INFORMATION RELEVANT TO THE REVIEW OF ANNEXES A AND B
31 May 2019

1. Dental Amalgam

Under Article 4, paragraph 3 of the Minamata Convention on Mercury, each Party is required to take measures to phase down the use of dental amalgam in accordance with the provisions set forth in Part II of Annex A. Among other issues, concerns were expressed during the negotiations about the global availability, efficacy and cost of mercury-free dental restorative materials when compared with dental amalgam.

As summarized below, mercury-free fillings are widely available [i], safer for the environment[ii], preserve more tooth structure[iii], and are easier to repair– all resulting in less costs.[iv] On the other hand, amalgam often result in weakened tooth structure[v] and more challenging repairs,[vi] environmental pollution,[vii] and methylmercury exposure[viii] – all factors contributing to higher costs. Since material costs are about the same[ix] and trained dentists can place composite as fast as amalgam,[x] the costs for placement of amalgam and composites are similar.

<u>Global availability of mercury-free dental restorative materials</u>

Since 2013, the global availability of mercury-free dental restorative materials has continued to increase, along with improvements in performance and efficacy. There are a number of techniques and materials utilized in many countries that have either phased down or phased out dental amalgam. Alternatives to amalgam include composite resins, glass ionomer cements, compomers, giomers, and dental porcelain. [xi] Composites are most commonly used and studies show their efficacy in replacing amalgam in virtually every type of clinical situation.[xii]

A 2016 UNEP report presented information from country submittals. Several reported a virtual phase-out of amalgam use (quantities in kilograms) in dentistry, per the below table.[xiii]

Country	**1980-89**	**1990-99**	**2000-09**	**2010-2011**	**Future**
Japan	4,189	1,189	503	minimal	minimal
Switzerland	1,700	1,400	260	<80	zero
Denmark	n.a.	9,094	4,221	78	minimal
Norway	n.a.	894	128	zero	zero
Finland	n.a.	n.a.	n.a.	est. 150	zero

In Japan, dental amalgam was used in around 11% of dental restorations in the 1980s, and fewer than 4% in the 1990s, according to the UNEP report. Since January 2008, there has been a ban on amalgam in Norway, resulting in near zero use. In Sweden, amalgam use effectively ended in 2010. Denmark has introduced a “phasing-down” practice for amalgam, resulting in less than 5% use.

Other countries – including Switzerland, Italy, Estonia, Cyprus, Latvia, Malta and the Netherlands – have reduced amalgam use to under 10%.[xiv] Amalgam use in Switzerland dropped from 47% in the 1990s, to less than 10% in 2010, with the future target to eliminate. In 2012, Hungary's amalgam use was approximately 12%, and use in Singapore was around 16%. Amalgam use is less than 20% in Mongolia and Vietnam. [xv]

Other policies and/or measures in place to phase out the use of dental amalgam

- **European Union:** The European Union has banned amalgam use for children under age 15, pregnant women, and breastfeeding mothers.[xvi]
- **Hungary:** In Hungary, the 2008 national inspectorate of dentists' recommendation on dental restoration materials advises against using dental amalgam in new dental restorations.[xvii]
- **Netherlands:** In the Netherlands a major shift away from amalgam took place in the 1990s. As a result, the average use of amalgam in the 2000s was around 7% of all dental restorative fillings, dropping to less than 1% by 2011.[xviii]
- **Mongolia:** Mongolia has taken steps to limit procurement of amalgam, effectively phasing down its use.[xix]
- **Bangladesh:** The Bangladesh army has limited amalgam procurement, effectively phasing down its use. The Bangladesh Army ended new procurement of amalgam in January 2018, a decision that circulated to all forces – about 1.5 million persons under treatment.[xx]
- **Mauritius:** A decade ago, the Ministry of Health phased out amalgam use in pregnant women and children under 10. Since then, there has been a significant reduction in the percentage of children receiving amalgam, and a reduction for adults too.[xxi]
- **Vietnam:** The Health Service Administration Department recently requested that amalgam use be discontinued in children under 15 and in pregnant and lactating women by April 1, 2019, and that a roadmap by developed for discontinuing amalgam use after 2020.[xxii]
- **Nigeria:** In its Minamata Initial Assessment, Nigeria prioritized "setting national guidelines aiming at minimizing the use of dental amalgam, particularly in the care of children's primary teeth and of pregnant women."[xxiii]

Advantages of mercury-free dental restorative alternatives to dental amalgam

A considerable body of evidence now indicates mercury-free dental fillings offer advantages that make them more effective than dental amalgam. For example:

- **Environment-friendly:** The alternatives to amalgam are mercury-free, and there is no evidence of environmental toxicity.[xxiv]
- **Preserve the tooth structure:** Amalgam often requires the removal of more tooth tissue, leading to additional and more expensive repairs over time.[xxv] The WHO states that "*Adhesive resin materials [like composite] allow for less tooth destruction and, as a result, a longer survival of the tooth itself.*"[xxvi] In addition, composites can strengthen and enhance the biomechanical properties of the restored tooth due to their binding properties.[xxvii]
- **Prevent caries:** Glass ionomers release fluoride, which is widely considered to help prevent tooth decay.[xxviii] Composite placement can also incorporate preventive measures, including sealing of adjacent pits and tooth fissures.[xxix]

- **Easier repairs:** Composites permit localized repairs and are often repaired more successfully than amalgam, with Opdam *et. al.* explaining that *"The annual failure rate (AFR) after 4 years for repairs of amalgam restorations was 9.3%, while the AFR of repaired composite restorations was 5.7%."*[xxx]
- **More accessible:** Glass ionomers, though less durable than composites or amalgam, have proven invaluable in more challenging clinical situations (e.g., treating children's milk teeth in communities with no electricity), and they can be less expensive than amalgam.[xxxi]
- **Efficient to place:** Because mercury-free dental fillings have been developed and studied for more than fifty years,[xxxii] dentists in many areas around the world are now routinely trained and equipped to use alternative materials. Dental schools have assisted as well.
- **Durability:** Mercury-free alternatives are at least as durable. According to the 2012 BIOIS report, *"…the longevity of Hg-free fillings is no longer a factor with significant effect on the overall cost difference between dental amalgam and composite or glass ionomers."*[xxxiii]

2. Rocket Fuel

A U.S. company, Apollo Fusion, is reportedly poised to use elemental mercury as a propellant in thrusters for satellites to be launched by communication companies taking advantage of both the lack of regulation and the coming boom in satellite "mega-constellations" designed to provide global internet broad service starting in 2019.[xxxiv] In the case of satellite propulsion systems, mercury-free alternatives have been available and almost universally used for decades.[xxxv] The Public Employees for Environmental Responsibility (PEER), a US based NGO, recently filed a complaint with a US government agency that contains more information and detail about the anticipated rocket fuel mercury usage and significant air emission consequences.[xxxvi] This potential use of mercury as a rocket fuel may be appropriate for consideration in the Annex A review process.

3. Skin lightening Creams Implementation Issue

The manufacture, import and export of products listed in Annex A of the Minamata Convention, including cosmetics with more than 1 part per million (1ppm, or 1 μg/g) mercury, are banned after 2020. An important compliance issue has been identified with respect to the 1 ppm limit. The issue is whether and how portable field detection devices, such as an XRF instrument, can be used to enforce the mercury use prohibition.

One of the main challenges facing governments, as well as civil society, is the labor intensive work and expense involved in conducting market surveillance, lab testing, and enforcement to detect illegal mercury levels in cosmetics. The cost of analysis differs from one laboratory to another, and can range from USD 50–150 per sample. Availability of laboratory capacity is another very serious concern.

The rationale for the 1 ppm limit is to set a level of intentionally added mercury, since WHO indicates background levels of mercury in ground and surface waters are normally below 0.5 ppm,[xxxvii] and detection limits for many analytical methods are lower than 1 ppm. However, the lower the regulatory limit the more sensitive and sophisticated analytical methods are necessary, so detection costs may increase even further.

Many of the portable testing devices have detection limits above the WHO 0.5 ppm background concentration for most waters, but do not meet the 1 ppm level. So in a majority of cases, the portable devices would not detect skin-lightening creams contaminated with background levels of mercury, but would with creams with intentionally added mercury. The X-ray fluorescence spectrometer/analyzer, for example, is an affordable and already in use by many government authorities carrying out compliance checks. Many civil society organizations already have the necessary screening equipment and could, thus, more easily assist in identifying mercury-added skin creams.

Consistent with other research, a new Zero Mercury Working Group (ZMWG) study released last fall indicates that a significant percentage of skin lightening creams sold worldwide contain dangerous levels of mercury.[xxxviii] Yet this market surveillance, sampling and testing was quite labor intensive and costly, particularly when lab tests are required to prove that a products contains over 1 ppm mercury.

In 2017 and 2018, 338 skin-lightening creams from 22 countries were collected by seventeen of our non-governmental organization (NGO) partners from around the world and tested for mercury. The purchased creams were first screened with a portable instrument in order to identify those with high mercury levels. Then the high mercury creams were subjected to more accurate mercury analysis using standardized sample preparations and more sensitive instruments. Screening was used not only to limit the number of creams requiring expensive laboratory analysis, but also to protect sensitive laboratory instruments from contamination.

34 creams (10 % of the samples) had mercury concentrations ranging from 93 - 16,353 parts per million (ppm). These levels significantly exceeded not only the legal standard established by countries that regulate these products, but also the provisions set forth in the Minamata Convention disallowing after 2020 the "manufacture, import or export" of cosmetics with a mercury content above 1 ppm. Portable instruments would have been effective in identifying such creams.

For countries where samples were collected, our study summarized relevant legislation with respect to use, manufacture, import, and export of skin-lightening cosmetics. Laws/regulations conforming to the Minamata Convention requirements (i.e., less than 1ppm mercury content) were noted, as well as laws/regulations governing ingredient lists for cosmetics and personal hygiene products. Finally, our research demonstrates that hazardous substance restrictions and accompanying risk communication strategies in many countries are incomplete and/or inadequately enforced, thereby raising the risk of health effects, primarily to women.[xxxix]

The toxic trade of often illegal mercury-added skin-lightening products may worsen with skyrocketing demand, especially in Asia, the Middle East and Africa with sales of $17.9 billion in 2017, and projected to reach $31.2 billion by 2024, according to Global Industry Analysts.[xl] In order to comply with the Convention, Parties will need to increase their vigilance around prohibiting sales of these illegal products. Accordingly, it may be appropriate to consider this implementation issue during the review of Annex A.

4. Mercury containing lamps

Among many uses, mercury is currently also present in different types of lamps, widely used in residential as well as commercial spaces. The Minamata Convention has set maximum limits for the for the mercury content allowed in Compact fluorescent lamps (CFL), linear fluorescent lamps (LFL), high pressure mercury lamps and cold cathode fluorescent lamps (Annex A), after 2020.

Indian Experience
Important to bring to the notice of the Convention Secretariat that the mercury limits set in the Convention are higher than what is currently achievable and practiced in a developing country like India. India has one of the largest consumption of mercury containing lamps, with almost 28 million pieces of CFL lamps and 132 million pieces of LFL sold annually (2018).

The Industry had voluntarily reduced mercury content to 3.5 mg for CFLs of less than 26 watts by the end of 2014, as has been stated by ELCOMA, the lighting association in India (http://www.elcomaindia.com/). This was lower than Bureau of Indian Standards mercury limit of 5 mgs for the same category of lamp, applicable at that point.

Mercury containing lamps were brought under the ambit of E-waste management Rules in India in 2016[xli], which prescribes the mercury content for different kinds of lamps based on the rationale of ROHS limits for metals as prescribed by the EU. These limits have been in force since October 2016 and have been followed by all lighting companies registered in India. The allowed limits, listed below, are much lower than the maximum mercury content limits set by Minamata convention.

1	*Mercury in single capped (compact) fluorescent lamps not exceeding (per burner):*
1(a)	For general lighting purposes <30 W : 2.5 mg
1(b)	For general lighting purposes = 30 W and <50 W : 3.5mg
1(c)	For general lighting purposes = 50 W and <150 W : 5mg
1(d)	For general lighting purposes =150 W : 15 mg
1(e)	For general lighting purposes with circular or square structural shape and tube diameter =17 mm : 7mg
1(f)	For special purposes:5 mg
2(a)	*Mercury in double-capped linear fluorescent lamps for general lighting purposes not exceeding (per lamp)*
2(a)(1)	Tri-band phosphor with normal life time and a tube diameter < 9mm (e.g.T2): 4mg
2(a)(2)	Tri-band phosphor with normal life time and a tube diameter = 9 mm and = 17 mm (e.g. T5): 3 mg
2(a)(3)	Tri- band phosphor with normal life time and a tube diameter >17 mm and = 28 mm(e.g. T8): 3.5 mg
2(a)(4)	Tri-band phosphor with normal life time and a tube diameter >28 mm (e.g. T12):3.5 mg
2(a)(5)	Tri-band phosphor with long life time (=25000 h):5mg
2(b)	*Mercury in other fluorescent lamps not exceeding(per lamp):*
2(b)(1)	Linear halophosphate lamps with tube >28 mm (e.g. T 10 and T12):10 mg
2(b)(2)	Non-linear halophosphate lamps(all diameters):15mg
2(b)(3)	Non-linear tri-band phosphor lamps with tube diameter >17 mm(e.g.T9):15 mg
2(b)(4)	Lamps for other general lighting and special purposes (e.g. induction lamps):15mg

3	*Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL)for special purposes not exceeding (per lamp):*
3(a)	Short length(< 500 mm):3.5mg
3(b)	Medium length(>500 mm and<1500 mm): 5mg
3(c)	Long length(>1500 mm): 13mg
4(a)	*Mercury in other low pressure discharge lamps (per lamp): 15mg*
4(b)	*Mercury in High Pressure Sodium(vapour) lamps for general lighting purposes not exceeding (per burner)in lamps with improved colour rendering index Ra>60:*
4(b)-I	P =155 W : 30 mg
4(b)-II	155 W < P <405 W : 40 mg
4(b)-III	P >405 W: 40 mg
4(c)	*Mercury in other High Pressure Sodium(vapour)lamps for general lighting purposes not exceeding (per burner):*
4(c)-I	P<155 W:25mg
4(c)-II	155 W < P < 405 W:30 mg
4(c)-III	P >405 W:40 mg

In the table below, the Minamata convention and the Indian standards have been compared for select types of lamps.

Type	**Minamata Convention allowed content**	**Indian Regulation allowed content**
Compact fluorescent lamps (CFLs) for general lighting purposes that are ≤ 30 watts	≤5 mg per lamp burner	≤2.5 mg per lamp
Linear fluorescent lamps (LFLs) for general lighting purposes:		
(a) Triband phosphor < 60 watts with a mercury content exceeding;	≤5 mg per lamp	≤3-3.5 mg per lamp
(b) Halophosphate phosphor ≤ 40 watts	≤10 mg per lamp	≤10 mg per lamp
Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for electronic displays:		
(a) short length (≤ 500 mm)	≤3.5 mg per lamp	≤3.5 mg per lamp
(b) medium length (> 500 mm and ≤ 1 500 mm)	≤5 mg per lamp	≤5 mg per lamp
(c) Long length(>1500 mm)	≤ 13 mg per lamp	≤13 mg

The Indian experience clearly shows that it is feasible to achieve lower mercury limits in lamps and is being attained by the lighting industry. Precise dosing techniques, required to achieve the same, are low cost, globally available and applicable for automated production lines as well as manual production facilities in emerging countries. These developments may be appropriate for consideration in the Annex A review process.

[i] Mercury Policy Project Report to the UNEP Chemicals BranchDivision of Technology, Industry and Economics (UNEP) on "Phasing Down Dental Amalgam: Country Case Studies" ; Project Account Number: MC/4030-09-04-2204.
[ii] Health Care Research Collaborative of the University of Illinois at Chicago School of Public Health, the Healthier Hospitals Initiative, and Health Care Without Harm, *Mercury in Dental Amalgam and Resin-Based Alternatives: A Comparative Health Risk Evaluation* (June 2012), p.6.
[iii] World Health Organization, *Future Use of Materials for Dental Restoration* (2011), p.16.
[iv] Opdam NJ, Bronkhorst EM, Loomans BA, Huysmans MC, Longevity of repaired restorations: A practice based study, Journal of Dentistry 40 (2012) 829–835, https://www.researchgate.net/profile /Niek_Opdam/publication/228441700_Longevity_of_repaired_restorations_A_practice_based_study/links/0c96052766a325245a000000.pdf
[v] EC's science committee, SCENIHR, *Final opinion on the safety of dental amalgam and alternative dental restoration materials for patients and users*, http://ec.europa.eu/health/scientific_committees/emerging/docs/scenihr_o_046.pdf, p.69, April 2015
[vi] Opdam NJ, Bronkhorst EM, Loomans BA, Huysmans MC, Longevity of repaired restorations: A practice based study, Journal of Dentistry 40 (2012) 829–835, https://www.researchgate.net/profile /Niek_Opdam/publication/228441700_Longevity_of_repaired_restorations_A_practice_based_study/links/0c96052766a325245a000000.pdf
[vii] Lars D. Hylander & Michael E. Goodsite, Environmental Costs of Mercury Pollution, Science of the Total Environment 368 (2006) 352-370, http://www.aikencolon.com/assets/images/pdfs/Nikro/MercuryVacuum/STOTENbestpaper.pdf
[viii] Pichery,C. et al, Environ Health. 2012; 11: 53. *Economic evaluation of health consequences of prenatal methylmercury exposure in France,* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3533723/,https://www.jstor.org/stable/3436250?seq=1#page_scan_tab_contents
[ix] UNEP, Chemicals Branch, *Phasing down dental mercury use: Advisory note for the insurance working group of UNEP Finance Initiative*.
[x]BIO Intelligence Service (2012), *Study on the potential for reducing mercury pollution from dental amalgam and batteries*, Final report prepared for the European Commission-DG ENV, p.67.
[xi] KemI (2005) – Mercury-Free Dental Fillings, Phase-out of amalgam in Sweden, Swedish Chemicals Inspectorate (KemI), 2005; http://www.who.int/ifcs/documents/forums/forum5/pm9_05.pdf
[xii] Ibid.
[xiii] Mercury Policy Project Report to the United Nations Environment Program Chemicals Branch Division of Technology, Industry and Economics on "Phasing Down Dental Amalgam: Country Case Studies"; Project Account Number: MC/4030-09-04-2204; https://wedocs.unep.org/bitstream/handle/20.500.11822/11624/Dental.Amalgam.10mar2016.pages.WEB.pdf.
[xiv]BIO Intelligence Service (2012), *Study on the potential for reducing mercury pollution from dental amalgam and batteries*, Final report prepared for the European Commission-DG ENV, p.67.
[xv] World Health Organization, *Future Use of Materials for Dental Restoration* (2011), p.16; WHO 2010
[xvi] Regulation (EU) 2017/852 of EU Parliament and of the Council of 17 May 2017 on mercury, and repealing Regulation (EC) No 1102/2008
[xvii]MPP Report to the United Nations Environment Program Chemicals Branch Division of Technology, Industry and Economics on "Phasing Down Dental Amalgam: Country Case Studies"; Project Account Number: MC/4030-09-04-2204. https://wedocs.unep.org/bitstream/handle/20.500.11822/11624/Dental.Amalgam.10mar2016.pages.WEB.pdf.
[xviii] UNEP, *Lessons from Countries Phasing Down Dental Amalgam Use* (2016), https://wedocs.unep.org/bitstream/handle/20.500.11822/11624/Dental.Amalgam.10mar2016.pages.WEB.pdf.
[xix] Joint Order of The Minister of Health and The National Emergency Management Agency of Mongolia (11 January 2011)
[xx] UN Environmental Programme, *Promoting Dental Amalgam Phase-Down Measures Under the Minamata Convention and Other Initiatives, For "Especially Women, Children and, Through Them, Future Generations", Workshop Report* (2018), https://mercuryfreedentistry.files.wordpress.com/2018/06/workshop-report.pdf, pp.29-29.
[xxi] UN Environmental Programme, *Promoting Dental Amalgam Phase-Down Measures Under the Minamata Convention and Other Initiatives, For "Especially Women, Children and, Through Them, Future Generations", Workshop Report* (2018), https://mercuryfreedentistry.files.wordpress.com/2018/06/workshop-report.pdf, pp.29-29; *Inventory of Mercury Releases in Mauritius* (2014), http://health.govmu.org/English/Departments-Hospitals/Departments/Documents/Hg%20Inventory%20Report%20(1).pdf, p. 19.
[xxii] Directive No: 261/KCB - QLCL&CĐT, SOCIALIST REPUBLIC OF VIETNAM, MINISTRY OF HEALTH, HEALTH SERVICE ADMINISTRATION DEPARTMENT, March 25, 2019
[xxiii] Minamata Convention on Mercury, Initial Assessment Report for Nigeria, pp.81-82; GEF, UNIDO, UNITAR, June 2017
[xxiv] Health Care Research Collaborative of the University of Illinois at Chicago School of Public Health, the Healthier Hospitals Initiative, and Health Care Without Harm, *Mercury in Dental Amalgam and Resin-Based Alternatives: A Comparative Health Risk Evaluation* (June 2012), p.6.

[xxv] DHSA (2003) – A National Clinical Guideline for the Use of Dental Filling Materials, Department for Municipal Health and Social Services, Directorate for Health and Social Affairs, Universitesgata 2, Oslo,Norway, ISBN 82-8081-031, December 2003,
[xxvi] World Health Organization, *Future Use of Materials for Dental Restoration* (2011), p.16.
[xxvii] Lynch et. al., *Managing the phase-down of amalgam: part I. Educational and training issues*, BR DENT J. (Aug. 2013).
[xxviii]Mandari GJ, Mandari GJ, Frencken JE, Frencken JE, van't Hof MA, *Six-Year Success Rates of Occlusal Amalgam and Glass-Ionomer Restorations Placed Using Three Minimal Intervention Approaches*. CARIES RES 2003;37:246-253.
[xxix] Lynch et. al., *Managing the phase-down of amalgam: part I. Educational and training issues*, BR DENT J. (Aug. 2013).
[xxx] Opdam NJ, Bronkhorst EM, Loomans BA, Huysmans MC, Longevity of repaired restorations: A practice based study, Journal of Dentistry 40 (2012) 829–835, https://www.researchgate.net/profile /Niek_Opdam/publication/228441700_Longevity_of_repaired_restorations_A_practice_based_study/links/0c96052766a325245a000000.pdf
[xxxi] Pan American Health Organization, *Oral Health of Low Income Children: Procedures for Atraumatic Restorative Treatment (PRAT)* (2006), p.xi.
[xxxii] Jack L Ferracane, *Resin composite--state of the art*, DENTAL MATERIALS, Vol.27, issue 1, p.29-38 (Jan. 2011).
[xxxiii] BIO Intelligence Service (2012),Final report prepared for the European Commission-DG ENV, p.69; In 2015 SCENIHR further confirmed *"The longevity of restorations of alternative materials in posterior teeth has improved with the practitioner's familiarity with effective placement"*
[xxxiv] https://www.bloomberg.com/news/articles/2018-11-19/this-space-startup-could-lace-the-atmosphere-with-toxic-mercury?utm_medium=email&utm_source=newsletter&utm_term=181121&utm_campaign=climatechanged.
[xxxv] http://aerospace.mtu.edu/__reports/Conference_Proceedings/2005_Kieckhafer_1.pdf; https://www.spacex.com/sites/spacex/files/starlink_press_kit.pdf.
[xxxvi] https://www.peer.org/assets/docs/fcc/11_19_18_FCC_complaint.pdf.
[xxxvii] Mercury in drinking water (https://www.who.int/water_sanitation_health/dwq/chemicals/mercuryfinal.pdf).
[xxxviii] https://eeb.org/publications/59/industry-health/95798/report-mercury-added-skin-lightening-creams-available-inexpensive-and-toxic.pdf.
[xxxix] Peripheral neuropathy" (PN) is damage to or disease affecting nerves, which may impair sensation, movement, gland or organ function, or other aspects of health, depending on the type of nerve affected.
[xl] Global Industry Analysts, Inc. (https://www.strategyr.com/MarketResearch/Skin_Lighteners_Market_Trends.asp).
[xli] Indian 2016 E-waste rules
http://cpcb.nic.in/displaypdf.php?id=UHJvamVjdHMvRS1XYXN0ZS9FLVdhc3RlTV9SdWxlc18yMDE2LnBkZg==