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IPEN combined submission to the Minamata Convention secretariat on;

- **mercury emissions resulting from the open burning of waste.**
- **capacity-building and technical assistance and technology transfer,**

Lee Bell
Mercury Policy Officer
IPEN
leebell@ipen.org

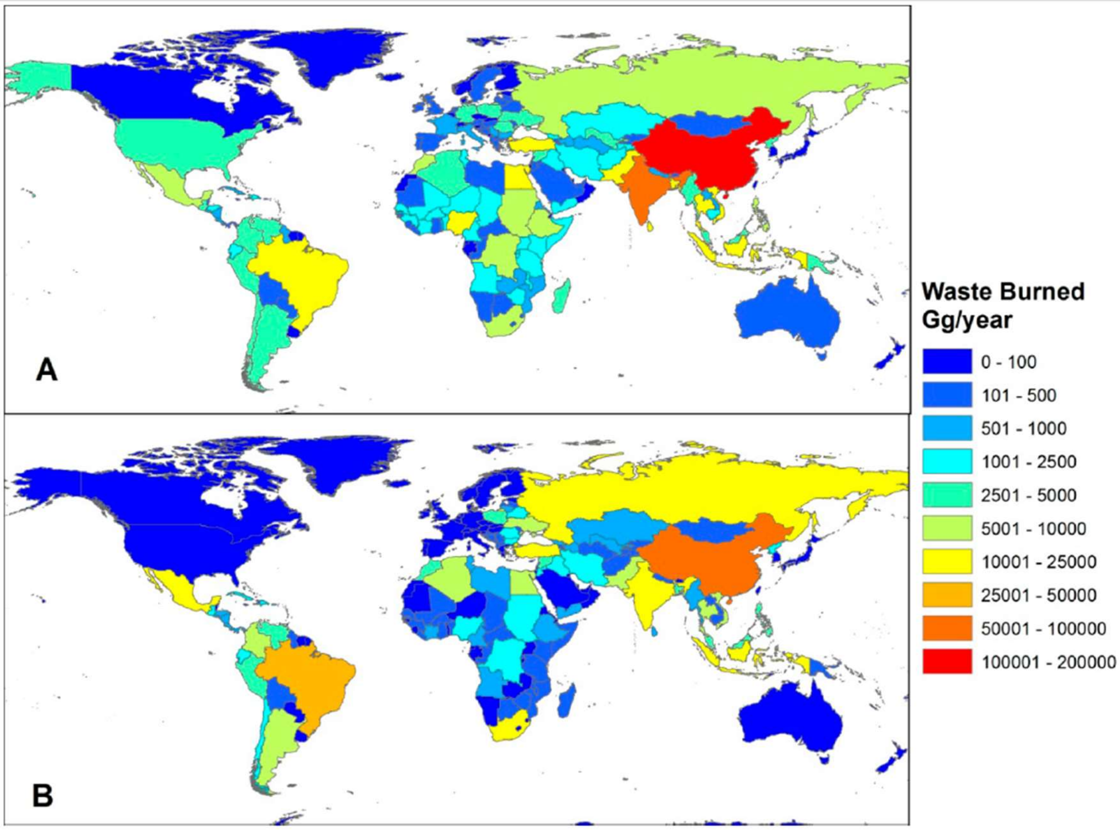
Mercury emissions from the open burning of waste.

In many developing countries (and in some developed countries) the practice of open burning of waste is practiced for a range of reasons including;

- volume reduction in the absence of a waste management/collection system;
- sanitation in the absence of a waste management/collection system;
- recovery of valuable metals from some waste streams (such as e-waste);
- mixed waste is too contaminated to recycle
- spontaneous or deliberately lit landfill fires.

This submission comments on the potential for capacity building and technology transfer to dramatically reduce the prevalence of open burning and the mercury emissions that result from it. Technology and capacity building should be extended beyond a narrow mercury focus to establish programmes that establish basic waste collection and separation systems that have an emphasis on separating organic and hazardous waste (highlighting mercury waste streams) from the recyclable waste stream. Synergies with funding, capacity building and technology transfer mechanisms of other chemical conventions should be explored as open burning is also a significant contributor of UPOPs such as PCDD/DF (Wiedinmyer et al 2014) and could be addressed in joint waste management projects based around collection and source separation to allow for recycling and treatment of discreet waste streams. Without basic source separation and collection systems mercury waste will continue to be a major contributor to anthropogenic mercury emissions from open burning.

Mercury can be liberated as vapor phase and particulate bound emissions from open burning waste fires leading to air, soil and water contamination as well as human health impacts. Waste containing mercury such as e-waste, medical waste and consumer products (CFLs, cosmetics, switches, thermometers) contribute to these emissions. It has been estimated that open burning of waste may contribute up to 10% of current anthropogenic emissions of mercury (Wiedinmyer et al 2014). A significant amount of open burning is situated in South Asia, south east Asia, Latin America and to a lesser extent, Africa (see fig 1). Open waste burning is also conducted in Pacific Islands.



l. Total estimated annual waste burned (Gg yr^{-1}) at the residential level (A) and at dumps (B).

Fig 1 Open burning estimates for residential and landfill mass. (source Wiedinmyer et al 2014)

A key response to open burning of waste which is leading to mercury emissions is the need to implement decentralised, economical waste management systems that maximise reuse and recycling of materials, separate hazardous materials for recycling or disposal and which directs organic wastes to value added processes while creating local employment opportunities.

Capacity building programmes for developing countries and countries with EIT to develop basic waste management systems based on collection and separation of material types is essential. Aid programmes often prioritise the construction of landfills and waste incinerators which sit at the bottom of the waste management hierarchy and are the least sustainable waste management and resource recovery options. They lead to ongoing groundwater contamination, UPOPs release and destruction of resources. Waste incineration is often proposed as a ’solution’ to landfill and even as a better alternative to open burning as incineration allegedly takes place in ‘controlled conditions’. However, the production of thousands of tonnes of toxic ash from incinerators requires additional landfill so the landfill problem is not in any sense 'solved'. Mercury waste management experts also contend that waste incineration is not appropriate for mercury contaminated or containing wastes as the risk of release of mercury vapors is high (Merly and Hube, 2014).

Fortunately, mercury waste is amenable to recovery despite its hazardous nature. If capacity building programmes can be directed at development of locally relevant, basic waste collection and sorting systems then hazardous components of the waste stream such as mercury bearing waste can be separated for treatment and recovery of mercury using technology that is readily available in developed countries and which is a fraction of the expense of establishing landfills or incinerators.

These technologies include fluorescent lamp and other mercury bearing lighting recycling, continuous distillation processes for mercury contaminated soils, mining wastes and sludges from the petrochemical and gas industries. Distillation technologies are already employed in the oil and gas sector to remove mercury from produced gas to protect gas storage systems from corrosion.

Technology transfer and capacity building that addresses the whole of the waste system in developing countries is important. The waste sector should be seen through the lens of the emerging circular economy and sustainable development goals. Instead of perceiving waste as a problem to be buried or burned it should be an opportunity to build small sustainable businesses in impoverished communities, generate local scale clean energy and employment while protecting human health and the environment.

Attention should be given to non-combustion waste management alternatives in terms of technology transfer. Waste management policy in the EU is moving away from incineration of waste and subsidies are being withdrawn in recognition that incineration is not compatible with the circular economy. Developing countries should be given the opportunity to 'leap-frog' polluting incineration and burial technology in the waste management sector and adopt cutting edge techniques to manage their waste through the capacity building and technology transfer processes.

A key aspect of this sustainable waste management process is source separation of organics. Organic waste is the main contributor to anaerobic conditions in landfill, leaching metals under reductive conditions into the groundwater and releasing large volumes of methane- a potent GHG. Organic waste also poses problems for incineration due to its high moisture content requiring supplemental fuel application (usually gas or oil) to reduce moisture levels. This leads to further emissions. Far more productive is the separation of organic materials from the waste stream and their use in anaerobic digestion (AD) and/or composting. The development of biogas from AD can be utilised for energy generation without the release of UPOPs and ash, a major problem suffered by waste incineration. The AD systems can be scaled up from basic household models through to school, commercial and fully industrialised models. Biogas from AD can also be used for cooking displacing more polluting cooking fuels. The final solid residue, digestate, is a valuable fertiliser for agricultural communities. There are clearly opportunities for technology transfer and capacity building programmes to address the waste systems of developing countries more holistically and the instruments of the Minamata Convention dedicated to these purposes (such as the Specific Trust Fund) could be applied. There is a clearly a need to use such mechanisms to address the uptake of AD in developing countries. Sub-Saharan Africa being a case in point where biogas could have enormous positive impacts but lacks seed funding and institutional understanding (Mwirigi et al 2014).

Once organics are removed from the waste stream other benefits are apparent. Organic wastes contaminate recycling in mixed waste systems. Their removal at the source separation stage increases the value of the recyclable component of the MSW stream which remains clean. Mixed waste and recyclables contaminated with organic materials has low value and is at higher risk of open burning. One sector of the recyclable components includes mercury impacts wastes.

A key source of mercury waste in municipal waste generation is compact fluorescent lighting (CFL) and associated fluorescent tubes. Once added to burning waste and broken the mercury phosphor powder escapes the glass lamp and can cause significant contamination and human exposure in vapor phase and as particulate.

Small-scale recycling facilities can be developed for CFL and tubes which contain the mercury-based powder, while separating glass, metal and plastic components for recycling. Many spent lamp recycling collection systems are being established at point of sale to allow customers to return burned out lamps intact. These collected lamps can then be consolidated and sent to regional recycling facilities.

Figure 2. Fluorescent lamp recycling unit

These semi-automated units can recycle between 1 and 10 million lamps per year, are fitted with carbon filters and claim to limit mercury emissions to 0.001-0.002 mg/m^3. The outputs are separated mercury bearing phosphor power, glass cullet, and metal or plastic end caps.

Figure 3. CFL recycling unit fitted in Surabaya Indonesia 2013 and glass cullet from the process.

Locations that lack waste collection infrastructure may benefit from point of sale collection systems where clusters of recycling collection can take place for other hazardous and problematic wastes such as batteries and plastic. This helps to streamline the collection systems for the end recycling operation and is more convenient for the consumer resulting in higher collection rates.

Figure 4. Collection points for fluorescent lamps using mercury can also be combined with collection points for other problematic wastes such as batteries and plastics.

Small scale recycling systems are only as effective as the collection system established for them as they may require significant volumes to remain profitable. National governments can consider extended producer responsibility schemes to help fund the establishment of these recycling operations. Poor disposal of CFL and mercury tube lamps is widespread in developing countries (Ecowaste Coalition, 2018) as represents a sector where successful recycling could be implemented economically based on commercialised technology.

Medical, dental, commercial, mining, oil/gas and industrial mercury waste.

These sources of mercury waste may also be included in open burning practices where waste collection infrastructure is absent. Technologies to extract mercury from these wastes and preventing them from entering the environment are readily available. Capacity building and technology transfer could see the implementation of regional, national and state mercury recovery centres in developing countries to manage these sources of mercury pollution.

Dental amalgam separators fitted in dental clinics where mercury amalgam is used can play a role in reducing mercury in the waste stream. However, eliminating mercury from dental therapy is a far more efficient solution which is clinically and economically feasible on a global scale. Many countries no longer use dental amalgam and the alternatives are well established and cost effective. However, for those dental practices that persist in using mercury separators are a significant barrier to environmental releases assuming that the waste they collect is managed in an environmentally sound manner. Mercury waste from dental amalgam separators can be processed for mercury recovery in the same way as industrial mercury waste through distillation and recovery methods.

Figure 5. Dental amalgam waste separator

Continuous distillation processes from recovering mercury from commercial, mining, oil/gas and industrial mercury waste are well established. However, under the article 11 of the Minamata Convention recovered mercury can still be marketed as a commodity for uses allowed under the convention. For uses where the mass balance of mercury inputs and waste can be potentially be contained by recovery technologies (e.g. CFL recycling) this may not present a large problem. However, if mercury recovery technology becomes widespread in developing countries the supply of this form of mercury could dramatically increase global supply. This is especially true of the mining and gas sectors where large volumes of mercury can be recovered from production gas and tailings.

Continuous Flow Distiller

Figure 6. Continuous Flow Distillation plant for mercury extraction from waste

Careful thought need to be given to control mechanisms to restrict the supply of recovered mercury to the global market to prevent a proliferation of mercury supply. At the same time any restriction of sales of mercury by those operators of recovery systems may undermine the viability of their operation. It is clear that if mercury produced through recovery operations is to be ‘retired’ from the commodity market then consideration needs to be given to purchasing mercury for retirement from recovery operations. A key consideration will be who should pay for mercury to be retired? For the mining, petroleum and gas sector there are clearly opportunities to implement polluter pays systems. For products containing mercury, the costs of retirement could be directed to manufacturers who choose to use mercury in production and processes. In any event if the twin policy aspirations or mercury recovery and permanent mercury retirement are to be achieved, then this issue will need to be resolved.

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