Mixed industrial and waste site: Douala in Cameroon

IPEN Mercury-Free Campaign Report

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Introduction

In 2009, the Governing Council of the United Nations Environment Programme (UNEP GC) decided to develop a global legally binding instrument on mercury to reduce risks to human health and the environment (UNEP GC25/5). The UNEP GC noted that mercury is a substance of global concern due to its long-range transport, persistence, ability to bioaccumulate, and toxicity. Its conclusions were based in part on the 2002 UNEP Global Mercury Assessment which noted that mercury is present in fish all over the globe at levels that adversely affect humans and wildlife (UNEP 2002). In humans, hair is widely accepted as a matrix for reliable estimations of the body burden of methylmercury, which likely comes from eating fish (Grandjean, Weihe et al. 1998); (Harada, Nakachi et al. 1999); (Knobeloch, Gliori et al. 2007); (Myers, Davidson et al. 2000).

This report focuses on the city of Douala, the largest in Cameroon and one with a dense industrial center that includes a cement plant, waste incinerator, waste dumpsites, paint industry, metal recycling, polyurethane production, airport, and sea port. Over 70% of the industries in Cameroon are located in the Douala metropolitan area (Asangwe 2006). We examined levels of mercury in hair of population living in Youpwe-Takele, a district of Douala containing fishermen and people consuming fish caught in the area. The study investigated whether mercury releases from industrial processes can be traced in human hair. In addition, since local mercury releases become global problems due to long range transport we considered how the draft treaty text will address mercury pollution in fast growing industrial cities in developing countries such as Douala.

Industrial facilities and waste sites in Douala City

The city of Douala has two million inhabitants. It is the largest city in Cameroon and located next to the Wouri River, a major location for fishing. Potential sources of mercury include a cement kiln (CIMENCAM Bonaberi Douala) and a waste incinerator (BOCOM International). The cement plant, CIMENCAM, produced more than 1.2 million tons of cement in 2009 with estimated mercury releases of 203 kg mercury to air; 68 kg mercury in by-products and impurities; and 68 kg mercury in general waste. The incinerator, BOCOM International, burnt 128 tons of hazardous wastes in 2009 and based on that capacity estimated releases were 2.8 kg mercury to air and 0.3 kg mercury in disposed waste. These mercury releases were calculated using the UNEP Mercury Toolkit and its default emission factors (UNEP 2005). The Toolkit is predominantly based on information available from developed countries and UNEP cautions that it may not fully reflect the magnitude of releases in developing countries, "*where uncontrolled releases may occur widely…*"

Other possible relevant industries to mercury releases include the Ader pesticides factory and a facility producing polyurethane. No data regarding mercury-containing pesticides or mercury releases is available from the pesticide factory. Information about the polyurethane

facility is also lacking. The area also contains a paint and metal recycling factory and the hazardous waste landfill in the Makepe district of Douala is suspected to be a place where pollution due to e-waste dumping can occur (Bikobo, Daho et al. 2010). Open burning of waste including e-waste and/or mercury in medical devices can occur from time to time in some other parts of the city as well. Mercury thermometers are still widely used in Cameroon (Kuepouo 2012).

Finally, the oil and gas industry may contribute to pollution in the city. Asangwe (2006) focused on environmental pollution of Douala lagoon due to the handling of significant amounts of oil. He suggested that "*the Bonaberi industrial zone complex has encroached into the lagoon itself. It becomes clearly evident that this situation most likely provoked increased discharge of effluents into the Bonaberi districts and as the fastest growing district in the Douala metropolis in terms of population density and spatial extent, the consequences becomes of disaster magnitude.*" The petrochemical sector is suspected to be a potentially significant source of mercury releases (Lang, Gardner et al. 2012).

Materials and methods

The Research and Education Centre for Development/*Centre de Recherche et d'Education Pour le Developpement* (CREPD) conducted sampling of human hair using protocols developed by IPEN (2011). Nineteen hair samples were taken in total for this study at Youpwe-Takele district of Douala (for a specific location see the map at Figure 1). Biodiversity Research Institute (BRI) measured mercury levels (total mercury content = THg) in hair samples in their laboratory in Gorham, Maine, USA. CREPD characterized the site and provided information about history of the site and presumptive mercury sources.

Figure 1: Location of the sampling sites Youpwe and Takele at satelite map from Google Earth.

Results and discussion

As noted above, there are many industrial facilities as well as waste dumpsites that can release mercury in Douala. We have chosen fishermen in the Youpwe-Takele community in Douala to look at the potential impact of this industrialized area on mercury levels in people who depend on fish in their diet, a major route of exposure to methylmercury (IOMC 2008).

Table 1 shows the levels of mercury (Hg) in hair samples from Youpwe-Takele, the part of Douala City, inhabited mainly by fishermen.

The results presented in Table 1 can be interpreted in two groups; 17 samples with similar levels and two samples with extremely high mercury levels (546 ppm and 541 ppm). The group of 17 samples shows average mercury levels almost 2-times higher than the US EPA reference dose and a maximum mercury value that is 3.8-times higher than the reference dose. Three-fourths (76%) of the samples in this group exceeded the reference dose and the four samples below this reference dose were close to 1 ppm (see minimum THg level = 0.832 ppm). Two samples showed extremely high mercury levels (greater 500 ppm) that grossly exceeded the reference dose. These results were re-checked in the lab analysis to insure that the levels were correct.

Table 1: Mercury content in hair samples from Youpwe-Takele district in Douala, Cameroon

	Sample Size	**Hg Mean (ppm)**	**St Dev**	**Min Hg (ppm)**	**Max Hg (ppm)**	**Reference dose (ppm)[a]**	**Fraction over Reference Dose**
All samples	19	59	171	0.832	546	1.00	79%
All samples excluding 2 extremely high samples	17	1.925	1.068	0.832	3.769	1.00	76%
Two extremely high samples	2	543	3.265	541	546	1.00	100%

Abbreviations: Hg, mercury; ppm, parts per million or mg/kg; st dev, std deviation; min, minimum; max, maximum

Fish is a common part of the diet in Douala and is especially pronounced in the fishing community of Youpwe-Takele. This is the most likely reason for the elevated levels of mercury in hair found in this study. The two samples with extremely high levels of mercury may be caused by additional mercury exposures. According to a review of high levels of mercury in hair by Nuttall (2006), one of the potential sources of high exposure to mercury can be skin-lightening products containing mercury (Harada, Nakachi et al. 2001). Another potential explanation could be consumption of clay or kaolin. Kaolin from Cameroon can contain significant levels of heavy metals including mercury (Bonglaisin, Mbofung et al. 2011),

Fish from the Wouri River can be contaminated with mercury from the large number of industrial and waste activities in Douala and the surrounding area, however we cannot point to a single mercury source from the mixture of industrial and waste activities that likely caused the high mercury levels in hair. The results likely reflect a contribution of mercury from many

[a] U.S. EPA's RfD is associated with a blood mercury concentration of 4-5 μg/L and a hair mercury concentration of approximately 1μg/g." US EPA (1997). Mercury study report to Congress, Volume IV, An assessment of exposure to mercury in the United States. EPA-452/R-97-006**:** 293.

different sources. This more complicated picture is likely to be the situation in many cities and countries.

Industrial mixture and products containing mercury and the mercury treaty

High levels of mercury in the hair of volunteers from the fishing community in Douala provoke questions about how the mercury treaty might mandate actions to eliminate mercury pollution from a broad range of industries, including their waste handling practices.

The current treaty text offers some vague options for controlling air emissions from existing cement kilns and waste incinerators if they are above a certain output threshold (not yet determined). However these provisions may not reduce mercury emissions from individual plants on a scale sufficient to offset the new mercury emissions that come from increased numbers of cement kilns or incinerators. Neither cement kilns nor waste incinerators are included as a possible source of mercury releases to land or water. There is also no agreement about whether to include oil and gas production and processing facilities in the treaty so this possible source of mercury may not be addressed.

The contribution of mercury-containing products to exposure has not been fully assessed in this study, though it may play a role, especially in the two samples with very high levels of mercury. The current treaty text prohibits soaps and cosmetics containing mercury but there is no agreement on the phase-out date. Kaolin is not covered and may be exempted under a clause which allows continued sale of mercury-containing products for cultural/heritage uses. The current treaty text also permits new mercury-added products to be introduced into the market if it can be justified based on *"compensating environmental or human health benefits…"*

In the case of Douala it would also be helpful to insure protection of human health and environment from toxic mercury wastes. To prevent problems related to the generation of mercury waste in the future, it would be helpful for the treaty to require the minimization and prevention of generating mercury-containing waste, but the current text does not do this (UNEP (DTIE) 2012). [b] Used electronic devices such as computers and/or e-waste could also be one of potential sources of mercury releases in Douala as it is in other African countries. The current treaty text does not include open burning of these types of wastes as an air emission source. In addition, the current text passes most of the responsibility for waste issues including e-waste to the Basel Convention, so the problem of releases of mercury from irresponsible handling of e-waste and/or end of life electronic products will not be regulated by the new mercury treaty.[c]

Many cities and countries are likely to find themselves in a situation to Douala – significant mercury exposure with a number of possible sources. Until these sources can be identified and the problems rigorously addressed, mercury will continue to contaminate both the local area and contribute to global mercury pollution.

Acknowledgements:

[b] **UNEP**(DTIE)/Hg/INC.5/3; Not present in Article 13 on Wastes

[c] **UNEP**(DTIE)/Hg/INC.5/3; Electric and electronic equipment is not listed in Annex C and current text of article 13 does not prevent e-waste exports to developing countries.

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