Ministry of Environment and the Protection of the Nature (MINEP)

INVENTORY OF MERCURY RELEASES IN CAMEROON

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1 Executive summary

The general objective of this work is to perform the preliminary inventory of mercury in Cameroon in order to protect human health and the environment.

To fulfill this general objective, the following activities were carried out based mostly on documentation existing (Dioxins and Furans Inventory Report, 2011; *Impact of medical mercury-thermometers consumption on the mercury "hot spots" development in a setting lacking sound disposal capacities: Case of the healthcare sector in Cameroon*: Draft paper by KUEPOUO Gilbert in CREPD; UN ComTrade database, and INS).

We then identified the main sources of mercury emission and release in Cameroon and then use the default values set in the "Toolkit for Identification and Quantification of Mercury Releases," to calculate the releases from these sources based on detailed quantitative information on the sources identified obtained from the documentation sources.

This mercury release inventory was made with the use of the "Toolkit for identification and quantification of mercury releases" made available by the United Nations Environment Programme's Chemicals division (UNEP Chemicals). The Toolkit is available at UNEP Chemicals' website:

http://www.unep.org/hazardoussubstances/Mercury/MercuryPublications/GuidanceTrainingMaterialToolkits/MercuryToolkit/tabid/4566/language/en-US/Default.aspx.

This inventory was developed on the Toolkits Inventory Level 1. The Toolkit is based on mass balances for each mercury release source type. Inventory Level 1 works with pre-determined factors used in the calculation of mercury inputs to society and releases. The so-called default input factors and default output distribution factors. These factors were derived from data on mercury inputs and releases from such mercury source types from available literature and other relevant data sources.

In the context of this work, the following sources categories were screened in the Cameroon context regarding the mercury issue.

1. Coal combustion and other coal use
2. Other fossil fuel and biomass combustion
3. Oil and gas production
4. Gold production with mercury amalgamation
5. Primary metal production
6. Other material production
7. Chlor-alkali production with mercury-cells

8. Other production of chemicals and polymers
9. Production of products with mercury content
10. Use and disposal of dental amalgam fillings
11. Use and disposal of other products
12. Production of recycled metals
13. Waste incineration and open waste burning
14. Waste deposition
15. Informal dumping of general waste
16. Waste water system/ treatment
17. Crematoria and cemeteries

The first stage in applying the Toolkit was to preparing a rough selection matrix to identify the principal mercury source categories in Cameroon. In the second stage subcategories and additional qualitative information were added for the purpose of identifying specific activities and sources of mercury release present in the country.

It is important to highlight that among the above 17 sources, there were no activities identified as mercury emission sources for the following source categories: Coal combustion and other coal use; gold production with mercury amalgamation; other production of chemicals and polymers; production of products with mercury content; and production of recycled metals.
Chlor-alakli production with mercury-cells is not yet established in the context of Cameroon.

Emissions to various media were estimated using the electronic spreadsheets for calculation of estimates of mercury inputs and releases based on the default input factors recommended in the Toolkit for identification and quantification of mercury releases. Preliminary estimates indicate that kg of Hg mercury releases in Cameroon per year in various media is as follows: air (3540 kg Hg/year); water (19 960 kg Hg/year); land (1140 kg Hg/year); by-products and impurities (170 kg Hg/year); general waste (25 560 kg Hg/year); and sector specific waste treatment/disposal (990 kg Hg/year).

Based on the estimated results, the largest source of mercury release in the country corresponds to the category “Use and disposal of other products”. This is due to the general waste management system in Cameroon, specifically to the uncontrolled burning and dumping the municipal and medical wastes.

Comparative analysis of the results obtained, based on the input factors applied (low end and high end), indicates that five of the ten categories studied show the highest mercury releases. The increment in general deposits is attributed to mercury-containing waste products such as batteries, thermometers, lamps and other items that are not treated before disposal.

In regard to air releases, at the national level the source with the highest releases are “Informal dumping of general waste” and “Waste incineration and open waste burning”.

Introduction

Inventory for anthropogenic releases of mercury constitutes an important decision making tool in the process of mitigating environmental impacts from this highly toxic substance in Cameroon. Estimate of both the relative and the absolute contributions to mercury releases from the different sources present in the country is needed. This information can be used to determine which release

source types are significant and which sources should be addressed through release reduction initiatives.

Mercury inventory results combined with additional knowledge play a role in identifying the most cost-effective reduction measures for decision making. Often, such inventories are also vital in the communication with stakeholders such as industry, trade and the public.

Furthermore, baseline inventories, and subsequent up-dates, can be used to set goals, priorities and monitor progress.

The present inventory carried out in November 2011, was based primarily on data collected for dioxins and furans inventory within the framework of national implementation plan of the Stockholm Convention using 2009 as reference year. Other information sources used are the UNComTrade database and relevant ministries and institutions.

Compilation of results and subsequent discussions are given in the following paragraphs.

Results and discussion

An aggregated presentation of the results for main groups of mercury release sources is presented in Table 1.1 below.

Table 1-1 Summary of mercury inventory results

Source category	Estimated Hg input. Kg Hg/y	Estimated Hg releases, standard estimates, Kg Hg/y					
		Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal
Coal combustion and other coal use	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other fossil fuel and biomass combustion	59.1	59.1	0.0	0.0	0.0	0.0	0.0
Oil and gas production	318.8	21.9	47.1	0.0	0.0	13.1	0.0
Primary metal production (excl. gold production by amalgamation)	96.4	14.4	9.6	0.1	0.0	62.6	9.6
Gold extraction with mercury amalgamation	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other materials production	338.0	202.8	0.0	0.0	67.6	67.6	0.0
Chlor-alkali production with mercury-cells	-	-	-	-	-	-	-
Other production of chemicals and polymers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Production of products with mercury content	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Use and disposal of dental amalgam fillings	2 910.0	58.2	966.1	0.0	104.8	558.7	558.7
Use and disposal of other products	44 191.2	520.5	17 353.6	1 129.6	0.0	24 857.8	329.8
Production of recycled metals	1.3	0.4	0.0	0.4	0.0	0.4	0.0
Waste incineration and open waste burning	1 152.5	1 065.6	0.0	0.0	0.0	0.0	86.9
Waste deposition and waste water treatment	1 890.0	18.9	0.2	0.0	-	-	-
Informal dumping of general waste *1	15 812.5	1 581.3	1 581.3	12 650.0	-	-	-

Waste water system/treatment	18.0	0.0	16.2	0.0	0.0	1.8	0.0
Crematoria and cemeteries	10.1	0.0	0.0	10.1	0.0	0.0	0.0
TOTALS	**49 810.0**	**3 540.0**	**19 960.0**	**1 140.0**	**170.0**	**25 560.0**	**990.0**

Note *1: The estimated quantities include mercury in products which has also been accounted for under each product category. To avoid double counting these quantities have been subtracted automatically in the TOTALS.

Keeping in mind the principles for common but differentiated responsibility, waste disposal including the life cycle management of products containing mercury and its compounds; and cement production are the main source of mercury concern in the Cameroon context.

For more detail as shown in the table 1-1 above, the following source groups contribute with the major mercury inputs:

1- Use and disposal of other products (44 191.2 kg Hg/y)

2- Informal dumping of general waste (15812.5 kg Hg/y)

3- Use and disposal of dental amalgam fillings (2910 kg Hg/y)

4- Waste deposition and waste water treatment (1890 kg Hg/y)

5- Waste incineration and open waste burning (1152 kg Hg/y)

The individual mercury release sub-categories contributing with the highest mercury inputs were “Use and disposal of other products” and “Informal dumping of general waste”.

The individual mercury release sub-categories contributing with the highest mercury releases to the atmosphere were “Informal dumping of general waste” and “Waste incineration and open waste burning”.

Detailed presentation of mercury inputs and releases for all mercury release source types present in the country are shown in the following report sections.

2 Mercury release source types present

Table 2-1 shows which mercury release sources were identified as present and absent respectively in Cameroon. Only source types positively identified as present are included in the quantitative assessment.

It should be noted however that the presumably minor mercury release source types shown in Table 2-2 were not included in the detailed source identification and quantification work in this report. These may however be present in some countries.

Table 2-1 Identification of mercury release sources in the country; sources present (Y), absent (N), and possible but not positively identified (?).

Source category	Source present?
	Y/N/?
Energy consumption	
Coal combustion in large power plants	N
Other coal uses	N
Combustion/use of petroleum coke and heavy oil	Y
Combustion/use of diesel. gasoil. petroleum. kerosene	Y
Biomass fired power and heat production	Y
Charcoal combustion	N
Fuel production	
Oil extraction	Y
Oil refining	Y
Extraction and processing of natural gas	Y
Primary metal production	
Mercury (primary) extraction and initial processing	N
Production of zinc from concentrates	N
Production of copper from concentrates	N
Production of lead from concentrates	N
Gold extraction by methods other than mercury amalgamation	Y
Alumina production from bauxite (aluminium production)	Y
Primary ferrous metal production (iron. steel production)	N
Gold extraction with mercury amalgamation - without use of retort	?
Gold extraction with mercury amalgamation - with use of retorts	N
Other materials production	
Cement production	Y
Pulp and paper production	N
Production of chemicals and polymers	
Chlor-alkali production with mercury-cells	N

VCM production with mercury catalyst	?
Acetaldehyde production with mercury catalyst	?
Production of products with mercury content	
Hg thermometers (medical. air. lab. industrial etc.)	N
Electrical switches and relays with mercury	N
Light sources with mercury (fluorescent. compact. others: see guide-line)	N
Batteries with mercury	?
Manometers and gauges with mercury	N
Biocides and pesticides with mercury	?
Paints with mercury	?
Skin lightening creams and soaps with mercury chemicals	?
Use and disposal of products with mercury content	
Dental amalgam fillings ("silver" fillings)	Y
Thermometers	Y
Electrical switches and relays with mercury	Y
Light sources with mercury	Y
Batteries with mercury	Y
Polyurethane (PU. PUR) produced with mercury catalyst	N
Paints with mercury preservatives	?
Skin lightening creams and soaps with mercury chemicals	Y
Medical blood pressure gauges (mercury sphygmomanometers)	Y
Other manometers and gauges with mercury	Y
Laboratory chemicals	Y
Other laboratory and medical equipment with mercury	Y
Production of recycled of metals	
Production of recycled mercury ("secondary production")	N
Production of recycled ferrous metals (iron and steel)	Y
Waste incineration	
Incineration of municipal/general waste	Y
Incineration of hazardous waste	Y
Incineration of medical waste	Y
Sewage sludge incineration	N
Open fire waste burning (on landfills and informally)	Y
Waste deposition/landfilling and waste water treatment	
Controlled landfills/deposits	y
Informal dumping of general waste *1	y
Waste water system/treatment	Y
Crematoria and cemeteries	
Crematoria	N
Cemeteries	Y

Table 2-2 Miscellaneous potential mercury sources not included in the quantitative inventory; with preliminary indication of possible presence in the country.

Source category	**Source present?**
	Y/N/?
Combustion of oil shale	N
Combustion of peat	N
Geothermal power production	N
Production of other recycled metals	N

Source category	Source present?
Production of lime	N
Production of light weight aggregates (burnt clay nuts for building purposes)	N
Chloride and potassium hydroxide produced from mercury-cell technology	Y
Polyurethane production with mercury catalysts	Y
Seed dressing with mercury chemicals	Y
Infra red detection semiconductors	?
Bougie tubes and Cantor tubes (medical)	N
Educational uses	Y
Gyroscopes with mercury	?
Vacuum pumps with mercury	Y
Mercury used in religious rituals (amulets and other uses)	?
Mercury used in traditional medicines (ayurvedic and others) and homeopathic medicine	?
Use of mercury as a refrigerant in certain cooling systems	?
Light houses (levelling bearings in marine navigation lights)	?
Mercury in large bearings of rotating mechanic parts in for example older waste water treatment plants	?
Tanning	?
Pigments	Y
Products for browning and etching steel	?
Certain colour photograph paper types	?
Recoil softeners in rifles	Y
Explosives (mercury-fulminate a.o.)	N
Fireworks	?
Executive toys	?

3 Summary of mercury inputs to society

Mercury inputs to society should be understood here as the mercury amounts made available for potential releases through economic activity in the country. This includes mercury intentionally used in products such as thermometers. blood pressure gauges. fluorescent light bulbs. etc. It also includes mercury mobilised via extraction and use of raw materials which contains mercury in trace concentrations.

Table 3-1 Summary of mercury inputs to society

Source category	Source present?			Estimated Hg input. Kg Hg/y
	Y/N/?	Activity rate	Unit	Standard estimate
Energy consumption				
Coal combustion in large power plants	N	0	t coal combusted/y	-
Other coal uses	N	0	t coal used/y	-
Combustion/use of petroleum coke and heavy oil	Y	376 797	t oil product combusted/y	21
Combustion/use of diesel. gasoil. petroleum. kerosene	Y	1 293 344	t oil product combusted/y	7
Biomass fired power and heat production	Y	14 900	Nm3 gas/y	0
Charcoal combustion	N	0	Nm3 gas/y	-
Fuel production				
Oil extraction	Y	4 206 395	t crude oil produced/y	231
Oil refining	Y	1 590 124	t oil refined/y	87
Extraction and processing of natural gas	Y	0	Nm3 gas/y	0
Primary metal production				
Mercury (primary) extraction and initial processing	N	0	t mercury produced/y	-
Production of zinc from concentrates	N	0	t concentrate used/y	-
Production of copper from concentrates	N	0	t concentrate used/y	-
Production of lead from concentrates	N	0	t concentrate used/y	-
Gold extraction by methods other than mercury amal-gamation	Y	2	t gold ore used/y	0
Alumina production from bauxite (aluminium production)	Y	192 546	t bauxit processed/y	96
Primary ferrous metal production (iron. steel production)	N	0	t pig iron produced/y	-
Gold extraction with mercury amalgamation - without use of retort	?	0	kg gold produced/y	?
Gold extraction with mercury amalgamation - with use of retorts	N	0	kg gold produced/y	-
Other materials production				
Cement production	Y	1 229 227	t cement produced/y	338
Pulp and paper production	N	0	t biomass used in production/y	-
Production of chemicals				
Chlor-alkali production with mercury-cells	N	0	t Cl2 produced/y	-

Source category	Source present?			Estimated Hg input. Kg Hg/y
	Y/N/?	Activity rate	Unit	Standard estimate
VCM production with mercury catalyst	?	0	t VCM produced/y	?
Acetaldehyde production with mercury catalyst	?	0	t acetaldehyde produced/y	?
Production of products with mercury content				
Hg thermometers (medical. air. lab. industrial etc.)	N	0	kg mercury used for production/y	-
Electrical switches and relays with mercury	N	0	kg mercury used for production/y	-
Light sources with mercury (fluorescent. compact. others: see guideline)	N	0	kg mercury used for production/y	-
Batteries with mercury	?	0	kg mercury used for production/y	?
Manometers and gauges with mercury	N	0	kg mercury used for production/y	-
Biocides and pesticides with mercury	?	0	kg mercury used for production/y	?
Paints with mercury	?	0	kg mercury used for production/y	?
Skin lightening creams and soaps with mercury chemicals	?	0	kg mercury used for production/y	?
Use and disposal of products with mercury content				
Dental amalgam fillings ("silver" fillings)	Y	19 400 000	number of inhabitants	2 910
Thermometers	Y	1 158 666	items sold/y	2 337
Electrical switches and relays with mercury	Y	19 400 000	number of inhabitants	2 716
Light sources with mercury	Y	4 038 665	items sold/y	101
Batteries with mercury	Y	68	t batteries sold/y	20 806
Polyurethane (PU. PUR) produced with mercury catalyst	N	19 400 000	number of inhabitants	-
Paints with mercury preservatives	?	0	t paint sold/y	?
Skin lightening creams and soaps with mercury chemicals	Y	572	t cream or soap sold/y	17 160
Medical blood pressure gauges (mercury sphygmomanometers)	Y	50	items sold/y	4
Other manometers and gauges with mercury	Y	19 400 000	number of inhabitants	97
Laboratory chemicals	Y	19 400 000	number of inhabitants	194
Other laboratory and medical equipment with mercury	Y	19 400 000	number of inhabitants	776
Production of recycled of metals				
Production of recycled mercury ("secondary production")	N	0	kg mercury produced/y	-
Production of recycled ferrous metals (iron and steel)	Y	1 145	number of vehicles recycled/y	1
Waste incineration				
Incineration of municipal/general waste	Y	158 125	t waste incinerated/y	791
Incineration of hazardous waste	Y	518	t waste incinerated/y	12
Incineration of medical waste	Y	2 746	t waste incinerated/y	66
Sewage sludge incineration	N	0	t waste incinerated/y	-
Open fire waste burning (on landfills and informally)	Y	56 700	t waste burned/y	284
Waste deposition/landfilling and waste water treatment				
Controlled landfills/deposits	y	378 000	t waste landfilled/y	1 890
Informal dumping of general waste *1	y	3 162 500	t waste dumped/y	15 813
Waste water system/treatment	Y	3 428 390	m3 waste water/y	18
Crematoria and cemeteries				
Crematoria	N	0	corpses cremated/y	-
Cemeteries	Y	4 035	corpses buried/y	10
TOTAL of quantified releases				**49 810**

Note that the following source sub-categories made the largest contributions to mercury inputs to society:

- Batteries with mercury (20 806 kg Hg/year)
- Skin lightening creams and soaps with mercury content (17 160 kg Hg/year)
- Informal dumping of general waste (15 813 kg Hg/year)
- Dental amalgam fillings (2 910 kg Hg/year)
- Thermometer (2 337 kg Hg/year)

4 Summary of mercury releases

In the Table 4-1 below, a summary of mercury releases from all source categories present is given. The key mercury releases here are releases to air (the atmosphere), to water (marine and freshwater bodies. including via waste water systems), to land, to general waste, and to sectors specific waste. An additional output pathway is "by-products and impurities" which designate mercury flows back into the market with by-products and products where mercury does not play an intentional role. See Table 4-2 below for a more detailed description and definition of the output pathways.

Table 4-1 Summary of mercury releases

Source category	Estimated Hg releases, standard estimates, Kg Hg/y					
	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal
Energy consumption						
Coal combustion in large power plants	-	-	-	-	-	-
Other coal uses	-	-	-	-	-	-
Combustion/use of petroleum coke and heavy oil	20.7	0.0	0.0	0.0	0.0	0.0
Combustion/use of diesel. gasoil. petroleum. kerosene	7.1	0.0	0.0	0.0	0.0	0.0
Biomass fired power and heat production	0.0	0.0	0.0	0.0	0.0	0.0
Charcoal combustion	-	-	-	-	-	-
Fuel production						
Oil extraction	0.0	46.3	0.0	0.0	0.0	0.0
Oil refining	21.9	0.9	0.0	0.0	13.1	0.0
Extraction and processing of natural gas	-	-	-	-	-	-
Primary metal production						
Mercury (primary) extraction and initial processing	-	-	-	-	-	-
Production of zinc from concentrates	-	-	-	-	-	-
Production of copper from concentrates	-	-	-	-	-	-
Production of lead from concentrates	-	-	-	-	-	-
Gold extraction by methods other than mercury amalgamation	0.0	0.0	0.1	0.0	0.0	0.0
Alumina production from bauxite (aluminium production)	14.4	9.6	0.0	0.0	62.6	9.6

Source category	Estimated Hg releases, standard estimates, Kg Hg/y					
	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal
Primary ferrous metal production (iron. steel production)	-	-	-	-	-	-
Gold extraction with mercury amalgamation - without use of retort	?	?	?	?	?	?
Gold extraction with mercury amalgamation - with use of retorts	-	-	-	-	-	-
Other materials production						
Cement production	202.8	0.0	0.0	67.6	67.6	0.0
Pulp and paper production	-	-	-	-	-	-
Production of chemicals						
Chlor-alkali production with mercury-cells	-	-	-	-	-	-
VCM production with mercury catalyst	?	?	?	?	?	?
Acetaldehyde production with mercury catalyst	?	?	?	?	?	?
Production of products with mercury content						
Hg thermometers (medical, air, lab, industrial etc.)	-	-	-	-	-	-
Electrical switches and relays with mercury	-	-	-	-	-	-
Light sources with mercury (fluorescent. compact. others: see guideline)	-	-	-	-	-	-
Batteries with mercury	?	?	?	?	?	?
Manometers and gauges with mercury	-	-	-	-	-	-
Biocides and pesticides with mercury	?	?	?	?	?	?
Paints with mercury	?	?	?	?	?	?
Skin lightening creams and soaps with mercury chemicals	?	?	?	?	?	?
Use and disposal of products with mercury content						
Dental amalgam fillings ("silver" fillings)	58.2	966.1	0.0	104.8	558.7	558.7
Thermometers	233.7	701.2	0.0	0.0	1 402.3	0.0
Electrical switches and relays with mercury	271.6	0.0	271.6	0.0	2 172.8	0.0
Light sources with mercury	5.0	0.0	0.0	0.0	95.9	0.0
Batteries with mercury	0.0	0.0	0.0	0.0	20 806.0	0.0
Polyurethane (PU. PUR) produced with mercury catalyst	-	-	-	-	-	-
Paints with mercury preservatives	?	?	?	?	?	?
Skin lightening creams and soaps with mercury chemicals	0.0	16 302.0	858.0	0.0	0.0	0.0
Medical blood pressure gauges (mercury sphygmomanometers)	0.4	1.2	0.0	0.0	2.4	0.0
Other manometers and gauges with mercury	9.7	29.1	0.0	0.0	58.2	0.0
Laboratory chemicals	0.0	64.0	0.0	0.0	64.0	66.0

Source category	Estimated Hg releases, standard estimates, Kg Hg/y					
	Air	Water	Land	By-products and impurities	General waste	Sector specific waste treatment /disposal
Other laboratory and medical equipment with mercury	0.0	256.1	0.0	0.0	256.1	263.8
Production of recycled of metals						
Production of recycled mercury ("secondary production")	-	-	-	-	-	-
Production of recycled ferrous metals (iron and steel)	0.4	0.0	0.4	0.0	0.4	0.0
Waste incineration						
Incineration of municipal/general waste	711.6	0.0	0.0	0.0	0.0	79.1
Incineration of hazardous waste	11.2	0.0	0.0	0.0	0.0	1.2
Incineration of medical waste	59.3	0.0	0.0	0.0	0.0	6.6
Sewage sludge incineration	-	-	-	-	-	-
Open fire waste burning (on landfills and informally)	283.5	0.0	0.0	0.0	0.0	0.0
Waste deposition/landfilling and waste water treatment						
Controlled landfills/deposits	18.9	0.2	0.0	-	-	-
Informal dumping of general waste *1	1 581.3	1 581.3	12 650.0	-	-	-
Waste water system/treatment	0.0	16.2	0.0	0.0	1.8	0.0
Crematoria and cemeteries						
Crematoria	-	-	-	-	-	-
Cemeteries	0.0	0.0	10.1	-	0.0	0.0
TOTAL of quantified releases	**3 540.0**	**19 960.0**	**1 140.0**	**170.0**	**25 560.0**	**990.0**

Note that the following source sub-categories made the largest contributions to mercury releases to the atmosphere:

1- Informal dumping of general waste (1581.5 Kg Hg/year)

2- Incineration of municipal /general (711.6 Kg Hg/year)

3- Open fire burning (on landfills and informally) (283.5 Kg Hg/year)

4- Electrical switches and relays with mercury (271.6 Kg Hg/year)

5- Thermometers (234.4 Kg Hg/year)

6- Cement production (202.8 Kg Hg/year)

The first three important sources sub-categories are linked to waste management practices and techniques, whereas the fourth and fifth source sub-categories are in relation with product life cycle management.

Cement industry (CIMENCAM) is the only stationary mercury source sub-category related to the industrial production in Cameroon far in front of Aluminium production industry (ALUCAM) (Table 4-1).

Table 4-2 below provides general descriptions and definitions of the output pathways.

Table 4-2 Description of the types of results.

Calculation result type	**Description**
Estimated Hg input. Kg Hg/y	The standard estimate of the amount of mercury entering this source category with input materials, for example calculated mercury amount in the amount of coal used annually in the country for combustion in large power plants.
Air	Mercury emissions to the atmosphere from point sources and diffuse sources from which mercury may be spread locally or over long distances with air masses; for example from: • Point sources such as coal fired power plants. metal smelter. waste incineration; • Diffuse sources as small scale gold mining. informally burned waste with fluorescent lamps, batteries, thermometers..
Water	Mercury releases to aquatic environments and to waste water systems: Point sources and diffuse sources from which mercury will be spread to marine environments (oceans), and freshwaters (rivers. lakes. etc.). for example releases from: • Wet flue cleaning systems from coal fired power plants; • Industry, households, etc. to aquatic environments; • Surface run-off and leachate from mercury contaminated soil and waste dumps
Land	Mercury releases to soil, the terrestrial environment: General soil and ground water. For example releases from: • Solid residues from flue gas cleaning on coal fired power plants used for gravel road construction. • Uncollected waste products dumped or buried informally • Local un-confined releases from industry such as on site hazardous waste storage/burial • Spreading of sewage sludge with mercury content on agricultural land (sludge used as fertilizer) • Application on land. seeds or seedlings of pesticides with mercury compounds
By-products and impurities	By-products that contain mercury, which are sent back into the market and cannot be directly allocated to environmental releases. for example: • Gypsum wallboard produced from solid residues from flue gas cleaning on coal fired power plants. • Sulphuric acid produced from desulphurization of flue gas (flue gas cleaning) in non-ferrous metal plants with mercury trace concentrations • Chlorine and sodium hydroxide produced with mercury-based chlor-alkali technology; with mercury trace concentrations • Metal mercury or calomel as by-product from non-ferrous metal mining (high mercury concentrations)
General waste	General waste: Also called municipal waste in some countries. Typically household and institution waste where the waste undergoes a general treatment, such as incineration. landfilling or informal dumping. The mercury sources to waste are consumer products with intentional mercury content (batteries. thermometers. fluorescent tubes. etc.) as well as high volume waste like printed paper, plastic, etc., with small trace concentrations of mercury.

Calculation result type	Description
Sector specific waste treatment /disposal	Waste from industry and consumers which is collected and treated in separate systems. and in some cases recycled; for example. • Confined deposition of solid residues from flue gas cleaning on coal fired power plants on dedicated sites. • Hazardous industrial waste with high mercury content which is deposited in dedicated. safe sites • Hazardous consumer waste with mercury content. mainly separately collected and safely treated batteries, thermometers, mercury switches, lost teeth with amalgam fillings etc. • Confined deposition of tailings and high volume rock/waste from extraction of non-ferrous metals

5 Data and inventory on energy consumption and fuel production

5.1 Data description

Data on heavy oil consumption were obtained within the dioxins and furans inventory in the framework of NIP implementation of Stockholm Convention for the reference year 2009 (MINEP. 2011).

Power Stations	***Type of combustible***	***Consumption t/a***
Heavy and Light Fuel Thermal power station in Bertoua	HFO	9871.62
	LFO	749.87
Heavy and Light Fuel Thermal power station Logbaba_Dla	HFO	3673.6
	LFO	2357
Heavy and Light Fuel Thermal power station Bafoussam	LFO (gasoil)	2550.0
Heavy and Light Fuel Thermal power station Yassa_Dla	HFO	55764
	LFO	4326
Heavy and Light Fuel Thermal power station Oyomabang_Yde	HFO	4480
	LFO	3.16
Heavy and Light Fuel Thermal power station Limbé	HFO	52 346.51
	LFO	10.06
CAMSUCO Nkotteng/power cogeneration from bagasse	Bagasse	179938.179

Data on combustion/use of diesel, gasoil, petroleum, kerosene; natural gas; biomass fire power were retrieved from various national institutional and industry sources that are well documented in the dioxins and furans inventory (MINEP. 2011) in the framework of NIP implementation of Stockholm Convention for the reference year 2009. The Ministries of Mines and Water provided the fossil fuel (oil and gas) consumption data for that inventory; whereas, the sugar company CAMSUCO provided the data on biomass fire power.

Data on oil extraction, and oil refinery were obtained from dioxins and furans inventory (MINEP. 2011) in the framework of NIP implementation of Stockholm Convention for the reference year 2009 that used the importation/exportation database of the Ministry of Economy (2008 and 2009).

5.2 Background calculations and approximations

The following conversion factors were applied for to convert volume (L) to mass (kg) for gasoil and diesel:

Conversion factor Volume ------- Mass	L	Kg
Gasoil	1	0.74
Diesel	1	0.84

Data obtained from CAMSUCO on quantity (179 938 tones in 2009. *Dioxins and furans inventory* MINEP. 2011) of bagasse fired for power and heat production is used in this work.

5.3 Data gaps and priorities for potential follow up

Cameroon has a fuel and natural gas processing facility located in the coastal city of limbe in the South-West region of the country. This facility process most of the natural gas consumed domestically. However it was not possible within the scope of this work to have quantity of gas extracted and processed in the country per year. Collection of this data must be considered during the update of the present inventory.

6 Data and inventory on domestic production of metals and raw materials

6.1 Data description

The three sources sub-categories pertinent for the Cameroon context here are the Alumina production from bauxite; Gold extraction by methods other than mercury amalgamation; and cement production. Data on quantity of bauxite used for Alumina production were obtained from Aluminium oxides importation data from the importation database of the Ministry of Economy (2009). Other data sources are from dioxins and furans inventory (MINEP. 2011).

Artisanal and Small Gold Mining activities are common in Cameroon. The extraction method is gravity, mercury use in that sector in Cameroon ended in 1960 (Environmental and Socio-Economic assessment of an Artisanal Gold Mine field: Case of Bétaré-Oya. East-Cameroon, *CREPD Report*, 2007). Numerous artisanal gold workings are known (producing around 1500 kg/year), but it appears that no modern exploration methods have been used to locate Cameroon's primary gold potential. Alluvial gold production is derived purely from elluvial and alluvial workings. To date no primary deposits have been successfully located. However, work carried out by the BRGM suggests that gold mineralization is related to the volcano-sedimentary belts characteristic of the Birimian belt in Niger, Burkina Faso and Mali, Artisanal mining accounts for around 45 000 oz/year. Lom River Gold Corp (formerly Lorica Resources Inc) from Canada has an option to obtain a gold prospect in south eastern Cameroon (http://www.mbendi.com/indy/ming/af/ca/p0005.htm#sectors)

6.2 Background calculations and approximations

Raw importation data of bauxite from Guinea is used for calculation of the subcategory of "Alumina Production"; while the estimate quantity of gold production from the above internet source is used. Note that this estimate is two-folds the estimate from the ministry of Economy's database. This situation pertains well the vagueness of information on gold trading sector in Cameroon.

6.3 Data gaps and priorities for potential follow up

7 Data and inventory on domestic production and processing with intentional mercury use

7.1 Data description

The industrial sector in Cameroon is embryonic, hence domestic production and processing with intentional mercury use is limited and not well studied.

It is more probable that domestic production and of paint with mercury (latex paint), skin lightening creams and soap with mercury chemicals been important in Cameroon, unfortunately there is lack of official information on these activities.

A global overview of Hg-cell cl-alk capacity shows that there is none in Cameroon. Reference:
http://www.unep.org/hazardoussubstances/Mercury/PrioritiesforAction/ChloralkaliSector/Reports/tabid/4495/language/en-US/Default.aspx

7.2 Background calculations and approximations

Not applicable

7.3 Data gaps and priorities for potential follow up

Promote actions, both immediate and in long-term to facilitate information gathering on production and processing of products with intentional use of mercury and mercury compounds in Cameroon.

8 Data and inventory on waste handling and recycling

8.1 Data description

Data used for waste handling and recycling were obtained from dioxins and furans inventory (MINEP. 2011), summarizing all the data from different institutional sources in Cameroon for the reference year 2009. From this study one major ferrous metal recycling facility is now operating in Douala; along with some others functioning in the informal sector, their annual production was estimated to about 916 tones per year.

Industries du fer et de l'acier	***Production t/an***
Métal Afrique Douala	416
RESTE cumulé	500
Total	916

Source. Dioxins and furans inventory (MINEP. 2011)

8.2 Background calculations and approximations

For this study, we assume that all the metals produced were obtained from recycling personal car. With an estimation that a personal car weighs an average of 800 kg, a total production of 916 tonnes of metal could derived from recycling of about 1 145 vehicles a year.

8.3 Data gaps and priorities for potential follow up

Not applicable

9 Data and inventory on general consumption of mercury in products, as metal mercury and as mercury containing substances

9.1 Data description

Data sources here were population census result (2010). UNComTrade data-base for importation of well known consumer mercury added-products, and field survey coupled with extrapolation of data on Hg glass thermometers in Cameroon healthcare facilities (CREPD. 2011).

Mercury-amalgam fillings consist of an alloy or mercury, silver, copper and tin (with usual mercury content of 44 to 51% by weight).

Light source with mercury

Period	Trade Flow	Reporter	Partner	Code	Trade Value	NetWeight (kg)
2009	Import	Cameroon	World	81315	$2301565	*96846*
2009	Import	Cameroon	France	81315	$966196	69211
2009	Import	Cameroon	China	81315	$852411	787192
2009	Import	Cameroon	Belgium	81315	$82864	3483
2009	Import	Cameroon	United Kingdom	81315	$70899	2201
2009	Import	Cameroon	Spain	81315	$57598	7413
2009	Import	Cameroon	United Arab Emi-rates	81315	$57216	36069
2009	Import	Cameroon	Morocco	81315	$37708	1816
2009	Import	Cameroon	Germany	81315	$36366	1783
2009	Import	Cameroon	USA	81315	$28755	1915
2009	Import	Cameroon	Italy	81315	$28324	306

2009	Import	Cameroon	Tunisia	81315	$19052	21809
2009	Import	Cameroon	Singapore	81315	$16645	521
2009	Import	Cameroon	Portugal	81315	$14011	3599
2009	Import	Cameroon	Poland	81315	$6798	250
2009	Import	Cameroon	Other Asia nes	81315	$6297	2615
2009	Import	Cameroon	Netherlands	81315	$3975	1774
2009	Import	Cameroon	Greece	81315	$3325	3185
2009	Import	Cameroon	Saudi Ara-bia	81315	$3193	438
2009	Import	Cameroon	Thailand	81315	$2022	896
	Total					1043322

Source. UNComTrade (2009)

Battery with mercury

- **Mercury oxide or button cells or mercury-zinc cells**

Period	Trade Flow	Reporter	Partner	Code	Trade Value	NetWeight (kg)
2009	Import	Cameroon	World	850630	$31626	32477
2009	Import	Cameroon	China	850630	$17951	31123
2009	Import	Cameroon	USA	850630	$11555	1291
2009	Import	Cameroon	France	850630	$1203	4
2009	Import	Cameroon	Hungary	850630	$917	59
	Total					64954

Source. UNComtrade (2009)

- Other button cells (zinc-air)

Period	Trade Flow	Reporter	Partner	Code	Trade Value	NetWeight (kg)
2009	Import	Cameroon	World	850640	$3666	1483
2009	Import	Cameroon	China	850640	$2777	1457
2009	Import	Cameroon	France	850640	$759	11
2009	Import	Cameroon	Germany	850640	$130	15
	Total					2966

Source. UNComtrade (2009)

Mercury is released into the air and water and as waste during the production. use and disposal of amalgam fillings. Mercury amalgam is still widely used in the public health sector in Cameroon.

9.2 Background calculations and approximations

The activity rate suggested by the Toolkit is based on the number of inhabitants that, for the purpose of this study, corresponds to the population from 2010 census (19400 000 inhabitants) for mercury amalgam fillings use.

- To estimate the number of medical mercury-base thermometers consumed in Cameroon per year in this work, the result of a recent survey from hospitals in Yaoundé followed by extrapolation to the entire country situation was used. In fact, recent survey (in preparation KUEPOUO. 2011) in pharmacy of the Gyneco-Obstetrical and Pediatric Hospital of Ngousso in Yaoundé, and the Yaoundé Central Hospital showed that an average of 5475 Hg-thermometer/year corresponding to a rate of 15 Hg-thermometer/day in each hospital investigated. From this minimal estimate, simulation of the consumption of Hg-thermometer by all the healthcare facilities (3492. INS 2008) in Cameroon could best be made on 5.5% (weighting factor to consider the size and standard among healthcares) of the total facilities. It should be noted that some people buy medical thermometers out of the healthcare pharmacies.
  Calculation method: (15 thermometers/day x 365 days a year x 3492 healthcare facilities in Cameroon x 5.5)/100 = 1 051 528 medical thermometers per year as the lowest estimate.
  An average of purchasing of 5 medical pressure gauges per each of the 10 regions of Cameroon was estimated for this study, giving a total of 50 items for this sub-category in the country per year.

- To determine the number of lamp items consumed per year. the following estimations were made: (1) 70% of the total import of 1043322 kg represents the lamps only; this gives a quantity of 625 993 kg of lamps imported as calculation basis; (2) 100% of the lamps imported were inferred to contain mercury; and (3) a conversion of the quantity imported (kg) to items was made using the average weight of a lamp (in the literature) of about 155g/item as follow: (625 993 kg of lamps x 1000)/155 that gave 4 038 665 lamps imported. Due to the lack of breakdown data on various sub-categories of lamps in the toolkit. it was assumed for this study that all the lamps item imported were fluorescent tubes (double end) because it is common on the market.

- To estimate the quantity of skin lightening creams and soaps with mercury content from the reported imported value (Table above). it was set in this study that 13% of the total import of perfumery, cosmetics and dentifrices represent skin lightening creams and soaps. The use of this

category of products is extensive in most African countries including Cameroon.

With this reasoning, the quantity is calculated as follow: (4 424 tones x 13)/100 to obtain 572 tones of skin lightening creams and soaps per year.

- Raw import values (UNComTrade. 2009) were used for the consumption of batteries with mercury per year in Cameroon.

NB: Part of illegal trade flow in Cameroon is important so that the above estimates of domestic consumption of mercury-added products (lightening creams and soaps, button cell battery, lighting goods etc.) could only represent lower estimates. So more detailed study is need to document the exact consumption of products with mercury and mercury compounds in Cameroon.

9.3 Data gaps and priorities for potential follow up

Yet consumed in Cameroon, important data gap exist on the following source sub-categories

- Engine control Hg thermometers and other large industrial/speciality Hg thermometers. They can be found in ship engines as waste or spare parts in the ship yard ("Chantier Naval du Cameroon" in the sea port city of Douala) in Cameroon. It was not possible to obtain those data for the purpose of this report due to time constraints.

- Other mercury containing light sources and compact fluorescence lamps data could not been obtains from resources used for this study including the custom database. One reason is that lighting goods are imported as aggregates and custom services are not working with Rotterdam Convention and Basel Convention guidelines.

- The above similar reason stands for information gap on "Other batteries with mercury (plain cylindrical alkaline, permanganate, etc)" which are the most commonly used battery types in the country.

- Paint with mercury preservatives might exist in Cameroon among the rich range of latex paint (both imported and locally made) sometimes presented as having fungicide properties.

All these information/data gap need to be address during the update of the present inventory in order to reflect the real situation of the country concerning the management of mercury.

10 Data and inventory on crematoria and cemeteries

10.1 Data description

Crematoria practices are not applicable to Cameroon; however, cemeteries practices (both at the familial or municipal levels) are applicable to the Cameroon context. Data used here were obtained from the National Institute of Statistics (INS) on its Health Sector report.

10.2 Background calculations and approximations

Estimation was made on the basis of 19400 000 inhabitants and gross mortality rate of 8‰ combined with infant mortality rate of 74‰ from this gross mortality (INS database). We assume that only adults are buried in cemeteries after death. The final calculation give about 40 352 corpses buried per year.

Calculation:

Annual 8‰ mortality rate implies (19400 000 inhabitants x 8)/1000 or 155200 deaths per year. Only 26‰ of this total are adults and since the rationale behind this sub-category is found on the average number of amalgam fillings present on people at their death, adjusting the number of deaths to adults is wise.

The approximate adult death per year is obtained as follow: (155200 deaths x 26)/1000 or 4035.

10.3 Data gaps and priorities for potential follow up

Not applicable

11 List of major data gaps

Overall, the data gaps across various source categories could be listed as follows:

- Absence of data on extraction and processing of natural gas
- Uncertainty on whether "Gold extraction with mercury amalgamation without use of resort" is applicable or not considering the increase in ASGM activities in Cameroon since 2007 were in-situ survey were carried out by CREPD
- Absence of statistic on "Engine control mercury thermometers and other large industrial/speciality Hg thermometers
- Absence of statistics on the import of "Compact fluorescent lamps (CFL)"
- Absence of statistics on import of "Other mercury containing lighting sources"
- Not information on "Paint with mercury preservative", yet presence of latex paint with fungicide properties may suggest the presence of that kind of mercury source in Cameroon.

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Appendix 1 - Inventory Level 1 calculation spreadsheets

Not applicable