermore, testing is the first step to determine mercury emissions in a “snapshot” form (i.e., what mercury emissions potentials exist for this source category?). This section describes the measurement of mercury in terms of discovery, daily, weekly or

monthly measurements, when we believe it is really referring to “testing.” The term “monitoring” should only be used to relate information about continuous and long term mercury emissions quantification.

The reference to “random grab samples” of mercury at the end of paragraph 4 on P8, should be replaced with “short term testing efforts”. Under no circumstance should mercury measurement be conducted as a random grab, but as a concerted effort to measure discrete quantities. The low emissions levels that are measured in-stack require careful and deliberate effort to quantify with any appreciable precision and accuracy.

P9, 1.8.2, Direct Measurement Methods – Suggest rolling this section in with section 1.8.2.1 and renaming it “Emission Characterization Test Methods”, followed by a description of why they are short term measurements. Then describe the methods. The term “estimation” in the first paragraph should be replaced with the term “measurement”.

P10, Section 1.8.2.1.1, Impinger Sampling – Isokinetic sampling accounts for all the particulate loading in the gas stream and is the only method suitable for heavy particulate loading, including control device inlet locations. Therefore, we suggest renaming this section “Isokinetic sampling” rather than “Impinger Sampling”, as there is more to it than the impingers, as described in paragraph 3 of this section. Furthermore, in para 3, the first should be revised to read “A probe and sample nozzle are inserted...” The nozzle size is integral to the isokinetic sampling rate and to successful measurement of mercury. In addition, we suggest that the last sentence should read “It is paramount to avoid any loss of sample as it would bias the test result low.” Finally, results from isokinetic sampling provide increased understanding of actual source emissions over time as you increase the number of data points. A single test does not provide a good picture of annual operations, but three measurements per year over many years does provide a good overall picture of steady state operations.

P13, Section 1.8.2.1.2, US EPA Method 30B – As written, the emphasis is on use for RATAs, whereas we suggest that the emphasis should be on performance-based method that gives source measurements of known quality which the others do not.

P12, Section 1.8.2.1.2, Sorbent Trap Sampling - Suggest adding to the end of the sentence in the second paragraph, “...; in general this is a location following a particulate control device. This mitigates the impact of any potential for bias from particulate bound mercury in the sample.” Another advantage of sorbent trap analysis is that the results from thermal desorption analysis may be known while the tester is still in the field; this is useful for engineering tests with varying conditions or for mercury monitor Relative Accuracy Test Audits.

P14, Section 1.8.2.2.1, Sorbent trap monitoring – Suggest moving this to section 1.8.3 since PS-12 is actually a continuous emission monitoring approach, just like instrumental CEMS. Performance Specification 12 is a Performance Specification, not a “method”, please refer to it as such.

P15, Section 1.8.3, Continuous Measurements – Suggest renaming section “Continuous Emission Monitoring” and include an introductory paragraph on what it is and why it’s needed (e.g., compliance, emission characterization, process control, etc.). In turn, we suggest adding a section on using measurements for process control and characterization, which should include speciated measurements.

P16, Section 1.8.3.1, Continuous Emissions Monitoring Systems (CEMS) – The first sentence in the 4th paragraph should read, “The CEMS must be calibrated to ensure data accuracy” rather than “should be calibrated”. Performance Specification 12A is a Performance Specification, not a “method”, please refer to it as such.

P19, Section 1.8.4.1, Mass Balance – Suggest adding the following before the last sentence in the last paragraph of this section, “Full digestion of the sample is required to accurately determine a mass balance of mercury from a solid or liquid sample.”

Coal-fired Power Plants and Industrial Boilers Chapter

On the list of figures at the beginning of the chapter, some of the figures and tables need to be referenced. For example, no references are provided for Figures 11 and 12 either in the list of figures or in the text.

P6 paragraph 1, L1-2 - The term “deposit” is generally used with respect to metallic deposits, not coal. Revise to read “...even in the same coal. The quality of a coal is determined by its composition...”. Alternatively, coal can be described in terms of beds, seams, or basins, but commercial coals can be blended from multiple sources so I think it is best to just delete the term “deposit” and revise to read as shown above.

P6 Fig. 1. - Unclear what is signified by arrows immediately above the terms “Brown coal” and “Hard coal”

P7 table 1 - Number of decimals presented for averages and range is inconsistent and not all decimals included are significant.

P8 paragraph 2 L5-6 - Statement that cinnabar is a dominant mineral host for mercury in coal is incorrect and highly misleading. Cinnabar is present only in very rare cases, in coals having mercury contents of about 5.0 mg/kg or more. These are anomalous mercury enrichments and do not represent mercury levels present in commercial coals. This sentence should be revised to read: “Accordingly, pyrite (FeS₂) is the dominant mineral host for mercury in coal, and in rare cases with anomalous mercury enrichment, cinnabar (HgS) may also be present (Kolker et al., 2006; Kolker, 2012 and references therein)”

Please add the following references:

Kolker, Allan, Senior, C. M., and Quick, J. C., 2006, Mercury in coal and the impact of coal quality on mercury emissions from combustion systems: Applied Geochemistry, v. 21, p. 1821-1836

Kolker, Allan, 2012, Minor element distribution in iron-disulfides in coal: A geochemical review: International Journal of Coal Geology, v. 94, p. 32-43.

P10 paragraph 2 L3 - It is improper to say that “rock” is a mineral impurity. Revise to read: “Raw coal contains mineral impurities such as clays, and may also contain fragments or partings of co-occurring rock. Together, this inorganic portion of coal is referred to as ash”

P10 paragraph 3 L6 - Description of coal washing procedures is very generalized compared to the detail with which mercury control technologies are discussed. Expand on this section to discuss specific approaches such as froth flotation.

P11-12, Section 3.2, Contributions of APCs in terms of mercury removal – Suggest changing the last sentence of the last paragraph on page 11 to read, “Therefore, co-benefit techniques, which can control air pollutants emission and moreover remove mercury, can be quite effective as a comprehensive air pollution control.

P21-22, Section 3.3.2, Mercury Oxidation Additives - The text might reference that another halogen being investigated by industry and others for mercury control is iodine, which may have less corrosive potential than bromine but which may have other uncertainties.

Two additional references which address the issue and could be added to the chapter follow:

“The development of iodine based impinger solutions for the efficient capture of Hg⁰ using direct injection nebulization-inductively coupled plasma ...” - PubMed - NCBI <http://www.ncbi.nlm.nih.gov/pubmed/11783657>

D. Wu, J. Du, H. Deng, W. Wang, H. Xiao, P. Li, “Estimation of atmospheric iodine emission from coal combustion”, International Journal of Environmental Science and Technology, March 2014, Volume 11, Issue 2, pp 357-366,
<http://link.springer.com/article/10.1007%2Fs13762-013-0193-4>

P22, Section 3.3.2, Cross Media Effects for Mercury Oxidation Additives - Recommend that this paragraph also acknowledge that the full range of scientific uncertainties associated with pollutant releases from bromine addition is still the subject of investigation. In other words, the scope of the characterization presented in the document itself has a degree of uncertainty.

P26, Section 3.4.3, ACI applicability restrictions – Suggest adding additional references to the support the statements in the first paragraph of the “Cross-media impacts for ACI” heading.

P34, Section 5.2.5, Environmentally sound management of coal combustion residues – Suggest the following changes to the second and third sentences of the second paragraph: “Sludge from wet FGD and other CCRs are either stored at the site or reused, including further processing of FGD into gypsum wallboard. In the latter case, after FGD gypsum has been filtered out of the sludge, mercury may need to be extracted from FGD wastewater effluent, depending on the levels present.”

Suggest the following changes to the next to last and last sentences of that same paragraph: “However, another study by Liu et al. (2013) indicated that 12-55 per cent of total mercury in the FGD gypsum would be emitted during wallboard production, and a third study found releases ranging from 2% to 66% of the mercury in the incoming FGD gypsum (Sanderson et.al, 2008). Given the potential variability in release rates, wallboard production using FGD gypsum is not regarded as BEPs unless the mercury re-emissions are shown to be minimal or are captured during the wallboard production.”

P35 – Suggest the following changes to the fifth sentence of the third paragraph: “In these same studies, some leach results for other heavy metals, such as arsenic, were found to exceed existing standards for concentration in well water in the United States.”

P36, Section 6.1, CEMS – The elements described in the third paragraph as being special considerations are standard procedure, called “blowback” used to keep probes clean of water and particulate. Heated sampling lines and probes are used regardless of gas stream moisture content. For wet gas streams, dilution probes are used to handle wet gas streams in order to prevent condensation of water and loss of Hg in the sample.

Please add the following reference: (Sanderson et.al., Fate of Mercury in Synthetic Gypsum Used for Wallboard Production, USG Corporation, 2008) available at:
<https://www.netl.doe.gov/File%20Library/Research/Coal/ewr/42080FinalRpt20080624.pdf>

P43, Section 7, References - Recommend listing the report of an EPA demonstration project, undertaken in collaboration with various Russian Institutes, UNEP and the Swedish Environmental Institute on the mercury control efficiencies of both ACI and brominated ACI at a Russian plant burning Russian coal:

USEPA, UNEP and Swedish Environmental Institute (2014). Mercury Emissions Capture Efficiency with Activated Carbon Injection at a Russian Coal-Fired Power Plant, prepared by All Russia Thermal Engineering Institute (VTI) and Zelinsky Institute of Organic Chemistry, Moscow EPA600/r-14/299/September 2014.

Editorial:

P5 paragraph 3 L1-2 - Awkward sentence; “electricity” stated 3 times in the same sentence

P5 paragraph 3 L5 - Orphan close-parenthesis.

P6 paragraph 3 L1 - Insert space between “45” and “per cent”

P8 Table 1 notes: - “Mercury” should be lower case; “This data” should be “These data”

P9 paragraph 4 L1-2 - “finely grounded coal” should be “finely ground coal”

P9 paragraph 5 L5 - “particulate matters” should be “particulate matter”

P10 paragraph 6 L2 - Add period after “not safely managed”

P11 paragraph 1 L1-2 - Revise to read “An overview of the magnitude of co-benefit mercury removal for different configurations of existing APCs is shown in Table 2”

P12 paragraph 1 L2 - “Is quite effective” should be “are quite effective”

P12 Fig. 3 caption - Should read “...configuration of a coal-fired power plant...”

P12 paragraph 2 L1 - Unclear. Subject carried over from a previous paragraph.

P12 paragraph 2 - “averagely” should be “averaging”

P14 paragraph 3 L1-2 - Revise to read “have been observed for ESPs” and also “whether it is an ESPc or ESPh installation”

P14 paragraph 4 L1 - Revise to read “modeling of mercury removal in ESPs indicates...”

P14 paragraph 4 L11-12 - Revise to read “likely a function of halogens present”

P15 paragraph 1 L3 - “The study” should be “This study”

P15 paragraph 2 L4 - Should read “with higher halogen contents”

P16 paragraph 2 L1 - Should read “which has a comparative application rate”

P17 paragraph 1 L1-2 - Should read “results in temperature reduction from 135 to 90 °C”

P18 paragraph 2 L3 - Should read “.....optimization of co-benefit strategy....”

P18 paragraph 2 L4 - Should read “.....to prevent re-emission of mercury. Mercury re-emission may take place....”

P19 paragraph 2 L6 - Should read “....achieved by appropriate coal blending....”

P19 paragraph 6 L3 - “environmentally sound disposed” should be “disposed in an environmentally sound manner”

- P20 paragraph 4 L5 - Revise to read "...and hence a higher percentage of elemental mercury"
- P22 paragraph 2 L3 - Should read "...activated carbon results in an increase in bromine..."
- P23 Fig. 10 - Lettering too small to view
- P23 paragraph 7 L2 - Should be "Selective Mercury Oxidation Catalyst" or "selective mercury oxidation catalyst"
- P24 paragraph 2 L3 - Should read "...by a high mercury oxidation SCR catalyst"
- P24 paragraph 4 L1 - Should read "Sorbents with or without chemical treatment..."
- P24 paragraph 4 L6-7 - Revise to read "Furthermore, ACI has been demonstrated at a Russian power plant..." and "in a number of U.S. States (for example, Massachusetts,...."
- P24 paragraph 6 - Pleasant Prairie Test and Gaston Test are not mentioned elsewhere in the text. Need to cite Fig.11 each time these are mentioned.
- P25 paragraph 3 L1 - Unclear what is meant by "this set of limiting conditions" Subject is carried over from a previous paragraph.
- P26 paragraph 1 L1-3 - Revise to read "Despite ACI being commercially implemented in multiple and diverse applications, there are some remaining potential issues that include fly ash marketability for concrete manufacturing and the effect of SO₃ on ACI performance"
- P26 paragraph 3 L1 - "Another effective way" should be "An effective way"
- P26 paragraph 5 L1 - Replace "Other non-carbon sorbents were also tested that were designed to preserve fly ash quality..." with "Other non-carbon sorbents are designed to preserve fly ash quality"
- P27 paragraph 7 L9 - Should read "varies with the capacity of the plant"
- P28 paragraph 1 L3 - Should read "should be referred to..."
- P28 paragraph 2 L4 - Should read "...and distributed the total annual cost..."
- P30 paragraph 4 L3 - "cab" should be "can"
- P31 paragraph 1 L2 - Should read "at the bench- or pilot-scale stage..."
- P31 paragraph 1 and 2 - "sorbent" should be "sorbents"
- P31 paragraph 3 L3 - Unclear- electrical discharge of what?
- P31 paragraph 3 L8 - Should read "...system reached 40, 98, and 55 per cent, respectively..."
- P33 paragraph 4 L1 - Should read "The energy efficiency of a coal-fired power plant..."
- P33 paragraph 4 L8 - Should read "...only about half of new coal-fired power plants..."
- P33 paragraph 5 L1-2 - Revise to read "As plants age their efficiency decreases, requiring more coal to generate the same output"
- P34 paragraph 1 L1-2 - Should read "...new blading for turbines, overhaul/upgrade of the condenser, new packing for the cooling tower..."
- P34 paragraph 3 L2-4 - Rearrange awkward sentence beginning with "This incremental amount of mercury removal..."
- P34 paragraph 7 L1 - "Mercury" should be lower case
- P35 paragraph 2 L7 - "Mercury" should be lower case

P35 paragraph 2 L13 - Delete extra period
P37 paragraph 2 L2-3 - Rearrange to read "...are not a direct monitoring method for mercury air emissions and it can be expected that the accuracy of air emissions calculated from mass balance will be low"

Waste Incineration Facilities Chapter

P1, Summary, last paragraph – Article 8 requires the use of BAT for new sources and as an option for existing sources. It does not require meeting an emission limit value. This chapter (as well as the others) needs to be cautious about how the indicative performance values are being characterized. In addition, we don't necessarily agree with the implication that in all cases the application of the techniques described as BAT would achieve the indicative performance values included in the chapter. We believe that performance values would be higher in circumstances other than those examples included in the reference materials in this chapter. We suggest that the meaning of the indicative performance values in the context of the guidance document be clarified. While this comment is being made with respect to this chapter, we believe that the characterization of indicative performance values needs to be consistent across all the chapters.

P5, Reuse of "waste." - Wastes are not reused. Materials are reused. The first sentence conflicts with the second sentence and should be changed to be consistent. Therefore, it should refer to "the reuse of materials" or "the reuse of materials and wastes." Finally, the last sentence should be clarified, as it is not clear why or how care should be taken reusing such materials. We do not believe that materials contaminated with mercury should be reused and products containing mercury should be reused in the same context as new products that contain mercury.

P6, 2nd paragraph under 2.1.2.1 Municipal Waste - This paragraph is unclear and should be deleted. It does not provide any information and uses vague phrases that will not assist countries implement the Minamata Convention.

P8, 2.1.2.6 Scrap Wood, last sentence - Contaminated wood should not always be incinerated. The wood may be less likely to leach the heavy metals in a landfill environment. This sentence should read, "Regulatory officials should evaluate whether it is more appropriate to landfill or incinerate contaminated wood, depending on the potential for negative environmental impacts of each option."

P26-27, Section 3.6 - There seems to be an inconsistency in advice in Sections 3.6.1 and 3.6.3. Section 3.6.1 states that bottom ash can be reused in construction, but 3.6.3 states that such use is very problematic and cannot be considered BEP.

P28, Section 3.6.5 Final Disposal of Residues, 1st sentence - This sentence is too broad. Residues that contain mercury over a certain threshold should not be recycled, but low levels and de minimis amounts may be recycled.

P32, Section 5.2, Waste Incineration Facilities - The last paragraph of this section discusses non-incineration techniques and seems to say that section 4 discusses alternatives to incineration (where the document states “see section 4 of the present document”). There are no alternatives to incineration discussed in section 4 of the waste incineration facilities chapter.

P33, Section 5.4, Waste Incineration Facilities - The introductory paragraph of this section states, “To achieve the highest level destruction, the aim is complete combustion. On the other hand, mercury control techniques tend to be more efficient if there is some unburnt carbon in the flue gas stream. There therefore has to be a balance struck between these competing factors in order to achieve the best overall outcome.” Would recommend that this document not suggest or promote a lower combustion efficiency than can be achieved. The BAT section discusses the use of carbon injection as a gas treatment.

P39, Section 5.6, Introduction to Best Environmental Practices - Many of the bullets are very broad and are likely to be unhelpful to the audience of the guidelines. They are also duplicative of the information in Section 5.6.1. We believe that they should be removed and/or integrated into Section 5.6.1. The following changes should be made to the information in the bullets:

- 1st bullet - “Installations” is unclear; we suggest changing it to “incinerators.”
- 4th bullet - It is unclear how labeling would help in this situation. Removing this bullet and adding some examples to the 2nd bullet on information and education to the public would improve the clarity of this section. The 2nd bullet could include text such as, “(e.g. through labeling of mercury-containing products, etc.)”.
- 5th bullet - “Saving resources, including energy” is too broad and unhelpful. It should be removed.
- 6th bullet - “Making collection and disposal systems available to the public” is also unhelpful. Perhaps it could be rephrased as, “integrating waste collection and disposal systems into residential, commercial, and industrial processes to ensure that all waste is managed in an environmentally sound manner”.
- 9th and 10th bullets - These bullets are duplicative of the 7th bullet. They should be removed and examples could be included in the 7th bullet, such as: “(e.g. through restrictions, bans, economic incentives, certifications, standards, or other policy tools)”.

P48, Section 7, References – These need to be checked. For example, some references in the text are not included in the references section. Two examples (from section 3.6.3) are

Skinner et al, 2007 and deVries et al., 2007. Other references appear to be incomplete such that a reader would not be able to find them. One example is Pless-Mulloli, Edwards et al. 2001.

Editorial:

P14 – 2.2.4.1, 1st paragraph - A comma is needed after “disposal of municipal solid waste”.

Cement Clinker Production Chapter

P5, Section 2.3.1, Mercury content in different input streams - The last paragraph in section 2.2.4.2 “Waste Incineration Facilities” in the Waste Incineration chapter (page 16) references additional discussion in the cement chapter regarding the use of waste in the cement production process. It would be helpful to the reader to make clear that “hazardous waste” is considered an “alternative waste or fuel” or “waste-derived fuel” in this section.

P11, Section 3.2.1, Dust shuttling – References for the percent reduction range included under the “Achieved environmental benefits” would be very useful and should be included.

P13, Section 3.2.2, Dust shuttling with sorbent injection – References for the percent reduction range included under the “Achieved environmental benefits” would be very useful and should be included.

P14, Section 3.2.2, Dust shuttling with sorbent injection – Is there a dollar year (or range of dollar years) associated with the costs included under the “Cost” heading?

P17, Section 3.3.1, Wet scrubber – Under the “Cross-media” heading it indicates these are cross-media effects that do not relate to mercury, yet the second bullet in the list is related to mercury, noting that mercury is shifted to by-product production such as gypsum.

P20, Section 4.1, Mercury Roaster – An explanation of what then happens to the condensed mercury would be beneficial in order to address any potential cross media impacts.

P22, Section 5.2, Secondary Measures – The last sentence references that the use of additives such as bromine can increase the mercury removal efficiency of sorbent injection. The potential cross media impacts of the use of these halogens should be included here (page 22 of the coal combustion chapter references this).

Editorial:

P10, Section 3.2.1, Dust shuttling – Second bullet under number 2 of the two configuration discussion: Is it meant to be “bypass stream” instead of “bypass steam”?

Smelting and Roasting Processes Used in the Production of Non-ferrous Metals
Chapter

P. 20, Section 3.1.4, Cross-media impacts – Suggest deleting parenthetical from “Impacts on air and water due to the production of solid calomel waste, by leaching or vaporization of mercury. Calomel waste needs to be stabilized before environmentally sound disposal (e.g. in underground salt mines).” There are various ways to achieve ESM of calomel waste and salt mines should not be singled out.

In the second bullet on risk to workers’ health, suggest adding more discussion to make clearer the link with cross-media impacts.

P23, Section 3.4, Activated Carbon – Are there any references for this section?

P25, Section 3.5, Dowa Filter Process – Are there any references for this section?

P29, Section 4.2, Jerritt Process – Are there any references for this section?

P25, Section 3.4.6, Cross-media impacts – There should be no prescriptive statement of how to dispose of any potential waste from these processes. These should be disposed of according to national policies.

P29, Section 4.2.4, Cross-media impacts – In the second bullet on risk to workers’ health, suggest adding more discussion to clarify the link with cross-media impacts.

P31, Section 5, BAT – It is not clear why a process like Jerritt, which has been installed and operating for several years, would not considered a BAT.

Editorial:

Page numbering of the chapter would be useful.