# INVENTORY OF MERCURY RELEASES IN MAURITIUS

## (LEVEL1)


February 2014

# Inventory of Mercury Releases in Mauritius

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This inventory was performed in accordance with UNEP's "Toolkit for identification and quantification of mercury releases", Inventory Level 1 (version 1.02, April 2013).

# Contents

# List of Abbreviations

| | |
|---|---|
| AGO | Attorney General's Office |
| CASFU | Competent Authority – Seafood Unit (Ministry of Fisheries) |
| CEB | Central Electricity Board |
| CWA | Central Water Authority |
| DCAC | Dangerous Chemicals Advisory Council |
| DCCB | Dangerous Chemicals Control Board |
| GoM | Government of Mauritius |
| Hg | Mercury |
| HS | Harmonized System Codes |
| LFG | Landfill Gas |
| LPG | Liquefied Petroleum Gas |
| MCCI | Mauritius Chamber of Commerce and Industry |
| MCIA | Mauritius Cane Industry Authority |
| MoEPU | Ministry of Energy and Public Utilities |
| MoESD | Ministry of Environment & Sustainable Development |
| MoICCP | Ministry of Industry, Commerce and Consumer Protection |
| MoLGOI | Ministry of Local Government and Outer Islands |
| MoLIRE | Ministry of Labour, Industrial Relations and Employment |
| MSB | Mauritius Standards Bureau |
| NEL | National Environmental Laboratory (MoESD) |
| PANeM | Pesticide Action Network (PAN) Mauritius |
| PVC | Polyvinyl Chloride |
| QSP TF | Quick Start Programme Trust Fund |
| SAICM | Strategic Approach to International Chemicals Management |
| UNDP | United Nations Development Programme |
| UNEP | United Nations Environment Programme |
| UNITAR | United Nations Institute for Training and Research |
| UoM | University of Mauritius |
| VCM | Vinyl Chloride Monomer |
| WMA | Waste water Management Authority |

# Acknowledgements

The SAICM Project Management Team first and foremost wishes to express its gratitude to the SAICM Quick Start Programme Trust Fund for providing the funding for the "*Partnership Initiative for the implementation of the Strategic Approach to International Chemicals Management (SAICM)*, under which the Level 1 Mercury Release Inventory was carried out.

Further thanks goes out to the Ministry of Environment & Sustainable Development for leading the establishment of a Mercury Focus Group[1] in Mauritius and chairing this group. The Mercury Focus Group has been instrumental in the gathering and identification of information and data related to Mercury releases in the country, and has played a critical role in the review and improvement of the National Inventory Report of Mercury Releases in Mauritius. In the period prior to the Minamata Convention coming into force, but also once the Convention has been ratified, the Mercury Focus Group will continue to advise the Government of Mauritius on Mercury issues relevant for the country.

The SAICM project Team is also grateful to the Ministry of Health & Quality of Life, for the guidance provided throughout the Mercury Releases Inventory and the provision of data and information in relation to the health sector and granted permits for importation of Mercury containing chemicals. Special thanks go to the Occupational Health Unit, the Dangerous Chemicals Control Board (DCCB) and the Project Steering Committee members, who with their expert knowledge and expertise have provided useful guidance throughout.

We would also like to thank the following stakeholders who have not only provided critical information and data necessary for the compilation of this Level 1 Mercury Inventory, but which have also supported the review and revisions of the report.

Ministry of Energy and Public Utilities (MoEPU); Ministry of Fisheries - Competent Authority – Seafood Unit (CASFU); Ministry of Local Government and Outer Islands (MoLG); Ministry of Labour, Industrial Relations and Employment (MoLIRE); Ministry of Industry, Commerce and Consumer Protection (MoICCP); Central Electricity Board (CEB); Central Water Authority (CWA); Mauritius Cane Industry Authority (MCIA); Pesticide Action Network Mauritius (PANeM); Waste water Management Authority (WMA); University of Mauritius (UoM); United Nations Development Programme (UNDP); United Nations Environment Programme (UNEP) and United Nations Institute for Training and Research (UNITAR).

A full list of the individuals who have contributed to the elaboration of the Mercury Inventory and the Report is available in the section "*Personal Contacts*".

[1] At the time of writing this report the group had 23 members. A list of the members is presented in Appendix 1 of this inventory report.

# Executive summary

The Republic of Mauritius signed the Minamata Convention on Mercury on October 10, 2013. As a first step in preparing the country for meeting future obligations under the Minamata Convention and take early action towards reducing releases of Mercury and safeguarding its population and environment, The Republic of Mauritius indicated the need for an inventory of Mercury releases in the country.

With involvement of all relevant national stakeholders and entities involved in aspects of Mercury management, such an inventory was undertaken during the second half of 2013 with the objective to identify the main sources of Mercury releases in the country. The results of this preliminary inventory are presented in this report, and subsequently are expected to inform the development and adoption of a National Action Plan (NAP) on Mercury.

This mercury release inventory for the Republic of Mauritius was conducted by making use of the UNEP (2013) "*Toolkit for Identification and Quantification of Mercury Releases- Level 1*". Where available, 2012 input data was used, however when such data was not available the most recently available data was used instead.

The main conclusions of the inventory are that in the Republic of Mauritius the following source groups contribute the most Mercury in terms of inputs:

- **Coal combustion and other coal use (96.2 Kg Mercury per year)**
- **Other fossil fuel and biomass combustion (83.2 Kg Mercury per year)**
- **Application, use and disposal of dental amalgam fillings (59.4 Kg Mercury per year)**
- **Use and disposal of other products (368.2 Kg Mercury per year)**

In terms of percentage of total releases in the country, the inventory indicates the following sources and their respective contributions to Mercury releases:

- **Coal combustion and other coal use (13%)**
- **Other fossil fuel and biomass combustion (12%)**
- **Application, use and disposal of dental amalgam fillings (6%)**
- **Use and disposal of other products (51%)**
- **Waste incineration and open waste burning (7%)**

It is noteworthy that the toolkit for Level 1 inventory has been based on a desk exercise and has generated estimated values for emissions and releases, based on some predetermined assumptions. For more accurate estimations of Hg emissions and releases, a level 2 inventory is required. The latter entails a more detailed methodology for estimating the values including via direct measurement and ground-truthing. E.g. for Mercury emissions from any particular raw materials, the Level 1 inventory has only considered the amount of raw material imported without taking into consideration the real level of mercury in the imported raw material and the various abatement technologies in place to reduce stack emission pollutants (e.g. for coal). Similarly, for Mercury emissions from landfills, the toolkit has considered the amount of waste generated per capita and the GDP of the country.

In addition to that, as per the Technical Advisory Committee (TAC) report on Coal Ash Management, the coal used in Mauritius is classified as bituminous and is of medium ash category. Tests carried out by National Environmental Laboratory in August 2007, in collaboration with Wastewater Management Authority Laboratory and Ministry of Health & QL, had revealed that Mercury was not detected in the leachate from coal bottom ash and coal fly ash.

**Chapter 1** of the report provides an overview of which Mercury release sources are present in Mauritius, which ones are not as well as which sources have not been positively identified.

**Chapter 2** of the report summarizes the Mercury inputs to the Mauritian society. Based on the inventory findings the largest contributions of mercury inputs to society are made by the following source sub-categories:

1. Controlled landfills/deposits (2,070 kg Hg/year)
2. Waste Water System/Treatment (205 kg Hg/year)
3. Electrical switches and relays with Mercury (181 kg Hg/year)
4. Coal combustion in large power plants (96 kg Hg/year)
5. Dental amalgam fillings (59 kg Hg/year)

**Chapter 3** provides a summary of Mercury releases. The following source sub-categories made the largest contributions to Mercury Releases to the atmosphere:

1. Coal combustion in large power plants (84.7 Kg Hg/year)
2. Biomass fired power and heat production (40.9 Kg Hg/year)
3. Charcoal combustion (24.1 Kg Hg/year)
4. Open Fire waste burning (on landfills and informally) (21.1 Kg Hg/year)
5. Controlled landfills/deposits (20.7 Kg Hg/year)

**Chapter 4** provides information on energy consumption and fuel production.
In Mauritius there is currently no oil extraction, oil refining or extraction and processing of natural gas. However natural gas exploration is forecasted for the future, when the Government of Mauritius, together with Seychelles, would start exploiting the Joint Management Area (JMA).

Coal (mostly imported from South-Africa) is used primarily for power generation by thermal coal power plants as well as bagasse power plants[2]. During crop season (June – December) a number of bagasse power plants generate power from bagasse, while during off-season they convert to burning coal. Bagasse represents 94% of the local energy sources, with hydro, wind, fuel wood and landfill gas making up the remainder of the local energy sources.A small fraction of coal is used in the manufacturing sector. Considering there are no refineries present on the island it appears that no petroleum coke is being used for power generation, however fuel oil is used for this purpose.

Petroleum products are intended mostly for the sectors of transport, electricity generation, manufacturing and to a minor level household (LPG and kerosene), commercial and agriculture. Currently, there is no use of raw or pre-cleaned natural gas as Mauritius doesn't produce natural gas and no pipeline transporting natural gas exists between Mauritius and the main land. In Mauritius the distribution of gas (LPG) for domestic consumption is done in 6 and 12-kg metallic bottles. Finally, there is some fuel wood burning using local resources.

[2] Bagasse is a biomass derived from the processing of sugarcane. During crop season a number of bagasse power plants generate power from bagasse, while during off-season they convert to burning coal.

**Chapter 5** provides data on the domestic production of metals and raw materials
In Mauritius there is no domestic production of metals and raw materials. No primary metal production or other materials production takes place, which might directly or indirectly lead to releases of Mercury. In the past, Mauritius has primary ferrous metal production (pig iron production), however this production sector has stopped operating and currently only secondary metal production from recycled materials (iron bar production) is taking place (See chapter 7). Although Cement brand leaders are present in Mauritius they only distribute and repackage into smaller bags. As at 2013, no cement manufacturing takes place in Mauritius, however the Government of Mauritius has signalled its interest to allow a private cement making plant to operate in the region of Port Louis. With respect to pulp and paper production, only paper recycling is done.

The only remaining data gap might be related to the jewellery sector as in the past especially the informal jewellery sector has been known to use Mercury. Further data collection in this regard would be necessary.

**Chapter 6** provides data on domestic production and processing with the intentional use of Hg
In Mauritius there is no domestic production of chemicals, which involves the use of a Mercury catalyst or Mercury cells. The manufacturing of Polyvinyl Chloride (PVC) pipes use Vinyl Chloride Monomer (VCM), which is imported as pellets, but locally VCM is not produced.

It was also deemed unlikely that production of products with Mercury content (such as thermometers with Mercury, light sources with Mercury, Manometers/gauges with Mercury, biocides & pesticides with Mercury, batteries with Mercury, paints with Mercury or skin lightening creams and soaps with Mercury) is taking place, based on the limited quantities of Mercury that are imported on a yearly basis.

**Chapter 7** summarizes data and information on waste handling and recycling
No production of recycled Mercury is taking place in Mauritius. Certain companies recycle metals and produced metal iron bars to be used for construction. However, the amount of recycled ferrous metals is currently unknown. No incinerator for municipal/general waste is available in Mauritius. The engineered landfill at Mare Chicose is the only engineered landfill site in the country and it is assumed most collected refuse is deposited here and properly managed. According to the United Nations Statistical Division (UNSD, 2011), in 2009, 98% of the total population was served by municipal waste collection in Mauritius (not counting outer islands). In 2011, the total amount of municipal/general waste landfilled at Mare Chicose was 414,000 tonnes (MoLGOI, 2012). It is assumed about 4,224 tonnes/year is illegally dumped and a similar amount of waste is yearly burned in the open.

According to the 2012 Mauritius Hazardous Waste Inventory several types of hazardous wastes are incinerated in Mauritius (~715 tonnes/yr). Incineration and open Burning of Medical Waste is also practised (~552 tonnes/year). In Mauritius, the incineration of sewerage sludge is not practiced. Instead sewerage sludge (1,210 tonnes of dried solids/yr) is disposed by the Mauritius Waste Water Management Authority (WMA) at the Mare Chicose landfill. Mauritius produced and treated about 39.1 $Mm^3$ of waste water in 2012.

**Chapter 8** presents data and inventory results on general consumption of mercury in products, as metal mercury and as mercury containing substances. The chapter contains data on the amount of Mercury used in dental amalgam, thermometers, Mercury containing light sources, Mercury containing batteries, chemicals compounds containing Mercury, paints containing Mercury preservatives, toys containing Mercury etc. and elemental Mercury being imported on a yearly basis. As is indicated in the introduction, the estimation of the amount of Mercury contained in such products and the number of Mercury containing products imported on a yearly basis, requires further research as many uncertainties were identified.

**Chapter 9** presents data and inventory on crematoria and cemeteries.

**Chapter 10** summarizes quantities of Mercury containing products as wastes. The Mercury inventory has exclusively researched Mercury releases and not quantities/volumes of Mercury containing wastes that are currently being stored. However in certain cases the researchers came across information that seemed of interest to future Mercury related work and for the purpose of safekeeping, such information was captured. However it has to be kept in mind that the list of Mercury containing wastes listed is only a fraction of the Mercury containing wastes present in Mauritius.

# Introduction

With financial support provided by the SAICM Quick Start Programme Trust Fund (QSP TF), the Mauritius Ministry of Health and Quality of Life (MoHQL), the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP) are implementing the project "*Partnership Initiative for the implementation of the Strategic Approach to International Chemicals Management (SAICM)*."

The project aims to support the Government of Mauritius in its efforts to assess their capacity for the Sound Management of Chemicals (SMC), identify needs, and ultimately integrate identified priorities into national MDG-based development policies and plans.

As part of the project, an assessment of Mercury releases in Mauritius to identify its sources and emissions was also undertaken. Findings from this assessment are intended to inform the Government of Mauritius in their decision to accept or ratify the Minamata Convention on Mercury, as well as start discussions on the management options for Mercury releases in Mauritius. Ultimately, the Mercury release inventory is expected to inform the development of an Early Action Plan for Mercury, which will also be developed as part of the same SAICM project.

The level 1 inventory, led by the Ministry of Environment and Sustainable Development (MoESD) in partnership with the Ministry of Health and Quality of Life (MoHQL) and under the guidance of the SAICM project team, started in June 2013 and concluded in January 2014.

To support the assessment and to provide data, information and insight into various aspects pertaining to potential Mercury releases, a Mercury Focus Group was set-up under the lead of MoESD (Its first meeting took place on Wednesday 3 September 2013).

The Mercury Focus group consists of 35 members, representing various stakeholders involved in aspects related to Mercury Management (in Appendix 1, a list of the members of the Mercury Focus Group is provided). It is expected that the Mercury Focus Group will continue its efforts in improving the management of Mercury and reducing releases of Mercury beyond the scope of the SAICM project.

As previously mentioned, this inventory was developed in *2013*. Data for the year *2012* have been used in the inventory, when available. For some data types, data from this year have not been available. The year for all data given is noted with the data in question in the relevant sections of this report.

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

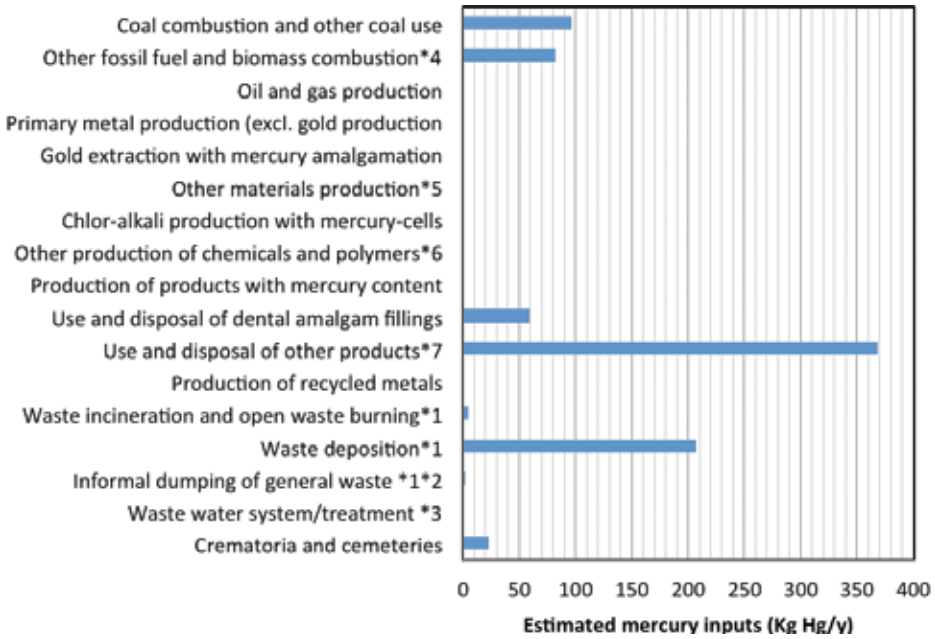
This inventory was developed on the Toolkit's Inventory Level 1[3]. The Toolkit is based on mass balances for each mercury release source type. Inventory Level 1 works with pre-determined factors used in the calculation of mercury inputs to society and releases, the so-called default input factors and default output distribution factors. These factors were derived from data on mercury inputs and releases from the relevant mercury source types from available literature and other relevant data sources.

Throughout the Level 1 Inventory, certain Mercury related data and information was obtained that was not required to complete the Level 1 inventory, however which data/information could proof useful for a future Level 2 Mercury inventory or specific Mercury management related activities. With the objective of safeguarding this information and allowing easy access to it for interested parties and/or a future level 2 inventory, it was captured nevertheless and incorporated into specific sections of the report.

**Results and discussion**

An aggregated presentation of the results for main groups of mercury release sources is presented in Figure 1 - 7 and Table 1 below.

*Figure 1: Estimated mercury inputs (Kg of Mercury per year)*




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

*Figure 2: Estimated mercury releases to air (Kg Hg/y)*

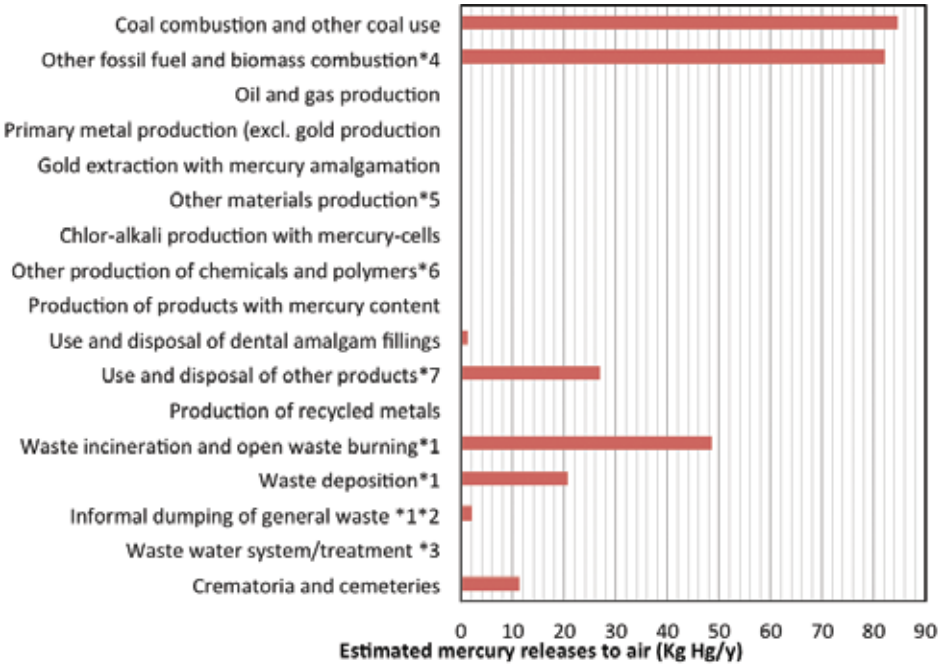



*Figure 3: Estimated mercury releases to water (Kg Hg/y)*

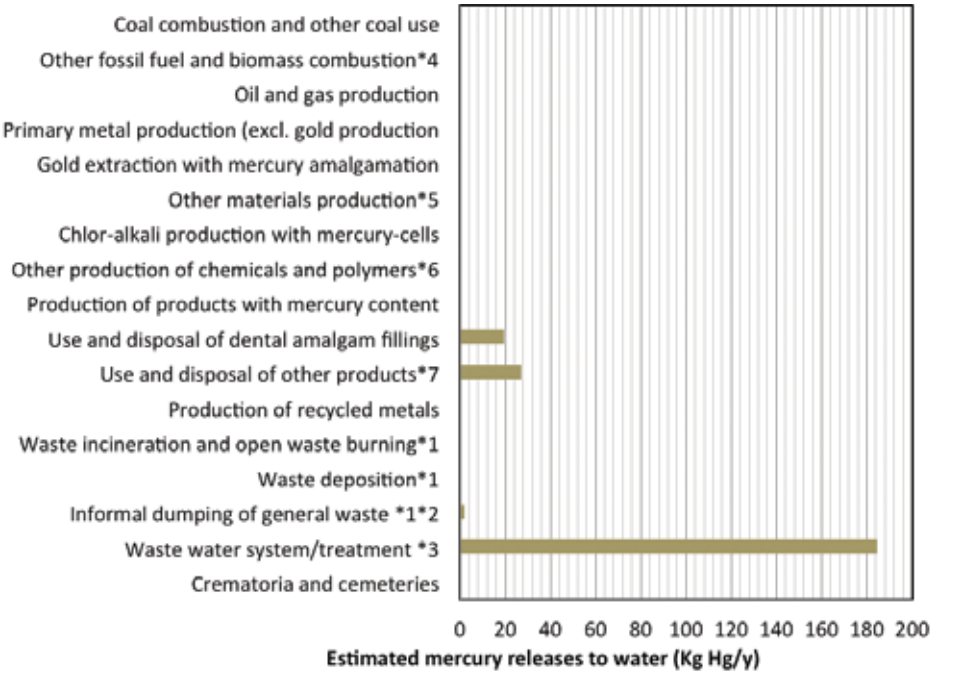


*Figure 4: Estimated mercury releases to land (Kg Hg/y)*

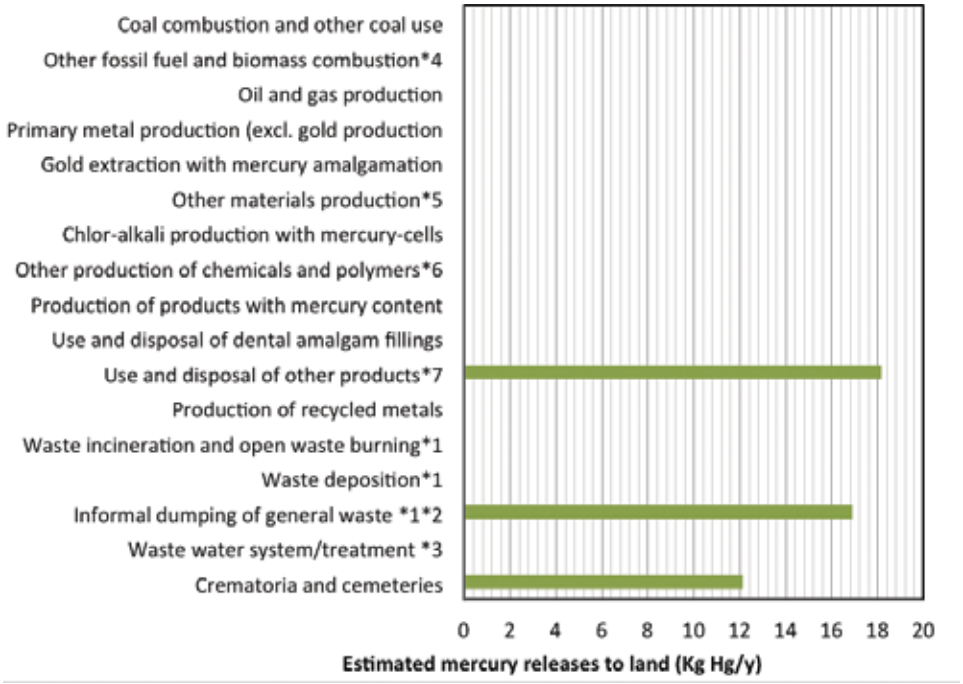



*Figure 5: Estimated mercury outputs to by-products and impurities (Kg Hg/y)*

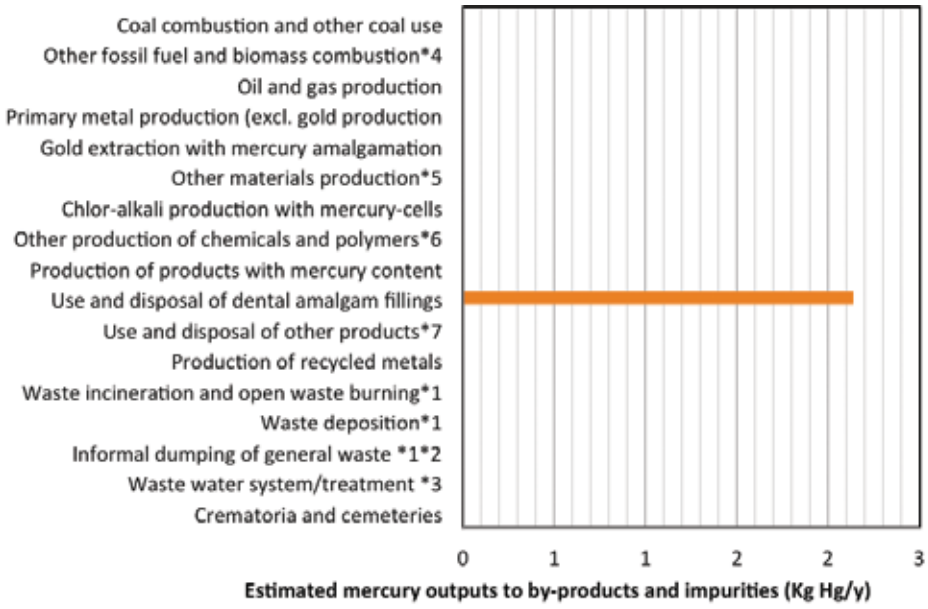


*Figure 6: Estimated mercury releases to general waste (Kg Hg/y)*

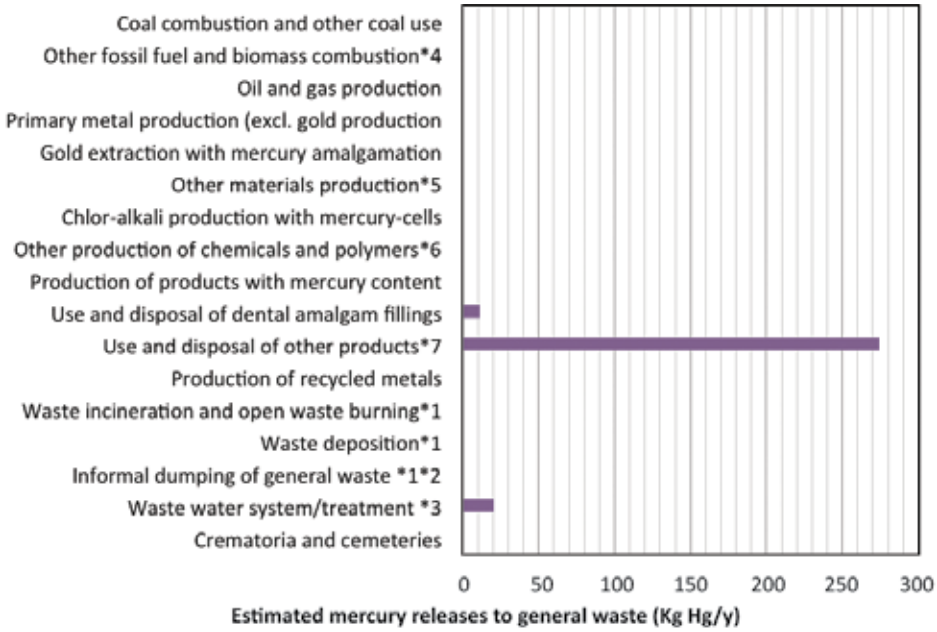
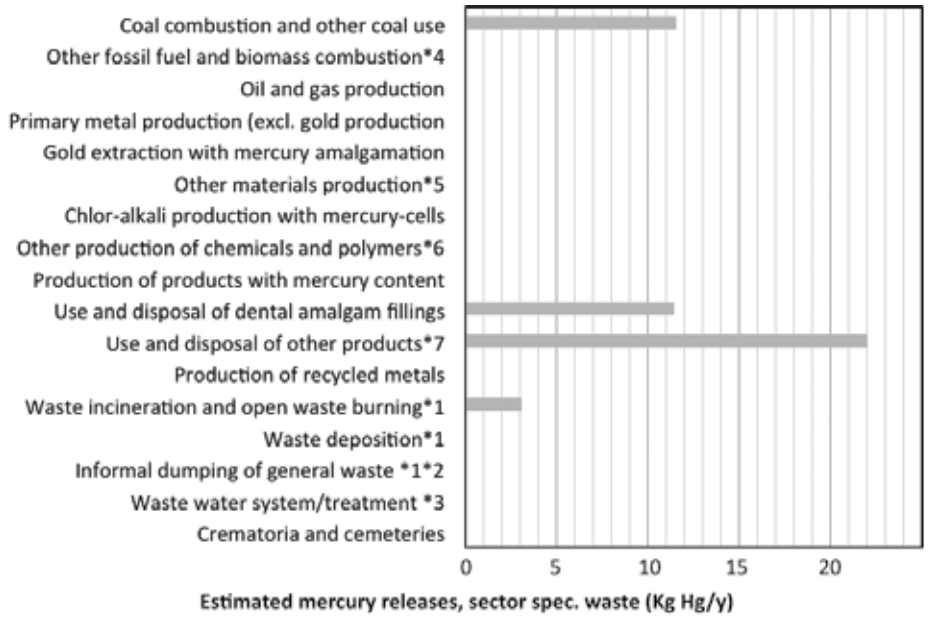



*Figure 7: Estimated mercury releases, sector specific waste (Kg Hg/y)*



*1: Waste is not an original source to mercury input to society. To avoid double counting of mercury inputs from waste and products in the graphs, only 10% of the mercury input to waste incineration, waste deposition and informal dumping is included in the chart for mercury inputs. These 10% represent approximately the mercury input to waste from materials, which were not quantified individually in Inventory Level 1 of this Toolkit. See Appendix 1 to the Inventory Level1 Guideline for more explanation.

*2: Waste is not an original source to mercury input to society. The estimated quantities include mercury in products, which has also been accounted for under each product category. To signal the importance of this release pathway, the release to land from informal dumping of general waste has NOT been subtracted in the charts.

*3: Wastewater is not an original source to mercury input to society. The estimated input and release to water include mercury amounts which have also been accounted for under each source category. To avoid double counting, input to waste water system/treatment has been subtracted automatically in the charts. To signal the importance of this release pathway, releases to water via waste water system/treatment has NOT been adjusted in the charts in spite of double counting.

*4: Includes petroleum coke, heavy oil, diesel, gasoil, petroleum, kerosene, natural gas, charcoal and other bio-fuels.

*5: Includes production of cement and pulp and paper.

*6: Includes production of VCM and acetaldehyde.

*7: Includes thermometers, electrical switches and relays, light sources, batteries, polyurethane with Hg catalyst, paints and skin creams with Hg, blood pressure gauges and other manometers, lab chemicals, and other lab and medical uses.

*Table 1: Summary of mercury inventory results*

| Source category | Estimated Hg input, Kg Hg/y | Estimated Hg releases, standard estimates, Kg Hg/y | | | | | | | Percent of total releases *3*4 |
|---|---|---|---|---|---|---|---|---|---|
| | | Air | Water | Land | By-products and impurities | General waste | Sector specific waste treatment /disposal | Total releases *3*4*5 | |
| Coal combustion and other coal use | 96.2 | 84.7 | 0.0 | 0.0 | 0.0 | 0.0 | 11.5 | 96 | 14% |
| Other fossil fuel and biomass combustion | 82.1 | 82.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 82 | 12% |
| Oil and gas production | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0% |
| Primary metal production (excl. gold production by amalgamation) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0% |
| Gold extraction with mercury amalgamation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0% |
| Other materials production | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0% |
| Chlor-alkali production with mercury-cells | - | - | - | - | - | - | - | 0 | 0% |
| Other production of chemicals and polymers | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0% |
| Production of products with mercury content*1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0% |
| Application, use and disposal of dental amalgam fillings | 59.4 | 1.2 | 19.7 | 0.0 | 2.1 | 11.4 | 11.4 | 46 | 6% |
| Use and disposal of other products | 368.2 | 26.8 | 27.1 | 18.1 | 0.0 | 274.1 | 22.0 | 368 | 52% |
| Production of recycled metals | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0% |
| Waste incineration and open waste burning*2 | 51.5 | 48.5 | 0.0 | 0.0 | 0.0 | 0.0 | 3.0 | 52 | 7% |
| Waste deposition*2 | 2,070.0 | 20.7 | 0.2 | 0.0 | - | - | - | 21 | 3% |
| Informal dumping of general waste *2*3 | 21.1 | 2.1 | 2.1 | 16.9 | - | - | - | 4 | 1% |
| Waste water system/treatment *4 | 205.3 | 0.0 | 184.7 | 0.0 | 0.0 | 20.5 | 0.0 | 21 | 3% |
| Crematoria and cemeteries | 23.3 | 11.2 | 0.0 | 12.1 | 0.0 | 0.0 | 0.0 | 23 | 3% |
| **TOTALS (rounded) *1*2*3*4*5** | **840** | **280** | **50** | **30** | **0** | **310** | **50** | **710** | **100%** |

**Notes to table above:**

*1 To avoid double counting of mercury in products produced domestically and sold on the domestic market (including oil and gas), only the part of mercury inputs released from production are included in the input TOTAL.

*2: To avoid double counting of mercury inputs from waste and products in the input TOTAL, only 10% of the mercury input to waste incineration, waste deposition and informal dumping is included in the total for mercury inputs. These 10% represent approximately the mercury input to waste from materials which were not quantified individually in Inventory Level 1 of the Toolkit.

*3: The estimated quantities include mercury in products which has also been accounted for under each product category. To avoid double counting, the release to land from informal dumping of general waste has been subtracted automatically in the TOTALS.

*4: The estimated input and release to water include mercury amounts which have also been accounted for under each source category. To avoid double counting, input to, and release to water from, waste water system/ treatment have been subtracted automatically in the TOTALS.

*5: Total inputs do not necessarily equal total outputs due to corrections for double counting (see notes*1-*3) and because some mercury follows products/metal mercury which are not sold in the same country or in the same year.

As shown in the table 1 and Figures 1 - 7, the following **source groups** contribute with the major mercury inputs:

- Coal combustion and other coal use;
- Other fossil fuel and biomass combustion;
- Application, use and disposal of dental amalgam fillings; and,
- Use and disposal of other products.

The origin of mercury in waste and wastewater produced in the country is mercury in products and materials. Waste fractions and wastewater do therefore not represent original mercury inputs to society (except imported waste). Waste and wastewater may however represent substantial flows of mercury through society. The following were found to be the major flows of mercury with waste and wastewater: Waste deposition and Waste water system/treatment.

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

The Toolkit spreadsheets used in the development of this inventory are posted along with this report, or can be submitted upon request.

**Data gaps**
Major data gaps were the following:

The most challenges were encountered by identifying and obtaining the data and information necessary to complete Step 6 of the inventory (Hg products and substances). The Metrology Unit of the Mauritius Standards Bureau (MSB), the Dangerous Chemicals Control Board (DCCB), the Ministry of Environment as well as other stakeholders have been very helpful in providing insight in the number of Hg containing thermometers and medical blood pressure meters that were being calibrated each year and an assessment of the number of Mercury

containing thermometers and sphygmomanometers that was carried out in 2007 (See Chapter 8).

However based on 2012 import records obtained from the Mauritius Statistical Bureau (http://statsmauritius.gov.mu/English/Pages/default.aspx), the Harmonized System Codes (HS) codes which describe a category such as "*Thermometers, not with other instruments, liquid-filled for direct reading*" does not allow for drawing a conclusion whether a thermometer does or does not contain Mercury. It is assumed that this particular category has been overestimated.

It would be advised that Step 6 of the inventory (which focuses on *data collection and inventory of the consumption of mercury contained in products, as metal mercury and as mercury containing substances*) will be further improved. Preferably such research would be undertaken as part of a level 2 inventory. Such an assessment should also work closely with various local equipment suppliers/distributors so that data collection captures the use of such products in the public, private and domestic sector.

A similar challenge was encountered for sphygmomanometers, which did appear in the 2012 import records as a separate category. It is certain though that sphygmomanometers are imported on a yearly basis, however exact import numbers are unknown as so it the ratio of Mercury-free versus Mercury containing sphygmomanometers. The MSB calibrates very few sphygmomanometers, but it is thought that most senior private medical practitioners possess one as they are very reliable and have sentimental value to the owner.

The HS codes for various light sources alone were not sufficient to provide a final conclusion on the number of Mercury containing light sources. In retrospect, emissions from these sources seemed to be on the high-end. It would be recommended that either the level 1 inventory can be improved by carrying out an assessment among distributors and importers on the number of Mercury lamps imported each year, their origin and an indication of the range of Mercury content. Such an assessment could also be carried out as part of a level 2 inventory.

For step 5 "*Waste Treatment and Recycling*", the data that was not obtained, but for which it was certain that activities were present in Mauritius, was the production of recycled ferrous metals (and the number of recycled vehicles a year).

Finally, for Step 8 "*Miscellaneous Hg release sources*" the responses provided in the Excel toolkit were mostly based on inputs received from the various government and public institutions knowledgeable in various sectors. Inputs were recorded based on personal experience rather than on factual information and data, however in most cases it was felt that the experience of the institutions was relatively accurate. Only for a few categories, institutions were uncertain whether such activities were or were not executed in Mauritius. Those categories have been indicated with a "?".

Additional information is also needed on the amount of Mercury, which is used in the jewellery sector in Mauritius. Based on a survey conducted by the Assay Office in 2007 (see Appendix 4) it is estimated that approximately 7 kg of Mercury/year is used to clean gold jewellery, recuperate gold from waste, purify and/or refine gold by jewellery shops which are generally small family-owned businesses with no formal operation procedures and waste disposal schemes. Import records however do not show this amount of elemental Mercury being imported each year.

In order to obtain additional clarifications, the Mauritius Assay office (part of the Ministry of Industry, Commerce and Consumer Protection) might be of help, as well as visiting some of the jewellery businesses to assess their practices and determine whether they have already made a shift to alternative methods or are applying retorts, might also be very useful.

**Main priorities for further assessment:**

- Considering the "*Use and disposal of other products*" seems to be the most significant input category of Mercury in Mauritius and is significantly influencing and impacting the outcomes of the Mercury assessment, it is therefore of the utmost importance that the data presented in Step 6 "Mercury products and substances" of the level 1 inventory accurately reflects the current situation. Either this data could be specifically improved for Step 6, or additional emphasis could be placed on this category during a level 2 inventory. Particular focus should be on Mercury containing **thermometers** and **sphygmomanometers**, Mercury containing **batteries**[4] and **light sources** with Mercury. Not only was the import data often unclear or even absent for certain Mercury containing products (e.g. sphygmomanometer), import data groups products and items by HS code. These HS codes do not distinguish between for example a Mercury containing thermometer or Mercury-free thermometers, neither do HS codes distinguish between CFLs and fluorescent tubes (which have a different Mercury content), in addition based on brands the Mercury content in energy efficient lamps can also dramatically vary. That said, import data needs to be compared and cross checked with information and data obtained through other sources (e.g. importers/distributors; centralized purchasing departments for the ministry of Health; conducting assessments/survey among users, etc.), in order to paint a holistic picture of the current situation. Such efforts to collect additional data could be carried out as part of this level 1 inventory, or additional emphasis could be placed on these Mercury sources as part of a level 2 inventory.

- **Jewellery Sector**: As previously mentioned, the jewellery sector should be assessed in more detail with respect to current use of Mercury.

- **Cosmetics/Paints**: Other areas of need, as suggested by some of the national stakeholders are areas such as cosmetics[5] (which might contain Mercury), paints (metallic paints might contain Mercury while imported road paint certainly does).

- **Mercury content of fuel for energy generation as well as incinerated hazardous wastes:** Others areas, which should be further explored are the specifications, origin and Mercury content of the consumer gas, coal, and heavy oil imported into Mauritius as well as hazardous wastes containing levels of Mercury that are being incinerated.

- **Releases from Compost**: Other suggestions include verifying Mercury releases from compost products, as it was suggested that segregation at times is sometimes not very effective.

[4] Mauritius Telecom is supporting a recycling campaign, which could be a useful source to characterize the amount of button cells collected, to extrapolate this data to come up with a more realistic estimate of the number of button cells imported on a yearly basis.

[5] According to the Pharmacy Board, the trade of Hg containing cosmetic is completely banned in Mauritius, Mercury-free cosmetics cannot be guaranteed for shipments received through unregistered imports. Recently there has been a case where mercury containing whitening creams have been seized by the authorities. Mercury and its compounds are listed as a Poison in the 1st schedule of the Pharmacy Act. The Pharmacy Board is working on strengthening the enforcement to ban mercury containing cosmetics on the market.Testing of incoming cosmetics and other products suspected of containg mercury will be made mandatory in the future.

- **Electrical switches**: Another areas of further research could be electrical switches. Information in this area could potentially be provided by the Mechanics or automobile electricians.

- **Storage of Mercury Waste**: As concluded in Chapter 9, there are currently no hazardous waste disposal solutions in Mauritius which could accept Mercury waste or Mercury containing waste products for either disposal or treatment. As a result most of the Mercury containing waste either ends up in the engineered Mare Chicose landfill or is kept in storage on the premises of private sector and public entities awaiting the identification of final disposal/treatment solutions. In addition it is known that certain facilities keep stockpiles of Mercury waste, which vary from a few kilograms to tens of kilograms, but an in-depth inventory on the quantities of Mercury containing wastes kept at facilities (NGOs, Laboratories, Schools, industries, etc.) has not yet been carried out. As part of a future level 2 inventory this aspect should be taken into consideration.

- **Production of recycled ferrous metals (iron and steel)**: Another area which needs further data collection is the production of recycled ferrous metals. Certain companies recycle metals and produced metal iron bars to be used for construction [MoLGOI/AI, 2012). However, the amount of recycled ferrous metals is currently unknown (which is expressed in the toolkit as number of vehicles recycled/year). Until data/ information has been obtained in this respect, this value has been left blank.

- **Waste handling and recycling**. The Level 1 inventory looked predominantly at the island of Mauritius because figures on municipal waste collection and disposal were relatively easily accessible. On the other hand though, the situation with respect to municipal waste collection on the outer islands should also be taken into consideration. During a level 2 inventory, it would be worthwhile to look more into waste collection and disposal on the outer islands.

- **Mercury containing dental amalgam**: Although import records do not provide any information on the quantities of dental amalgam that are imported on a yearly basis, the Dental Services of the Ministry of Health confirmed that public dental institutions still use dental Hg amalgam. Currently, there is no dental amalgam phase-out plan in place although dental amalgam, following recommendations by the MoHQL is not used for children and pregnant women. No specific waste management practices for Mercury containing waste streams are being promoted or have been put in place, except for a few dentists, which store excess amalgam in air-tight containers in their offices.

  During a level 2 inventory (or in the period to come) it will be important to determine the amount of dental amalgam being imported on a yearly basis and to obtain a sense of the use of alternative filling versus amalgam fillings. Furthermore early action could be promoted towards the phase-out of the use of dental amalgam while improving waste management practices of amalgam containing waste to minimize releases to the environment.

# 1 Mercury release source types present

Table 2 shows which mercury release sources were identified as present or absent in the country. 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 3 were not included in the detailed source identification and quantification work. These may however be present in some countries.

*Table 2: 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 | Y |
| Other coal uses | Y |
| Combustion/use of petroleum coke and heavy oil | Y |
| Combustion/use of diesel, gasoil, petroleum, kerosene | Y |
| Use of raw or pre-cleaned natural gas | N |
| Use of pipeline gas (consumer quality) | N |
| Biomass fired power and heat production | Y |
| Charcoal combustion | Y |
| **Fuel production** | |
| Oil extraction | N |
| Oil refining | N |
| Extraction and processing of natural gas | N |
| **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 | N |
| Alumina production from bauxite (aluminum production) | N |
| Primary ferrous metal production (pig iron production) | N |
| Gold extraction with mercury amalgamation - without use of retort | N |
| Gold extraction with mercury amalgamation - with use of retorts | N |
| **Other materials production** | |
| Cement production | N |
| Pulp and paper production | N |
| **Production of chemicals** | |
| Chlor-alkali production with mercury-cells | N |
| VCM production with mercury catalyst | N |
| Acetaldehyde production with mercury catalyst | N |
| **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 guideline) | N |
| Batteries with mercury | N |
| Manometers and gauges with mercury | N |
| Biocides and pesticides with mercury | N |
| Paints with mercury | N |
| Skin lightening creams and soaps with mercury chemicals | N |

| **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 | N |
| Polyurethane (PU, PUR) produced with mercury catalyst | Y |
| Paints with mercury preservatives | N |
| Skin lightening creams and soaps with mercury chemicals | N |
| 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 | N |
| Incineration of hazardous waste | Y |
| Incineration and open burning 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 | Y |
| Cemeteries | Y |

*Table 3: 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 | Y |
| Production of lime | Y |
| Production of light weight aggregates (burnt clay nuts for building purposes) | N |
| Production of other chemicals (than chlorine and sodium hydroxide) in Chlor-alkali facilities with mercury-cell technology | N |
| Polyurethane production with mercury catalysts | N |
| Seed dressing with mercury chemicals | N |
| Infra red detection semiconductors | ? |
| Boogie tubes and Cantor tubes (medical) | N |
| Educational uses | Y |
| Gyroscopes with mercury | N |
| Vacuum pumps with mercury | ? |
| Mercury used in religious rituals (amulets and other uses) | Y |
| Mercury used in traditional medicines (Ayurveda and others) and homeopathic medicine | N |
| Use of mercury as a refrigerant in certain cooling systems | N |
| Light houses (leveling bearings in marine navigation lights) | Y |
| Mercury in large bearings of rotating mechanic parts in for example older waste water treatment plants | N |
| Tanning | Y |
| Pigments | Y |
| Products for browning and etching steel | N |
| Certain color photograph paper types | ? |
| Recoil softeners in rifles | N |
| Explosives (mercury-fulminate a.o.) | ? |
| Fireworks | ? |
| Executive toys | ? |

# 2 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 contain mercury in trace concentrations.

*Table 4: 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 | Y | 641,400 | Coal combusted, t/y | 96 |
| Other coal uses | Y | 0 | Coal used, t/y | 0 |
| Combustion/use of petroleum coke and heavy oil | Y | 258,400 | Oil product combusted, t/y | 14 |
| Combustion/use of diesel, gasoil, petroleum, kerosene | Y | 527,700 | Oil product combusted, t/y | 3 |
| Use of raw or pre-cleaned natural gas | N | 0 | Gas used, $Nm^3/y$ | - |
| Use of pipeline gas (consumer quality) | N | 0 | Gas used, $Nm^3/y$ | - |
| Biomass fired power and heat production | Y | 1,363,300 | Biomass combusted, t/y | 41 |
| Charcoal combustion | Y | 201,000 | Charcoal combusted, t/y | 24 |
| **Fuel production** | | | | |
| Oil extraction | N | 0 | Crude oil produced, t/y | - |
| Oil refining | N | 0 | Crude oil refined, t/y | - |
| Extraction and processing of natural gas | N | 0 | Gas produced, $Nm^3/y$ | - |
| **Primary metal production** | | | | |
| Mercury (primary) extraction and initial processing | N | 0 | Mercury produced, t/y | - |
| Production of zinc from concentrates | N | 0 | Concentrate used, t/y | - |
| Production of copper from concentrates | N | 0 | Concentrate used, t/y | - |
| Production of lead from concentrates | N | 0 | Concentrate used, t/y | - |
| Gold extraction by methods other than mercury amalgamation | N | 0 | Gold ore used, t/y | - |
| Alumina production from bauxite (aluminium production) | N | 0 | Bauxite processed, t/y | - |
| Primary ferrous metal production (pig iron production) | N | 0 | Pig iron produced, t/y | - |
| Gold extraction with mercury amalgamation - without use of retort | N | 0 | Gold produced, kg/y | - |
| Gold extraction with mercury amalgamation - with use of retorts | N | 0 | Gold produced, kg/y | - |
| **Other materials production** | | | | |
| Cement production | N | 0 | Cement produced, t/y | - |
| Pulp and paper production | N | 0 | Biomass used for production, t/y | - |
| **Production of chemicals** | | | | |
| Chlor-alkali production with mercury-cells | N | 0 | Cl2 produced, t/y | - |
| VCM production with mercury catalyst | N | 0 | VCM produced, t/y | - |
| Acetaldehyde production with mercury catalyst | N | 0 | Acetaldehyde produced, t/y | - |
| **Production of products with mercury content** | | | | |
| Hg thermometers (medical, air, lab, industrial etc.) | N | 0 | Mercury used for production, kg/y | - |

| | | | | |
|---|---|---|---|---|
| Electrical switches and relays with mercury | N | 0 | Mercury used for production, kg/y | - |
| Light sources with mercury (fluorescent, compact, others: see guideline) | N | 0 | Mercury used for production, kg/y | - |
| Batteries with mercury | N | 0 | Mercury used for production, kg/y | - |
| Manometers and gauges with mercury | N | 0 | Mercury used for production, kg/y | - |
| Biocides and pesticides with mercury | N | 0 | Mercury used for production, kg/y | - |
| Paints with mercury | N | 0 | Mercury used for production, kg/y | - |
| Skin lightening creams and soaps with mercury chemicals | N | 0 | Mercury used for production, kg/y | - |
| **Use and disposal of products with mercury content** | | | | |
| Dental amalgam fillings ("silver" fillings) | Y | 1,303,717 | Number of inhabitants | 59 |
| Thermometers | Y | 2,922 | Items sold/y | 6 |
| Electrical switches and relays with mercury | Y | 1,303,717 | Number of inhabitants | 181 |
| Light sources with mercury | Y | 4,469,961 | Items sold/y | 70 |
| Batteries with mercury | Y | 0 | t batteries sold/y | 0 |
| Polyurethane (PU, PUR) produced with mercury catalyst | Y | 1,303,717 | Number of inhabitants | 39 |
| Paints with mercury preservatives | N | 0 | Paint sold, t/y | - |
| Skin lightening creams and soaps with mercury chemicals | N | 0 | Cream or soap sold, t/y | - |
| Medical blood pressure gauges (mercury sphygmomanometers) | Y | 0 | Items sold/y | 0 |
| Other manometers and gauges with mercury | Y | 1,303,717 | Number of inhabitants | 6 |
| Laboratory chemicals | Y | 1,303,717 | Number of inhabitants | 13 |
| Other laboratory and medical equipment with mercury | Y | 1,303,717 | Number of inhabitants | 52 |
| **Production of recycled of metals** | | | | |
| Production of recycled mercury ("secondary production") | N | 0 | Mercury produced, kg/y | - |
| Production of recycled ferrous metals (iron and steel) | Y | 0 | Number of vehicles recycled/y | 0 |
| **Waste incineration** | | | | |
| Incineration of municipal/general waste | N | 0 | Waste incinerated, t/y | - |
| Incineration of hazardous waste | Y | 715 | Waste incinerated, t/y | 17 |
| Incineration and open burning of medical waste | Y | 552 | Waste incinerated, t/y | 13 |
| Sewage sludge incineration | N | 0 | Waste incinerated, t/y | - |
| Open fire waste burning (on landfills and informally) | Y | 4,224 | Waste burned, t/y | 21 |
| **Waste deposition/landfilling and waste water treatment** | | | | |
| Controlled landfills/deposits | Y | 414,000 | Waste landfilled, t/y | 2,070 |
| Informal dumping of general waste *1 | Y | 4,224 | Waste dumped, t/y | 21 |
| Waste water system/treatment | Y | 39,100,000 | Waste water, m3/y | 205 |
| **Crematoria and cemeteries** | | | | |
| Crematoria | Y | 4,480 | Corpses cremated/y | 11 |
| Cemeteries | Y | 4,854 | Corpses buried/y | 12 |
| **TOTAL of quantified inputs*1*2*3** | | | | **850** |

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

1. Controlled landfills/deposits (2,070 kg Hg/yr)[6];

2. Waste Water System/Treatment (205 kg Hg/yr);

3. Electrical switches and relays with mercury (181 kg Hg/yr);

4. Coal combustion in large power plants (96 kg Hg/yr).

5. Dental amalgam fillings (“silver” fillings) (59 kg Hg/yr)

[6] Note that this is much higher than the estimate of 346 kg Hg/yr, which was made by (V. Dookhun, K. Mahadeo, 2009). During a level 2 inventory this should be looked at more closely.

# 3 Summary of mercury releases

In the Table 5 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 treatment. 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 5 below for a more detailed description and definition of the output pathways.

*Table 5: Summary of mercury releases*

| Source category | Estimated Hg releases, standard estimates, Kg Hg/y | | | | | |
|---|---|---|---|---|---|---|
| | Air | Wa-ter | Land | By-products and impurities | General waste | Sector specific waste treatment /disposal |
| **Energy consumption** | | | | | | |
| Coal combustion in large power plants | 84.7 | 0.0 | 0.0 | 0.0 | 0.0 | 11.5 |
| Other coal uses | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Combustion/use of petroleum coke and heavy oil | 14.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Combustion/use of diesel, gasoil, petroleum, kerosene | 4.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Use of raw or pre-cleaned natural gas | - | - | - | - | - | - |
| Use of pipeline gas (consumer quality) | - | - | - | - | - | - |
| Biomass fired power and heat production | 40.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Charcoal combustion | 24.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Fuel production** | | | | | | |
| Oil extraction | - | - | - | - | - | - |
| Oil refining | - | - | - | - | - | - |
| Extraction and processing of natural gas | - | - | - | - | - | - |
| **Primary metal production** | | | | | | |
| Mercury (primary) extraction and initial pro-cessing | - | - | - | - | - | - |
| Production of zinc from concentrates | - | - | - | - | - | - |
| Production of copper from concentrates | - | - | - | - | - | - |
| Production of lead from concentrates | - | - | - | - | - | - |
| Gold extraction by methods other than mercu-ry amalgamation | - | - | - | - | - | - |
| Alumina production from bauxite (aluminium production) | - | - | - | - | - | - |
| Primary ferrous metal production (pig iron production) | - | - | - | - | - | - |
| Gold extraction with mercury amalgamation - without use of retort | - | - | - | - | - | - |
| Gold extraction with mercury amalgamation - with use of retorts | - | - | - | - | - | - |
| **Other materials production** | | | | | | |
| Cement production | - | - | - | - | - | - |
| Pulp and paper production | - | - | - | - | - | - |
| **Production of chemicals** | | | | | | |
| Chlor-alkali production with mercury-cells | - | - | - | - | - | - |
| VCM production with mercury catalyst | - | - | - | - | - | - |
| Acetaldehyde production with mercury cata-lyst | - | - | - | - | - | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| **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) | 1.2 | 19.7 | 0.0 | 2.1 | 11.4 | 11.4 |
| Thermometers | 0.6 | 1.9 | 0.0 | 0.0 | 3.7 | 0.0 |
| Electrical switches and relays with mercury | 18.1 | 0.0 | 18.1 | 0.0 | 145.1 | 0.0 |
| Light sources with mercury | 3.5 | 0.0 | 0.0 | 0.0 | 66.9 | 0.0 |
| Batteries with mercury | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Polyurethane (PU, PUR) produced with mercury catalyst | 3.9 | 1.9 | 0.0 | 0.0 | 33.0 | 0.0 |
| Paints with mercury preservatives | - | - | - | - | - | - |
| Skin lightening creams and soaps with mercury chemicals | - | - | - | - | - | - |
| Medical blood pressure gauges (mercury sphygmomanometers) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Other manometers and gauges with mercury | 0.6 | 1.9 | 0.0 | 0.0 | 3.9 | 0.0 |
| Laboratory chemicals | 0.0 | 4.3 | 0.0 | 0.0 | 4.3 | 4.4 |
| Other laboratory and medical equipment with mercury | 0.0 | 17.1 | 0.0 | 0.0 | 17.1 | 17.6 |
| **Production of recycled of metals** | | | | | | |
| Production of recycled mercury ("secondary production") | - | - | - | - | - | - |
| Production of recycled ferrous metals (iron and steel) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Waste incineration** | | | | | | |
| Incineration of municipal/general waste | - | - | - | - | - | - |
| Incineration of hazardous waste | 15.4 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 |
| Incineration and open burning of medical waste | 11.9 | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 |
| Sewage sludge incineration | - | - | - | - | - | - |
| Open fire waste burning (on landfills and informally) | 21.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Waste deposition/landfilling and waste water treatment** | | | | | | |
| Controlled landfills/deposits | 20.7 | 0.2 | 0.0 | - | - | - |
| Informal dumping of general waste *1 | 2.1 | 2.1 | 16.9 | - | - | - |
| Waste water system/treatment *2 | 0.0 | 184.7 | 0.0 | 0.0 | 20.5 | 0.0 |
| **Crematoria and cemeteries** | | | | | | |
| Crematoria | 11.2 | 0.0 | 0.0 | - | 0.0 | 0.0 |
| Cemeteries | 0.0 | 0.0 | 12.1 | - | 0.0 | 0.0 |
| **TOTAL of quantified releases*1*2** | **280.0** | **50.0** | **30.0** | **0.0** | **310.0** | **50.0** |

Notes to table above: *1: The estimated quantities include mercury in products which has also been accounted for under each product category. To avoid double counting, the release to land from informal dumping of general waste has been subtracted automatically in the TOTALS. *2: The estimated release to water includes mercury amounts which have also been accounted for under each source category. To avoid double counting, input to, and release to water from, waste water system/treatment have been subtracted automatically in the TOTALS.

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

1. Coal combustion in large power plants (84.7 Kg Hg/y)
2. Biomass fired power and heat production (40.9 Kg Hg/y)
3. Charcoal combustion (24.1 Kg Hg/y)
4. Open fire waste burning (on landfills and informally) (21.1 Kg Hg/y)
5. Controlled landfills/deposits (20.7 Kg Hg/y)

Table 6 below provides general descriptions and definitions of the output pathways.

*Table 6: 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 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:<br>• Point sources such as coal fired power plants, metal smelter, waste incineration;<br>• Diffuse sources such as small-scale gold mining, informal burning of 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:<br>• Wet flue gas cleaning systems on coal fired power plants;<br>• Industry, households, etc. to aquatic environments;<br>• Surface run-off and leachate from mercury contaminated soil and waste dumps |
| Land | Mercury releases to the terrestrial environment: General soil and ground water. For example releases from:<br>• Solid residues from flue gas cleaning on coal fired power plants used for gravel road construction.<br>• Uncollected waste products dumped or buried informally<br>• Local un-confined releases from industry such as on site hazardous waste storage/burial<br>• Spreading of sewage sludge with mercury content on agricultural land (sludge used as fertilizer)<br>• 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:<br>• Gypsum wallboard produced from solid residues from flue gas cleaning on coal fired power plants.<br>• Sulphuric acid produced from desulphurization of flue gas (flue gas cleaning) in non-ferrous metal plants with mercury trace concentrations<br>• Chlorine and sodium hydroxide produced with mercury-based chlor-alkali technology; with mercury trace concentrations<br>• 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. |
| 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:<br>• Confined deposition of solid residues from flue gas cleaning on coal fired power plants on dedicated sites.<br>• Hazardous industrial waste with high mercury content which is deposited in dedicated, safe sites<br>• Hazardous consumer waste with mercury content, mainly separately collected and safely treated batteries, thermometers, mercury switches, lost teeth with amalgam fillings, etc.<br>• Confined deposition of tailings and high volume rock/waste from extraction of non-ferrous metals |

# 4 Data and inventory on energy consumption and fuel production

## 4.1 Coal Combustion in Large Power Plants

In Mauritius, coal (mostly imported from South-Africa) is used primarily for power generation by thermal coal power plants as well as bagasse power plants[7]. A small fraction of coal is used in the manufacturing sector.

For the purposes of simplification, all coal consumption has been grouped under the category "*coal combustion in large power plants*."

Data has been extracted from the Energy Observatory Report 2011(MoEPU, 2012), table "*Stock variation in 2011*" on page 12, using the coal consumption figure of 641.4 kton, which corresponds to 641,400 tonnes/year used as an input for the toolkit.

**Additional available information** (GoM, 2012): According to information gathered from coal importers/users, the coal imported from South-Africa contains Mercury in very low concentration that are hardly detectable (however these levels would have to be verified during a level 2 inventory). A few of the power plants have implemented the following measures to reduce pollution from their operation:

a. Improvement in energy conversion by increasing efficiency, achieved through the implementation of good housekeeping, preventive maintenance and optimisation of boiler efficiency.

b. Transition to other energy sources to reduce coal combustion, e.g. during crop season (June to December) using bagasse to generate power.

c. Use of air pollution control technologies, such as Electro Static Precipitators (ESP) which have very high particulate matter (PM) removal efficiency. In addition to other pollutants, they also capture Mercury.

## 4.2 Other Coal Uses

A small fraction of coal consumed on a yearly basis is used in the manufacturing sector. However for the year 2011 the percentage is unknown.

## 4.3 Combustion/Use of Petroleum Coke and Heavy Oil

The assumption was made that fuel oil, as referred to in the 2011 Energy Observatory Report, is similar in nature to heavy oil. Petroleum coke is not mentioned in the 2011 Energy Observatory Report as an imported/consumed energy source. Considering there are no refineries present on the island it was assumed that no petroleum coke is being used for power generation.

Data has been extracted from the Energy Observatory Report 2011(MoEPU, 2012), table "*Stock variation in 2011*" on page 12, using the 2011 fuel oil consumption figure of 258.4 kton, which corresponds to 258,400 tonnes/year which was used as an input for the toolkit.

[7] Bagasse is a biomass derived from the processing of sugarcane. During crop season a number of bagasse power plants generate power from bagasse, while during off-season they convert to burning coal.

### 4.4 Combustion/Use of Diesel, Gasoil, Petroleum and Kerosene

Petroleum products are intended mostly for the sectors of transport, electricity generation, manufacturing and to a minor level household (LPG and kerosene), commercial and agriculture.

The assumption was made that LPG is part of this category. Liquefied Petroleum Gas (LPG) is used mainly as a cooking and water heating fuel, to a lesser extent as fuel for vehicles.

Data for this category has been extracted from the Energy Observatory Report 2011(MoEPU, 2012), page 12. The consumption figures for 2011 (combining Gasoline, Diesel oil, Aviation Fuel, Kerosene and LPG) add up to 527,700 kton, which has been used as an input for the toolkit.

### 4.5 Use of Raw or Pre-cleaned Natural Gas

Currently, there is no use of raw or pre-cleaned natural gas as Mauritius doesn't produce natural gas and no pipeline transporting natural gas exists between Mauritius and the main land. However natural gas exploration is forecasted for the future, when the Government of Mauritius, together with Seychelles, would start exploiting the Joint Management Area (JMA).

### 4.6 Use of Pipeline Gas (Consumer Quality)

In Mauritius the distribution of gas (LPG) for domestic consumption is done in 6 and 12-kg metallic bottles, no pipeline gas is available *Source: University of Mauritius*.

### 4.7 Biomass Fired Power and Heat Production

Sugarcane remains the predominant crop in the agricultural sector. The area under sugar cane stood at 59,724 hectares in 2011. Large, medium and small producers combined have produced 3.9 million tonnes of cane and 409,200 tonnes of sugar in 2012 (4.2 million of tonnes of cane and 435,310 tonnes of sugar in 2011).

Bagasse is derived from the processing of sugarcane. During crop season (June – December) a number of bagasse power plants generate power from bagasse, while during off-season they convert to burning coal. Bagasse represents 94% of the local energy sources, with hydro, wind, fuel wood and landfill gas making up the remainder of the local energy sources (MoEPU, 2012).

Data as input to the toolkit have been extracted from the Energy Observatory Report 2011(MoEPU, 2012), table "*Primary Energy Requirements*" on page 9, using the 2011 consumption figure of 1363.3 ktonne, which corresponds to 1,363,300 tonnes/year, which was used as an input for the toolkit.

### 4.8 Charcoal Combustion

The Energy Observatory Report 2011(MoEPU, 2012) doesn't specify charcoal as an energy source. Instead "fuel wood", which is included in the report as a local energy source has been used instead.

Data as input to the toolkit have been extracted from the Energy Observatory Report 2011(MoEPU, 2012), table "*Primary Energy Requirements*" on page 9, using the 2011 consumption figure of 20.1 ktonne, which corresponds to 20,100 tonnes/year, which was used as an input for the toolkit.

### 4.9 Fuel Production (Oil Extraction, Oil Refining, Extraction and Processing of Natural Gas)

In Mauritius there is currently no oil extraction, oil refining or extraction and processing of natural gas. However natural gas exploration is forecasted for the future, when the Government of Mauritius, together with Seychelles, would start exploiting the Joint Management Area (JMA).

# 5 Data and inventory on domestic production of metals and raw materials

In summary there is no domestic production of metals and raw materials in Mauritius. No primary metal production or other materials production takes place, which might directly or indirectly lead to releases of Mercury.

Although it cannot be said with absolute certainty that these activities do not take place, inputs were received from various government and public institutions knowledgeable about these sectors. It was felt by the Mercury Focus Group (which represents the majority of representatives from organizations and entities that have substantial knowledge of Mercury related issues) that the experience of the institutions was sufficiently accurate.

In the past, Mauritius has primary ferrous metal production (pig iron production), however this production sector has stopped operating and currently only secondary metal production from recycled materials (iron bar production) is taking place (MoLGO0IU/AI, 2012), which is captured as part of Step 5 of the inventory toolkit (see section 7.2).


*Photo: Brochure produced by the Ministry of Industry and Commerce/Assay Office on the use of Mercury in the jewellery sector (MoIC, 2007)*

Although Cement brand leaders are present in Mauritius (Lafarge, Holcim, etc.) they only distribute and repackage into smaller 50 kg bags. As at 2013, no cement manufacturing takes place in Mauritius, however the Government of Mauritius has signalled its interest to allow a private cement making plant to operate in the region of Port Louis.

With respect to pulp and paper production, only paper recycling is done.

The only remaining data gap is related to the jewellery sector. It has been known that the Jewellery sector in Mauritius uses elemental Mercury to recuperate waste gold (GoM, 2012), in particular artisanal jewellers. Preliminary estimates based on a 2007 Survey (See Appendix 4) conducted by Assay Office of the Ministry of Industry, Commerce and Consumer Protection, indicated that the sector might use approximately 7 kg of Mercury/year[8]. Following the survey conducted among artisanal jewellers, the Mauritius Assay Office prepared a brochure a few years ago to inform them on alternative methods to the use of Mercury for the recuperation and cleaning of gold (see insert).

Recent import records however do not show any significant amounts of elemental Mercury being imported. It might be that significant percentage of artisanal jewellers which used to rely on elemental mercury for the cleaning of gold nowadays make use of alternative methods.

In order to obtain additional clarifications, the Mauritius Assay office might be of help, as well as on-site visits to some of the jewellery businesses in order to obtain a better idea of their practices (e.g. the use of retorts) and to determine whether they have already made a shift to alternative methods/chemicals.

[8] According to the Global Mercury Assessment - a ratio of 1.3 : 1 is used to separate the gold from the impurities. However if retorts are being used, Mercury can be recycled and last much longer.

# 6 Data and inventory on domestic production and processing with intentional mercury use

## 6.1 Production of Chemicals

In summary there is no domestic production of chemicals, which involves the use of a Mercury catalyst or Mercury cells.

Although it cannot be said with absolute certainty that these activities do not take place, inputs were received from various government and public institutions knowledgeable about these sectors. It was felt by the Mercury Focus Group (which represents the majority of representatives from organizations and entities that have substantial knowledge on Mercury related issues) that the experience of the institutions was sufficiently accurate.

Regarding the production of Polyvinyl Chloride (PVC), Vinyl Chloride Monomer (VCM), the "building stone" for PVC, is imported as pellets for manufacture of PVC pipes.

## 6.2 Production of Products with Mercury Content

In Mauritius it is very unlikely that production of products with Mercury content (such as thermometers with Mercury, light sources with Mercury, Manometers/gauges with Mercury, biocides & pesticides with Mercury, batteries with Mercury, paints with Mercury or skin lightening creams and soaps with Mercury) is taken place.

From the Dangerous Chemicals Control Board (DCCB) information was obtained on Mercury containing chemicals for which permits were issued during 2011 and 2012 (See table 7 below). Although the actual uses of these Mercury containing inputs would have to be verified during a level 2 inventory, it seems that the predominant uses are for Laboratory Supplies & Maintenance purposes.

*Table 7: Mercury containing chemicals for which an import permit was issued in 2011 and 2012.*

| Date | Product | Uses | Amount | Importer | Type of Business |
|---|---|---|---|---|---|
| Feb-11 | Mercury Nitrate | Used to make other chemicals<br>Used in Medicine | 1 L | Omnicane Thermal Energy | Thermal Energy generator |
| Feb-11 | Mercury (II) Oxide | To produce Mercury<br>Used as a Material for cathodes for Mercury Batteries | 100g | Ducray Lenoir Ltd | Supply, installation, maintenance and stock services of medical equipment and consumables & Laboratory Supply & Maintenance |
| Feb-11 | Mercury std | Elemental Mercury | 500ml | SGS Mauritius Ltd | Testing/Analysis etc. |
| Apr-11 | Mercury (II) Iodide | Reagent & Veterinary Medicine | 200 g | Ducray Lenoir Ltd | Supply, installation, maintenance and stock services of medical equipment and consumables & Laboratory Supply & Maintenance |
| Apr-11 | Mercury oxide | To produce Mercury; Used as a Material for cathodes for Mercury Batteries | 1000g | Biswal Trading Ltd | Wholesale Physicians and Surgeons Equipment and Supplies |
| Jun-11 | Mercury (II) Chloride | Laboratory Reagent | 100g | Ducray Lenoir Ltd | Supply, installation, maintenance and stock services of medical equipment and consumables & Laboratory Supply & Maintenance |
| Aug-11 | Mercury (II) Chloride | Laboratory Reagent | 100 g | Supply Solution Ltd | Laboratory Supply & Maintenance |
| Sep-11 | Merury oxide | To produce Mercury; Used as a Material for cathodes for Mercury Batteries | 100g | Solid Waste Recycling Ltd | Company has no presence on the internet |
| Dec-11 | mercury (II) Chloride + Mercury Sulphate | Laboratory Reagents | 3kg | Biswal Trading Ltd | Wholesale Physicians and Surgeons Equipment and Supplies & Laboratory Supply & Maintenance |
| Dec-11 | Mercury (II) Sulphate | Laboratory Reagent | 200 g | Ducray Lenoir Ltd | Supply, installation, maintenance and stock services of medical equipment and consumables & Laboratory Supply & Maintenance |
| Jan-12 | Mercury | Elemental Mercury | 100 g | Supply Solution Ltd | Laboratory Supply & Maintenance |
| Jan-12 | Mercury std | Elemental Mercury | 9.83 kg | Robert Le Maire Ltd | According to the Technical Manager at Robert LeMaire, the imported Mercury was used for calibrating equipment that the company had sold to various clients over the past. |
| | | | | | |
| Feb-12 | Mercury | Elemental Mercury | 200 ml | SGS Mauritius Ltd | Testing/Analysis etc. |
| Jun-12 | Mercury (II) Chloride | Laboratory Reagent | 100g | Ducray Lenoir Ltd | Supply, installation, maintenance and stock services of medical equipment and consumables & Laboratory Supply & Maintenance |
| Aug-12 | Mercury std | Elemental Mercury | 200g | Ducray Lenoir Ltd | Supply, installation, maintenance and stock services of medical equipment and consumables & Laboratory Supply & Maintenance |
| Nov-12 | Mercury Nitrate | Used to make other chemicals & Used in Medicine | 500g | Ducray Lenoir Ltd | Supply, installation, maintenance and stock services of medical equipment and consumables & Laboratory Supply & Maintenance |

# 7 Data and inventory on waste handling and recycling

According to the United Nations Statistical Division (UNSD, 2011), in 2009, 98% of the total population was served by municipal waste collection.

Note: Information pertaining to municipal waste collection and disposal, was relatively easily to come by for the island of Mauritius. However, such information was not readily available for the other island. Therefore, during a level 2 inventory, or a future refinement of the level 1 inventory, the aspect of waste collection and disposal for the outer island, should be more closely looked at.

## 7.1 Production of Recycled Mercury ("Secondary Production")

No production of recycled Mercury is taking place in Mauritius [source: University of Mauritius].

## 7.2 Production of Recycled Ferrous Metals (Iron and Steel)

Certain companies (e.g. SAMLO) recycle metals and produced metal iron bars to be used for construction [MoLGOI/AI, 2012). However, the amount of recycled ferrous metals is currently unknown (which is expressed in the toolkit as number of vehicles recycled/year). Until data/information has been obtained in this respect, this value has been left blank.

## 7.3 Incineration of Municipal/General Waste

No incinerator for municipal/general waste is available in Mauritius. The engineered landfill at Mare Chicose is the only engineered landfill site in the country and it is assumed most collected refuse is deposited here and properly managed.

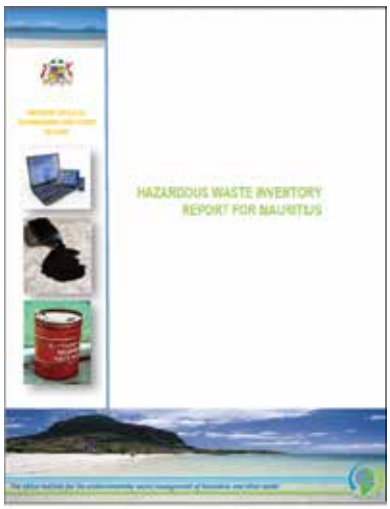
## 7.4 Incineration of Hazardous Waste

According to the 2012 Mauritius Hazardous Waste Inventory (MoLGOU/AI, 2012), several types of hazardous wastes are incinerated in Mauritius:

- The Central Electricity Board incinerates yearly 180 m3 of solid fuel oil sludge.
- On an annual basis about 1,575 litres of liquid organic solvents are incinerated, taken by recycling companies, evaporated or stored.
- The textile industry produces yearly 190 T of solid waste, which is either burnt in boilers or disposed in a landfill.
- Yearly 40 tonnes of solid used activated carbon is incinerated.

The used activated carbon and the solid fuel sludge are produced by the Petroleum and Petroleum Products Wholesale Sector. There are currently four petroleum and petroleum products wholesalers in Mauritius, namely Vivo Energy (ex-Shell Mauritius Ltd), Indian Oil Ltd, Total Mauritius Ltd and Engen Petroleum (Mauritius) Ltd. The local market share for each company is about 20-30% each.

According to the 2012 Mauritius Hazardous Waste Inventory one of the companies possesses an "Oil and Water Separator which generates around 30 tonnes of used activated carbon every 3 years, which are incinerated by a Detergent and Cosmetics Manufacturing Industry. During maintenance activities carried out by the company, mixtures of sediments and water are recovered (which are also due to accidental oil spill and contamination) and directed to the oil and water separator.



*2012 Mauritius Hazardous Waste Inventory (MoLGOU/AI, 2012)*

Sludge and recovered oil, generated from the separator are then given to an iron bars manufacturer, which makes use of these wastes as fuel for its melting furnaces. The oil-free water is discharged to the sewer network. Sludge, formed due to sedimentation, is also generated from the cleaning of tanks every 3 years.

If it is assumed that the other petroleum and petroleum products wholesalers handle their hazardous wastes mostly in the same way, this would lead to the conclusion that wastes of potential hazardous nature that are generated from petroleum and petroleum products wholesalers are mostly recycled or incinerated.

The 2012 Mauritius Hazardous Waste Inventory does not mention where liquid organic solvents are incinerated.

Assuming a density for the solid fuel oil sludge of 980 kg/m3, this converts to 180 tonnes of solid fuel oil sludge incinerated each year.

Assuming that the density of the liquid waste is 1 kg/liter and that 25% of this volume is incinerated yearly, this result in 400 tonnes of liquid organic solvents incinerated each year.

Based on the assumption that 50% of the solid waste produced by the textile industry is burnt in their boilers, this leads to 95 tonnes of solid textile waste burned each year.

In total this comes down to the incineration of 715 tonnes of hazardous waste year. This figure has been used as an input to the toolkit.

During the level 2 inventory it will be important to further investigate the Mercury content in these hazardous waste streams that are being incinerated.

### 7.5 Incineration and open Burning of Medical Waste

Based on the assumption that in Mauritius an average of 0.35 kg of infectious HCW is generated per bed/per day[9]. As per the 2006 Analysis of the Health situation (MoHQL, 2006), Mauritius counted 3,561 beds in government institutions. The latest survey carried out by the Ministry of Health and Quality of Life in 2010 showed that, as at 31st December 2010, a total of 17 clinics with a total bed capacity of 759 were operational in Mauritius (MoHQL, 2010). Private and public institutions combined, Mauritius therefore counts approximately 4,320 beds.

[9] This figure might be an overestimation and its source needs to be verified.

These statistics combined lead to the conclusion that each year a total of 552,000 kg (552 tonnes) of hazardous HCW is generated (for public and private healthcare facilities combined).

This calculation assumes that perfect waste segregation practices have been put in place and are being followed at hospital/clinic level – which is the best-case scenario. However, healthcare waste is often not perfectly segregated into infectious, hazardous and non-hazardous waste streams therefore it can be assumed that the actual quantity of infectious waste is much higher. The 2011 Hazardous Waste Inventory estimates that private clinics alone produce 200 tonnes of hazardous waste each year. It might therefore very well be that the 552 tonnes calculated is indeed an underestimation.

We are also assuming that all this waste is either incinerated or burned in the open, as per this assumption the figure of 552 tonnes/year has been used as an input to the inventory toolkit.

*NOTE*: Mercury emissions resulting from incineration and open burning are heavily influenced by the Mercury content of the waste being incinerated/burned. It is unclear at this stage of the inventory how many Mercury containing medical devices are spent each year, however whether these are incinerated along with the infectious waste streams or disposed of separately has a major impact on the release of mercury emissions to flue gas and incinerator ashes.

### 7.6 Sewerage Sludge Incineration

In Mauritius, the incineration of sewerage sludge is not practiced. Instead sewerage sludge is disposed by the Mauritius Waste Water Management Authority (WMA) at the Mare Chicose landfill. According to the 2012 Hazardous Waste Inventory Report (MoLGOU/AI, 2012) approximately 1,210 tonnes of dried solids are disposed each month at Mare Chicose landfill from the four major wastewater treatment stations.

Table 8 below (MoLGOU/AI, 2012) lists some results of analysis of sludge disposed in 2009 and 2010. The values observed are well below the ceiling limits recommended by USEPA [34] and EU [35] and may be considered as non-hazardous. It is noteworthy that currently no standards exist for disposal of sludge in local regulations.

*Table 8: Analysis results of sludge disposed by WMA at the Mare Chicose landfill*

| Parameter | Results | USEPA ceiling | EU Directive |
|---|---|---|---|
| Mercury (mg/kg) | 0.5 – 10.3 | 57 | 16 - 25 |

*Source: Table 56 (MoLGOU/AI, 2012)*

### 7.7 Open Fire Waste Burning (on landfills and informally)

Based on the assumption that 98% of municipal/general waste is collected (UNSD, 2011) and taken to the Mare Chicose engineered sanitary landfill, 98% of generated municipal/general waste in Mauritius will not be burned in the open (no landfill fires occur at Mare Chicose and if spontaneous ignition occurs such small fires would be put out).

However, the other 2% of municipal/general waste, which is not being collected, is most likely informally dumped or burned in the open. Assuming that half of that uncollected waste is burned in the open and the other half is illegally dumped, the following calculation can be made:

In 2011, the total amount of municipal/general waste landfilled at Mare Chicose was 414,000 tonnes (MoLGOI, 2012). Assuming that this amount of waste represents 98%, the corresponding 1% of municipal/general waste this inventory assumes is being burned in the open, corresponds to 4224 tonnes/year. This figure has been fed into the toolkit.

Data gaps regarding this section might be caused by the fact that there are more landfills on the island of Mauritius than just the one at Mare Chicose, and secondly, these figures do not take into account solid waste management practices on the outer islands of Mauritius. It would be recommended that a level 2 inventory looks more closely at this data.

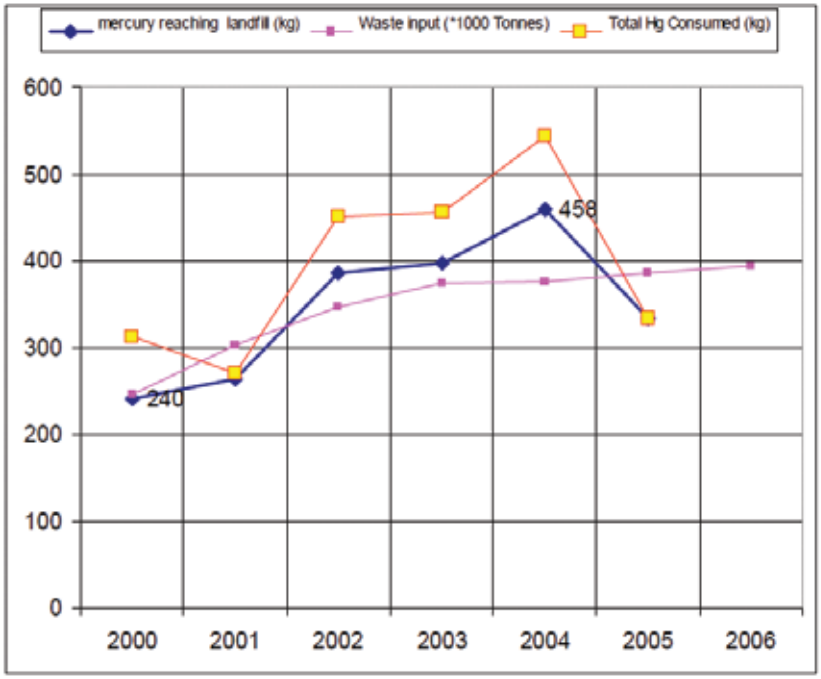
### 7.8 Controlled Landfills/Deposits

In 2011, the total amount of municipal/general waste landfilled at Mare Chicose was 414,000 tonnes (MoLGOI, 2012). This was the figure filled into the toolkit.

**Additional Data/Information**:

The annual mercury introduced to the landfill is estimated as a function of the total wastes going to the landfill and the overall consumption of mercury. In the period 2000 – 2005 (V. Dookhun, K. Mahadeo, 2009) the amount of Mercury was estimated to vary from 240 kg to 458 kg with a mean value of **346** kg of mercury. Results of the study "Assessment of Mercury Pollution at Mare Chicose Landfill in Mauritius" showed that almost all of the imported mercury ended up being dumped at the landfill. Only an amount of 47 kg was excluded from these calculations, as this amount of Mercury was "consumed" or embedded in product e.g. mercury quicksilver that was imported for industrial purposes, for laboratory experiments/analysis, in the jewelry sector or potentially for the production of mirrors.

*Figure 8: Mercury input to the Mare Chicose landfill for the period 2000 - 2005*



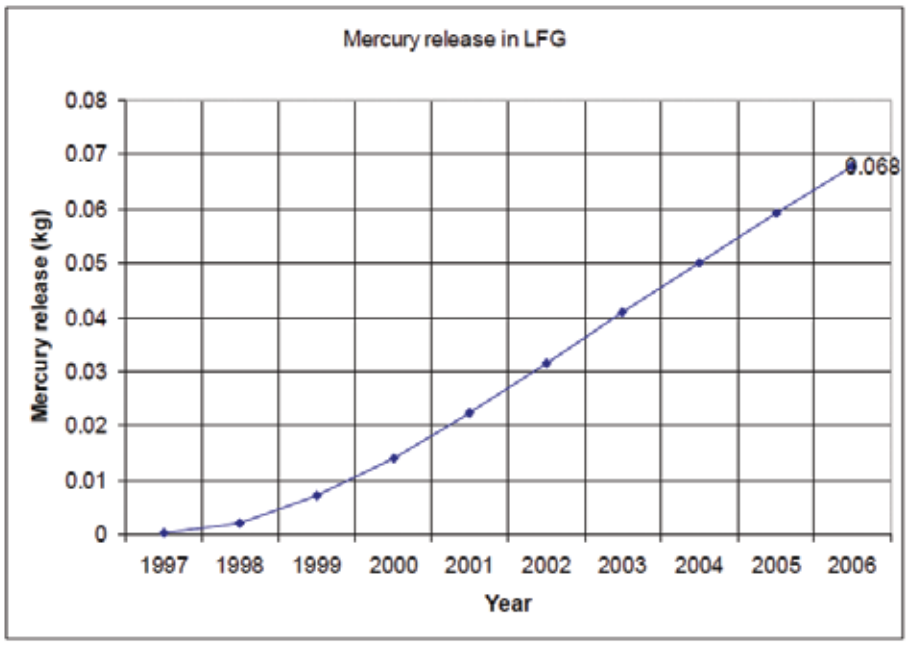

*Source: Copied from V. Dookhun, K. Mahadeo, 2009)*

**Results for Mercury in leachates**:

From the Mercury analysis carried out on the leachate samples, none of them were able to detect any Mercury with the test that has a detection limit of 0.0002 mg/l (V. Dookhun, K. Mahadeo, 2009).

As part of the "Assessment of Mercury Pollution at Mare Chicose Landfill" the amount of total Mercury, which would be emitted from the landfill, through landfill gas generation, was also simulated. The results have been presented in figure 9.

*Figure 9: Results from simulation for total Mercury emitted from the Mare Chicose landfill since its inception*




Mercury from a landfill can be released through three main pathways to the environment. It is released:

1. To the air through Landfill gas and the working face at the landfill.
2. To water through leachates.
3. To the land due to the accumulation of all the mercury wastes.

Analysis of the leachates and the groundwater has shown that mercury release to water is very low and would never reach a concentration greater than 0.0001 mg/l in the forthcoming years if the waste input trend stays the same at the Mare Chicose landfill.

Further the landfill gas (LFG) analysis has shown that the maximum amount of mercury that would be emitted through the LFG from the landfill during its life span and until production of LFG lasts would not be greater than 0.1 kg.

Surveys conducted to assess the amount of mercury entering both the country and the landfill have revealed that most of the mercury entering the country ends at the landfill, an annual mean value of 346 kg of mercury was calculated for the mercury introduction at the landfill.

The study also concluded that based on a Mercury Material Balance conducted at the landfill, the quantity of mercury released amounts to 1.11 kg annually (0.3%) (and the mercury that accumulates in the landfill unsaturated region is about 345 kg.

The key outcomes were that fortunately, the condition at the landfill was mostly alkaline whereby the formation of toxic organo-mercury compounds are inhibited and most of the mercury is trapped in the buffer zone that contains the waste piles but however, mercury does enter the environment from the landfill through the working face, LFG and leachates.

Even though mercury disposal through a controlled landfill releases very small amount of mercury to the air and water but the mercury accumulation in land can be sufficient to pose serious health hazards.

Mauritius is diversifying its Solid Waste Management strategy by moving from the traditional landfilling system to Waste to Energy, Recycling and Composting.

The situation of mercury pollution in the landfill will not be the same in the future years.

As seen in this project, most mercury going to the landfill is being trapped to the land but if ever an incineration facility is set up with no sorting of waste, mercury in the waste will be liberated to the environment.

### 7.9 Informal Dumping of General Waste

Based on the assumption that 98% of municipal/general waste is collected (UNSD, 2011) and taken to the Mare Chicose engineered sanitary landfill, the other 2% of uncollected municipal/general waste, is most likely informally dumped or burned in the open. Assuming that half of that uncollected waste is illegally dumped, the following calculation can be made:

In 2011, the total amount of municipal/general waste landfilled at Mare Chicose was 414,000 tonnes (MoLGOI, 2012). Assuming that this amount of waste represents 98% of the general waste amount generated n the country, the corresponding 1% of municipal/general waste this inventory assumes is being illegally dumped, corresponds to 4,224 tonnes/year. This figure has been fed into the toolkit.

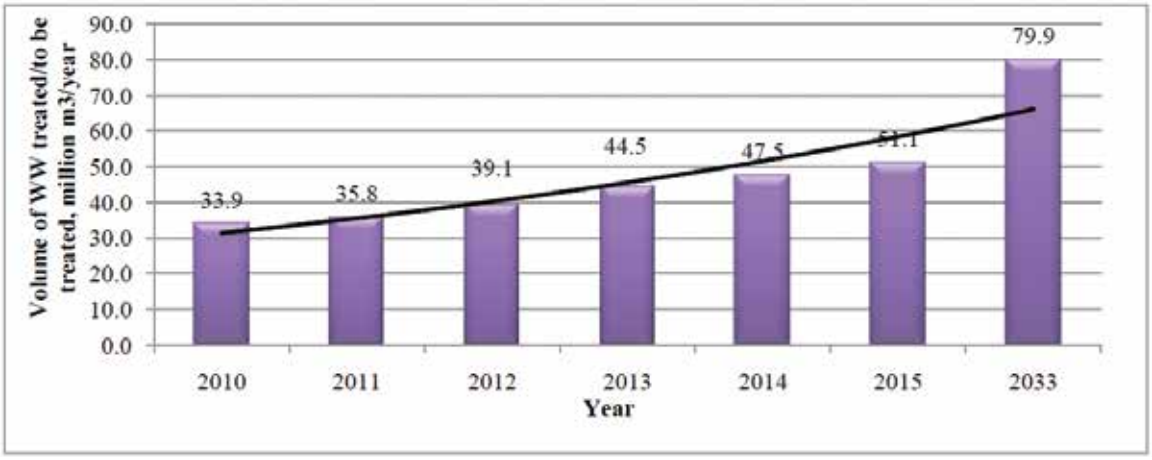
Data gaps regarding this section might be caused by the fact that there are more landfills in Mauritius than just the one at Mare Chicose, and secondly, these figures do not take into account solid waste management practices on the outer islands of Mauritius. It would be recommended that a level 2 inventory looks more closely at this data.

### 7.10 Waste Water System/Treatment

According to the paper on Safe use of wastewater in Agriculture (WMA, 2012), Mauritius produced and treated in 2012 39.1 Mm3/year. This is the figure that has been used in the toolkit.

In figure 10 is depicted the trend on the volume of treated wastewater in Mauritius.

*Figure 10: Trend on the volume of wastewater treated in Mauritius (Source: National Sewerage Master Plan)*



**Additional Information: Mercury Analysis of Water Bodies**

In 2012 the National Environment Laboratory (NEL), analysed the Mercury content in seven (7) water points (see table 9 below). It can be concluded for the below table that none of the values pass the maximum concentration levels, which are **0.1 g/l** for Surface Water, and **0.0005 mg/l** for Coastal Water Quality.

*Table 9: Mercury level in seven water bodies (NEL, 2013)*

| SN | Site | Analysis Method Based on | Mercury level (µg/L) |
|---|---|---|---|
| 1 | Groundwater in vicinity of Mare Chicose Landfill sites | EPA 1631 | <0.10 – 0.76 |
| 2 | Bassin Nenuphar, SSR Botanical Garden | EPA 1631 | <0.10 |
| 3 | Canal Ralier, SSR Botanical Garden | EPA 1631 | <0.10 |
| 4 | Bassin Jumeau, SSR Botanical Garden | EPA 1631 | <0.10 |
| 5 | River Citrol, in front of Pamplemousses Community Health Center | EPA 1631 | <0.10 |
| 6 | Effluent from outlet of Baie du Tombeau Wastewater Treatment Plant | EPA 1631 | 0.52 |
| 7 | Selected Boreholes tapping aquifer III | EPA 1631 | <0.10 |

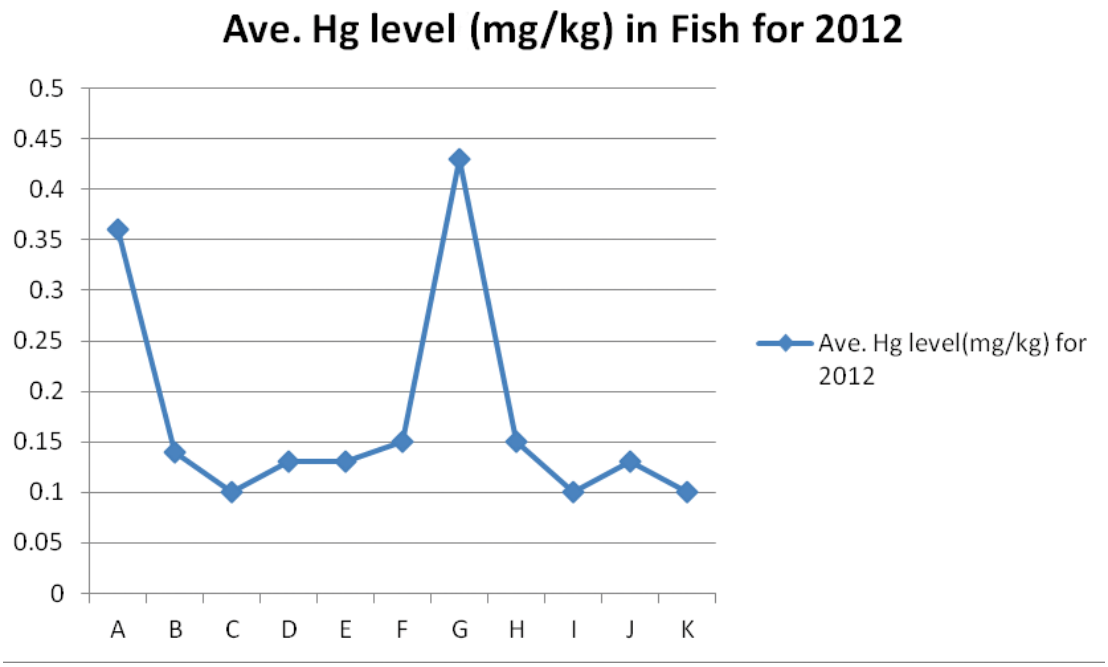
**Additional Information: Mercury content in Seafood analysis**

The Competent Authority – Seafood Unit (CASFU), part of the Ministry of Fisheries, oversees the analyses of 440 fish samples yearly (on a quarterly basis, 10 fish samples are taken from 11 EU approved establishments,). The samples (125 g each) are sent for analysis to an ISO 17025 accredited laboratory[10]. In total on a yearly basis 440 samples are analysed for heavy metals.

From the 2012 data obtained (see below), it can be observed that Hg level varies from 0.10 mg/kg to 0.43mg/kg. Hg levels do not exceed the recommended limit, i.e **1.0 mg/Kg** as set by the EC Regulation 1881/2006.

However, it is observed that Hg level is related to the fish species, for example Hg level was 0.43 mg/Kg and much higher in Swordfish as compared to other fish species such as Tuna and other demearsal fish.

*Figure 11: Trend of Hg levels in 2012 (CASFU, 2012)*




*Source: CASFU, 2012*

**Additional information: Mercury levels of women of childbearing age**

In 2013, the Zero Mercury Working Group supported an assessment of hair mercury levels of women of childbearing age in 9 countries (Armenia, Bangladesh, Côte d'Ivoire, Japan, India, Mauritius, Nepal, South Africa and Spain), with the primary goal to demonstrate the feasibility of testing hair samples[11] in widely different cultures around the globe, and to assess the ability of civil society to responsibly and credibly conduct such sampling.

The research focused on mercury hotspots around the globe, especially where fish with medium to high levels of mercury was consumed frequently, with the objective to determine current (and future) exposure levels, evaluate changes over time and promote exposure reduction and prevention efforts targeted at populations at risk of exposure due to local pollution sources (e.g. coastal populations; indigenous peoples; fishing communities, and other heavy fish eaters).

[10] The SOP-FOO-45 test method is used and the Mercury content is determined on the homogenized aggregate sample.

[11] Hair samples were analyzed for approximately 20 US$ per sample, by the Department of Environmental Medicine, University of Southern Denmark.

The study "*Assessing hair mercury levels of women of childbearing age in 9 countries"* revealed that women in several countries had higher mercury levels, in correlation with fish consumption. Nearly one-quarter (24%) of the samples exceeded the widely recognized U.S. Environmental Protection Agency guideline of 1 micrograms per gram. In 4 of the countries, a high percentage of women exceeded the threshold, specifically (Zero Mercury working Group, 2013):

71% in Japan
64% in Spain
**36% in Mauritius**
23% in Côte d'Ivoire

In Mauritius, the exercise was conducted among women living in La Chaux, Mahebourg, by the NGO Pesticide Action Network (Mauritius). In order to determine Mercury levels in strands of hair were tested[12]. The study's report concluded that the mercury levels in individuals and populations is enough to put the life of a fetus at risk.


*Photo: Cover of the Report on "Assessing hair Mercury Levels of Women of Childbearing age in 9 coun-tries – a Civil Society Pilot Project" (Zero Mercury working Group, 2013)*

[12] The hair strand test is one of the recommended methods to determine the level of mercury in a subject.

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

## 8.1 General background data

Background calculations for the product groups listed below were based on the data on population, electrification rate and dental personnel density shown in Table 10.

| Sub-category | Data types used as activity rates |
|---|---|
| Dental amalgam fillings ("silver" fillings) | Population, density of dental personnel |
| Electrical switches and relays with mercury | Population, electrification rate (percent of population with access to electricity) |
| Polyurethane (PU, PUR) produced with mercury catalyst | Population, electrification rate (percent of population with access to electricity) |
| Other manometers and gauges with mercury | Population, electrification rate (percent of population with access to electricity) |
| Laboratory chemicals | Population, electrification rate (percent of population with access to electricity) |
| Other laboratory equipment with mercury | Population, electrification rate (percent of population with access to electricity) |

*Table 10: Background data for default calculations for dental amalgam and certain other product types.*

| BACKGROUND DATA FOR DEFAULT CALCULATIONS AND RANGE TEST | | | |
|---|---|---|---|
| Country | Population in 2010 (or as recent as available data allow; UNSD, 2012) | Dental personnel per 1000 inhabitants | Electrification rate, % of population with access to electricity |
| Republic of Mauritius | 1,303 ,717 | 0.189 | 99 |

The data in Table 10 are provided as part of the Toolkit. For most countries they are based on authoritative international data sources (population data: UNSD; Dental data: WHO; Electrification data: IEA). For a few countries, data from these sources have not been available and other sources were used as described in the Toolkit Reference Report's Annex 8.4.

In table 11 below is the data provided which has been obtained through Mauritius Statistics (2012) on products which were imported into Mauritius in 2012 and which might contain Mercury, as per the Guidelines for Inventory Level 1 (last page). In red the argumentation on whether to include or exclude these quantities for the Inventory toolkit has been provided.

*Table 11:* Harmonized System (HS) Codes for Mercury containing products and related import data for 2012 (Mauritius Statistics, 2012)

| HS Custom Code | Description of HS Code | Total Quantity | Included in Inventory |
|---|---|---|---|
| **Thermometers** | | | |
| 90251100 | Thermometers, not with other instruments, liquid-filled for direct reading<br><br>*Argumentation: A certain percentage of these might contain Mercury, others might contain other liquids such as alcohol*<br><br>*As per the 2006 Analysis of the Health situation, Mauritius counted 3,561 beds in government institutions[13]. As per December 2010 Mauritius counted 17 private clinics with a total bed capacity of 759 (MoHQL). In total Mauritius counts approximately 4,320 beds. Therefore, the percentage of beds managed by the private sector is 18%. Assuming (over-simplified) that only the private sector still uses Hg containing thermometers since the 26 July 2007 note on "Replacement of Hg containing medical devices", approximately 20% of imported glass medical thermometers might contain Mercury.* | 13,108 | Yes (20% of the total amount) |
| 90251190 | Thermometers, not combined with other instruments, excl. 902511<br>*Argumentation: Most likely these are thermometers that do not contain liquids, therefore it is unlikely these contain Mercury.* | 38,942 | No |
| **Light Sources with Mercury** | | | |
| **85393100** | Discharge lamps, other than ultra-violet lamps, fluorescent, hot cathode<br>*It was assumed that this category refers to Gas Discharge Lamps and High Intensity Discharge Lamps, therefore it was likely that such lamps contain Mercury* | 1,156,967 | Yes |
| **85393200** | Mercury or sodium vapour lamps; metal halide lamps*<br>*Contain Mercury* | 15,789 | Yes |
| **85393910** | Low energy consumption lamps*<br>*It is assumed that this HS description refers to Compact Fluorescent Lamps (CFLs) and fluorescent* | 1,143,315 | Yes |

[13] http://www.gov.mu/portal/goc/moh/file/statsm06/analysis.pdf

| | | | |
|---|---|---|---|
| | *tubes, it was assumed that the majority of these lamps contain Mercury.* | | |
| **85393920** | Light emitting diode (LED) lamps<br>*Do not contain Mercury* | 266,740 | No |
| **85393990** | Discharge lamps, other than ultra-violet, low energy and fluorescent lamps<br>*It is assumed that this category describes incandescent lights* | 2,153,891 | Yes |
| 85394100 | Arc – Lamps*<br>*Could contain Mercury* | 127 | Yes |
| **85394900** | Ultra-violet or infra-red lamps excl. arc-lamps<br>*Includes Mercury containing ultraviolet fluorescent lamps used for tanning beds as well as infra-red lamps which do not contain Mercury. As it is unlikely that many tanning salons exist in Mauritius, although some might exist in the hotels tailoring to tourists. It is assumed however that the majority of this category does not contain Mercury.* | 11,411 | No |
| **Batteries with Mercury** | | | |
| 85061000 | Manganese dioxide primary cells or batteries | 1,322,991 | |
| **85066000** | Air-zinc primary cells or batteries<br>*Argumentation: Includes only part of the battery types in the Toolkit Category* | 140,472,849 | |
| **Chemical Compounds Containing Mercury** | | | |
| 28521000 | Chemically defined Compounds, inorganic or organic, of mercury, excluding amalgams | 6 kg | |
| 28529000 | Other Inorganic or organic compounds of mercury, whether or not chemically defined, excluding amalgams | 93 kg | |
| **Elemental Mercury** | | | |
| 28054000 | Mercury | 2 kg | |
| **Medical Blood Pressure Gauges (Mercury Sphygmomanometers)** | | | |
| No reference was found in the import records of any **Sphygmomanometers** being imported. However this is not realistic, and potentially we are overlooking a particular HS code describing this category. | | | |

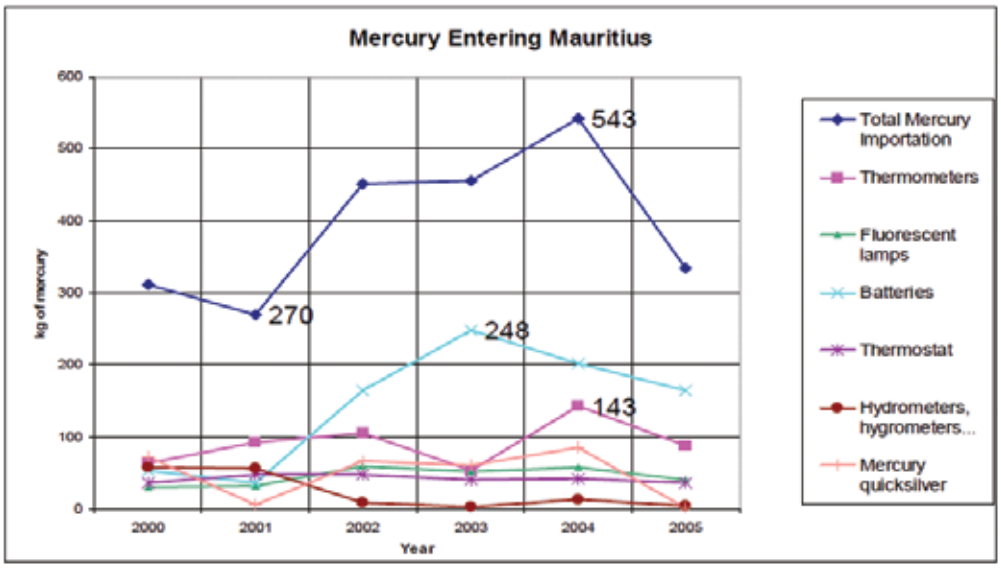
*Source: Statistics Mauritius, 2012*

**Additional information on Mercury containing products**

In 2009 the University of Mauritius (V. Dookhun, K. Mahadeo, 2009) published an article on the "*Assessment of Mercury Pollution at Mare Chicose Landfill in Mauritius*". The assessment looked at the amount of Mercury entering Mauritius and being disposed of in the Mare Chicose landfill over the period 2000 - 2005, in order to determine the resulting pollution at the landfill site. Some of the data collected during that assessment is highly relevant for this level 1 assessment and has therefore been incorporated in this section in order to provide more insight into the category "*Mercury contained in products*".

From figure 12, which shows the mercury consumption of Mauritius for the period 2000 – 2005, along with the individual contribution from the major "mercury" consumer products, it can be observed that the total mercury consumption varied from 270 to 543 kg of mercury annually with a mean value of 393 kg. Moreover, "mercury" battery consumption of the island underwent a considerable increase from the year 2001 and was at its peak in 2003 with a total contribution of 248 kg of mercury.

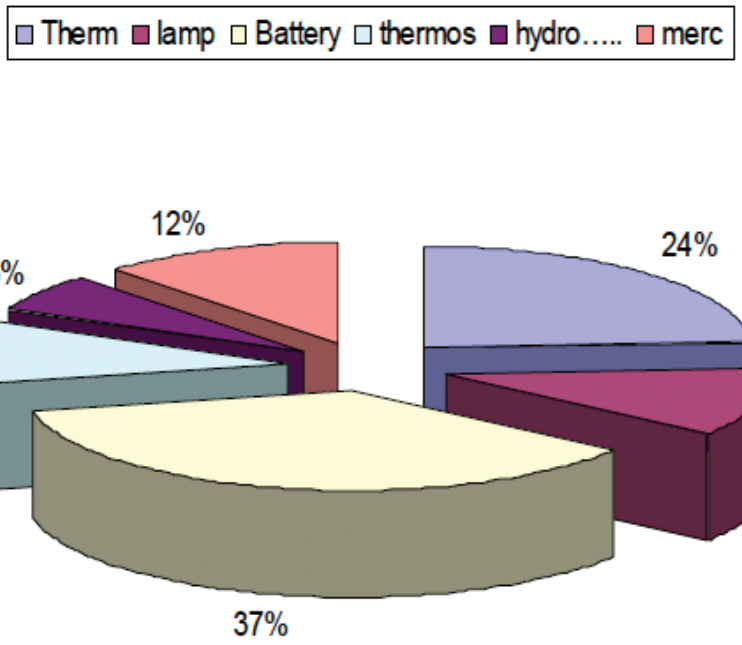
*Figure 12: Mercury Consumption for Mauritius for the year 2000 – 2005.*




*Source: Copied from V. Dookhun, K. Mahadeo, 2009)*

In the period 2000 – 2005 (see also figure 8.2) batteries had been the largest contributor for mercury pollution (37%), followed by thermometers (24%). The other contributors were: Thermostats (10%), Mercury quicksilver (12%), Lamps (12%) and hydrometers, hygrometers and pyrometers (6%).

*Figure 13: Major sources of mercury in Mauritius*




*Source: Copied from V. Dookhun, K. Mahadeo, 2009)*

**Additional information: Use of Mercury in dental amalgam**

Since about 25 years the Ministry of Health and Quality of Life has an oral health education policy. Although import records do not provide any information on the quantities of dental amalgam that are imported on a yearly basis, the Dental Department of the Ministry of Health confirmed that public dental institutions still use dental Hg amalgam. Dental amalgam for this purpose is imported in premixed single dose capsules and no mixing using elemental Mercury is taking place in public healthcare facilities and/or public dental clinics.

Some of the dentists capture excess amalgam and store it in air-tight containers in their offices, however there are currently no solutions for disposal of such wastes so such wastes are stored indefinitely.

Pulled teeth containing amalgam, or fillings that are removed, are disposed of along with regular municipal waste, infectious waste (and might end up going to a medical waste incinerator) or are flushed out through the sewerage system.

Currently, there is no dental amalgam phase-out plan in place, however dentists have been advised not to use dental amalgam on pregnant women and children.

In addition, based on a number of information interviews, private and public dentists seem to favor dental amalgam over composite fillings and it appears that dental amalgam remains the most used material in Mauritius (the reasons given are that it is less costly, more wear resistant, and has more applications than composite filling which are also more technique sensitive).

The Mauritius Dental Association has posted an article from the Mensual La Lettre – Order National des Chirurgiens-Dentistes, Sept 2008, No. 70 on its website[14]. The article, which dates from 2008, states that the Ministry of Health confirms the safety of dental amalgam.

However, emphasis of the article is placed on Mercury exposure to patients, and does not address the exposure of dentist office staff to Mercury, which is actually a high-risk group, as they are often involved in the handling of the amalgam. Finally, the article also doesn't address environmental contamination caused by inadequately disposing of dental amalgam waste, which often ends up being disposed in the sewerage or regular waste and ultimately exposes communities to elevated Mercury levels in water sources.

As a next step it would be helpful to gather additional information on the degree of use of dental amalgam versus Mercury-free alternatives in Mauritius and determine the main challenges that would need to be overcome to encourage a shift away from dental amalgam and possible actions that could be incorporated in a Dental Amalgam phase-out plan.

[14] http://mauritiusdentalassociation.com/MDA/Amalgames_Dentaires.html

### 8.2 Thermometers & Other Glass Hg Thermometers (air, laboratory, dairy, etc.)

The Harmonized System Code (HS 9025111000) for Mercury containing clinical thermometers was not found in the custom import records. However, as suggested by the Guidelines for Inventory Level 1, HS code 90251100 was used to identify "*Thermometers, not with other instruments, liquid-filled for direct reading*" (see table 12).

*Table 12: Thermometers, not with other instruments, liquid-filled for direct reading*

| HS Custom Code | Description of HS Code | Total Quantity | Included in Inventory |
|---|---|---|---|
| **Thermometers** | | | |
| **90251100** | Thermometers, not with other instruments, liquid-filled for direct reading<br>*Argumentation: A certain percentage of these might contain Mercury, others might contain other liquids such as alcohol.* | 13,108 | Yes |

However this group might also contain thermometers with other types of liquid (such as alcohol), as such the conclusion cannot be drawn that this category exclusively represents Mercury containing thermometers.

It might be worthwhile (in light of a level 2 inventory) to carry out a comprehensive survey among a selection of public and private healthcare facilities as well as households on the number and types of clinical thermometers being used.

**Additional information: Mercury containing medical equipment in the Healthcare sector**

A few of assessments to determine the number of Mercury containing medical devices have taken place in the past (see information provided below), however it is unclear how many institutions were surveyed, the data obtained seemed not to have been extrapolated and the surveys did not lead to an estimation of the total number of Mercury containing thermometers and sphygmomanometers in use at the time.

The Ministry of Health and Quality of Life (MoHQL) issued on 05 October 2007 a notice to the Chief Hospital Supply Officer informing the latter that the Ministry had decided to replace all mercury containing apparatuses over a period of 3 years and to take this into consideration when submitting annual requirements for sphygmomanometers and thermometers. However, this measure only applied for centralized procurement of medical equipment for public Healthcare facilities, and not for private ones. It is unclear at this point in time to what extent Mercury containing thermometers are still being used in the private and public healthcare facilities, although it is assumed that this measure promoted by the ministry of Health has indeed created a significant shift towards the use of Mercury-free thermometers in public health institutions.

*Table 13: Overview of the results from 3 surveys carried out by the MoHQL to identify the number of Mercury containing medical devices used in the Health Care Sector (Source: hard copy file of the MoHQL Occupational Health Unit)*

| Date of Survey | No. of Hg thermometers | No. of Hg Sphygmomanometers | Additional Remarks |
|---|---|---|---|
| 10 August 2006 | 665 | 566 | • 1st survey covered all government health institutions and health care centers<br>• 1kg of Elemental Mercury was imported by a company to top up Fortin Barometers in school laboratories |
| 18 June 2007 | 370 | 87 | • 2nd survey covered hospitals, private clinics, health care units, nursing homes and dispensaries. |
| January 2007 | 1053 | 653 | • This is data taken from the GoM, 2012, It is unclear from where this data is being sourced. |
| August 2007 | 702 | 708 | • 3rd survey of Mercury in hospitals, clinics and dispensaries<br>• 1.5 kg of mercury was used monthly for dental amalgams hospitals and dispensaries;<br>• 3 Urinometers, 2 hydrometers and 1 switch of steriliser was also found hospitals and dispensaries<br>• 76 BP (blood pressure) apparatus, about 400 thermometers and 7 x-ray tubes were found in private clinics. |

According to the Metrology Unit of the Mauritius Standards Bureau (MSB) the number of clinical thermometers at domestic level and in private clinics is difficult to estimate, and it is thought that many households still possess them. Secondly, it is challenging to estimate the numbers of sphygmomanometer in use as MSB in not involved in the calibration of sphygmomanometers). Although it is known that most senior private medical practitioners possess one as they are very reliable and have sentimental value to the owner.

**Additional information: Non-medical Mercury containing thermometers**

The Metrology Unit of the Mauritius Standards Bureau (MSB) calibrates about 150 thermometers per year (the trend is downwards, mostly because the ratio of digital thermometer to Mercury thermometers is increasing) and charges clients around $40-50 per calibration. Most of these thermometers come from government labs (AREU, Forensic Labs, National Environmental Lab, Government Analyst Division) private sector (textile industries, breweries companies) and very few from private clinics and hospitals. The MSB has not received thermometers from primary/ secondary/ tertiary education institutions to calibrate over the last few years but MSB personnel confirms that some educational institutions still use them.

The MSB estimates that there are more than **3000** Hg thermometers in labs/private sector/manufacturing industries still in active use – usually until they fail. Although there is no national policy to phase out Hg thermometers, the MSB has been advising their clients to gradually phase them out.

As from the import data it is hard to estimate how many Mercury containing glass thermometers are imported each year for labs/private sector/manufacturing industries, it was assumed that most entities (~ 60%) replace these with Mercury-free devices after they break, however that a percentage of 40% replaces them with Mercury containing devices. Assuming that each of these devices have an average life span of 4 years, each year: (3000*0.40)/4 = 300 are assumed to be imported.

In table 14 is information provided on Mercury containing equipment at MSB itself.

*Table 14: Mercury based equipment at MSB*

| Laboratory | Item Equipment containing Mercury | Quantity | Remarks |
|---|---|---|---|
| Food Microbiology | Thermometers | 4 | |
| Food and Agriculture | Thermometers | 4 in use | 2 broken and stored in Bottle |
| Chemical technology | 1. Thermometers<br>2. Calibration standards -100 ppm;<br>3. Calibration standards -10,000ppm;<br>4. Waste after analysis;<br>5. Elemental Mercury (not used) | 26<br>500ml<br>75ml<br>5L<br>4.5kg | |
| Fibre Technology | Thermometers | 5 in use | |
| Mass Metrology | Barometer | 1 | |
| Pressure Metrology | Hg Column testers (low and vacuum) | 2 | |
| Temperature Metrology | 1. Thermometers;<br>2. Assmann Hygrometer;<br>3. Wet and Dry bulb Hygrometers;<br>4. Mercury metal for calibration | 59<br>2<br>12<br>3kg | |

Some additional observations made by MSB:

- The lab at MSB is ISO 17025 compliant.
- MSB has a well establish protocol to calibrate Hg equipment and to deal with spills.
- The different MSB labs using Hg are all concerned about the disposal of Hg that is not being used. It is currently stored securely within the premises of the institutions.
- There is a gradual phase out of mercury equipment used at the MSB with non-mercury technology preferred.
- There could be several reasons for the continued use of Hg thermometers, firstly Hg thermometers are sometimes preferred by users to analogue ones and even to alcohol thermometers because of their perceived accuracy and reliability. Users also believe that shifting to Hg-free technologies might be costly. Finally, the fact that Hg containing thermometers continue to be used is simply because they are part of the inventory, and as long as they are not being phased-out, will continue to be used.
- The technical personnel of the Legal Metrology department proposed to have a National phase out plan whereby people still using Hg thermometers could exchange same for an alcohol one or electronic one for a nominal fee (as per a model used by the University of Calgary).

### 8.3 Light Sources with Mercury

As suggested by the Guidelines for Inventory Level 1, the HS codes included in Table 15 below, represent product categories, which may include products that contain Mercury. As described in the argumentation for each of these HS codes, not all of the items captured by such a HS code contain Mercury. Secondly, the Mercury content for each of these products varies based on its size, the brand, etc.

*Table 15: Light Sources, which may contain Mercury*

| HS Custom Code | Description of HS Code | Total Quantity | Included in Inventory |
|---|---|---|---|
| **Light Sources with Mercury** | | | |
| **85393100** | Discharge lamps, other than ultra-violet lamps, fluorescent, hot cathode<br>*It was assumed that this category refers to Gas Discharge Lamps and High Intensity Discharge Lamps, therefore it was assumed these lamps contain Mercury* | 1,156,967 | Yes |
| **85393200** | Mercury or sodium vapour lamps; metal halide lamps*<br>*Contain Mercury* | 15,789 | Yes |
| **85393910** | Low energy consumption lamps*<br>*It was assumed that this HS description refers to Compact Fluorescent Lamps (CFLs) and fluorescent tubes, leading to the conclusion that the majority of these lamps contain Mercury.* | 1,143,315 | Yes |
| **85393990** | Discharge lamps, other than ultra-violet, low energy and fluorescent lamps<br>*It was assumed that this category describes incandescent lights* | 2,153,891 | Yes |
| **85394100** | Arc – Lamps*<br>*Could contain Mercury* | 127 | Yes |

*Source: Statistics Mauritius, 2012*

If we combine all number of potentially Mercury containing lamps (4,469,962), and assume that 60% represent CFLs (2,681,977), 30% fluorescent tubes (1,340,988) and 10 % other Mercury containing lamps (446,996), as based on the Level 2 Mercury inventory conducted in Uruguay.

**Data gaps and priorities for potential follow up**

For this step of the inventory, like for the category on thermometers, it was hard to estimate how many of the items actually contain Mercury, and what the level of Mercury is that they contain. For example, fluorescent tubes contain more Mercury than CFLs, but the distribution between types of such lamps has to be obtained in another way than exclusively through Import Data (e.g. through distributors).

### 8.4 Batteries with Mercury

Mercury oxide batteries are no longer in use, they have been banned as per the Consumer Protection (Control of Imports) regulation of 1999. Since then Mercury Oxide batteries have been replaced by Ni / Cd batteries.

A national campaign was launched a few years ago to collect all mercury battery/cells, it was observed that the authorities were faced with a problem of the disposal. There is an ongoing sensitisation programme for proper management of mercury buttons cells (V. Dookhun, K. Mahadeo, 2009). This initiative is being led by Mauritius Telecom, which is supporting a recycling campaign. During a level 2 inventory, Mauritius Telecom could be approached to help characterize the amount of button cells collected and data obtained could be extrapolated for the entire country.

### 8.5 Paints with Mercury Preservatives

Mercury use in paint has been banned (MoESD, 2012), except for paints used for road marking (V. Dookhun, K. Mahadeo, 2009). Further research on the Mercury content of car paints (metallic paints) and Mercury content of road paints and amounts important might also be worthwhile during a level 2 Mercury Assessment.

### 8.6 Toys containing Mercury

At international level, sufficient documented research is available on Mercury content in certain toys. In the case of Mauritius, such data is not yet readily available.

### 8.7 Cosmetics containing Mercury

Mercury and its compounds are listed as a Poison in the 1st schedule of the Pharmacy Act. The trade of Hg containing cosmetic is banned in Mauritius, however Mercury-free cosmetics cannot be guaranteed for shipments received through unregistered imports.

The Pharmacy Board is working on strengthening the enforcement to ban mercury containing cosmetics on the market. Testing of incoming cosmetics and other products suspected of containing mercury will be made mandatory in the future.

# 9 Data and inventory on crematoria and cemeteries

The number of deaths registered in 2012 was at 9,334 with an increase of approximately 1.8% as compared to 2011 (Statistics Mauritius, 2012).

## 9.1 Crematoria

The Civil Status Department provided the following data on the number of burials and cremations for the years 2010 – 2012:

*Table 16: Number of burials and cremations over the period 2010 - 2012*

| | 2010 | 2011 | 2012 |
|---|---|---|---|
| Burial | 5447 | 5385 | 5452 |
| Cremation | 3660 | 3782 | 3879 |

*Source: Civil Status Department*

The figure for 2012, 3879 cremations was fed into the toolkit.

## 9.2 Cemeteries

The figure for 2012, 5452 burials was fed into the toolkit.

# 10 Quantities of Mercury containing products as wastes

This report has only looked at Mercury releases and not at the quantities/volumes of Mercury containing wastes that are currently being stored. Although it was not possible to provide a complete overview of Mercury containing wastes in storage in Mauritius at the time of writing of the report, the information that is available is provided below only for the propose of safe keeping.

As part of the GEF/UNDP "POPs Management" project in Mauritius, with cash co-financing provided by the private sector, several ministries and entities, a certain amount of hazardous waste qualities are being prepared for disposal abroad. Some of these wastes also contain Mercury components.

*Note*: the list is Mercury containing wastes listed below are only a fraction of the Mercury containing wastes present in Mauritius, and do not at all present an accurate reflections of the current situation.

*Table 17: Mercury containing wastes currently stored in companies/institutions*

| Company / Institution | Potential hazardous waste | Quantity | Remarks | Source of Information |
|---|---|---|---|---|
| **INS-B** | Mercury thermometers | 388 | Broken/out of use | MoLGOI (2012) |
| **CH-A** | Mercury wastes | 10 L | This amount has been generated over 15 years, per year the company generates ~ 0.7 liters of such wastes. | MoLGOI (2012) |
| **University of Mauritius, Faculty of Science Chemistry Lab** | Mercury | 1.6 kg / 1.5 liters | 2.9 kg (Weight of hazardous waste + container) | MoLGOI (July 2013) |
| **Albion Fisheries Research Centre, Chemistry Lab** | Vials containing mercury | See remarks | 6 kg (Weight of hazardous waste + container) | MoLGOI (July 2013) |
| **University of Mauritius, Department of Textile** | Mercury droplets from broken thermometers - collected in a glass flask | See remarks | 0.6 kg (Weight of hazardous waste + container) | MoLGOI (July 2013) |

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# Appendix 1 - Personal contacts

*Table 18: Contact points consulted as part of the preparation of the Mercury Inventory Report*

| Name | Designation | Org. | Address | Tel.No. | Fax.No. | Email |
|---|---|---|---|---|---|---|
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# Appendix 2 - Policy/Regulations pertaining to Mercury[15]

Actions and regulations have been initiated by responsible authorities in Mauritius to control the releases of mercury or mercury containing compounds from environmental sources.

**Regulations and standards pertaining to Mercury management**

The following regulations and standards that have a bearing on Mercury and/or mercury containing products, have already been put in place:

- Under the 2004 Dangerous Chemicals Control Act 2004, Mercury and its compounds are classified as extremely dangerous industrial chemicals and their import and use are restricted.
- The importation of batteries containing mercury (Mercury oxide batteries) has been prohibited under the Consumer Protection (Control of Imports) regulation 1999. Since a ban on its import, Mercury oxide batteries are no longer being used and have been replaced by Ni / Cd batteries.
- Mercury compounds as agricultural chemicals are prohibited (GoM, 2012).
- Standards for the maximum acceptable level of mercury concentration for different environmental media such as Drinking water, Surface water and Foodstuffs are in place (see table 19).
- Standards for the maximum permissible concentration of mercury present in a substance to be discharged or disposed to the environment have also been developed (see table 20).

[15] Although this particular section is not a requirement for a level 1 Mercury inventory, the authors deemed it useful to provide an overview of the existing policy and regulatory framework in Mauritius pertaining to Mercury, Mercury containing products and their management.

- In the Occupational Safety, Health and Safety Act, an occupational exposure standard to mercury is limited to 0.05 mg/m3. The biological exposure limit is 5 g/m3 of blood.

- No regulatory limit currently exists for airborne exposure to mercury outside of an occupational setting. (V. Dookhun, K. Mahadeo, 2009). In Mauritius, air pollution control is regulated under the Environment Protection (Standards for Air) Regulations if 1998, however emissions of Mercury are not covered by these regulation. This piece of legislation is currently being reviewed to cover, among others, mercury emissions (GoM, 2012).

- The 2000 Food Act (Seventh Schedule, regulation 62(2) (a)), has an action level for mercury of 1 ppm in fish. For other foodstuffs than fish, please refer to Appendix 3, which contains information on the maximum permitted proportion of metal contaminant in specified food. For assessing mercury levels in fish and fish products, Regulation (EC) 1881/2006 is used by the Competent Authority – Seafood Unit (CASFU) of the Ministry of Fisheries.

- Although no act has been put into place to support the phase-out of Mercury containing medical devices, the Ministry of Health (2007) urged the Central Supply Division to consider replacing Hg containing medical devices.

*Table 19: Standards for the Permissible Amount of Mercury in Environmental Media*

| Environmental Media | Maximum Allowable Concentration |
|---|---|
| Drinking Water | 0.001 mg/l |
| Surface Water | 0.1 g/l |
| Coastal Water Quality | 0.0005 mg/l |
| Foodstuffs (Fish)[17] | 1 ppm |

*Source: MoESD, 2012; Seventh Schedule (Regulation 62 (2) (a), V. Dookhun, K. Mahadeo (2009)*

*Table 20: Maximum Permissible Concentration of Mercury Allowed to Substances Dumped into the Environment*

| Environmental Media | Effluent Discharge Onto | Permissible Concentration |
|---|---|---|
| **Water Point Sources** | 1. Land | 0.005 mg/l |

| | | |
|---|---|---|
| | 2. Underground | 0.005 mg/l |
| | 3. Surface Water Course | 0.005 mg/l |
| | 4. Ocean | 10 g/l |
| **Waste Disposal Restrictions** | Treated Wastewater for irrigation Use | 0.02 mg/l |

*Source: MoESD, 2012; Seventh Schedule ( Regulation 62 (2) (a), V. Dookhun , K. Mahadeo (2009)*

**Guidelines**

The following guidelines that have a bearing on Mercury and/or mercury containing products, have already been developed:

- Guidelines for hazardous waste management (which includes Mercury containing wastes) are available.
- A protocol for the recovery of spilt mercury and for its safe handling in hospitals has been prepared and was submitted to the Ministry of Local Government.

# Appendix 3 – Maximum Permitted Proportion of Metal Contaminant in Specified Food

SEVENTH SCHEDULE *(regulation 62 (2) (a))*

*Table 21: Maximum Permitted Proportion in ppp in food*

| FOOD | Maximum Permitted Proportion in Parts per million (ppm) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ARSENIC | ANTIMONY | Pb | Cu | TIN | Zn | Hg | Cd | FLUORINE | SELENIUM |
| Agar | 1.0 | 1.0 | 10.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Alcoholic beverage | 0.2 | 0.15 | 0.5 | 5.0 | 40.0 | 2.0 | 0.0 | 1.0 | 10.0 | 2.0 |
| Alginic acid and algi-nate | 1.0 | 1.0 | 10.0 | 30.0 | 40.0 | 40.0 | 0.0 | 1.0 | 10.0 | 2.0 |
| Apples | 1.0 | 1.0 | 3.0 | 30.0 | 40.0 | 40.0 | 0.0 | 1.0 | 10.0 | 2.0 |
| Baking powder, cream of tartar | 2.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.0 | 1.0 | 15.0 | 2.0 |
| Beer | 0.2 | 0.15 | 0.5 | 5.0 | 40.0 | 2.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Caramel | 1.0 | 1.0 | 5.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Carragene | 1.0 | 1.0 | 10.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Chemical (excluding synthetic colouring) | 2.0 | 1.0 | 10.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Cider and Perry | 0.2 | 0.15 | 0.5 | 5.0 | 40.0 | 2.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Cocoa product | 1.0 | 1.0 | 2.0 | 70.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Coffee and Chicory | 1.0 | 1.0 | 2.0 | 70.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Country liquor | 0.2 | 0.15 | 0.5 | 5.0 | 40.0 | 2.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Curry powder | 1.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Dextrose monohydrate and anhydrous | 1.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Dried herb | 5.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Edible fat and oil | 0.1 | 1.0 | 0.1 | 0.5 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Edible gelatin | 2.0 | 1.0 | 2.0 | 30.0 | 40.0 | 100.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Fining and clearing agents | 5.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FOOD | Maximum Permitted Proportion in Parts per million (ppm) | | | | | | | | | |
| | ARSENIC | ANTIMONY | Pb | Cu | TIN | Zn | Hg | Cd | FLUORINE | SELENIUM |
| Fish and Fish product | 1.0 | 1.0 | 2.0 | 30.0 | 40.0 | 100.0 | 1.0 | 1.0 | 10.0 | 2.0 |
| Flavouring substance | 1.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Flour | 1.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 3.0 | 2.0 |
| Fortified country liquor | 0.2 | 0.15 | 1.0 | 5.0 | 40.0 | 2.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Fortified wine | 0.2 | 0.15 | 1.0 | 5.0 | 40.0 | 2.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Frozen confection | 0.5 | 1.0 | 0.5 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Fruit juice (vegetable juice) | 0.1 | 0.15 | 0.5 | 10.0 | 40.0 | 5.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Honey | 1.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Hop concentrate, except for commercial brewing | 5.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Hop dried, except for commercial brewing | 2.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Ice cream | 0.5 | 1.0 | 1.0 | 2.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Lecithin | 1.0 | 1.0 | 5.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Liquor ice | 2.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Meat and meat product | 1.0 | 1.0 | 2.0 | 20.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Milk and milk product | 0.5 | 1.0 | 1.0 | 20.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Molasse edible | 1.0 | 1.0 | 5.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Mustard | 5.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Onion -dehydrated | 2.0 | 1.0 | 10.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Pea | 1.0 | 1.0 | 3.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Pectin, liquid | 2.0 | 1.0 | 10.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Pectin, solid | 5.0 | 1.0 | 50.0 | 300.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Phosphate used in food preparation | 1.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 30.0 | 2.0 |
| Pickle | 1.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Protein, hydrolysed | 1.0 | 1.0 | 5.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Seaweed, edible fungus | 1.0 | 1.0 | 10.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |

| FOOD | Maximum Permitted Proportion in Parts per million (ppm) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ARSENIC | ANTIMONY | Pb | Cu | TIN | Zn | Hg | Cd | FLUORINE | SELENIUM |
| Shellfish | 1.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 15.0 | 2.0 |
| Soft drink concentrate | 0.5 | 0.15 | 2.5 | 20.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Concentrated soft drink | 0.5 | 0.15 | 1.0 | 10.0 | 40.0 | 25.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Soft drink for direct consumption | 0.1 | 0.15 | 2.0 | 2.0 | 40.0 | 5.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Special purpose food for infant and child | 0.1 | 1.0 | 0.5 | 5.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Sugar, raw | 1.0 | 1.0 | 5.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Sugar, white | 1.0 | 1.0 | 0.5 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Spice | 5.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 100.0 | 2.0 |
| Tea, scented tea | 1.0 | 1.0 | 2.0 | 150.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Tomato, pulp, paste, puree | 1.0 | 1.0 | 2.0 | 100.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Vegetable product, fruit product | 1.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Yeast, brewer's yeast for the manufacture of yeast product | 5.0 | 1.0 | 10.0 | 120.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Yeast and yeast product | 2.0 | 1.0 | 7.0 | 120.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Other food for which no limit is specified | 1.0 | 1.0 | 2.0 | 30.0 | 40.0 | 40.0 | 0.03 | 1.0 | 10.0 | 2.0 |
| Food packed in can and tin foil other than special purpose food | Nil | Nil | Nil | Nil | 250 | Nil | Nil | Nil | Nil | Nil |

Note:
Nil - The substance is prohibited in that food.

# Appendix 4 – Results of survey among jewellers on the use of Mercury (2007)

**MERCURY SURVEY**

No. of questionnaires distributed – 398

(i) Total number of replies received – 81
(ii) Total number of undelivered letters – 07

No. of dealers using mercury as per survey -- 31

Amount of mercury used by dealers annually as per survey -- 6.845 kg

Frequency of use of Mercury by dealers:

(i) Daily - Nil
(ii) Weekly - Nil
(iii) Monthly - 1
(iv) Yearly - 24
(v) Others - 6

List of processes where Mercury is used:

(i) To clean gold jewellery;
(ii) To recuperate gold from waste;
(iii) Purification state of gold;
(iv) Process of refining gold.

Awareness of hazards of mercury to health/environment:

(i) Positive reply - 46
(ii) Negative reply - 15
(iii) No indication - 25

Use of protective equipment:

(i) Yes - 21
(ii) No - 53

Alternatives suggested by participants of survey:

(i) Use of Nitric Acid
(ii) Refinery machine

# Notes

# Notes

Ministry of Environment and Sustainable Development
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