# Mercury Product Inventory Report

Mercury added products:
Country situation analysis in Bangladesh
(Product inventory and emission source identification)

ESDO

UNEP

# [DRAFT]

Study Report
On

# Mercury added products:
# Country situation analysis in Bangladesh

(Product inventory and emission source identification)

Study Report

On

# Mercury added products: Country situation analysis in Bangladesh

(Product inventory and emission source identification)


**Advisor**

Syed Marghub Murshed, Prof. Dr. Abu Jafar Mahmood

**Team Leader**

Shahriar Hossain, Ph.D.

**Editorial Team**

Siddika Sultana, Farida Shahnaz, Joanna Lovatt, Mahmood Hasan Khan

**Research Associate**

Pratitee Kamal

**Research Assistant**

Asia Akter

**Support Team**

Md. Ali Hossain, Md. Mamun UlHasan, Md. Kawser Uddin Maruf, Amena Begum Ruma

**Volunteers**

Adan Siddiqui, Md. Hamza, Tahmidul Haq, Syed Abrar, Yameen Irteza,
Fahad Ashhab, Robi Ray, Tareq Toukir, Jewel Mahmood, Abdullah Al Amin




**Disclaimer**

"While this publication has been produced with the assistance of the UNEP, the contents of the publication are the sole responsibility of ESDO together with UNEP. In addition, ESDO and UNEP entered into this SSFA with the overall objective of raising awareness as well as strengthening capacities to replace mercury-added products and ensure the environmentally sound management of end-of-life mercury-added products in Bangladesh. The views here in shall not necessarily be taken to reflect the official opinion of any of these organization."


Contact Address
House# 8/1, Level# 5, Block# C, Lalmatia, Dhaka-1207, Bangladesh
Phone: 880-2-912-2729, Fax: 880-2-913-0017
E-mail: info@esdo.org
Web: www.esdo.org or www.facebook.com/esdobd

## Environment and Social Development Organization-ESDO

ESDO is a non-governmental organization working on environmental and health issues with various stakeholders, to create a toxic free Bangladesh and sustainable living environment.

### UNEP

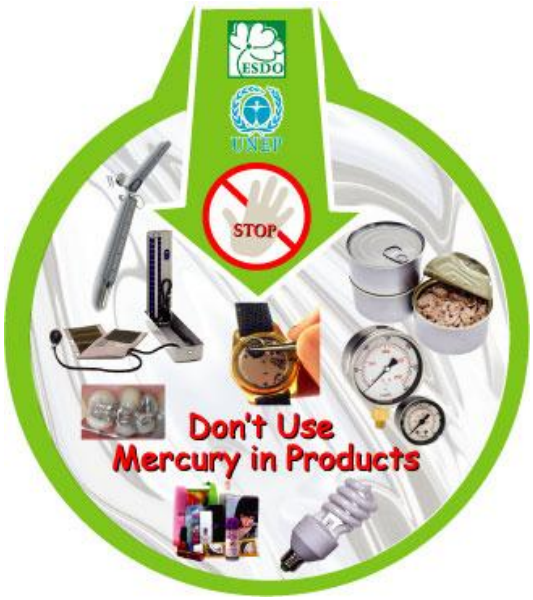
The United Nations Environment Programme (UNEP) is the leading global environmental authority that sets the global environmental agenda, promotes the coherent implementation of the environmental dimension of sustainable development within the United Nations System and serves as an authoritative advocate for the global environment.

### UNEP Global Mercury Partnership

Governments initiated partnership activities at Governing Council 23 and have subsequently specified the UNEP Global Mercury Partnership as one of the main mechanisms for the delivery of immediate actions on mercury during the negotiation of the global mercury convention. The overall goal of the UNEP Global Mercury Partnership is to protect human health and the global environment from the release of mercury and its compounds by minimizing and, where feasible, ultimately eliminating global, anthropogenic mercury releases to air, water and land. The Partnership works closely with stakeholders to assist in the timely ratification and effective implementation of the Minamata Convention on Mercury.

### UNEP Chemicals

UNEP Chemicals is a division of UNEP technology, Industry and Economics which has established by UNEP in response to the Governing Council's request with the immediate objective to encourage all countries to adopt goals and take actions, as appropriate, for the identification of mercury-exposed populations, for the minimization of mercury exposure through outreach efforts and for the reduction of anthropogenic mercury releases.



**Secretary**
Ministry of Environment and Forests
Govt. of the People's Republic of Bangladesh
Bangladesh Secretariat, Dhaka-1000

# Message

On behalf of Ministry of Environment and Forest (MoEF), Government of the People's Republic of Bangladesh, I sincerely congratulate Environment and Social Development Organization- ESDO on their efforts for successful implementation of the project "Reduction of demand for Mercury in mercury containing products in Bangladesh"in association with United Nations Environment Program (UNEP). Special thanks for conducting a comprehensive inventory of mercury source, emission and impact assessment in Bangladesh. Just like ESDO, we are also having ongoing efforts to raise awareness as well as strengthening capacities to replace mercury-added products. We know that it is not an easy task. If we receive any constructive suggestions, we will certainly go ahead with this. We have already taken some initiatives and hope that we will be able to ratify the Minamata Convention soon.

We would also like to congratulate ESDO for coming up with this "Study Report". It is refreshing to know that ESDO shares a common goal with us in creating awareness and promoting environmentally sound management of end-of-life mercury-added products in Bangladesh. I believe this report will provide valuable inputs in the preparation of a national policy regulation on import and use of mercury added products. Thorough ESDO's research work stakeholders will be more aware of the mercury level in the products and industrial processes.

Congratulations once again and best wishes to ESDO for its endeavor towards betterment of the environment and people of Bangladesh.

21.09.15

(Dr. Kamal Uddin Ahmed)

পরিবেশ ও বন মন্ত্রণালয়, বাংলাদেশ সচিবালয়, ভবন নং-৬, (১৪ তলা), ঢাকা-১০০০
ফোনঃ + ৮৮-০২-৯৫৪০৪৮১, ফ্যাক্স : ৮৮-০২-৯৫৪০২১০
ই-মেইল : secretary@moef.gov.bd ওয়েবসাইট : www.moef.gov.bd

# Foreword

Mercury pollution is a global problem that requires global action because it moves with air and water, transcends political borders, and can be transported thousands of miles in the atmosphere.

Investigations of developed countries and some developing countries reveal that the production, consumption and disposal of mercury and mercury containing compounds, especially when used in industrial and commercial sectors, have an enormous impact on the atmosphere, biodiversity, soil, water, human health, etc. This impact will last, not merely on this generation, but also for future generations. The devastation that will result from these environmental impacts pose a great obstacle to socio-economic development. The Minamata Bay tragedy, where great numbers of children in Minamata, Japan, were born with severe birth defects as a result of systematic mercury contamination in the water source during the 1950s, made the international community acutely aware of the potentially lethal effects of mercury which is discharged into the environment without proper treatment.

The Minamata Convention calls on governments around the world to learn and apply the lessons from the Minamata tragedy for the control of emission and release of mercury and mercury compounds in the future. Bangladesh is one of the signatory to Minamata convention.

Mercury in wastes, containing this free element and its compounds, and in equipment containing mercury, continues to harm the environment of Bangladesh. And will also do so years after being disposed. In Bangladesh we have no specific guidelines regarding the management of mercury wastes, or how to safely manage the uses of either products or equipment that contain mercury or mercury compounds. Evaluating mercury emission is, therefore, is required to assess new, potential and existing sources, of the mercury contamination from mercury and mercury-containing products.

Through the measures enumerated in the Convention, phasing-out of mercury containing products has already begun. United Nations for Environmental Programme (UNEP) is supporting the efforts towards an early entry into force of the convention and towards the implementation of its provisions.

The international demand for the control of mercury emissions arose following the UNEP's Governing Council's 22nd session in February 2003. After considering the key findings of the Global Mercury Assessment Report, the governing Council decided that there was sufficient evidence of significant global adverse impacts from mercury to warrant further international action to reduce the risks to humans and wildlife from the release of mercury into to the environment.

This commitment to addressing the global adverse impacts of mercury pollution was reinforced by 27 Governments and regional economic integration organizations at the 23rd session of the Governing Council in February 2005. The Governing Council also requested UNEP, in cooperation and consultation with other relevant organizations, to facilitate and conduct technical assistance and capacity building activities to support the efforts of all countries to take action on mercury pollution. The Governing Council specified the UNEP Global Mercury Partnership as one of the main mechanisms for the delivery of immediate actions on mercury during the negotiations of the global mercury convention.

In response to the Governing Council's request, UNEP has established a mercury program within UNEP, with the immediate objective to encourage all countries to adopt goals and take actions, as appropriate, for the identification of mercury-exposed populations, for the minimization of mercury exposure through outreach efforts and for the reduction of anthropogenic mercury releases.

We, the Environment and Social Development Organization-ESDO, in collaboration with UNEP took an initiative to carry out a research and survey on the project titled "Reduction of Demand of Mercury in Mercury Containing Products in Bangladesh". This was the first, ever, in depth study on mercury added products in Bangladesh.

Under the guidance and dynamic leadership of Dr. Shahriar Hossain; the ESDO research team was able to come forward with a comprehensive inventory report on the status of mercury emission and health impact in Bangladesh.

It may, also, to be mentioned that with the cooperation of different stakeholders from both public and private sectors the inventory report on "Mercury added products: in country situation analysis in Bangladesh (Product inventory and emission source identification)" was developed. Representatives of the government agencies, the private sector and other stakeholders contributed valuable inputs in this effort.

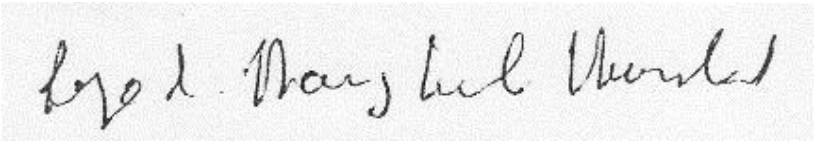
This inventory report focuses on a preliminary inventory of mercury use and release in Bangladesh, a quantification of mercury emission and releases, identification of potential hotspots, possible alternatives and a regulatory framework on mercury added products and processes.

It provides basic information that may be useful to government agencies, the private sector and all other stakeholders for the management and use of mercury in an appropriate way.

A background document titled "UNEP Toolkit for identification and quantification of mercury releases, April 2013" is a base for preparation of the mercury inventory report of Bangladesh. Identification of the emission and release sources for mercury in Bangladesh based on UNEP Toolkit. In this regard, and while depending on UNEP Toolkit it has not been possible to accurately quantify all mercury release sources in Bangladesh.

Inventories on the release of hazardous substances constitute an important source of information for all concerned. Such inventories are often of vital importance to stakeholders, in the industry, trade, manufacturing sectors as well as consumers.

We, in ESDO, trust that the inventory report prepared by the ESDO research team that appears in the following pages will be of interest as well as useful to policy makers in the government to all those concerned ministries, in the scientific community and all other stakeholders.



**Bangladesh, Dated:**
**21/09/2015**

Syed Marghub Murshed
Chairperson
ESDO

# Acknowledgment

We take this opportunity to thank all those who were instrumental in compiling and shaping this study report.

Sincere thanks goes to the United Nations Environment Programme (UNEP) for providing the technical and financial support.

We express our gratitude to Dr. Abu Jafar Mahmood, Professor (Retired), University of Dhaka; Mr. Mahmood Hasan, Director (Air Quality Department), DoE; Ms. Farida Shahnaz, ex-director, ESDO; Joanna Lovatt, communications consultant and volunteer for their counsel and guidance in on the writing and review of this report.

This report was produced under the UNEP Global Mercury Partnership. The overall objective was to raise awareness as well as strengthening capacities to replace mercury-added products and ensure the environmentally sound management of end-of-life mercury-added products in Bangladesh.

We also acknowledge relevant stakeholders such as relevant line ministries, civil organizations, regional and international organizations, industrial trade bodies, the public, and the media for their continued support and effective participation.

Finally, this study report would not have been possible without continuous effort of ESDO team and volunteers.


Environmental and Social Development Organization-ESDO
House # 8/1, Level # 5, Block # C, Lalmatia, Dhaka-1207, Bangladesh.
Phone: 880-2-912-2729, Fax: 880-2-913-0017, E-mail: info@esdo.org,
URL: www.esdo.org www.facebook.com/esdobd

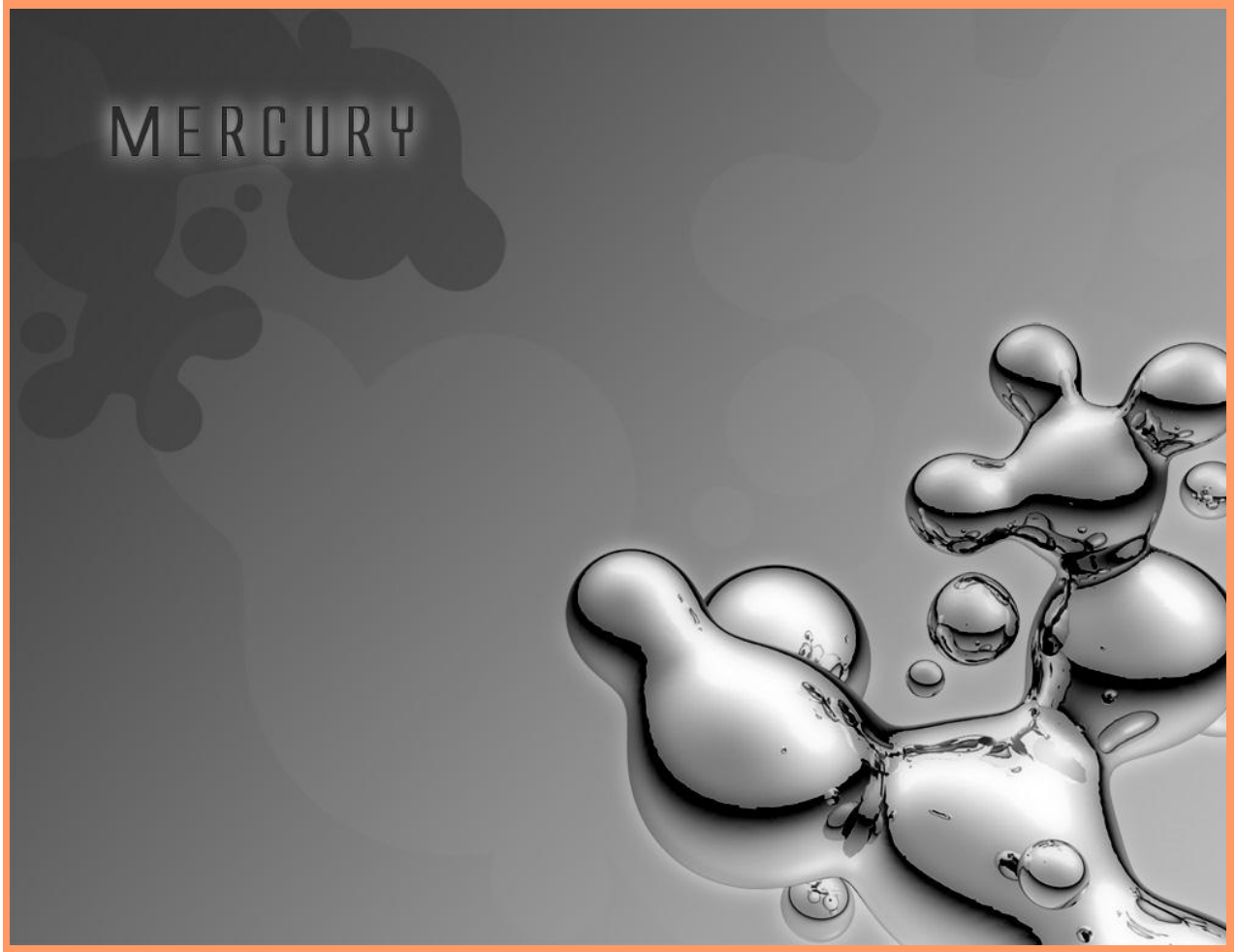
TABLE OF CONTENTS

## List of Tables



## List of figures

# Executive Summary



# Executive Summary

Mercury in the wastes, containing the free element and itscompounds, and the equipment containing mercury, continues to harm the environment of Bangladesh many years after their disposal. Bangladesh has no specific guidelines regarding the management of mercury wastes, or how to safely manage the uses of either products or equipment that contain mercury or mercury compounds.

The evaluation of mercury emission, therefore, is required to assess new, potential and existing sources, of the mercury emission as results of the uses of mercury and mercury-containing products. The calculations of mercury emission and release into the environment made in this report are based on surveys, guidelines, methods, sources and other factors.

The international demand for the control of mercury emissions arose following the UNEP's Governing Council's 22nd session in February 2003. After considering the key findings of the Global Mercury Assessment Report, the governing Council decided that there was sufficient evidence of significant global adverse impacts from mercury to warrant further international action to reduce the risks to humans and wildlife from the release of mercury into to the environment. The Governing Council decided that national, regional and global actions should be initiated as soon as possible and urged all countries to adopt goals and take actions, as appropriate, to identify populations at risk and to reduce human-generated releases of mercury.

This commitment to addressing the global adverse impacts of mercury pollution was reinforced by 27 Governments and regional economic integration organizations at the 23rd session of the Governing Council in February 2005. The Governing Council also requested UNEP, in cooperation and consultation with other relevant organizations, to facilitate and conduct technical assistance and capacity building activities to support the efforts of all countries to take action on mercury pollution.

In response to the Governing Council's request, UNEP has established a mercury program within UNEP Chemicals (UNEP Division of Technology, Industry and Economics), with the immediate objective to encourage all countries to adopt goals and take actions, as appropriate, for the identification of mercury-exposed populations, for the minimization of mercury exposure through outreach efforts and for the reduction of anthropogenic mercury releases.

Environment and Social Development Organization-ESDO has also undertaken the project titled "Reduction of demand of mercury in mercury containing products in Bangladesh" in collaboration with UNEP to raise awareness and document mercury use and mercury added products in Bangladesh. This initiative also aims to support Bangladesh government towards ratification of Minamata convention.

Inventories of releases of priority hazardous substances constitute an important decision making tool in the process of mitigating environmental impacts from the pollutants in question. Such inventories are often vital in the communication with stakeholders such as industry, trade, manufacturers and the public.

The information on mercury pollution contained in this report can be used to determine which sources of mercury should be addressed in Bangladesh for release reduction initiatives. Moreover, baseline inventories and related information can be used to set effective approaches and to draw further attention of the concerned government officials and

stakeholders to take appropriate actions and measures.

# Findings

This report is mainly focused on the preliminary field survey on mercury uses and releases, within Bangladesh territory. These surveys were undertaken during January-May, 2015 throughout Bangladesh by the ESDO team. The team followed the UNEP toolkit format in the design of the survey. Based on the preliminary data, the findings are as follows:

### Mercury trading: Import-Export

- ❑ Mercury is not mined or produced in Bangladesh. It is mostly imported from other countries.
- ❑ Bangladesh does not produce mercury compounds nor does it engage in mercury mining.
- ❑ According to the source of NBR, 2015, around 3.73 MT Mercury is imported each year in Bangladesh.
- ❑ Besides that, during the field survey ESDO has found that in Bangladesh approximately 40 chemical importers are present and they import "mercury" chemicals mainly from China and India in recent years. Most of them import and sale two forms of mercury. These are: encapsulated and liquid forms.
- ❑ According to the survey it was found that around 58 MT mercury is imported by the importers (both legal and illegal way through border belt areas).
- ❑ It was also found that annual storage of mercury (after supply or sell) for both the forms are 18600 kg or 18.6 MT.
- ❑ So, it has been found that in a year **39.4 MT** mercury usually sell to the following target customers. They are;
  - Dental Colleges/Chambers/ Quacks
  - Dental Assistants
  - Beauty Product or Cosmetics Producers
  - Jewelry Producers (used to re-collect gold from the waste)
  - Pharmaceutical Companies
  - Pesticide/biocide companies
  - Laboratories (Academic institutions/private sectors)

### Mercury Usage Inventory in Products and Processes

- ❑ Major consumers of mercury are: the industrial sector (Chlor-alkali, paper and pulp, cement production), the healthcare sector (healthcare instruments, dental amalgam), the energy sector and processes, the electronic sector (electronic device, batteries, CFLs), the cosmetics sector, the jewelry sector and others.

- ❑ **Industrial Sector**

- Calculations based on existing Chlor-alkali plants, those using previous technology for producing chlorine ($Cl_2$), suggest that, in total, 4.49 MT of mercury per year are released.
- Though 33 cement industries are present in Bangladesh but 8 have clinker and cement manufacturing facilities. It is estimated that the release of mercury from the8 cement factories of Bangladesh is 0.14 MT.
- Based on calculation on existing Aluminum production companies, total emission of mercury into air is 0.011 MT.
- Based on same calculation it was found that 0.16 MT mercury is being emitted into air during steel production process.

❑ **Health care sector**

- According to ESDO's baseline survey on mercury containing products in 2015 finds that 887472 thermometers are used yearly, and 37.8% of these thermometers break (552007.58). Similarly, yearly use of the number of sphygmomanometers is 305926 and 10% (275333.4) of the total sphygmomanometers break.
- Standard thermometers contain 0.5g – 2.0g mercury and standard sphygmomanometers contain 80-160g mercury.
- It is estimated that, in a year, approximately 0.69 tons of mercury is released into the environment and atmosphere due to thermometer breakage, and that 3.3 tons of mercury is released due to sphygmomanometer breakage.
- During the preparation of dental amalgams, mercury vapor isreleased, and the amalgamsare sources of exposure to mercury contamination. People associated with dental care such as dentists, students and health workers and, in some cases, patients, are exposed to mercury vapor during amalgam preparation through mercury spills, malfunctioning amalgamators, leaky amalgam capsules, trituration placement and condensation of amalgam, polishing and removal of amalgam andvaporization of mercury from other sources.
- Based on ESDO's baseline survey it is estimated that a person during amalgam dental fillings inhales, on an average, between 3 and 17 micrograms of mercury from its vapor into his or her blood each day. In a year it is 1095 mg to 6205 mg.
- Based on the same ESDO survey, 1.09 MT to 6.22 MT Mercury vapor is released from mercury amalgam fillings per year from the dental sector in Bangladesh.

❑ **Energy sector and processes**

- In Bangladesh a major contributor of mercury emissions into to atmosphere in the near future will be coal burning in power plants. The processing of mineral oils, natural gas and fossil fuel extraction are also sources of mercury emission to the atmosphere.
- Based on ESDO's country situation analysis, it is estimated that the potential mercury emissions from the energy sector (coal, gas, oil refining etc.) is 3058.158 Kg.
- It is estimated that 11 kg mercury can emit into the air during aluminum production and 160 kg mercury emit from the by-product during pig iron and steel production.

❑ **Electronic sector**

- According to the report *"Mercury Sources: Products and Hotspots in Bangladesh",* prepared by ESDO in 2012, it is estimated that fluorescent lamps represent approximately 80 percent of the total mercury used in lighting.
- Based on ESDOs baseline surveytotal CFL production in Bangladesh is 19,688,097.2 units in the period of 2012-2014 and mercury release from CFL light bulb is 0.118 MT.
- During the field survey of ESDO on 2015, it was found that each button cell battery may contain 1-2 ppm mercury as impurities in the salted layer.
- Button cell batteries also contain mercury as impurities. According to the survey the total mercury release from button cell batteries in Bangladesh are estimated 0.0179 MT per year.

❑ **Others**

Based on ESDOs baseline survey on 2015;

- Mercury release from jewelry sector was estimated to be 4.1 MT

- Based on calculation mercury release from measuring devices were 0.85 MT.
- According to the report of "Mercury Sources: Products and Hotspots in Bangladesh" prepared by ESDO in 2012, mercury concentration in beauty products ranges from 4653 ppm to 3361 ppm.

### MERCURY WASTE AND RELEASE INTO ENVIRONMENT

- ❑ Mercury has a very long life span, therefore, mercury in the wastes, sludge's, and by products is not destroyed with disposal but rather continues to subsist in environment.
- ❑ Based on focus group discussions ad surveys, we found that the majority of users of mercury are not aware of the importance of proper disposal of mercury waste or mercury containing compounds. There are also no systems for the large-scale disposal of mercury in Bangladesh. Based on ESDO baseline survey, it is estimated that 1.12 MT mercury waste is generated and released every year into environment through waste deposition, land filling and waste water treatment.
- ❑ Based on the same study, we found that annual mercury emission from cremation is 0.170 MT.

- Mercury release from the chemicals, reagents, solvents use in laboratories are 538.263 Kg.

Due to lack of information we were unable to obtain information for calculations including primary metal production, mercury in biocides and pesticides, paints, toys and related products, etc.

Lack of the absence of standardization and certification of the quality products and their high costs are some of the barriers of shifting from mercury to alternative healthcare instruments and dental amalgam. Absence of end-of-life management of discarded CFLs and other devices are also reasons for concern.

Bangladesh has limited strategies in place for identifying a site contaminated with mercury, as well as identifying and assessing the impact of mercury on environment and human health. The reason behind this is the lack of training, ability and capacity for knowledge sharing. Policy makers, regulators and the users of mercury containing goods are generally uninformed about the issue. There is also some lack of media awareness and the common mass is hardly informed of the toxicity of mercury.

Future recommendations to minimize mercury use and releases can be;

- ❑ *Promoting Alternatives of mercury added products*
- ❑ *Training on Alternatives of mercury added products*
- ❑ *Government Regulatory, and Institutional framework Programs*
- ❑ *Plan to Minimize and eliminate the uses of Mercury and Mercury based products and practices*

# Recommendations

Bangladesh does not yet have any specific guidelines regarding the management of mercury release into the environment, or regarding how to safely manage the use of products/equipment that contain mercury, mercury compounds or other specific chemicals. The existing legislation generally focuses on the overall management of chemicals particularly related to pesticides (for agricultural purposes) and waste management (for the environmental purposes).

# National Information

# 1 NATIONAL INFORMATION

## 1.1 COUNTRY PROFILE

### 1.1.1 Physical Geography

Bangladesh emerged as an independent State on 16th December, 1971.

It is a semi-tropical, riverine country with a monsoon climate. It lies in the north-eastern part of South Asia between the borders of India and Myanmar (Burma).

The physical geography of Bangladesh is varied and has an area characterized by two distinctive features: a broad deltaic plain subject to frequent flooding, and a small hilly region crossed by swiftly flowing rivers. The country has an area of 147,570 square kilometers and extends 820 kilometers north to south and 600 kilometers east to west. Bangladesh is bordered on the west, north, and east by a 4,095-kilometer land frontier with India and, in the southeast, by a short land and water frontier (193 km) with Burma (Myanmar).On the south is a highly irregular deltaic coastline of about 580 kilometers, fissured by many rivers and streams flowing into the Bay of Bengal. The territorial waters of Bangladesh extend 12 nautical miles (22 km), and the exclusive economic zone of the country is 200 nautical miles (370 km). Bangladesh has about 250 Major rivers with a total length of 24,140 km and innumerable canals, oxbow lakes and wetlands. The forest covers about 7 percent of the land area.[1]

Bangladesh is divided into seven major administrative divisions. Each division is named after the major city within its jurisdiction that serves as the administrative capital of that division

| Division | Area (km2)[2] |
|---|---|
| Barisal Division | 13,225.20 |
| Chittagong Division | 33,908.55 |
| Dhaka Division | 31,177.74 |
| Khulna Division | 22,284.22 |
| Rajshahi Division | 18,153.08 |
| Rangpur Division | 16,184.99 |
| Sylhet Division | 12,635.22 |

Bangladesh has a subtropical monsoon climate characterized by wide seasonal variations in rainfall, moderately high and humidity. There are six distinct seasons in Bangladesh: In general, maximum summer temperatures range

[1]http://www.moedu.gov.bd/old/bangladesh.htm
[2]"2011 Population & Housing Census: Preliminary Results" (PDF). Bangladesh Bureau of Statistics. Retrieved 12 January 2012.

between 30°C and 40°C. June is the warmest month in most parts of the country. January is the coldest month, when the average temperature for most of the country is about 10°C. Heavy rainfall is characteristic of Bangladesh. With the exception of the relatively dry western region of Rajshahi, where the annual rainfall is about 1600 mm, most parts of the country receive at least 2000 mm of rainfall per year. Because of its location towards the south of the foothills of the Himalayas, where monsoon winds turn west and northwest, the regions in northeastern Bangladesh receives the highest average precipitation, sometimes over 4000 mm per year. About 80 percent of Bangladesh's rain falls during the monsoon season.

### 1.1.1 Population[3]

- The population of Bangladesh is estimated at 158,512,570 as of July 1 2014.
- Bangladesh's population is 2.19% of the total world population.
- Bangladesh ranks number 8 in the list of countries by population.
- The population density in Bangladesh is 1,101 people per $Km^2$.
- 30% of the population is urban (47,334,620 people in 2014).
- The median age in Bangladesh is 25.4 years.
- 10 204 live births average per day (425.18 in an hour).
- 2 553 deaths average per day (106.39 in an hour).
- 55 529 324 young people under 15 years old (28 160 941 males / 27 368 383 females).
- 98 990 368 persons between 15 and 64 years old (46 973 260 males / 52 017 108 females).
- 7 557 667 persons above 64 years old (3 696 985 males / 3 862 303 females.

[3]http://www.worldometers.info/world-population/bangladesh-population/

## 1.2 SECTORIAL PROFILE

### 1.2.1 Agricultural profile

Most of Bangladesh lies within the broad delta formed by the Ganges and Brahmaputra rivers and is exceedingly flat, low-lying, and subject to annual flooding. Much fertile, alluvial soil is deposited by the floodwaters. The only significant area of hilly terrain, constituting less than one-tenth of the nation's territory, is the Chittagong Hill Tracts District in the narrow southeastern panhandle of the country.

There, on the border with Myanmar, is MowdokMual (1,003 m/3,291 ft), the country's highest peak. Small, scattered hills lie along or near the eastern and northern borders with India. The eroded remnants of two old alluvial terraces-the Madhupur Tract, in the north central part of the country, and The Barind, straddling the northwestern boundary with India-attain elevations of about 30 m (about 100 ft). The soil here is much less fertile than the annually replenished alluvium of the surrounding floodplain.[4]

**Land**

Total area: 144,000 square kilometers;
Land area: 133,910 square kilometers
Land boundaries: 4,246 km total; 193 km with Myanmar, 4,053 km with India,
Coastline: 580 km

**Land distribution:**

· arable land 67%
· forest and woodland 16%
· permanent crops 2%
· meadows and pastures 4%
· others 11%

[4]http://www.discoverybangladesh.com/meetbangladesh/land_resources.html

**Agriculture Sector in Bangladesh**

Agriculture plays a key role in ensuring food security and accelerating poverty reduction. About three-fourths of Bangladesh population live in rural areas and are directly or indirectly dependent on the sector. About 47.0% of the total labor force is employed in agriculture, although the share of agriculture in GDP is declining (19.0% in FY2006 to 15.9% in FY2014).

Agriculture in Bangladesh is heavily dependent on the weather, and the entire harvest can be wiped out in a matter of hours when cyclones hit the country. Farms are usually very small due to heavily increasing population, unwieldy land ownership, and inheritance regulations. The 3 main crops—rice, jute, and tea—have dominated agricultural exports for decades, although the rice is grown almost entirely for domestic consumption, while jute and tea are the main export earners. In addition to these products, Bangladeshi farmers produce sugarcane, tobacco, cotton, and various fruits and vegetables (sweet potatoes, bananas, pineapples, etc.) for the domestic market.

Meeting the nation's food requirements remains the key-objective of the government and in recent years there has been substantial increase in grain production. However, due to calamities like flood, loss of food and cash crops is a recurring phenomenon which disrupts the continuing
progress of the entire economy.

Agricultural holdings in Bangladesh are generally small. Through Cooperatives the use of modern machinery is gradually gaining popularity. Rice, Jute, Sugarcane, Potato, Pulses, Wheat, Tea and Tobacco are the principal crops. The crop sub-sector dominates the agriculture sector contributing about 72% of Total production. Fisheries, livestock and forestry sub-sectors are 10.33%, 10.11% and 7.33% respectively.

Crop diversification program, credit, extension and research, and input distribution policies pursued by the government are yielding positive results. The country is now on the threshold of attaining self-sufficiency in food grain production.

### 1.2.2 Industrial Profile[5]

Supply disruptions and subdued consumption demand due to political unrest cut industry growth to 8.4% in FY2014, from 9.6% a year earlier. Manufacturing growth slowed to 8.7% from 10.3%, reflecting weaker production for the domestic market, although garment production strengthened. Expansion in electricity output slowed to 8.2% from 9.7%. Construction growth picked up to 8.6% from 8.0%, reflecting higher government development spending.

Industry growth is expected to rise to 9.2% on a rise in domestic demand supported by increased remittances and a likely pick up in exports in the second half of the year.

[5]http://www.adb.org/sites/default/files/institutional-document/151071/ban-qeu-september-2014.pdf

The central bank's closer attention to directing more credit to SMEs and to agro based industries is expected to lead to higher production. Industry's share of GDP is 27.9% and employment 17.5%. To address Bangladesh's stark employment challenge, with about 2.0 million people joining the labor force every year, many better paying jobs need to be created in the industry sector, especially in manufacturing, where productivity is higher.

The quantum index for medium- and large-scale manufacturing industries rose by 8.2% during July–May FY2014. Wearing apparel, the major industrial group, grew by 11.2%; textiles fell by 0.8%, food products, rose by 8.0%; pharmaceuticals and medicinal chemicals by 13.6%; other nonmetallic mineral products by 2.3%; leather and leather products by 5.7%; basic metals by 9.9%; fabricated metal products, except machinery, by 9.2%; printing and reproduction of recorded media by 2.6%; electrical equipment by 2.9%, beverages by 29.6%, tobacco products by 4.5%; wood and cork products by 2.0%; other machinery and equipment by 10.0%; computer, electronic, and optical products by 5.8%; rubber and plastic products by 6.8%; motor vehicles, trailers, and semitrailers by 9.9%; and other transport equipment by 13.3%. Coke and petroleum products fell by 9.4%. Pre-election supply disruptions cut industry growth The general index for small-scale manufacturing(1995/96 base) rose by 5.3% during July– March, FY2014. Food, beverages, and tobacco rose by 3.4%; textiles, leather, and apparel by 19.6%; metal products and machinery by 10.7%; basic metal industries by 6.6%; paper, printing, and publishing by 5.3%; wood and wood products by 2.5%; and other manufacturing industries by 23.6%. Chemicals, rubber, and plastic rose by 1.2%; and nonmetallic products fell by 11.6%.

### 1.2.3 Health Profile[6]

The Healthcare system in Bangladesh provides inpatient care services through sub-district, district level public hospitals, medical college and specialized hospitals, private for-profit and not for profit hospitals. District hospital is considered as secondary level referral facility and the medical colleges and specialized hospitals as the tertiary facilities. While information on public facilities is available from government sources, no reliable data is found for private ones. A complete picture, therefore, cannot be provided. An effort is made below for presenting the existing facilities in public, private for-profit and private not for-profit sectors.

## Public facilities

A total of 536 public hospitals with 37,387 beds provide inpatient care services in Bangladesh. There are 413 Upazila (sub-district) Health Complexes which have limited inpatient services. District hospitals are usually termed secondary hospitals since unlike the medical college hospitals these have fewer specialty cares.

[6]http://www.jointlearningnetwork.org/uploads/files/resources/BHW_Report_2011_0.pdf

Apart from these, there are different types of special care centers such as, infectious disease hospitals, tuberculosis hospitals, and leprosy hospitals which fall under secondary care health facilities. The medical college hospitals are located in the regional level covering several districts, and provide specialty care in a wide range of disciplines.

These hospitals are called tertiary hospitals. Tertiary hospitals include even national level super specialty hospitals or centers which provide high end medical care services, specialized in only one particular area of healthcare. Over the last few decades, Bangladesh has experienced a rapid development in secondary and tertiary care network all over the country. Of 64 districts, 59 have a hospital with secondary health care. However, these hospitals have limited specialist, diagnostic and laboratory services. In addition, there are nine general hospitals with 100-250 bed capacity. The types and number of public hospitals, number of beds and service packages are presented in the table below. Varieties of inpatient care services are available in public hospitals. In its three tier-system (sub-district, district and region), a good network of hospitals has been established in Bangladesh.

**Private for-profit**

The government of Bangladesh has been encouraging private investment in health sector since early 1980s. Government policy has reiterated and reaffirmed the need for the private sector to share the provision of health care with the public sector "with a view to achieving the spirit of participation and owner-ship in health development" (GOB 1998: 463). The private health care facility constitutes an important component of the national health care system of Bangladesh, providing services to people with better affordability to pay. Private sector offers both modern and alternative (homeopathic, ayurvedic) care. Private facilities are naturally developed in urban areas where affluent sections of the population reside. In the early 1980s there were only 150 private clinics and hospitals in Bangladesh, which increased to 2,501 registered hospitals and clinics (Directorate General of Health Services 2010). These facilities contain a total number of 42,237 beds in the registered private hospitals and clinics. Moreover, 5,122 registered diagnostic centers are currently available. Apart from these, there are a large amount of private clinics in different districts and cities that are not registered. Private for profit hospitals naturally intend to maximize profit and such hospitals targets middle- to high-income segments of the society.

**Private not for-profit (NGOs)**

Private not for-profit (NGOs) facilities normally provide outpatient services in Bangladesh. A handful number of NGOs has successfully established secondary and tertiary inpatient healthcare services. Some NGOs have established their own hospitals, aiming to provide free or subsidized healthcare for the poor. A number of these hospitals offer some kind of health insurance. Such insurance generally covers consultations and a minimum level of treatment. 34 NGOs are providing secondary healthcare that are operating mainly

on charity basis. The numbers of inpatient care beds vary largely across NGO-run hospitals, operated nationally and internationally. Among the national NGO hospitals Gonoshasthay Kendro (GK), AK Khan Healthcare Trust, Dhaka Community Hospital, BIRDEM hospital etc. are well known ones. The number of hospital beds and cabins vary largely across these hospitals. For instance, GK Dhaka hospital has a capacity of about 410 beds and 46 cabins.

AK Khan Healthcare trust is operating a 50 bed hospital for women and children in Chittagong. Wide range of services are provided by these hospitals, for instance, in the specialty areas of burns, endocrinology, cardiology, surgery, and obstetrics/gynecology, diabetes, Surgery, ERCP and CT Scan. Example of international NGOs, which provide secondary and tertiary healthcare are ICDDRB, LAMB Hospital. ICDDRB has two hospitals, one in Dhaka and the other in Matlab. These hospitals, with a total of 370 beds are providing service mainly for diarrheoal and cholera diseases and also in obstetrics/ gynecology and paediatrics. Lamb Hospital in Parbatipur, Dinajpur provides inpatient service through departments of obstetrics/ gynecology, paediatrics, surgery and medicine with 115 beds.

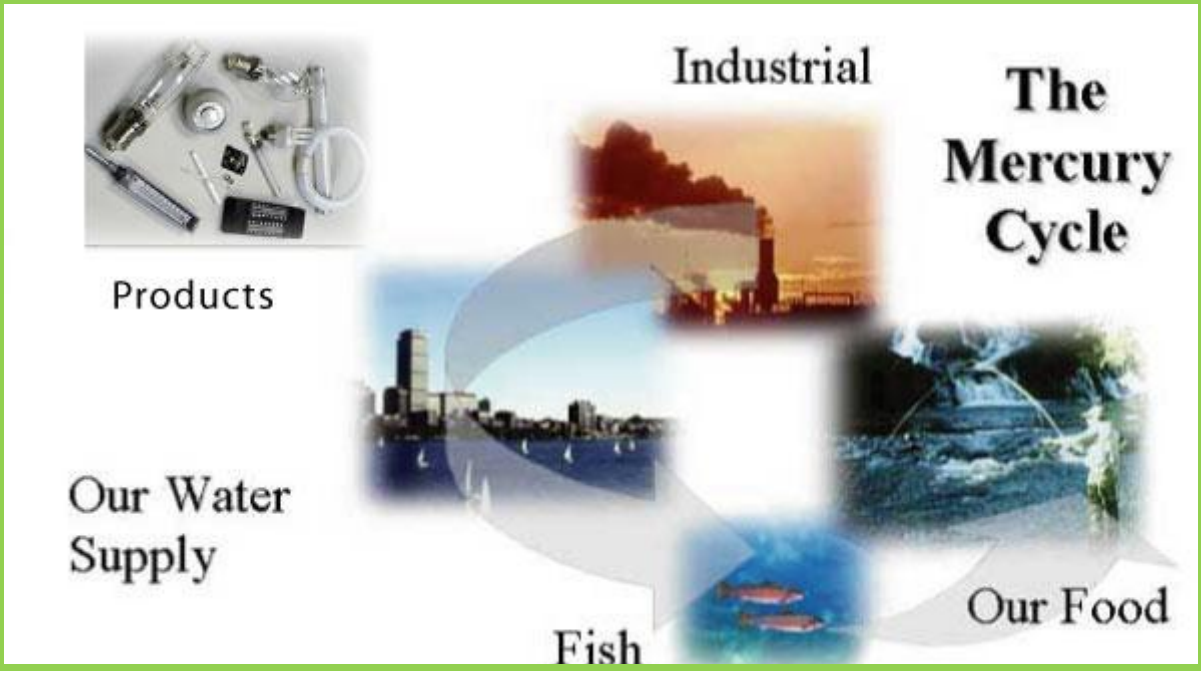
**Distribution of inpatient care facilities**

Bangladesh is divided into six administrative divisions (excluding Rangpur division which has been recently separated from Rajshahi). Available data from district hospitals shows that the number of beds per hospital ranges between 100 and 250.

**Health Workforce**

Unlike many service sectors, inpatient healthcare demands highly qualified labor force (health workforce) including physicians, dentists, nurses, midwives and medical technologists. Inadequacy of health workforce has been observed in Bangladesh and considered to be a strong limiting factor of population health (Joint Learning Initiative 2004). Bangladesh government has sanctioned 20,234 positions for physicians of which 11,300 are currently filled up, which means a total vacancy of 44.2%. In total 13,483 nurses are currently working in the public health facilities, while the total number of positions sanctioned are 17,183. The Distribution of vacant positions of different levels of nurses shows that around 96 percent positions of senior nurse are vacant. Corresponding vacancies for junior (class II) and aide nurse (class III) are 67.6 and 19.5 percent respectively. It means that vacant position is higher among the nurses with higher qualification. However, the physicians in public sector often provide services in private hospitals. The highest vacancy in medical staffs is observed in Barisal (64.9%), followed by Khulna (58.2%), Rajshahi (55.3%), Sylhet (54.7%), Chittagong (50.7%) and Dhaka (25.4%). There are currently 20 public medical colleges in Bangladesh of which 17 have the capacity to produce 2,509 physicians and the rest can produce 210 dentists. A total of 1,250 places for nursing education are available in public institutions. Furthermore, places for educating 650 medical assistants are available in public institutions. From the public medical colleges 10,990 physicians have been graduated between 2004 and 2009 of which 49.2 percent is female. The scope for medical education has been extending beyond public medical institutions since the beginning of 1990s. A sum of 44 private medical colleges can educate 3,335 physicians. Twelve dental colleges have the capacity to educate 770 dentists. A sum of 530 nurses, 140 midwives and 1,855 medical assistants can be graduated by private institutions.

# Preliminary inventory of mercury use and release in Bangladesh



# 2 PRELIMINARY INVENTORY OF MERCURY USE AND RELEASE IN BANGLADESH

## 2.1 INTRODUCTION

Investigations of developed countries and some developing countries have revealed that the production, consumption and disposal of chemicals and/or chemical compounds, especially those that are used in industrial and commercial sectors, have an enormous impact on the atmosphere, biodiversity, soil, water, human health, etc. This impact will last, not merely on this generation, but also for future generations. The devastation that will results from these environmental impacts poses a great obstacle to socio-economic development. The Minamata Bay tragedy, where great numbers of children in Minamata, Japan, were born with severe birth defects as a result of systematic mercury contamination in the water source during the 1950s, made the international community acutely aware of the potentially lethal effects of some chemicals which are discharged into the environment without proper treatment. The reports of many developed countries have also elaborated on the other types of adverse environmental impacts that they have encountered when industrial activities were undertaken without considering the sustainable environment.

The Minamata Convention is designed to protect human health and the environment from the human induced emission and release of mercury and mercury compounds. Bangladesh is a signatory of Minamata convention and salient [7] features of the conventions are:

- Mercury is one of the most toxic substances known to humans
- Mercury can pass through skin, blood-brain and placental barrier and can cause devastating effects on the function of growth of brain in the growing fetus
- Mercury is a neuro and nephro-toxicant and can damage kidney and central nervous system.
- Mercury can cross global barriers and can move from one country to other.
- Mercury bio- accumulates and bi-magnifies
- A likely route of exposure includes inhalation or absorption of mercury vapor from a spill or during a manufacturing process or ingestion of methyl mercury from contaminated fish.
- Mercury can pose significant health threat when spilled in a small and poorly ventilated room.

The international demand for the control of mercury emissions arose following the UNEP's Governing Council 22nd session in February 2003. After considering the key findings of the Global Mercury Assessment Report, the governing Council decided that there was sufficient evidence of significant global adverse impacts from mercury to warrant further international action to reduce the risks to humans and wildlife from the release of mercury into to the environment.

[7] Mercury Free India Right Choice: a study by toxics link.

The Governing Council decided that national, regional and global actions should be initiated as soon as possible and urged all countries to adopt goals and take actions, as appropriate, to identify populations at risk and to reduce human-generated releases.

This commitment to addressing the global adverse impacts of mercury pollution was reinforced by 27 Governments and regional economic integration organizations at the 23rd session of the Governing Council in February 2005. The Governing Council also requested UNEP, in cooperation and consultation with other relevant organizations, to facilitate and conduct technical assistance and capacity building activities to support the efforts of all countries to take action on mercury pollution.

In response to the Governing Council's request, UNEP has included mercury within its program for Chemicals, with the immediate objective to encourage all countries to adopt goals and take actions, as appropriate, for the identification of mercury-exposed populations, for the minimization of mercury exposure through outreach efforts and for the reduction of anthropogenic mercury releases.

Products and equipment containing mercury or mercury compounds have been used and imported in Bangladesh since 1940s and this mercury continues to harm the environment many years after it has been disposed of. Bangladesh has no specific guidelines regarding the management of mercury disposal, nor any guideline to safely manage the use of either products or equipment that contain mercury or mercury compounds.

The evaluation of mercury emission in Bangladesh, is required to assess new, potential and existing sources, of mercury emission as a result of the use of mercury and mercury-containing products. The calculations of mercury emission and release into the environment made in this report are based on surveys, guidelines, methods, sources and other factors.

Environment and Social Development Organization-ESDO has undertaken a small project titled "Reduction of demand of mercury in mercury containing products in Bangladesh" in collaboration with UNEP to create awareness and document mercury uses and mercury added products in Bangladesh. This initiative also aims to support Bangladesh government towards ratification of Minamata convention.

This initiative of ESDO, has tried to identify mercury sources, usages, products and hotspots in Bangladesh. The study was conducted in Dhaka and its adjoining areas to find out mercury sources, mercury-containing products and their hotspots in Bangladesh. Information was collected from different sectors, namely: energy sources, metal production, health care, electronics and electrical equipment, battery industry, cement, users of mercury chemicals, jewelry and beauty products consumer as well as consultations with stakeholders. This study includes simultaneous, discussion on the possibility of phasing out of uses of mercury and mercury contained products with indication of alternatives. This study has tried to quantify amount of mercury release and emission from the information on its primary and secondary sources.

This report titled "Mercury added products: Country situation analysis in Bangladesh (Product inventory and emission source identification) is a part of a planned "mercury phase out program", regulated by Environmental and Social Development Organization – ESDO.

## 2.2 IDENTIFICATION OF MERCURY RELEASE SOURCES IN BANGLADESH

Major source categories and subcategories of mercury release listed in the UNEP toolkit are listed in Table 1. The table also shows mercury sources that exist in Bangladesh. Due to limitations in data availability and constraints in time and budget, it has not been possible to quantify all mercury release sources present in Bangladesh. The table shows the sources that have been identified as part of this preliminary inventory work.

**Table 1. Existing categories and possible sources of mercury release in Bangladesh according to UNEP toolkits format**

| No. | Categories and sub-categories of mercury release courses | Bangladesh source |
|---|---|---|
| **1** | **Extraction and use of fuels/energy sources** | |
| 1.1 | Coal combustion in large power plants (Possible source) | ✓ |
| 1.2 | Other coal use(Brick Production/ Burning) | ✓ |
| 1.3 | Mineral oils - extraction, refining and use (unintentional emission source) | ✓ |
| 1.4 | Natural gas - extraction, refining and use(unintentional emission source) | ✓ |
| 1.5 | Other fossil fuels - extraction and use | × |
| 1.6 | Biomass fired power and heat production | × |
| 1.7 | Geothermal power production | × |
| **2** | **Primary (virgin) metal production** | |
| 2.1 | Mercury (primary) extraction and initial processing | × |
| 2.2 | Gold and silver extraction with mercury amalgamation processes | × |
| 2.3 | Zinc extraction and initial processing | × |
| 2.4 | Copper extraction and initial processing | × |
| 2.5 | Lead extraction and initial processing | × |
| 2.6 | Gold extraction and initial processing by methods other than mercury amalgamation | × |
| 2.7 | Aluminum extraction and initial processing | ✓ |
| 2.8 | Other non-ferrous metals - extraction and processing | × |
| 2.9 | Primary ferrous metal production | ✓ |
| **3** | **Production of other minerals and materials with mercury impurities** | |
| 3.1 | Cement production | ✓ |
| 3.2 | Pulp and paper production | ✓ |
| 3.3 | Production of lime and light weight aggregates | × |
| 3.4 | Other minerals and materials | × |
| **4** | **Intentional use of mercury in industrial processes** | |
| 4.1 | Chlor-alkali production with mercury-technology | ✓ |
| 4.2 | VCM production with mercury catalyst (indirect source) | ✓ |
| 4.3 | Acetaldehyde production with mercury catalyst | × |

| No. | Categories and sub-categories of mercury release courses | Bangladesh source |
|---|---|---|
| 4.4 | Other production of chemicals and polymers with mercury | × |
| **5** | **Consumer products with intentional use of mercury** | |
| 5.1 | Thermometers with mercury | ✓ |
| 5.2 | Electrical switches and relays with mercury | ✓ |
| 5.3 | Light sources with mercury | ✓ |
| 5.4 | Batteries with mercury | ✓ |
| 5.5 | Biocides and pesticides | ✓ |
| 5.6 | Gold and Imitation Jewelry production | |
| 5.6 | Paints with mercury | ✓ |
| 5.7 | Pharmaceuticals for human and veterinary uses | ✓ |
| 5.8 | Cosmetics and related products with mercury | ✓ |
| **6** | **Other intentional product/process use** | |
| 6.1 | Dental mercury-amalgam fillings (in clinics and hospitals) | ✓ |
| 6.2 | Manometers and gauges with mercury | ✓ |
| 6.3 | Laboratory chemicals and equipment with mercury | ✓ |
| 6.4 | Mercury metal use in religious rituals and folklore medicine | × |
| 6.5 | Miscellaneous product uses, mercury metal uses, and other sources | ✓ |
| **7** | **Production of recycled metals ("secondary" metal production)** | |
| 7.1 | Production of recycled mercury ("secondary production") | × |
| 7.2 | Production of recycled ferrous metals (iron and steel) | × |
| 7.3 | Production of other recycled metals | × |
| **8** | **Waste incineration** | |
| 8.1 | Incineration of municipal/general waste | ✓ |
| 8.2 | Incineration of hazardous waste | × |
| 8.3 | Incineration of medical waste | ✓ |
| 8.5 | Informal waste incineration (open burning) | ✓ |
| **9** | **Waste deposition / land-filling and waste water treatment** | |
| 9.1 | Controlled landfills/deposits | ✓ |
| 9.2 | Diffuse disposal under some control | × |
| 9.3 | Informal local disposal of industrial production waste | ✓ |
| 9.4 | Informal dumping of general waste | ✓ |
| 9.5 | Waste water system/treatment | ✓ |
| | Deposition through Sewage Sludge | |
| **10** | **Crematoria and cemeteries** | |
| 10.1 | Crematoria | ✓ |
| 10.2 | Cemeteries | ✓ |
| **11** | **Miscellaneous product uses, mercury metal uses, and other sources** | ✓ |
| **12** | **Potential hotspots** | ✓ |

## 2.2 METHODOLOGY

The study was conducted in Dhaka and its adjoining areas to find out mercury sources, mercury containing products and their hotspots in Bangladesh. Primary information was collected from different sectors, namely: industrial and energy sectors, health care, electronics and electrical equipment's, battery industry, cement, chemical, and jewelry and beauty product's consumer based on purposive sampling. Secondary information was collected from online sources.

- **Literature review**: Preparation of baseline data/inventory of mercury and mercury products about the current situation in the country. Identification of mercury and mercury product uses and releases.
- **Survey tools**: Semi-structured questionnaires were prepared for primary data collection from the identified sectors.
- **Key informant interviews:** These were done for direct observation and expert opinion
- **Workshops with key stakeholders**: The objectives of the consultations with scholars and scientists of several industries and universities, health specialists, officials from Department of Environment (DoE), Bangladesh Standard Testing Institute (BSTI), Bangladesh Chemical Industries Corporation (BCIC), government wings were: (i) to share technical assistance and knowledge sharing on the banning of mercury based products and processes as the need of ratifying the Minamata Convention; (ii) to recommend and propose guidance in line with the existing international standard, regulatory framework and best practice for alternatives to mercury in products; (iii) to propose an environmentally safe & sound mercury waste management; and (iv) to disseminate study findings and possible outcomes.
- **Data Analysis**: Data collection of mercury and mercury products from mercury usage markets/industries in the country. Input of data on the excel sheet according to the filled up questionnaire sets, assessing the present scenario and survey data, information compilation and calculation were done.

Identification of the release sources for mercury in Bangladesh based on the UNEP Toolkit posed some difficulty and complexity. In this regard, and while depending on local information, the mercury inventory team decided to focus the survey work for primary data on selected sources including:

1. Chlor-alkali plants
2. Health sector (hospital, health care, and clinic) for both mercury contained in products (thermometer and amalgam filling) and mercury release from waste incineration,
3. Cell batteries, CFL Light Bulb, cement production

Besides undertaking field survey for primary data production, the inventory team also undertook desk research on other sources of possible mercury release, including:

4. Secondary ferrous and non-ferrous metal production
5. Energy sources
6. Landfill (municipal waste :industrial and medical waste dumping)

# Quantification of mercury releases

# 3 QUANTIFICATION OF MERCURY RELEASES

The estimated amount of mercury use and release in Bangladesh will be discussed by each category set under UNEP Toolkit as the following description.

## 3.1 EXTRACTION AND USE OF FUELS/ENERGY SOURCES

| Categories and sub-categories of mercury release courses | Bangladesh source |
|---|---|
| Extraction and use of fuels/energy sources | |
| Coal combustion in large power plants (Possible source) | ✓ |
| Other coal use (Brick Production/ Burning) | ✓ |
| Mineral oils - extraction, refining and use (unintentional emission source) | ✓ |
| Natural gas - extraction, refining and use (unintentional emission source) | ✓ |
| Other fossil fuels - extraction and use | × |
| Biomass fired power and heat production | × |
| Geothermal power production | × |

In Bangladesh the major contributor of mercury emission to atmosphere in the near future will be coal burning in power plants. There is chance of mercury emission if Fly Ash from Coal Fired Power Plant is used. Besides this, mineral oils, natural gas, fossil fuel extraction are also possible sources of mercury emission to the atmosphere. Currently Brick burning sector is becoming one of the major source of mercury emission, because coal is required as fuel, mandatorily in brick burning sector.

Fossil fuel naturally contain trace concentrations of mercury, and this mercury is released when the fuel is burned. Most of this mercury is released to the atmosphere, but some is captured by flue gas cleaning systems and ends up in residues from this system. Mercury concentrations in fuel vary depending on the fuel source and the fuel type. Large coal fired power plants are generally equipped with air pollution reduction equipment which retain parts of the mercury from flue gasses and transfer them to solid or wet residues. During extraction, refining and treatment of oil and natural gas, some of the mercury in the fuel may be released to the environment. Due to the enormous amounts of coal combusted annually, coal fired power plants are the single largest emitter globally of mercury to the atmosphere.

For oil and gas extraction, two mercury inputs may be present: mercury naturally present in trace concentrations in the oil and gas and as a mineral in drilling fluids.

Natural gas may be processed with or without dedicated mercury removal (retention) systems. According to the citation of literature default output distribution factors for extraction are estimated by assuming that 50% of the gas is processed without mercury removal and 50% with mercury removal.[8]

**Table 2. Default input factors according to the UNEP toolkit inventory for mercury emission[9]**

| Source | Default input factor |
|---|---|
| Coal combustion in large power plants | 0.15 g Hg/t |
| Extraction and refining of oil | 4 mg Hg/ton |
| Combustion/use of diesel, gasoil, petroleum, kerosene | 5.5 mg Hg/ton |
| Extraction and processing of natural gas | 100 μg Hg/Nm3 |

[8] Toolkit for Identification and Quantification of Mercury Releases; United Nations Environment Programme, 2013

[9] Toolkit for Identification and Quantification of Mercury Releases; United Nations Environment Programme, 2013

**Table 3. Possible mercury by-product emission from anthropogenic sources in Bangladesh (in kg)**

| Base | Type | Name | Present Generation Capacity (MW) | Mercury emission into air as by-product (Kg) |
|---|---|---|---|---|
| Gas | Public | Ashuganj | 543 | 9.22824 kg |
| | | Siddhirganj | 240 | |
| | | Haripur | 93 | |
| | | Ghorasal | 870 | |
| | | Tongi Power Station | 80 | |
| | | Shahjibazar | 124 | |
| | | Fenchuganj CC | 90 | |
| | | Sylhet | 20 | |
| | | Raozan | 180 | |
| | | Sikalbaha | 71 | |
| | | Baghabari | 71 | |
| | | Baghabari 100 MW | 100 | |
| | | Rural Power Company (RPC) (Mymensingh) | 140 | |
| | Private | Haripur BMPP | 110 | |
| | | Haripur , AES, | 360 | |
| | | Baghabari BMPP | 90 | |
| | | Megnaghat,AES | 450 | |
| | | REB | 30 | |
| | | Total | 3662 MW/day or, 1098600 MW/Yr. or 92282400 T | |
| Furnace oil | Public | Khulna | 172 | 28.54 kg |
| | Private | KPCL | 110 | |
| | | Total | 282 MW/day or, 84600 MW/Yr. or, 7136010 T | |
| High Speed Diesel | Public | Bheramara | 56 | |
| | | Saidpur | 22 | |
| | | Barisal | 34 | |
| | | Rangpur | 20 | |
| | Private | - | - | |
| | | Total | 132 MW/day or 39600 MW/Yr. or 3340260 T | 18.37 Kg |
| Coal (One of the biggest source of mercury emission in the near future) | | | 6560128.171 MW/Yr. or 53397406.8 T | 3002.02 Kg |
| | | Total | | |

** 1 Ton = 0.00352 MW; 1 MW= 84.35 T

**Brick Burning Sector:**

As per new Brick Law, 2013 COAL as is mandatory as fuel for brick burning. According to the Vice-President of Bangladesh Brick Manufacturing Owners Association, Md. Asadur Rahman Khan there are about 6000 brick field in Bangladesh and the amount of coal requirement is about 4 Million ton. According to the default input factor of coal combustion in large power plants(Table 2) mercury emission into air from brick burning sector is (40,0000 T x 0.15 g or 60000 g or 60 kg or 0.06 MT).

| **Mercury emission into air from Brick burning sector is 0.06 MT** |
|---|

## 3.2 PRIMARY METAL PRODUCTION

| **Primary (virgin) metal production** | **Bangladesh source** |
|---|---|
| Mercury (primary) extraction and initial processing | × |
| Gold and silver extraction with mercury amalgamation processes | × |
| Zinc extraction and initial processing | × |
| Copper extraction and initial processing | × |
| Lead extraction and initial processing | × |
| Gold extraction and initial processing by methods other than mercury amalgamation | × |
| Alumina production from bauxite (aluminum production) | ✓ |
| Other non-ferrous metals - extraction and processing | × |
| Primary ferrous metal production (iron and steel) | ✓ |

Bangladesh is an agricultural country. So far no primary mercury production is extracted in Bangladesh context.

### 3.2.1 Aluminum production

There are four major aluminum production companies in Bangladesh. They are, KAI Bangladesh Aluminum, BD Thai, Chung Hua (former Fu-Wang Aluminum) and Dhaka Thai. According to them, the annual capacity of aluminum production varies from 5,000-6,000 tonnes.[10] In total the production is 20,000-24,000 tonnes across the four companies.

**Table 6. Default input factors according to the UNEP toolkit inventory for mercury emission[11]**

| Source | Default input factor |
|---|---|
| Aluminum production | 0.5 g Hg/t bauxite |

**Table 7. Possible Mercury by-product emission from aluminum production in Bangladesh (in kg)**

| Aluminum production[12] | Mercury emission into air as by-product (in g/Kg) |
|---|---|
| 20,000-24,000 T | 11000 g or 11 Kg |
| Aluminum production[13] | Mercury emission into air as by-product (in g/Kg) |
| 20,000-24,000 T | 11000 g or 11 Kg |

[10]http://www.btaalu.com/index.php?option=com_content&view=article&id=66&Itemid=104

[11]Toolkit for Identification and Quantification of Mercury Releases; United Nations Environment Programme, 2013

[12]http://www.oced.org/env/waste/46194971.pdf

[13]http://www.oced.org/env/waste/46194971.pdf

**Mercury emission into air from aluminum production is 0.011 MT**

### 3.2.2 Primary ferrous metal production/steel production

Mercury may be emitted from various locations in an integrated iron and steel facility, including the sinter plant, the blast furnace that produces iron and the basic oxygen process (BOP) furnaces that produce steel, among others. The major pathway for mercury release is via air, and to a lesser extent in wastes/residues.

Bangladesh has more than 400 steel, re-rolling and auto-re-rolling mills with a combined annual production capacity of 80 lakh tonnes. But it consumes only 40 lakh tonnes of rod a year.

**Table 8. Emission factors used in the AMAP mercury emission inventory for pig iron and steel production**[14]

| Source | Emission factor |
|---|---|
| Pig iron and steel production | 0.04 g/t of steel |

**Table 9. Possible mercury by-product emission from pig iron and steel production in Bangladesh (in kg)**

| Pig iron and steel production | Mercury emission as by-product (in g/Kg) |
|---|---|
| 40,00000 T | 160000 g or 160 Kg |

[14]AMAP (2008) Technical background report to the global atmospheric mercury assessment. Olso, Norway, Arctic Monitoring and Assessment Programme/UNEP Chemicals Branch, 159 pp. (2008)

**Mercury emission into air from steel production is 0.16 MT**

## 3.3 PRODUCTION OF OTHER MINERALS AND MATERIALS WITH MERCURY IMPURITIES

| Production of other minerals and materials with mercury impurities | Bangladesh source |
|---|---|
| Cement production | ✓ |
| Pulp and paper production | ✓ |

### 3.3.1 Cement production

Urbanization is happening very quickly in Bangladesh, and as a result of this the construction industry is growing. At the same time, the cement industry has been stable growth in last three years driven by the increased construction. At present Bangladesh has 33 cement industries, mostly situated in Dhaka, Narayongonj, and Chittagong. Usually most of these industries are located near major river systems of Bangladesh for ease of transportation.

Under the ESDO study, a questionnaire-based survey was conducted in seven cement factories industries situated in Narayongonj and Dhaka. All these industries produce both Portland and Portland composite cement. According to the survey it has been found that the total production of these seven cement factories is 34, 09000 Tones/ year. So, total production of one cement industry is 4, 87,000 Tones/year.

**Table 10.Production and actual consumption of cement in Bangladesh per annum (found from the survey)**

| Sl. No | Company name | Production(Ton)/Year |
|---|---|---|
| 1. | Shah Cement | 8,40,000 |
| 2. | King brand Cement | 7,00,000 |
| 3. | Fresh Cement | 5,60,000 |
| 4. | Holcim Cement | 5,04,000 |
| 5. | Crown Cement | 4,20,000 |
| 6. | Premier Cement | 2,80,000 |
| 7. | Modern Cement | 1,05,000 |
| | | Total: 34,09000 Tones/ Yearly |

**Release of mercury**

During the survey we found that the following elements are used for the production of Portland cement:

Clinker = 82-94%
Zipsum = 0-5%
Other (Slag, Lime Stone, Slage) = 6-20%

In Bangladesh, eight companies have clinker and cement manufacturing facilities[15]. The clinkerisation process in which the calcium oxide reacts at high temperature (typically 1,400 °C – 1,500 °C) with silica, alumina and ferrous oxide to form the silicates, aluminates and ferrites of calcium that comprise the Portland clinker (SC BAT Cement, 2008)- using coal fuel burning in most cases. Basically, the clinker production process consists of the clinker burning as such (preheating, kiln firing process with or without precalcination, and with or without a kiln-gas bypass) followed by the clinker cooling. The burnt clinker is fed to the cement mill where clinker is ground together with additives to produce the final product (i.e., cement).

Mercury is also present in limestone and in the fuel (e.g. Coal) that is released during the combustion process. These emissions into the atmosphere are the major pathway for mercury releases from the cement industry. According to the report "Mercury in Cement Industry, 2010", the average mercury released is **0.035 g/ton or 0.035 g/MT globally.**[16]

Considering the average mercury released into air and land from one factory is **0.0035 g/MT**, this means that the total amount of mercury release from one industry is industries is 0.01705 MT per year. On the basis of consideration that **0.01705 MT mercury release from one industry**, it can be estimated that release of mercury from 8 cement industries of Bangladesh is **0.14MT**.

**Mercury Release into air from Cement Industries in Bangladesh is 0.14 MT**

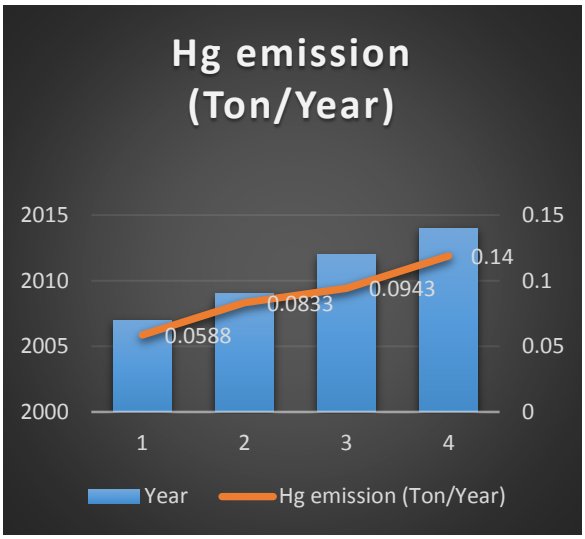
**Trend of mercury release from the surveyed industries**

The survey revealed that the mercury release from cement industries has increased significantly during last five years. The survey found that in 2014 the release of mercury from 8 cement industries was 0.14 Tons, which is much higher than the release in 2012 (0.0943 MT), 2009 (0.0833 MT), 2007 (0.0588 MT).

[15]Bangladesh Cement Traders' Association (BCTA)

[16]http://www.wbcsdcement.org/pdf/MercuryReport.pdf

**Figure 1. Mercury emission from the surveyed seven industries**




## Industry demand &production of cement in Bangladesh

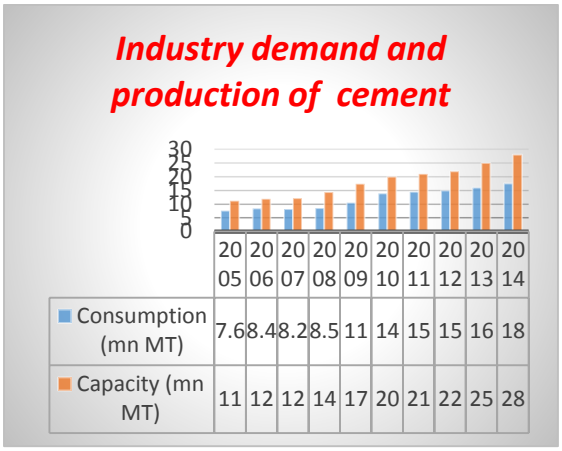
In 2005, cement consumption was 7.6 million MT, whereas, in 2014(17.5 million MT) it was almost two and a half times higher that of 2005. (Table11)

**Table 11. Cement consumption during last 10 years in Bangladesh[17]**

| Year | Consumption (million MT) | Growth rate % | Capacity (million MT) | Growth rate % |
|---|---|---|---|---|
| 2005 | 7.6 | 18.50% | 11.2 | 5.20% |
| 2006 | 8.4 | 10.50% | 11.9 | 6.60% |
| 2007 | 8.2 | -2.40% | 12.2 | 2.40% |
| 2008 | 8.54 | 4.10% | 14.4 | 18.40% |
| 2009 | 10.57 | 23.80 % | 17.4 | 20.20 % |
| 2010 | 13.93 | 31.80 % | 20 | 15% |
| 2011 | 14.5 | 4.00% | 21 | 5.30% |
| 2012 | 15 | 3.50% | 22 | 4.80% |
| 2013 | 16 | 6.70% | 25 | 13.60 % |
| 2014 | 17.5 | 10.00 % | 28 | 10.00 % |

[17]Research Report: Cement Sector of Bangladesh - Update, IDLC investment Ltd.

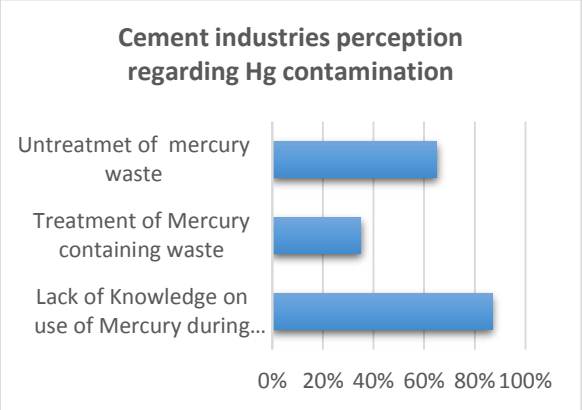
**Figure 2. Industry demand and production of cement**




## Waste disposal

The findings of this survey also demonstrate that 87% factories lack of knowledge on the use of mercury during the combustion process, that almost 65% do not treat mercury containing wastes and that the remaining rest 35% of industries treated their produced waste during cement production. In addition, those industries that have waste treatment facilities are aware about mercury and other heavy metal pollution. On the other hand, the industries that are dumping their waste in adjacent land and water bodies are not familiar with mercury hazards. During the survey, one of the government officials from BSTI stated the limited value for mercury concentration from the cement manufacturing waste must be 0.2 mg/Nm3 and for SPM is 200 ppm. The cement manufacturers could be aware about the standard limit of mercury, but they are not maintaining it properly.

**Figure 3. Cement industries perception regarding mercury**




## Regulation by Department of Environment

Bangladesh Standards and Testing Institution (BSTI) has Bangladesh Standards and Testing Institution Ordinance act, 1985 and BSTI (Amendment) Act 2003 to provide for the establishment of an institution for standardization, testing methodology, quality control, grading and marking of goods. The threshold value for cement production SPM is below 200 ppm.

## 3.4 INTENTIONAL USE OF MERCURY IN INDUSTRIAL PROCESSES

| Intentional use of mercury in industrial processes | Bangladesh Source |
|---|---|
| Chlor-alkali production with mercury-technology | ✓ |
| VCM production with mercury catalyst | ✓ |
| Acetaldehyde production with mercury catalyst | × |
| Other production of chemicals and polymers with mercury | × |

### 3.4.1 Chlor- Alkali Production

Chlor-alkali production with mercury cell technology is one of the major intentional uses of mercury during industrial processes in Bangladesh. The status of Chlor-alkali industry in Bangladesh regarding use of mercury is as described below

There are 4 Chlor-alkali factories in Bangladesh. Under the ESDO study, surveys were conducted with four selected factories out of five factories on random sampling basis. These were Samuda Chemical Complex Ltd., ASM Chemical Industries, Tasnim Chemical and Global Heavy chemicals Ltd.

The ESDO survey team were faced with difficulties in accessing confirmed information such as methods used by factories while producing chlor–alkali. Out of four surveyed factories, one mentioned as using the mercury cell method, whereas other companies remained non–responsive. According to the former president of Bangladesh Chemical Society, though developed technologies are been introduced by the companies but still mercury cell process is been in operation by some of them. According to him two companies are still using mercury cell process to produce chemicals.

During the survey we found that mercury is used in mercury cell process where sodium metal forms an amalgam at a mercury cathode. This sodium is then reacted with water to produce NaOH that is used in the other steps during the chemicals production in Chlor-alkali factory.

The Chlor-alkali process refers to two chemicals (chlorine and an alkali) which are simultaneously produced as a result of the

electrolysis of sodium chloride/saltwater. It is the technology used to produce chlorine and sodium hydroxide (caustic soda), which are commodity chemicals required by industry.

Generally, there are 3 types of electrolytic processes used in the production of chlorine and caustic soda: the diaphragm cell process, the mercury cell process, and the membrane cell process. While the mercury cell method produces chlorine-free sodium hydroxide, the use of several tonnes of mercury leads to serious environmental problems. In a normal production cycle a few hundred pounds of mercury per year are emitted, which accumulate in the environment.

In the ESDO survey we found that 5 different chemicals are produced. These are chlorine, caustic soda, hydrochloric acid, sodium hypochlorite and chlorinated paraffin wax. Total production of chlorine in 4 industries are 89,700 MT per year. Moreover, hydrochloric acid, sodium chlorate, sodium hypochlorite and chlorinated paraffin wax production are lower in comparison with chlorine and caustic soda.

**Figure 4. Production of basic chemical industries**

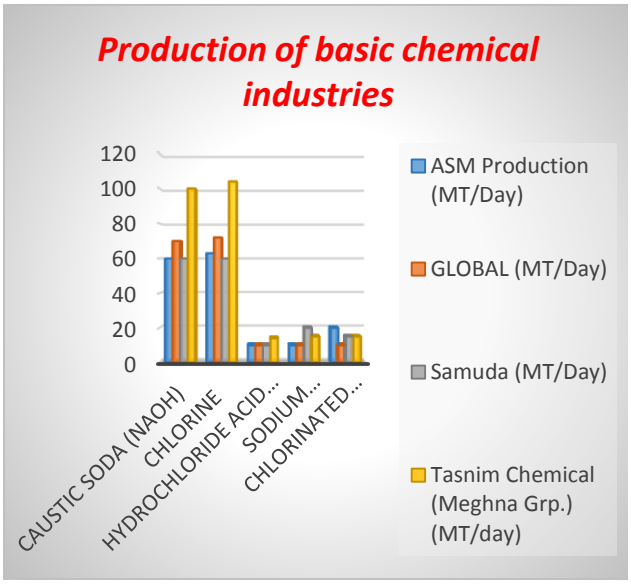



**Table 12. Market demand and comparative study of different basic chemical industries (reported from the survey)**

| Product name | ASM Production (MT/ Day) | GLOBAL (MT/ Day) | Samuda (MT/ Day) | Tasnim Chemical (MeghnaGroup.) (MT/day) | Total production from 4 industry (MT/Year) |
|---|---|---|---|---|---|
| Caustic Soda (NaOH) | 60-100 | 70 | 60 | 100 | 87,000 |
| Chlorine | 63 | 72 | 60 | 104 | 89,700 |
| Hydrochloride Acid (32% HCL) | 10 | 10 | 10 | 14 | 24,000 |
| Sodium Hypochlorite (Naocl) | 10 | 10 | 20 | 15 | 16,500 |
| Chlorinated Paraffin Wax | 20 | 10 | 15 | 15 | 19,500 |

[Note: On the basis of the toolkit for Identification and Quantification of Mercury Releases; United Nations Environment Programme, 2013; default input factor for mercury emission in 100 g Hg/t chlorine. So, from calculation 1MT contains 100 g Hg; 44850 MT (89,700 MT chlorine is produced by 4 factories. So, 44850 MT chlorine is produced by two factories, which use mercury cell process) contains 4485000 g or 4.485MT Mercury. It can be considered that approximately 4.49 MT of Hg is emitted to environment from 4 Chlor-alkali industries]

**Possible Mercury emission from Chlor-alkali Industries in Bangladesh is 4.49 MT**

According to these, it is clear that industries are aware of their mercury usage during the chemical production in their industries and when recycling the mercury. One third of the industries deposited mercury sludge into landfills. They demonstrate little awareness of the harmful effects of mercury to environment and human health.

### 3.4.2 VCM production with mercury catalyst

Poly vinyl chloride (PVC) is a type of plastic that is used for everything from water and sewer pipes to plastic toys and clothing. Vinyl chloride monomer (VCM), is the building block of PVC. PVC granule-producing plants (i.e., VCM section) consume chlorine as a raw material. A viable PVC granules plant requires 400 MT of chlorine per day, while total current production capacity is 250 MT per day. This shows that VCM production requires chlorine produced from local Chlor-alkali plants.

Generally, there are two routes to synthesize VCM, which are acetylene route and ethylene route. In the context of Bangladesh, the ethylene route is mostly preferred. There are two special reasons for adopting ethylene route: (i) ethylene route utilize chlorine which can directly be supplied by the local chlor-alkali industries and (ii) ethylene needed to produce VCM is also needed to domestically produce the PE polymer granules, which are also consumed in Bangladesh at a very large amount.[18] From the previous section, it was estimated that mercury is released from the chlor-alkali plants during the chlorine production. Mercury is also therefore released during VCM production.

[18]http://www.thefinancialexpress-bd.com/old/print.php?ref=MjBfMTFfMjlfMTJfMV8yN18xNTE0MjE

## 3.5 CONSUMER PRODUCTS WITH INTENTIONAL USE OF MERCURY

| Consumer products with intentional use of mercury | Bangladesh Source |
|---|---|
| Thermometers, Sphygmomanometers with mercury (Used as Medical Devices) | ✓ |
| Light sources with mercury | ✓ |
| Batteries with mercury | ✓ |
| Electrical switches and relays with mercury | ✓ |
| Biocides and pesticides with mercury | ✓ |
| Paints with mercury | ✓ |
| Pharmaceuticals for human and veterinary uses | ✓ |
| Cosmetics and related products with mercury | ✓ |
| Jewelry with mercury | ✓ |

There are 8 sub-categories addressed in the UNEP Toolkit regarding consumer products with intentional use of mercury including:

1. Thermometers, sphygmomanometers with mercury
2. Electrical and electronic switches, contacts and relays with mercury
3. Light sources with mercury
4. Batteries containing mercury
5. Biocides and pesticides
6. Paints
7. Pharmaceuticals for human and veterinary uses
8. Cosmetics and related products

Mercury use in medical apparatus and products is one of the major causes of hazardous exposure from medical waste around the world.

The situation in Bangladesh is no different in this respect.

Bangladesh has total 8802 health care facilities and 91,106 [19] functional beds (in MOHFW and registered private hospitals), which are given below;

- Government hospitals under MOHFW: 593 (DGHS 2013)
  -Government hospitals of secondary and tertiary levels under MOHFW: 126 (DGHS 2013)
  -Government hospitals at upazila and union levels: 467 (DGHS 2013)
- No. of private registered hospitals and clinics under DGHS: 2,983 (DGHS 2013)
- No. of private registered diagnostic centers under DGHS: 5,220 (DGHS 2013)

When the mercury containing products are broken inside the house, clinic or hospitals elemental mercury can evaporate and be inhaled. From the lungs the mercury is quickly transported to the brain (and to the fetus in pregnant women) where it causes damage to the central nervous system. If mercury containing products are put in the trash, to be incinerated or put in a land field's the mercury can be carried through air and soil and to the lakes and rivers. Mercury ends up in to the water may be transformed in to methyl-mercury, the most toxic form. Methyl-mercury builds up in to the flesh of fish; humans consume mercury when they eat mercury-contaminated fish, like tuna.

Typically, the hospitals manage their waste by disposing of them in city corporation waste bins (dustbins). In the locations where these types of bins are unavailable, hospital authorities dispose of their waste into open spaces. In the educational sector of Bangladesh, most of the educational institutions have no clear concept of mercury containing waste and therefore, have no formal system of disposal**Mercury containing medical devices in healthcare sector in Bangladesh**

**Table 13. Mercury containing medical devices in healthcare sector in Bangladesh[20]**

| Types of Medical Devices | Mercury quantity in the devices |
|---|---|
| Fever thermometer | 0.5g – 2.0g |
| Sphygmomanometers | 80-160g |
| Laboratory thermometers | 3-4g |
| Wall blood pressure units and floor portable units | 110-200g |
| Cantor tubes | 54 - 136g |
| Dennis tubes | 136 g |
| Foley catheter | 68g |

**Table 14. Thermometers (T) and sphygmomanometers (S) imported in Bangladesh in 2013-2014[21]**

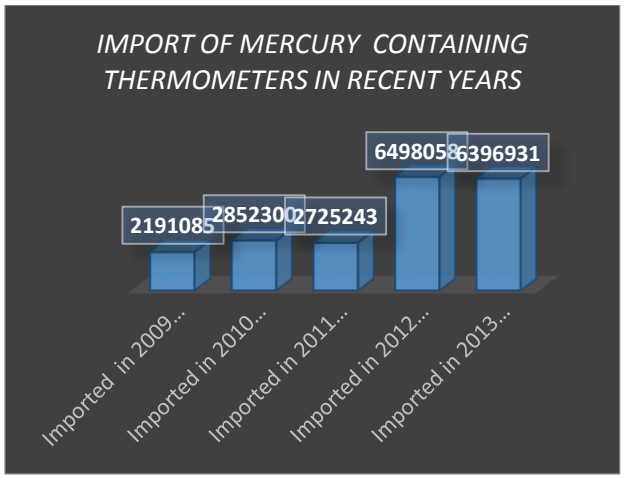
| Product | Imported in 2009 [Piece] | Imported in 2010 [Piece] | Imported in 2011 [Piece] | Imported in 2012 [Piece] | Imported in 2013-2014 [Piece] |
|---|---|---|---|---|---|
| T | 2191085 | 2852300 | 2725243 | 6498058 | 6396931 |
| S | 158069 | 93999 | 168705 | 177163 | 404649 |

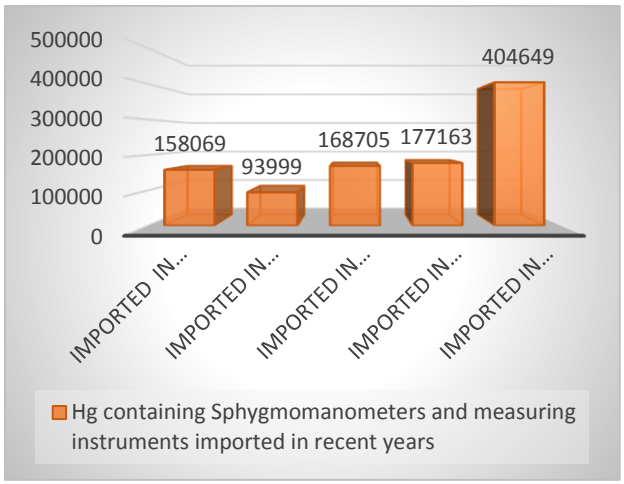
[19]http://hpnconsortium.org/admin/essential/HB_2013_final_-_Full_version_1March14.pdf

[20]Situation of Mercury Sources and Hotspots in Bangladesh, June, 2012. ESDO

[21]Annual Report of Ministry of Commerce, 2013-2014

**Figure 5. Import of mercury containing thermometers and sphygmomanometers in Bangladesh**




### 3.5.1 Thermometers and sphygmomanometers

This ESDO survey was conducted during last 3 months (from January, 2015 to March, 2015) in 50 public and private medical colleges, hospitals & clinics of Dhaka City Corporation.

A semi-structured questionnaire was used to collect primary information from the respondents involved in health care sector (hospitals and clinics). Total number of thermometers and sphygmomanometers used in each healthcare were recorded. Import and supply of this mercury containing equipment's were also noted. Moreover, secondary information was collected from various literature review ranging (e.g. book, magazine, govt. report, Ministry of health and family welfare, journal, internet surfing). Collected data were analyzed using MS Excel.

**Table 15. List of government and private medical colleges, hospitals and clinics, surveyed during the study in Dhaka city**

| City corporation | Government medical college and hospitals | Private medical college and hospitals | Private clinic | Diagnostic center | Total |
|---|---|---|---|---|---|
| Dhaka | 10 | 20 | 15 | 5 | 50 |

Based on the survey of 50 healthcare facilities the real number thermometers and sphygmomanometer were found, which is given below;

**Table 16. Average number of beds, Thermometers, sphygmomanometers recorded during the study in Dhaka city**

| Facility/Instrument | Governmenthospital and medical college | Private hospitals & clinics | Private diagnostic centers |
|---|---|---|---|
| Thermometers | 654 | 150 | 10 |
| Sphygmomanometers | 160 | 62 | 5 |

**Table 17. Estimated number of thermometers, sphygmomanometers based on the calculation of medical devices for hospitals and clinics**

| Facility | Total number of thermometers | Total number of sphygmomanometer |
|---|---|---|
| Government hospitalsandmedical colleges | 387822 | 94880 |
| Private registered hospitals and clinics | 447,450 | 184946 |
| Private registered diagnostic centers | 52200 | 26100 |
| | Total-887472 | Total-305926 |

According to the study findings, the estimated number of thermometers used per year used in health care institutions from union to capital level is 887472 and the number of the broken thermometers is about 552007.58 (37.8%). The estimated number of sphygmomanometers used per year is 305926and the number of the broken sphygmomanometers is about 10% (275333.4). According to the survey/study and expert opinion, one fever thermometer contains 0.5g – 2.0g mercury and sphygmomanometers contain 80-160g mercury. The annual mercury storage in these thermometers is therefore 1109.34 Kg or 1.2 MT and in the sphygmomanometers 3671.1kg or 3.67 MT.

**Table 18. Estimation of mercury release per year based on survey data and calculation**

| Devices | Total number of usage | Total number of break up | Total amount of mercury released (in g) | Total amount of mercury released (in MT) |
|---|---|---|---|---|
| T | 887472 | 552007.6 | 690009.5 | 0.69001 |
| S | 305926 | 275333.4 | 3304008 | 3.304008 |

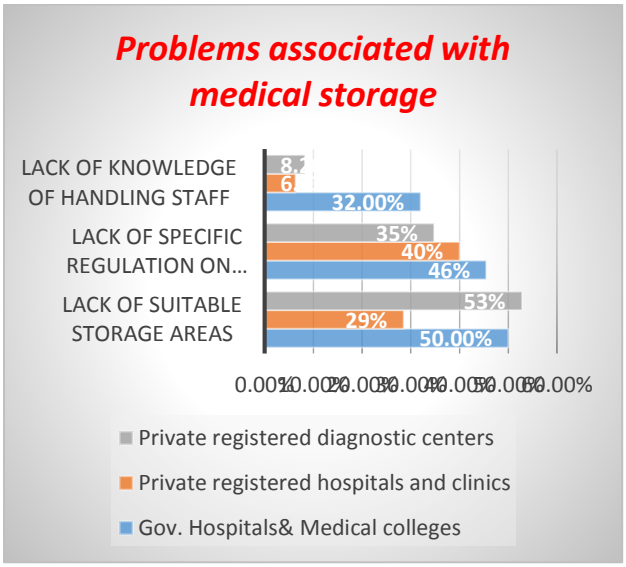
Considering the above calculation it can be estimated that in a year the mercury released in the healthcare sector due to thermometers breaking is approximately 0.69 tons, and due to sphygmomanometers breaking (mercury Blood Pressure Instrument) is 3.3 tons.

| **Mercury release from thermometer breakage is 0.69 tons** |
|---|
| **Mercury release from sphygmomanometer breakage is 3.3 tons** |

**Problems associated with the storage of phased out mercury devices**

Simple cartons or plastic boxes are used to store mercury equipment and products. After the collection of mercury containing equipment, they are stored in plastic bottles with some water. In few hospitals of Dhaka city corporation glass bottles are also used to store mercury containing medical devices. This is a very risky practice, however, due to the potential of breakage.

**Figure 6. Problems associated with medical storage**

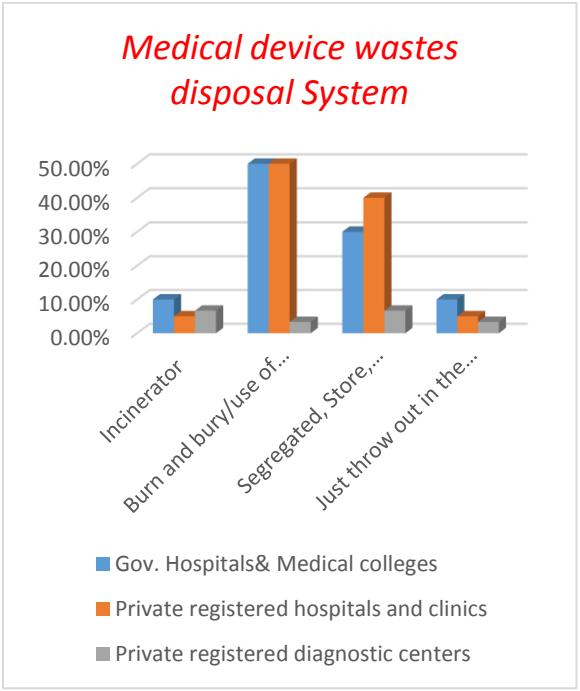



Mercury storage sites in hospitals, medical colleges and clinics do not follow standard. Mercury contained devices need certain room temperature and adequate ventilations for storage and maintenance. Unfortunately, most of the healthcare storage sites are in relatively hotter and less ventilated areas of hospitals. Staff who handle the mercury containing devices are often unaware of their toxicity. In Bangladesh there are no guidelines on the storage of mercury. As of yet, no international treaty has been signed for the storage and management of mercury.

**Mercury waste disposal**

Under the survey, most of the health facilities reported that they use burial pit for medical devices wastes generated in the hospitals. They also reported having an incinerator. About two-fourths of health care facilities segregated the medical wastes into three color coded bins.

**Figure 7. Medical device waste disposal system**




Dhaka is a densely populated city in Bangladesh. There are numerous health care centers, namely hospitals (both government and private), government and private medical college, clinics, community health care center, and so on. These healthcare centers use different medical devices, products and equipment and the aftermath of these products is the generation of large amounts of mercury waste. Bangladesh has no rules, regulations or policy for the disposal of mercury containing products, and as a result these wastes are dumped without adherence to any specific regulations. However, some local authorities have begun use separated coded color bins for disposing the wastes.

Electrical and electronic items are dominantly imported in Bangladesh. As this sector is one of the growing sectors in Bangladesh, it's very likely that we will experience increased demand

and a greater supply of electrical and electronic items containing mercury.

Considering energy efficiency and longer life mercury containing bulbs, lamps and variety of switches are abundant in use in Bangladesh. These equipment are locally produced as well as imported from outside, however an inventory of such items does not yet exist within the country.

Generally among numbers of mercury contents items, compact florescent light bulbs (CFL), batteries, switches and mercury-containing electrical items are the most commonly used lighting products in Bangladesh.

| **Mercury containing items** | **Quantity of mercury in the item** |
|---|---|
| CFL Light Bulbs | 3-5 mg of mercury |
| Button Cell Battery | 0-25 mg of mercury |
| Switches | 100 mg – 50 kg |

### 3.5.2 CFL Light Bulbs

In an energy deficit country like Bangladesh, people are encouraged to use low-energy bulbs or compact fluorescent lamps (CFL) that consume less electricity. There had been a marked rise in the demand for CFLs throughout the country. According to the report "Mercury Sources: Products and Hotspots in Bangladesh" prepared by ESDO in 2012, because of CFL's bulb large market share, it has been estimated that fluorescent lamps represent approximately 80 percent of the total mercury used in lighting. According to the report the annual demand for CFL bulbs in Bangladesh has reached 11 million.

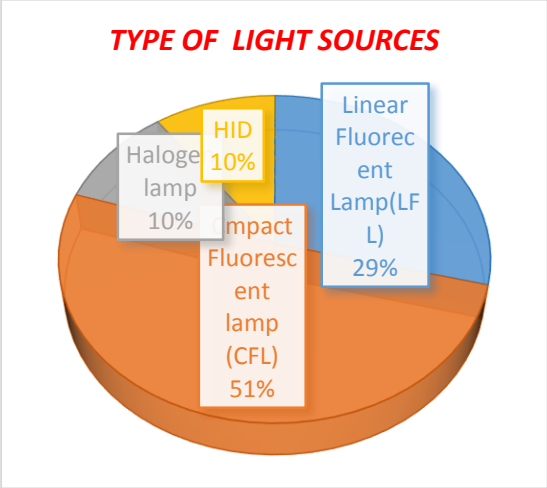
However, certain environmental and public health concerns have been raised in relation to the use and disposal of CFLs because the bulbs contain mercury, which poses a serious risk to health and safety. In a report by the European Commission (EC), children and babies in the womb are the most vulnerable to mercury pollution. Even though CFLs contain lower levels of mercury than fluorescent tube lights, inhaling the mercury vapors released by broken CFL bulbs can impair the central nervous system or cause kidney failure. The report states that in Bangladesh, garbage handlers and children engaged in scavenging are particularly at risk, and are often the worst victims of the unplanned disposal of bulbs. However, more than 95% of the mercury from the bulbs can be extracted through recycling.

Every year in Bangladesh, several million used CFLs end up in waste bins because people using the bulbs lack awareness of the dangers of mercury poisoning and contamination. The absence of proper recycling facilities to dispose of these bulbs puts people's health at great risk, as CFLs must be disposed of safely to avoid contamination and poisoning.

ESDO surveyed using random sampling with 100 stores from different markets and collected data from those 100 store. ESDO used both direct interview and observation method to collect the data from the importers, wholesalers and retailers of different markets in Mohammadpur, Mirpur, Stadium market, Nawabpur area. These markets represent about 70% of the lighting and electric market of Dhaka city.

According to the survey, among the 100 retailers the majority (51%) supply Compact Fluorescent Lamp/Light Bulb followed by Linear Fluorescent Lamp (29%), Halogen lamp (10%) and High Intensity Discharge Lamp (HID) (10%).

**Figure 8. Types of light sources used in Bangladesh**




Besides, based on random sampling we went to different CFL bulbs manufacturing companies for questionnaire survey and data collection. All of these companies produce a variety of lighting products namely, GLS, CFL, LED and Tube etc. The companies were Superstar, Philips, and Transtec. The study design is descriptive in nature. Specific information was collected from the retailers, wholesalers, employers, importers and consumers.

According to an expert opinion, the total production of CFL light bulb usually increased 35% of total year to year. The lifetime of a CFL light bulb is not more than 1 year to 18 months. Up to 40% of the CFL light bulb usually dumped into the waste bin as rejected bulb or breakage in every year from the companies.

ESDO field survey conducted with three companies associated with production of mercury containing CFL bulb and online survey stated that production quantity per year as below:

| **Name of the companies** | **Yearly production/unit** | | **Yearly generated waste/unit** | **Mercury** release from the waste from 2012-2014 (up to June ) (1 CFL light bulb contain 3-5 mg Hg) |
|---|---|---|---|---|
| | **2012-2013** | **2013-2014 (up to June )** | **2012-2014 (up to June )** | |
| Philips | 49,10,750 | 66,29,512 | 4616104.8 | |
| Energy Pac | 24,60,375 | 33,21,506 | 11,169,752.4 | 78,752,388.8 mg<br><br>Or, **0.079 MT** |
| Transcom | 32,00,000 | 43,20,000 | 3008000 | |
| Other companies (remaining companies) | 9,93,600 | 12,42,000 | 894240 | |
| **Total** | **11,5,64,725** | **15,5,13,018** | **19,688,097.2** | |

[Calculation is based on data collection and online information[22]]

Consumer Survey was also conducted in Dhaka, Chittagong, and Rajshahi region. 600 respondents (housewife, professionals, students etc.) were surveyed and asked for information on the use of CFL Light Bulbs in Bangladesh. According to the survey it is found that, one consumer use at least 3 CFL light bulbs per year and number of broken/spoiled CFL bulbs that are disposed to waste bins or landfills are 2-3.

[22]http://archive.thedailystar.net/newDesign/news-details.php?nid=86641

The total release of mercury from the household and industrial sector can be estimated as follows:

| Category | Number | No. of used CFL light bulb | Number of broken CFL light bulb sent to landfill/year | Mercury release during land filling(1 CFL light bulb contain 3-5 mg Hg) |
|---|---|---|---|---|
| Household Sector | 3679532 | 11038596 | 8278947-11038596 | 39390939 mg<br><br>**OR, 0.039** MT |
| Industrial Sector | 3, 5993 | 107979 | 80984.25-107979 | |
| Total | | **11,1,46,575** | **9847734.75** | |

According to the census 2014; there are 3679532 households in town and cities and 3, 5993 industrial establishment in Bangladesh.[23]

From the total working process including data gathering and data analysis, calculation of mercury release in Bangladesh per year can be summarized as follows: mercury release from the CFL Bulb industrial sector is **0.079 MT** per year, and from consumer use is **0.039 MT**. In total the mercury release from CFL light bulb is **0.118 MT per year.**

Apart from CFL light bulbs, a number of other types of lamps on the market also contain mercury. Many of them are considered high-intensity discharge lamps (HID). These are[24]:

| Name | Mercury quantity |
|---|---|
| Metal halide lamps | 10 mg to 1,000 mg |
| Ceramic metal halide lamps | <10 mg to <50 mg |
| High pressure sodium lamps | 10 mg to 40 mg |
| Mercury vapor lighting | 10 mg to 50 mg |
| Mercury short-arc lamps | 100 mg to 1000 mg |
| Mercury capillary lamps | 100 mg to 1000mg |

Due to poor pollution controls and a lack of well-controlled recycling operations, some factories that produce lamps release large quantities of mercury vapors to the indoor or outdoor air. Some also generate large quantities of mercury-contaminated solid and liquid waste streams.

The lack of a functional system to ensure the environmentally sound management of spent mercury-containing lamps, especially in developing countries like Bangladesh, poses serious threats to waste workers and their communities, who often retrieve waste lamps from mixed trash disposed in dump sites or landfills and recycle them in uncontrolled conditions.

The use of fluorescents poses its own problems. Fluorescents release hazardous mercury vapors into the indoor environment when they break. Also, all the mercury pollution associated with the life cycle of fluorescents, need to consider not only the mercury content of the lamp and the pollution caused at the end of its useful life but also the mercury that goes into the lamp

[23]http://203.112.218.65/WebTestApplication/userfiles/Image/National%20Reports/Union%20Statistics.pdf

[24]Ibid

and the mercury pollution associated with producing the lamp. CFL bulbs contain significant quantities of mercury (3mg-5mg or more), which is released to the environment when the bulb is broken, discarded among regular trash, disposed of in landfill or incinerated.

Fortunately, new energy-efficient lamps that contain no mercury are being developed. The most promising is LED technology. LED lighting is becoming available at prices that can compete with CFLs. As more consumers invest in LED technology, costs can be expected to come down over time due to economies of scale. Retail prices for LED lamps have already fallen rapidly in the last few years as more consumers purchase them for domestic, commercial and automotive applications. Increasing electricity prices in many countries has also driven consumers to seek out the most energy efficient lighting available. Vendors claim that commercially available LED bulbs now coming onto the market contain no mercury, provide 77 percent energy savings over incandescent bulbs, last 25 times as long, are cool to the touch, and offer full brightness from the moment they are turned on (unlike fluorescents).[25]

### 3.5.3 Battery

According to the report "Mercury Sources: Products and Hotspots in Bangladesh" prepared by ESDO in 2012, there are a variety of button-cell batteries that contain mercury, including zinc air, silver oxide, and alkaline manganese oxide batteries. Button-cell batteries are small, thin, energy cells that are not rechargeable. They are most commonly used in watches, toys, hearing aids, and other small and portable electronic devices. The manufacturing of small electronic devices is often possible due to the small size of the button-cell batteries.

- A button cell battery contains 0-25 mg of mercury
- Highest mercury content is in mercuric oxide batteries, which is 40% mercury by weight.
- Zinc air, silver oxide, and alkaline manganese button batteries typically contain from 0.1% to 2.0% mercury by weight.

According, to the researcher, Prof Abu Jafar Mahmmod, University of Dhaka, importing of mercury containing button cell batteries has been stopped since 2010. In Bangladesh, importers usually import alkaline cell: MnO2/Zn/Alkaline 1.5 V batteries. But it is also need to be noted that mercury is still present as impurities in the salted layer paste. This salted layer is usually used to pass the electricity more frequently. According to the researcher of chemical engineering department, BUET, Dr. Mohidus Samad Khan, each button cell batteries may contain mercury impurities up to 1-2 ppm.

On the basis of random sampling ESDO did a survey among 90 battery retailers and suppliers to assess the recent situation of mercury containing button cell batteries in Bangladesh.

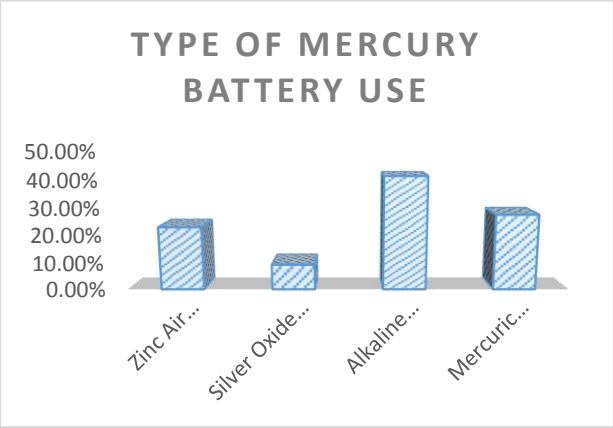
The ESDO survey was done with 90 different stores in different markets. According to the survey, among 90 retailers, 44 respondents (48.89%) reported that mercury containing batteries are used primarily for hearing aid, watches, calculators, electronic cameras, toys, remote controls and other personal electronic items that require a small battery in Bangladesh. Among 44 respondents, 40.91%

[25]Light Bulb War? New LEDs by GE, Home Depot Compete," *USA Today*, May 10, 2010, http://content.usatoday.com/communities/greenhouse/post/2010/05/light-bulb-warnew-leds-by-ge-home-depot-compete/1.

sold Alkaline Manganese Oxide button-cell batteries, followed by Mercuric Oxide batteries (27.27%) and Zinc Air miniature batteries (22.72%) [Figure 9]

| Category | Number | Number of used button cell batteries | Number of spoiled button cell batteries sent to landfill/year | Mercury release during land filling(1 button cell battery contain 0-25 mg Hg) |
|---|---|---|---|---|
| Household Sector | 3679532 | 7359064 | 6991110.8 | 17837702 mg<br><br>Or, 0.0179 MT |
| Industrial Sector | 3, 5993 | 71986 | 143970 | |
| Total | | **7431050** | **7135080.8** | |

**Figure 9. Types of mercury batteries use**




Gas can form in all of these batteries due to the corrosion of zinc. Zinc in the battery gets corroded into the electrolyte as the battery is used. This corrosion can cause electrolysis and can cause the generation of hydrogen gas in the canister. Build-up of hydrogen gas can cause the battery to leak, limiting the ability of the battery to function. Mercury suppresses this zinc corrosion, which is why it is added to button-cell batteries. These batteries may contain mercury in the insulating paper surrounding the battery, or mercury may be mixed in the anode itself. All of these different button-cell batteries can contain up to 25 milligrams) of mercury in a single unit.

A consumer survey was also conducted in the Dhaka, Chittagong, and Rajshahi regions. 100 respondents (housewife, professionals, students etc.) were surveyed and asked for information on the use of button cell batteries in Bangladesh. According to the survey it is found that each consumer uses at least 2 button cell batteries (because life time of these batteries are almost 1-2 year) per year and the percentage of spoiled button cell batteries that are disposed to waste bins or landfills are approximately 95% of the total. The total release of mercury from the household and industrial sector is therefore estimated as:

According to the census 2014; there are 3679532 households in town and cities and 3, 5993 industrial establishment in Bangladesh.[26]

From the total working process including data gathering and data analysis, calculation of mercury release in Bangladesh per year can be summarized like this; Mercury release from button cell batteries into soil due to consumer use is **0.0179 MT**.

[26]http://203.112.218.65/WebTestApplication/userfiles/Image/National%20Reports/Union%20Statistics.pdf

### 3.5.4 Switches

Mercury containing switches are not produced in Bangladesh. The survey data showed out of 80 stores in different market, 65 respondents reported that they import switches and supply in all over the country.

However, the import of mercury containing switches is increasing. Electric switch vendors are exposed to mercury during handling of switch in the event of breakage. This broken/end-of-life electric equipment are dumped in open places. Management of this equipmentis done in correctly due to a lack of awareness of mercury hazards and a non-compliance with the implementation of existing policies.

**Types of switches imported by the suppliers**

According to the survey it is found that several kinds of electrical switches that contain mercury supplied in Bangladesh. These include:

| Switches | Use | Mercury quantity |
|---|---|---|
| Tilt | Tilt switches are used on under hood and trunk lighting applications (one switch per light). | 500 mg – 4 kg |
| Float | Float switches are commonly used to operate pumps and control the level of a liquid. Basically used in municipal sewer systems, as controls for irrigation pumps and industrial applications. | 100 mg - 67 g |
| Electrical Switches | | up to 50 Kg |
| Mercury-Containing Relays | Relays are often used to turn on and off large current loads by supplying relatively small currents to a control circuit | 100 mg - 40 kg |

**Usage of these batteries in following:**

- Welding,
- Power supply switching,
- Industrial process
- Street lighting)
- Wall switches
- Building security & fire alarms (tilt & trembler devices)
- Cameras (still, video, film)
- Laptop computer (screen shut-off when closed)
- Portable Phones
- Temperature controls
- Thermostats
- Washing machine lids (spin-cycle shut-off)

These are devices that open or close electrical contacts to control the operation of other devices. Relays are often used to turn on and off large current loads by supplying relatively small currents to a control circuit. Mercury-containing relays include mercury displacement relays, mercury wetted reed relays, and mercury contact relays. There are many types of mercury-containing switches and relays besides those described above. These include pressure and temperature switches, flame-sensor switches, reed switches, vibration switches, and others. Much of the mercury that

is contained in switches in existing products and equipment will eventually enter the environment unless measures are taken to re-cover this mercury.

**Mercury content imported switches:**

Among 65 respondents, there is a variation in their imported switches. Some import tilt switches (37.50%), some electrical switches (35%), some float switches (15.2%) and relays (12.3%).

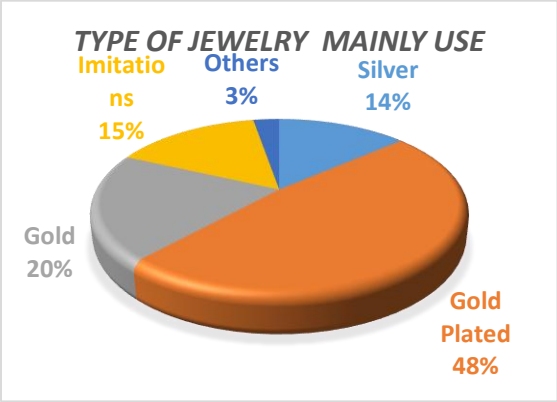
Based on our calculation we found that 12.5 kg-1000 kg mercury is used in tilt switches per month; 1.95 kg-13,065 kg mercury is used in the float switches per month; 1.5 kg - 6000 kg mercury is used in the relays per month; and approximately 16,250 kg mercury is used in the electrical switches per month.

### 3.5.5 Jewelry with mercury

ESDO randomly selected 110 jewelry importers and retailers for taking response about mercury in their products, mercury hazards, whether they are aware about mercury contamination or not. In this study five jewelry shops that have their own workshop along the shop in the same building were surveyed. During the survey we found that there are approximately 36 jewelry shops in Tatibazar and approximately 120 jewelry shops (out of these, 100 have their own workshops) in Bangladesh.

**Type of Jewelry mainly Use**

**Figure 11. Type of jewelry mainly use in Bangladesh**




Among the total surveyed jewelers, 36.18% produce, import and retail gold jewelry followed by white gold importers (20.00%), gold plated/imitations producers and importers (27.45%) and silver (13.66%) jewelers.

**Retailer Perception**

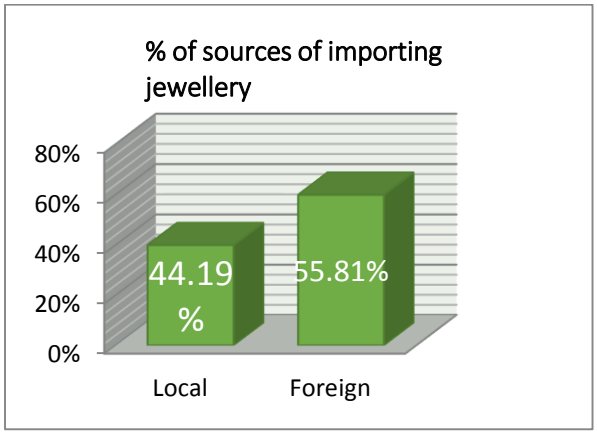
Under the survey, we covered almost 110 importers and retailers who generally sell jewelry in Dhaka and Rajshai division. The ESDO team asked several questions to determine the jewelry vendor and manufacturers awareness about mercury.

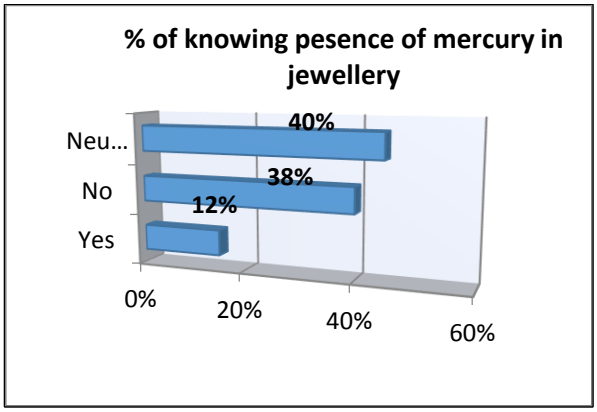
Among the total surveyed jewelers, 36.18% produce, import and retail gold jewelry followed by white gold importers (20.00%), gold plated/imitations producers and importers (27.45%) and silver (13.66%) jewelers.

**Source of their jewelry**

55.81% of the retailer said they imported their jewelry from foreign sources and 44.19% said they imported it from local sources.

**Figure 12. Sources and awarnessabout the use of mercury in jeweleries**




**Awarness about the use of mercury in jeweleries**

Figure-12 demonstrates the level of awareness of retailers regarding the use of mercury in. Only 38% reported that they knew about the use of mercury used in jewelryproduction.40% were neutral, and 12% said they have no idea about the use of mercury in jewelry. These statistics demonstrate a poor level of. It was estimated that annually **340.91 kg mercury** containing white gold jewelry is imported by per jewelry store from other counties (mainly from Italy).

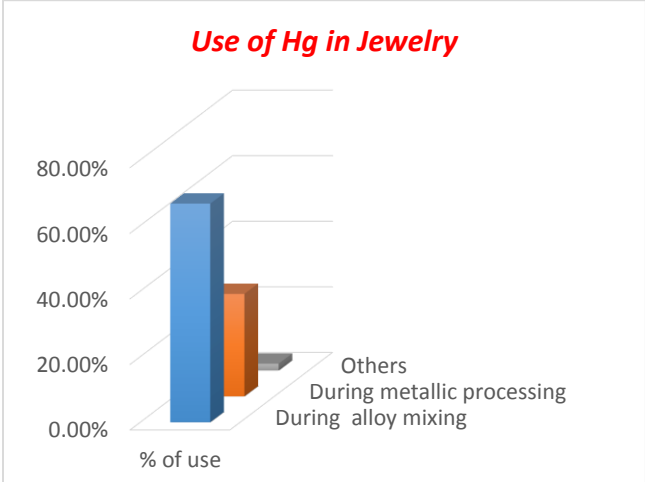
- **Mercury use in gold manufacturing sector**

Use of Mercury in Gold Jewelry

During the survey it was found that, there are seven steps from production to sell all types of jewelry in Bangladesh. These are,

Metal Processing unit (Paka); **Hg use**→Mixing of alloy (khad or gorit), **Hg use**→ Jewelry polish → Jewelry designing → sent to Jewelry shops → Disposal of waste to the side drains →Re-collect of gold from the wastes; **Hg use**

**Figure 13. Methods of using Jewelry**




31.25% of the jewelers reported that mercury is used during alloy mixing while 23.68% said it is used during metallic processing. The majority said (45.07%) that mercury is usually used to re-collect the gold from the by-product or waste. It is used a magnate and attached to gold to make it a form a proper shape.

**Metal processing unit:**

Based on the survey information it has been found that mercury liquid (or locally called ***Pani***) is used during the flattening of gold biscuit into a thin sheet alongside a number of other chemicals (like: Borax; Na2B4O7.10H20). Two

melting pots for gold biscuits, under hoods; unventilated centrifuges; wall storage racks for rubber moulds are used in this process.

**Mixing of alloy (khad or gorit):**

To make a proper gold jewelry; chemicals are mixed with gold like, Zn, Hg, Cu etc. into a certain amount. According to a jeweler during the survey in their workshop, **0.01136 Kg Hg is used for 0.5 Kg Gold**

According to them approximately 1500 kg gold is processed to make jewelry per month. This implies that 18000 Kg gold is processed per year, and that 408.96 Kg Mercury is used per year from individual jewelry workshops and in total **40896 Kg or 4.1 MT** mercury is used per year in the jewelry sector in Bangladesh. Information was also found on white gold and gold-plated jewelries.

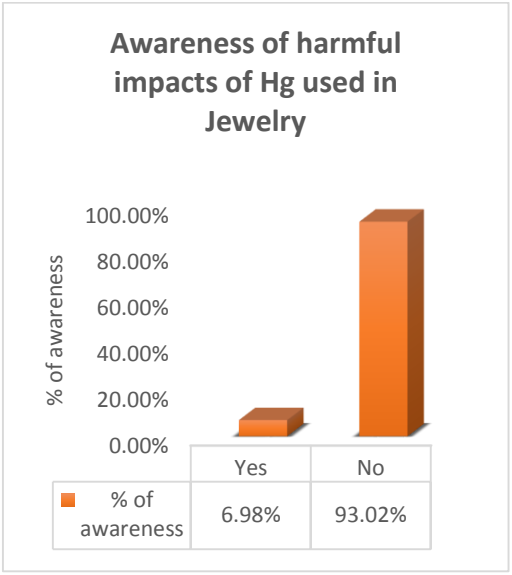
**4.1 MT Mercury vapor is released from Jewelry sector, 340.91 Kg Mercury is imported in the form of white-gold jewelry, and mercury vapor is also released to air during re-collection process**

**Re-collection of gold from the wastes:**

During the survey, we also discovered that mercury is used to re-collect gold from the scraps. After the processing of gold jewelry, the remaining by-products are disposed to roadside drains or canals. Jewelry by-product mixed with other chemicals and wastes. Gold producers or retailers buy those wastes for a very low price from the vendors. They then use mercury solution to re-collect the gold content from the total waste. After collecting gold from the waste the remaining liquid (containing mercury solution) is kept in big drums and, consequently, mercury vapor is released into air. Mercury emission during re-collection process is very much hazardous. According to the respondents they re-collect gold by this process once a week.

**Harmful Impacts of mercury used in jewelry**

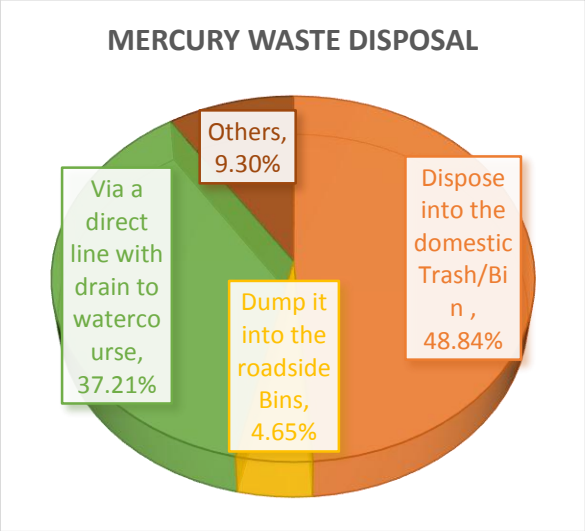
**Figure 14. Awareness level on harmful impacts of mercury used in jewelry**




The majority of the jewelry – makers (93.02 %) were unaware of the harmful impacts of mercury used in jewelry. Brief information about the harmful impacts of mercury (i.e. skin inflammation, rashes, allergic reaction, black pigmentation, skin cancer) needs to be shared among the importers as well as manufacturers. Encouragement to promote awareness among public as well as retailers, establish regulation on the export/import of mercury containing jewelries, continuous monitoring are required to educate people about the harmful consequences of mercury

**Mercury waste disposal**

**Figure 15. Mercury waste disposal from jewelry sector**




48.84% said that their locality, domestic trash/bin are used for mercury wastes, and there is no separate section/bin for mercury waste disposal. 37.21% indicated that the mercury waste disposed of collectively through direct drain line with other municipal wastes, where as 4.65% respondent's dump mercury byproduct directly into roadside bins.

This shows that as majority dispose of mercury/mercury amalgam in combination with the other waste, so there is no segregation of mercury waste. Moreover, people who are aware about mercury toxicity do not manage their waste properly. They still dump their waste into sewerage system of Dhaka City Corporation. It is assumed that as a result of combining mercury waste with the other leads to even worse environmental pollution as a result of the combination of chemicals and materials.

### 3.5.6 Biocides and pesticides with mercury

**List of Mercury and mercury containing biocides and pesticides in Bangladesh are given below;**

- Mercuric benzoate (Hg $(C_7G_5O_2)_2$)
- Mercuric chloride,
- Mercury bichloride
- Mercuric oxide (HgO)
- Corrosive sublimate ($HgCl_2$)
- Mercurous iodide ($Hg_2I_2$)

### 3.5.7 Paints with Mercury

The size of the Bangladesh paint industry is more than 20 billion, (approx. 0.26 billion USD).41 formal/structured and 20+ non-structured paint manufacturers are involved in Bangladesh. Berger, Asian, Roxy, Pailac, Aqua, and Elite are the major players and command an almost 90% market shares. Three (Alfa, FMC, Jotun) new enamel decorative paint brands are newly included in the paint production in Bangladesh. All these companies together produce 77,000 MT of paints annually, although the demand of the country is nearly 98,000 MT. According to the Ministry of Trade and Commerce Bangladesh imports the rest about 21,000 MT of paint annually from different countries.[27]

According to the survey it was found that:

Mercuric arsenate ($HgHAsO_4$) is used in waterproofing paints
Mercuric oxide (HgO) is used in red or yellow pigment in paints
Mercuric sulfide (HgS) is used in red or black pigment in paints
Mercurous chromate (Hg2CrO4) used in green pigment in paints

[27]Information collected from annual report of Bangladesh Paint Manufacturers Association, 2014

**Mercury release from paints**[28]

Among the techniques suitable for the quantification of metal ions, ICP-MS, ICP-AES and atomic absorption or emission spectroscopy are likely to be the most widely employed in Bangladesh for quantifying mercury release from paints. Spectrophotometric techniques, which tend to be less costly and labor-intensive, are viable alternative to those methods requiring more sophisticated instrumentation. A spectrophotometric procedure for the simultaneous determination of mercury using DDTC as ligand is used.

Using the spectrophotometric method, mercury release from paints to water and soil are given below;

| Areas | Mercury concentration (ppm) |
|---|---|
| Water | 2.48-2.51 |
| Soil | 1.38-2.24 |

### 3.5.8 Pharmaceuticals for human and veterinary uses

There is approximately 258 manufacturers, with approximately 8000 branded generics in Bangladesh pharmaceuticals market. Companies manufacture pharmaceuticals by assembling known generic and patented (in some cases) products. Some firms have been engaged in producing active pharmaceuticals ingredients (APIs), the core of pharmaceutical products, but these productions are limited to synthesis stage (final stage) only.[29]

The production of APIs Excipients, Solvents etc. that are used as raw material in producing the final drug formulations is also done in Bangladesh. Among these, the major business area is in production of APIs, also known as bulk drugs business, which has a large global market.

Historically, Bangladesh has been dependent on imports for APIs and other ingredients. Companies imported APIs and other materials and used them for final production. The pharmaceutical manufacturers in Bangladesh procure raw materials from various countries namely UK, France, Germany, Japan, Holland, Italy, Denmark, China, Switzerland, Austria, Hungary, India, Ireland etc. Recently, local firms has been approaching to producing ingredients locally, especially API.

The survey was conducted in pharmaceutical companies and medicine stores along with drugs/medicine suppliers covering the Dhaka, Chittagong and Rajshahi city. A total of three pharmaceutical companies and 60 pharmaceutical stores were surveyed to collect information on mercury containing active pharmaceuticals ingredients (API), Excipients, Solvents.

Based on ESDO's survey it was found that at present, there are 21 companies in Bangladesh manufacturing 45 APIs (included mercury containing APIs). It was also found that, local APIs take a 30% share in domestic production. The rest, 70%, is imported. The major findings of the survey were given below:

**Table 22. Mercury containing pharmaceutical products in Bangladesh**

| | |
|---|---|
| A. Mercury containing APIs produced in Bangladesh | 1. Diclofenac Free Acid<br>2. Diclofenac Potassium<br>3. Diclofenac Sodium<br>4. DiclofenacDiethylamine<br>5. Thimerosal (Mercury carboxy phenyl thioethyl sodium salt)<br>6. Mucolexx (Thimerosal) |

[28]http://www.spp-j.com/spp/1-1/spp.2014.05A0003

[29]Research Report : Pharmaceutical Industry of Bangladesh, 2011

| | |
|---|---|
| | 7. Nesslar's Reagent (Potassium tetra-iodomercurate)<br>8. Phenylmercuric acetate<br>9. Phenylmercuric nitrate |
| B. Mercury containing eye drops imported | 1. Diclofenac potassium eye drops (0.1%)<br>• Thiomersal= 1.00 mg/ml<br>• Tromethamine = 50.0 mg/ml<br>2. Diclofenac potassium eye drops (0.05%)/ diclofenac sodium eye drops (0.1%)/<br>• Tromethamine = 0.6 mg/ml |
| C. Other pharmaceutical reagents/solvents | 10. Contact lens solutions<br>11. Formalin (Mercury contaminant)<br>12. Ophthalmic products containing thimerosal<br>13. Diuretics with mersalyl and mercury salts<br>14. Pregnancy test kits with Hg containing preservatives<br>15. Merbromin water solution<br>16. Nasal spray with thimersol |

### 3.5.9 Cosmetics with mercury

ESDO conducted a cross-sectional study, comprising of face-to face personal interviews using a semi-structured interview schedule containing both qualitative and quantitative variables.

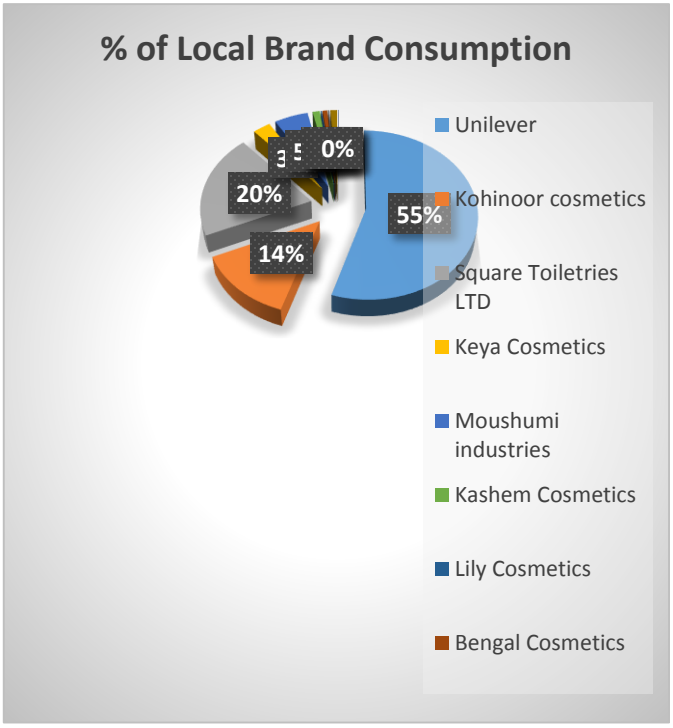
This study was conducted among 600 randomly selected people from the Dhaka, Chittagong and Rajshahi through convenience sampling. The study subjects included market retailers, consumers and cosmetics producers. Informed consent was taken from all the participants before interview. The whole study was conducted from December, to March, 2015, spanning over duration of three month.

Out of the total subjects, 402 (67%) subjects belonged to 18-30 years while 198 (33%) subjects belonged to more than 30 years age group. Out of the sample selected there were 252(42%) males and 348(58%) females in the study.

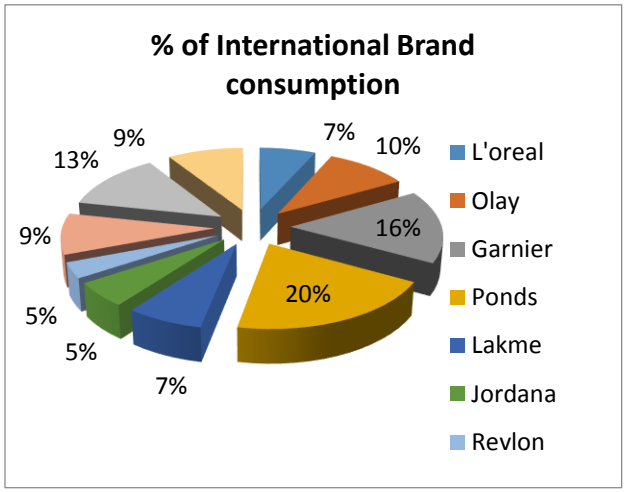
**Consumer brand choice**

ESDO surveyed 450 consumers in different shopping complexes of Dhaka city. According to questionnaire survey, it was found that a majority (nearly 55%) of consumers purchase beauty products of Unilever. Square and Kohinoor are the second and third highest brand of beauty products, figuring out 20% and 14% consumers choice respectively (Figure 16).

**Figure 16. Consumer brand choice and consumption of international cosmetics**



**Consumption of international brand**

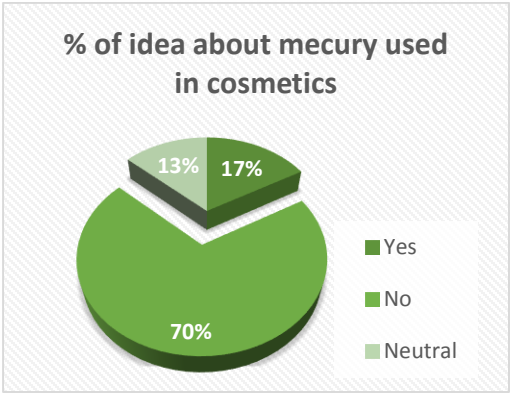



The study revealed that a majority (20%) of consumers buying international brands buy products of Ponds. Garnier (nearly 16%), Nivea (> 13%), Olay (>10%), Neutrogena (>9%), L'orealand Lakme (>7%), Jordana (>5%), Revlon (>4%) are also purchased (Figure -16).

**Awareness of the level of mercury in cosmetics**

**ESDOs** objective was to know about the awareness of the levels of mercury use in cosmetics. We surveyed our target group to that end.

**Figure 17. Awareness level of mercury in cosmetics**



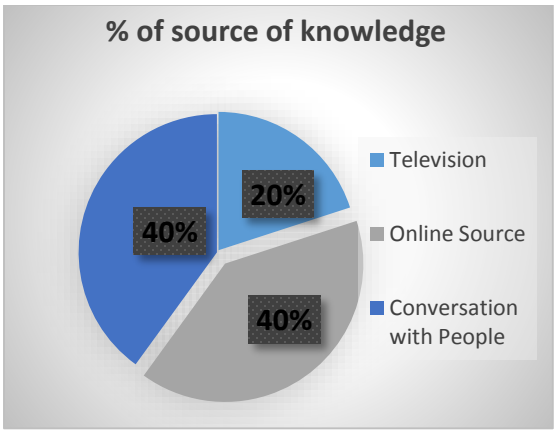




**Figure 17.1Figure 17.2**

In figure 17.1, it can be seen that most of the consumers have a poor understanding of the use of mercury in cosmetics. Almost 70% of those surveyed responded that they have no idea about the use of mercury. 13% of consumers answered they are actually not sure about using mercury in cosmetics and only 13 % said that they know about mercury and other related elements are used in cosmetics manufacturing and that this is bad for skin. Of this 13%, found out about mercury from online articles and journals, 40% of them came to know from talking with their friends and relatives and the final 20 % knew from television news and talk shows on international television channels; [Figure 17.2].

**Retailer Perception**

Under the survey, we covered almost 120 retailers who generally sell beauty products and cosmetics in the Dhaka and Rajshahi division. To understand the level of awareness about mercury in cosmetics, the ESDO team had asked several questions.

**Source of their cosmetics**

60% of the retailer said they import their cosmetics from foreign sources and 40% said they import from local sources. This implies that if governments regulated the export of mercury contained cosmetics then it could be beneficial to the consumers.

**Figure 18. Sources of importing cosmetics**

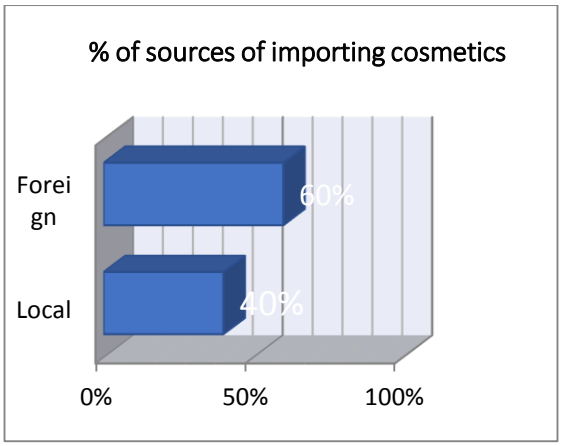
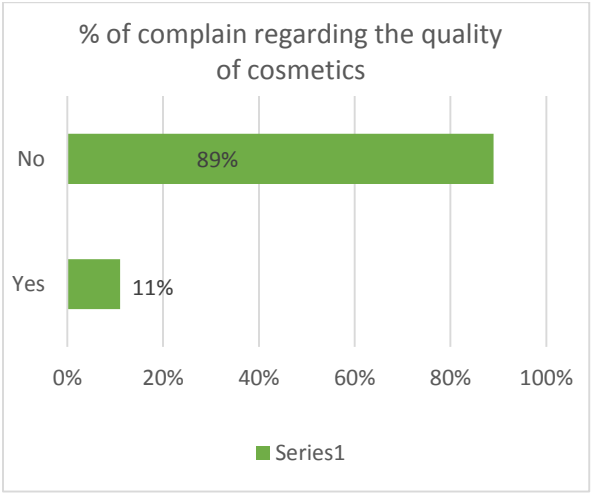


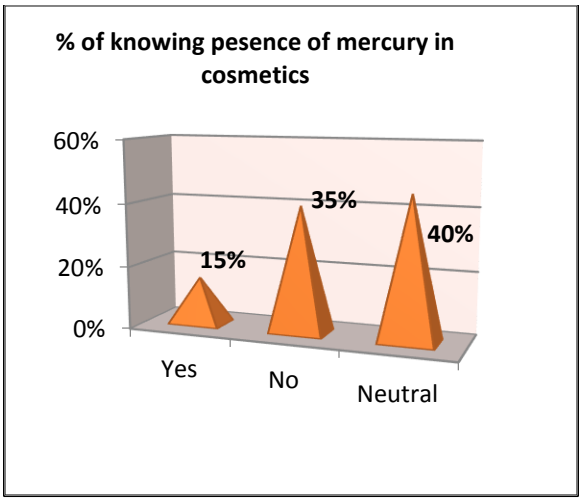

**Figure 19. Range of guarantee level for cosmetics**


Figure-19.Shows the guarantee level of cosmetics from retailer shops. 62% of them said they give guarantee of more than years. 30% of them gave guarantee for six months. In terms of quality, questions were asked them regarding the percentage of complaints that they get from customers.

From the figure-20 it can be seen, 89% retailer said they usually don't get complain against their cosmetics and only 11% agreed that they get complain regarding durability and quality of cosmetics.

**Figure 20. Complaintsabout the quality of cosmeticsFigure 21. Awareness level for Hg containing cosmetics**



## Awarness level of knowing about use of mercury in cosmetics

Figure-21. demonstrates the level of knowledge of the regarding mercury use in cosmetics. Only 15 % said that they knew about mercury used in production.40% were neutral, and 35% said they have no idea about the use of mercury incosmetics. This statistics are showing low knowledge level and awareness level of mercury in cosmetics among retailers. The 15% that reported knowing about mercury told us that they got to know about it from conversation with manufacturers and also from television and media.

**Mercury in Cosmetics**

According to the report "Mercury Sources: Products and Hotspots in Bangladesh" prepared by ESDO in 2012, ESDO has collected 12 fairness beauty products that have more demand from consumer purchasing point of view. These products were analyzed in Bangladesh Council of Science and Industrial Research (BCSIR). All the samples were analyzed in Atomic Absorption Spectrometer using Cold Vapour Unit. The table below shows the mercury concentration in each product.

It is very alarming that all consumer fairness beauty products that ESDO has analyzed contained harmful mercury. The highest (4653 ppm) level of mercury was recorded in Garnier, and the lowest (3361 ppm) in Shumons Aroma. Moreover, mercury content in Fair & Lovely Ayurvedic (4004 ppm), Fair & Lovely Max fairness (4174 ppm), Modern (4152 ppm) and Fair & Handsome (Emami) (4133 ppm) exceeded 4000 ppm. Rest of the fairness products contain a lower concentration but still above 3000 ppm.

It can be said from analysis that all products contain mercury ranging from 3000 to 5000 ppm. Details are given in the following table;

| Products | Quantity of Hg |
|---|---|
| Garnier | 4653 ppm |
| Fair & Lovely Ayurvedic | 4004 ppm |
| Fair & Lovely Max fairness | 4174 ppm |
| Modern | 4152 ppm |
| Fair & Handsome | 4133 ppm |
| Botanic | 3929 ppm |
| Tibbat | 3752 ppm |
| PONDS | 3450 ppm |
| Olay | 3603 ppm |
| Shumon's Aroma | 3361 ppm |

**Preference regarding steps against mercury contained cosmetics by retailer**

After learning about mercury use in cosmetics, 45% of the respondents said they will carefully sell their cosmetics (specific attention should be given on its' permissible limit), 20% said they will try to avoid selling those products which is containing hazardous mercury and they will switch to alternatives and 35 % were neutral on that because they have to look their profit margin as well.

**Figure 22. Steps against Hg containing cosmetics**

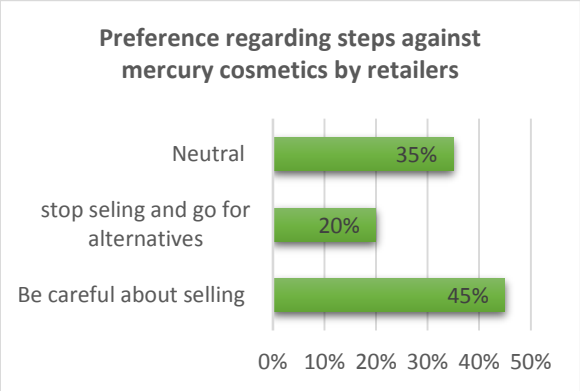
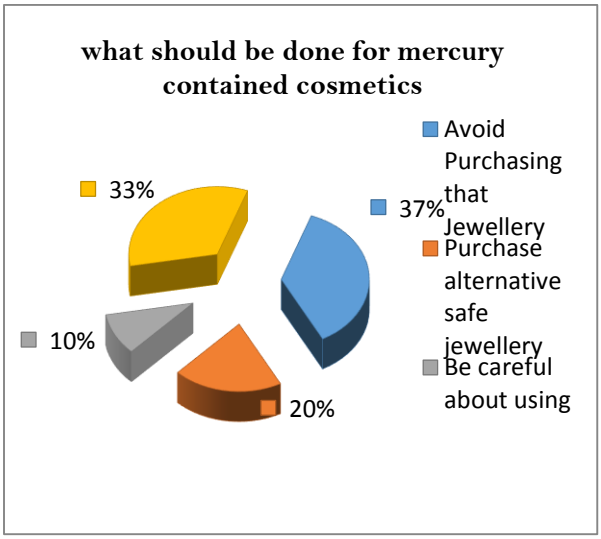



**Figure 23. Perception concerning mercury contained cosmetics**




Though most of the surveyed people don't have any idea of mercury which is used in manufacture of their regular cosmetics and beauty products, they want to make themselves aware regarding this. During the field survey, 37% wanted to avoid purchasing mercury contained cosmetics, 33% will go for making themselves more aware regarding this, 20 % said they will go for alternative mercury free beauty products and 10 % said they will follow safety while using products.

Moreover, after analyzing all the collected data from consumer group, we came to know people especially young group are now tend to use different cosmetic both from local and foreign shops. Their preferences for cosmetics are mostly for fairness cream and fancy cosmetics. But most of them are unaware about it. Though some of them knew about hazardous element in mercury, they are not properly aware of its effect on their skin. All of them need to become aware regarding hazardous element in beauty products for safer health in future.

## Regulations on mercury containing cosmetics

Mercury level for skin whitening creams being manufactured and marketed in local markets of Bangladesh was standardized by the Bangladesh Standards and Testing Institution below 1 ppm, after the draft finalized by the Cosmetics and Related Product Sectional Committee and approved by the Chemical Divisional Committee. The standard was revised by in 2011.[30] But specialized skin creams, such as antiperspirant creams, whitening creams, acne creams, hormone creams etc. which have an effect on the physiological functions of the body or for which therapeutic claims are generally made, are not included in this standard. Atomic Absorption Spectrophotometric method is used to determine mercury vaporizer unit in skin creams by BSTI.

[30] Bangladesh Standard Specification for Skin creams, Second revision, BDS 1382: 2015

## 3.6 OTHER INTENTIONAL PRODUCTS/PROCESS USES

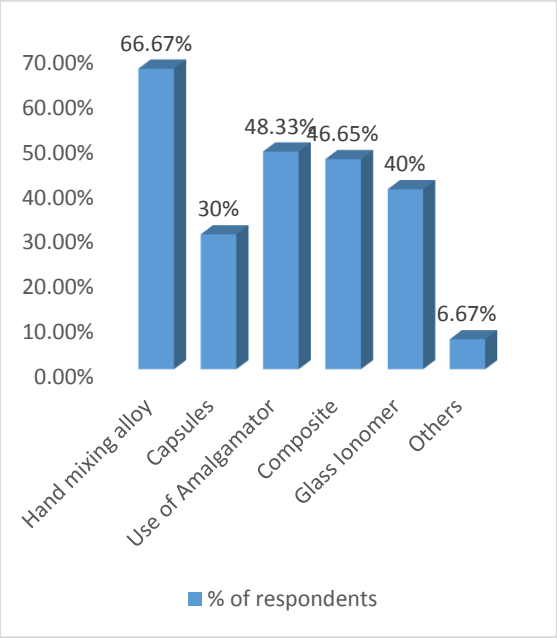
| Other intentional product/process use | Bangladesh Source |
|---|---|
| Dental mercury-amalgam fillings | ✓ |
| Manometers and gauges with mercury/Measuring devices | ✓ |
| Laboratory chemicals and equipment with mercury | ✓ |

### 3.6.1 Mercury in dentistry

The survey was conducted in dental colleges along with dental practitioners covering the Dhaka, Chittagong and Rajshahi city. A total of 25 dental colleges and 60 dentists were consulted, some of them were associated with the dental colleges itself. The survey was intended to assess their occupational exposure to mercury from day to day use of mercury based dental filling and removal as well as lack of any proper waste handing process.

The major findings of the survey have been classified and discussed under relevant heads.

**Figure 24. Types of Dental Practices**



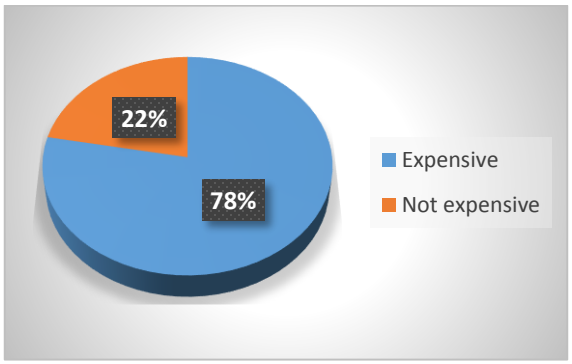

According to the survey most of the dental set ups (including majority of dental colleges) are using hand mixing alloy (66.67%) and amalgamator (48.33%) which leads to more mercury wastage. Out of the total 24 colleges visited, 15 of them had this amalgamator machine. Most of them are still using loose mercury and silver powder, as use of capsules (30%) becomes expensive. Only some dental colleges and some high end private clinics use composite (46.65%) and glass ionomer (40%).

**Comparison between costs of fillings**

The survey found that:

| Cost of amalgam fillings- | Cost of alternatives- |
|---|---|
| i. Tk. 150-600 for dental colleges<br>ii. Tk. 1000 to Tk. 2400 for private practitioners | i. Tk. 350 to Tk. 1000 for dental colleges<br>ii. Tk. 1600 up to Tk. 4500 for private practitioners |

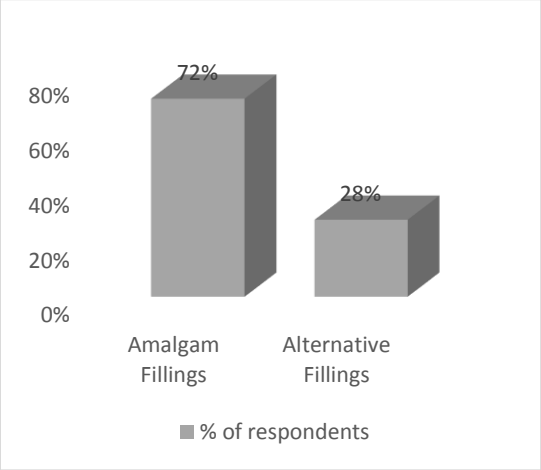
**Figure 25. Dentist's opinion on cost of alternatives**



Out of 60 dentists 78% respondents that the cost of composites was more because the material cost is high and they are mostly imported whereas, some dentists (22%) felt that the mercury cost has gone up considerably and thus doing amalgam is turning out to be a costly affair.

## Amalgam Restorations Perform Per Year

**Figure 26. Type of restorations performed**




According to the survey it was found that approximately 72% dentists performed amalgm fillings and rest (28%) performed other fillings. Out of 60 respondents, 43 respondents performed **8350** amalgam restorations **per month**. On a yearly basis, the number of restorations performed are **1,00,200**.

### Mercury content and release per year

Mercury is utilized in the preparation of dental amalgam. During preparation, mercury vapors are released and are one of the sources of mercury exposure. Professional dentists, students and health workers are exposed to mercury vapors through accidental: mercury spills, malfunctioning amalgamators, leaky amalgam capsule, trituration placement and condensation of amalgam, polishing and removal of amalgam and vaporization of mercury from contaminated instruments.

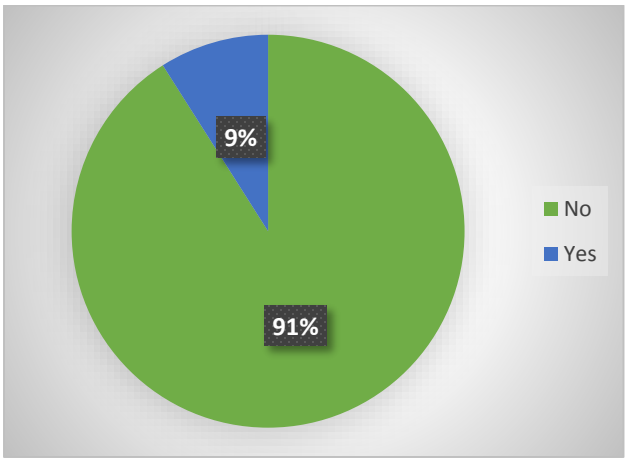
If it is consideredthat a person with amalgam dental fillings absorbs, on average, between **3 and 17 micrograms of mercury vapor** into his or her blood each day then in a year it is **1095 mg to 6205 mg.** Considering this amount it can be calculated that **1.09 MT to 6.22 MT Mercury vapor** is causing occupational risk and environmental pollution each year in our country from the dental care sector.

**1.09 MT to 6.22 MT Mercury vapor is released from mercury amalgam fillings**

### Safety of dental practitioners/ assistants

In clinics, most of the amalgam mixing is done by the dental assistants by their hands and they rarely use any personal protective equipment. In dental colleges students also do amalgam mixing by hand. According to the survey we have found that 91% respondents do hand mixing without wearing protective equipment.

**Figure 27. Use of personal protective equipment**

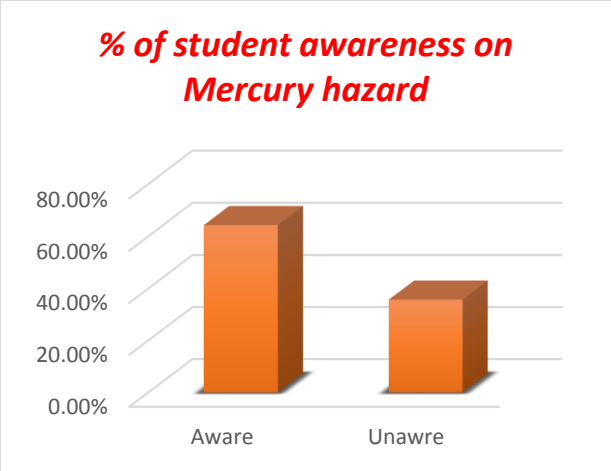



### Dental student awareness

64.27% of respondents believed that the

students were well aware of the potential health hazards caused due to mercury/mercury vapors while 35.73% were of the opinion that the students did not know about the health hazards due to mercury/ mercury vapors.

**Figure 28. Student awareness on mercury hazard**

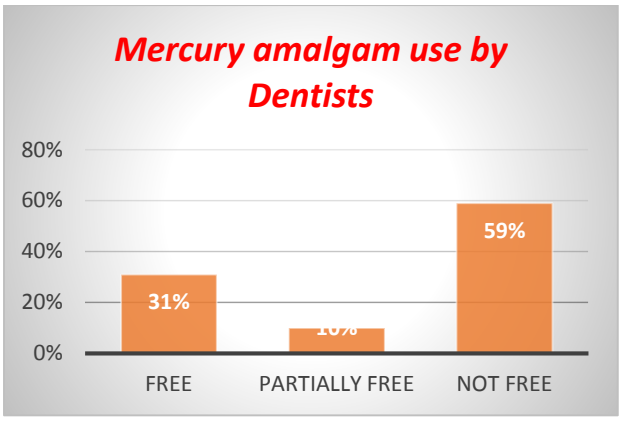


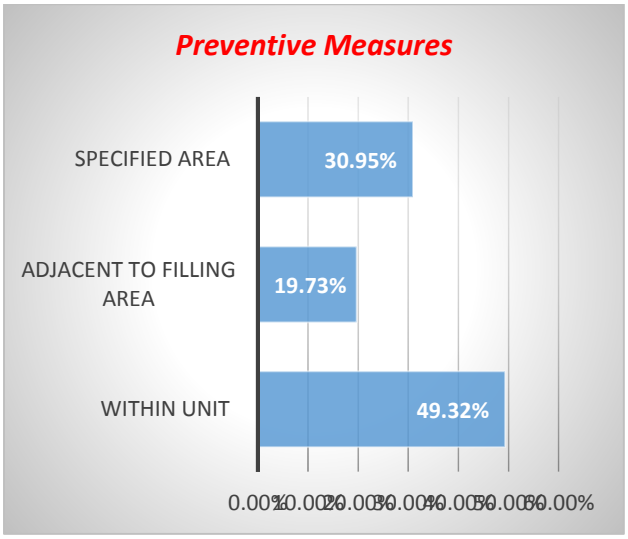

There is a need to address the health hazards due to mercury in dental practice and the necessary education/training be provided by inclusion of the relevant contents in curriculum offered at dental teaching institutions in the country.

**Situation of Dentists**

According to the survey, 31% dentists have already stopped using of mercury in their daily restoration process while 10% have partially stopped using it. The majority (59%) said they are still using mercury in dental restoration process for a number of years (>5-6 years).

**Figure 29. Mercury amalgam use by dentists and preventive measures in dental colleges and clinics**




49.32% responded that the amalgam mixing area is adjacent to filling area while19.73% indicated amalgam mixing area is within unit.30.95% respondents indicated different specified area. It is necessary that amalgam mixing area should be away from the filling area for safety purposes and emphasis should be given on that.

## Mercury/mercury amalgam waste management

**Figure 30. Mercury amalgam waste management**


45.23% said that, at their institutions, separate bins were used for mercury/mercury amalgam contaminated wastes. 54.77% indicated that the mercury/mercury amalgam waste was not disposed of separately but collectively with the other hospital/municipal wastes.

It shows that the majority dispose of mercury/mercury amalgam in combination with the other waste, so there is no segregation of mercury waste. It is assumed that as a result of combining mercury waste with the others lead to even more environmental pollution. It is obvious that at majority of dental colleges, the on-going waste disposal practices are not environmentally sound and that this is resulting in environmental degradation and causing threats to the health of population residing close by the hospital refuse dumps. Guidelines for environmentally sound management should be established for mercury contaminated wastes and these must be included as part of the dental syllabus.

### 3.6.2 Measuring Devices

As the only metal that is liquid at room temperature, mercury expands and contracts evenly with temperature and pressure changes. These characteristics have made mercury useful in devices used for measuring temperature and pressure, including the following[31]:

**Table 19. Type of measuring devices used in Bangladesh**

| Type of measuring devices | Uses | Amount of mercury in individual component or product (grams) |
|---|---|---|
| Barometers | Measure atmospheric pressure | 400 g to 620 g of mercury |
| Laboratory thermometers | Measure temperature | 0.5 g and 54 g of mercury |
| Manometers | Measure differences in gas pressure | 30 g to 75 g of mercury |
| Psychrometers | Measure humidity | 5g to 6g of mercury |
| Flow meters | Measure the flow gas, water, air and steam | 2 g to 4 g of mercury |
| Hydrometers | Measure the specific gravity of liquids | < 5 g of mercury |

Barometers can be stand-alone devices or attached to the wall. Mercury barometers consist of a glass tube that is closed at one end, with a mercury-filled reservoir at the base.

[31]http://www.newmoa.org/prevention/mercury/imerc/factsheets/measuring_devices_2014.pdf

Often, one end of the tube is open to the atmosphere so that the elemental mercury is exposed to air. The mercury rises and falls with changes in atmospheric pressure.

Mercury expands and contracts evenly with changes in temperature. This characteristic has made mercury useful in scientific, medical and industrial devices that measure temperature. Thermometers are the most common mercury-containing measuring devices. Thermometers are used in a variety of applications such as fever thermometers as well as other types of thermometers used in homes and in industrial, laboratory and commercial applications.

Mercury manometers are generally U-shaped glass or plastic tubes containing elemental mercury with one end of the tube closed and the other open to the atmosphere. The difference in the levels of mercury in each side of the tube indicates the pressure of the substance being measured.

Psychrometers contain two mercury thermometers, a “dry bulb,” or ordinary thermometer, and a “wet bulb” thermometer, which is kept constantly wet. In psychrometers, the humidity is determined by comparing the difference in the temperatures shown by the two thermometers. Some schools and laboratories may still have mercury psychrometers in use.

Flow Meters are often used in water treatment, sewage plants, power stations, and other industrial applications. Some industrial settings still have mercury flow meters in use.

Mercury was often used in hydrometers as a weight. Some schools and laboratories have mercury hydrometers in use.

**Mercury use in measuring devices**

**Table 20. Total mercury containing devices import and sold in Bangladesh in 2014 based on survey data**

| Total mercury containing devices imported into Bangladesh in 2014 | | | | |
|---|---|---|---|---|
| Importers | Measuring devices | Total quantity of devices import | Total mercury contained in the devices (g) | Total mercury contained in the devices (Kg/MT) |
| Laboratories (2) Local Importers (20) | Barometers | 66.25 | 33787.5 g | 62.526 Kg or 0.062526 MT |
| | Thermometers | 978 | 26650.5 g | |
| | Hydrometers | 396 | 1980 | |
| | Psychrometers, Flow meters and other measuring devices | 24 | 108 g | |
| | | | Total= 62526 g | |

During the survey of 20 local importers and two laboratories in Dhaka, it is found that approximately 62.526 Kg/ 0.062526 MT of mercury contained in measuring devices was imported and sold in 2014. Currently there are eight Laboratories and approximately 50 local importers in Bangladesh. So, the annual (2014) sold and import of mercury in measuring devices is total 0.6253 MT.

Mercury emissions from measuring devices using mercury around 0.6253 MT of mercury is annually purchased by laboratories (School, Colleges, Universities, others) to be used with parts like mercury electrodes in voltammetry

and metering devices for determining the softening point. These devices in generally contain mercury, besides this mercury is used during the measurements and consequently the devices need to be refilled with mercury regularly. The estimated amount of mercury purchased for the use with measuring devices is presented in the following Table 21.

**Table 21. The amount of mercury estimated to be purchased in Bangladesh in 2014 to be used with measuring devices based on survey data**

| Parts of the measuring devices using mercury | Amount of mercury purchased to be used in the instrument (Liter/Year) or (MT/Year) |
|---|---|
| Mercury electrodes (used in voltammetry) | 100- 200 liter/Year or 0.1- 0.2 MT/Year |
| Mercury probes | 1-4 liter/Year or 0.001-0.004 MT/Year |
| Mercury devices for the softening point determination | Not available |

The above parts are used as "an analytical chemical" for devices functioning. They have to fill with mercury regularly and amount of mercury purchased for the instruments (electrodes and probes) was found in total to be 0.2275 MT/year.

**Mercury emissions from measuring devices using mercury around 0.6253 MT/Year and amount of mercury purchased for the instruments (electrodes and probes) were found in total 0.2275 MT/year**

**Waste disposal of mercury containing measuring devices**

Among the 20 local importers, 45% said they dispose of mercury containing measuring devices into landfills, 40 % dispose it into separate bins and 15% use the incineration method.

### 3.6.3 Laboratory Chemicals

There are mainly 6 laboratories in Bangladesh: OTS Calibration Laboratory, Hamdard Laboratory, Albion Laboratory, Acme Laboratory, Pi-Lab Bangladesh Ltd., Bangladesh Council of Scientific and Industrial Research (BCSIR). Apart from these there are a total of 21742 institutions [32] (school, college, universities) in Bangladesh and almost all of them have at least one laboratory in their facility.

**Table 23. Default input factors according to the UNEP toolkit inventory for mercury emission**[33]

| Source | Default input factor |
|---|---|
| Laboratory chemicals | 0.015g Hg/t |

[32]http://www.moedu.gov.bd/old/edu_statistics.php

[33]Toolkit for Identification and Quantification of Mercury Releases; United Nations Environment Programme, 2013

**TABLE 24.** MERCURY AND MERCURY CONTAINING CHEMICALS IN LABORATORIES/INSTITUTES OF BANGLADESH

| Laboratory chemicals | Laboratory tools |
|---|---|
| Mercury (Hg) (commercial)<br>Mercuric Chloride (HgCl2)<br>Mercuric Iodide (HgI) (red)<br>Mercuric Nitrate (HgNO3)<br>Mercuric Oxide (HgO) Yellow & Red<br>Mercuric Sulphate (HgSO4)<br>Mercuric Sulphide (HgS) (red)<br>Mercurous Acetate (C4 H6 Hg2 O2)<br>Mercurochrome | Stone analysis kits<br>Antibody test kits<br>Antigens<br>Antiserums<br>Buffers<br>Acetic acid<br>Ammonium regent<br>Calibration kits<br>Diluents<br>Conjugate kits<br>Enzyme immunoassay test kits<br>Enzyme tracers<br>Ethanol<br>Extraction enzymes<br>Immu- sol<br>Phenobarbital reagent<br>Positive & negative control kits<br>Phenyloin regent<br>Potassium hypochlorite<br>Lab stains<br>Substance abuse test kits<br>Sulfuric acid<br>Fixatives<br>Hematology reagents<br>Hormones<br>Thimersol<br>Tracer kits<br>Urine test kits<br>Immuno electrophoresis regent<br>Immuno fixation phoresis regent |

According to an expert opinion, approximately 5-6tons of Mercury waste are released form each laboratory institution each day. So, in total 35884200 T Hg waste is released into the environment from 21748 laboratories in Bangladesh. Considering the default input factor, total emission of mercury from laboratories chemicals can be estimated is 538263 g or 538.263 Kg.

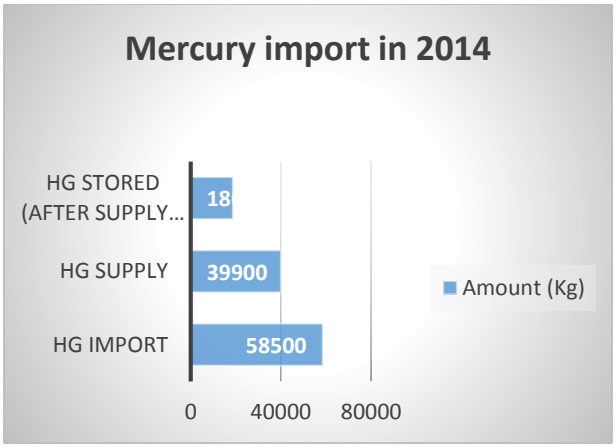
## 3.7 MERCURY SUPPLY: EXPORT AND IMPORT

Bangladesh does not produce mercury compounds nor does it engage in mercury mining. In case of Bangladesh, either mercury containing products/equipment are imported from outside of the country or mercury/ mercury compounds are being imported by the sectors where it has been in use for various material productions. An ESDO survey has found that mercury has been collected within country and imported to other countries too. Enforcement of national regulatory measures for mercury trading is weak or absent.

According to the source of NBR, 2015, around 3.73 MT Mercury is imported each year in Bangladesh. Besides that ESDO has done a field survey which found that “mercury” chemicals are imported mainly from China and India in recent years. In Bangladesh locally it is called Pani (water). Most of them import and sale two forms of mercury. These are: encapsulated and liquid forms.

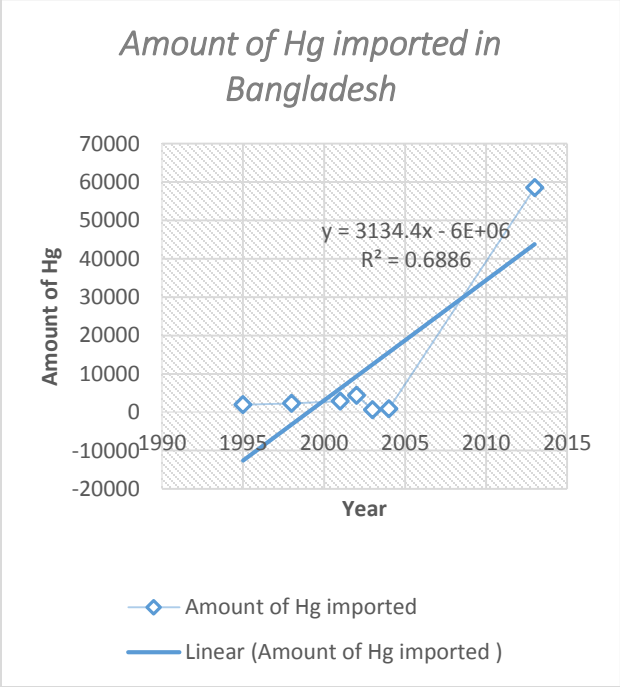
ESDO has done random sampling with a semi-structured questionnaire among 27 “mercury” chemical importers (In Bangladesh approximately 40 chemical importers are present). Based on the survey data and calculation it was found that in 2014:

**Figure 31. Mercury import in 2014**




- Annual encapsulated mercury import per store is 840 Kg. So, in 25 stores the annual encapsulated mercury storage is 12000 Kg or 12 MT.
- It was also found that annual liquid mercury storage per store is 1500 Liter so in 25 stores the annual liquid mercury storage is 37500 Liter or 37.5 MT.
- So, total import of mercury is 49.5 MT.
- If, we consider 10% more illegal import of mercury from neighboring countries around the border areas that the percentage will be turn into 58 MT. It is also to be noted that most of the border belt cities buyer are depending on smuggle products.
- It was also found that annual storage of mercury (after supply or sell) for both the forms are 18600 kg or 18.6 MT.

**Figure 32. Graphical representation of amount of mercury imported in Bangladesh up to 2014**




Besides the 2014 data, the table below summarizes all of the basic statistics for imports and exports of elemental mercury to and from Bangladesh during 1995- 2005

| Period | Exporting partner countries | | | Imported into Bangladesh | |
|---|---|---|---|---|---|
| | | Exported | | Reported imports from countries (on left) | |
| Year | Country name | Kg mercury | Value ($US) | Kg mercury | Value ($US) |
| 1995 | Germany | | | 851 | 5546 |
| 1995 | Japan | 97 | 2623 | 289 | 9187 |
| 1995 | Rep. of Korea | 347 | 8797 | | |
| 1995 | Spain | | | 805 | 1203 |
| | | | | | |
| 1996 | Areas, nes | | | 2750 | 15623 |
| 1996 | Dem. Rep. of the Congo | | | 718 | 4063 |
| 1996 | Germany | 296 | 2657 | 355 | 2007 |
| 1996 | Poland | | | 1562 | 8714 |
| 1996 | Rep. of Korea | | | 960 | 5418 |
| 1996 | Russian Federation | | | 3062 | 17291 |
| 1996 | United Kingdom | | | 152 | 876 |
| | | | | | |
| 1997 | Areas, nes | | | 4 | 260 |
| 1997 | Germany | | | 78 | 2907 |
| 1997 | Japan | 97 | 2165 | | |
| 1997 | Poland | | | 2 | 10000 |
| 1997 | Rep. of Korea | | | 207 | 5708 |
| 1997 | United Kingdom | | | 2 | 793 |
| | | | | | |
| 1998 | Algeria | | | 753 | 2486 |
| 1998 | Areas, nes | | | 29 | 94 |
| 1998 | Germany | 66 | 1000 | 792 | 2616 |
| 1998 | Japan | 199 | 3916 | 679 | 2250 |
| | | | | | |
| 1999 | Japan | 277 | 5840 | | |
| | | | | | |
| 2000 | Japan | 597 | 13991 | 0 | 18609 |
| | | | | | |
| 2001 | Areas, nes | | | 30 | 96 |
| 2001 | Germany | 597 | 3561 | 2812 | 9069 |
| 2001 | Japan | 199 | 4307 | | |
| | | | | | |
| 2002 | Germany | | | 3000 | 5283 |
| 2002 | Japan | | | 1375 | 8084 |
| 2003 | Algeria | | | 550 | 4010 |
| 2003 | Areas, nes | | | 41 | 730 |
| 2004 | Germany | | | 898 | 16000 |

(Source: UN DESA/ESD/UNSD- Comtrade statistics- downloaded 11 Apr2006)

Data on Imports of mercury compounds are very limited as well as provided data currently address only aggregated quantities of all mercury compounds, and do not track individual compound quantities.

According to the survey it was found that the target consumers are:

- Dental Colleges/Chambers
- Beauty Product or Cosmetics Producers
- Jewelry Producers
- Pharmaceutical Companies

A literature review under this ESDO survey found that, very recently, mercury prices have dramatically gone up. The price per kilo of mercury has increased up to U.S.D 86 and 95[34], which is a significant increase over recent low prices. The rise may reflect a reduction in mercury supply based on mercury mine closures and actions by government to restrict mercury exports.

High mercury prices will discourage some uses of mercury and will make it easier to implement substitutes and alternatives that eliminate or minimize the use of mercury. Therefore, the objectives of the mercury treaty are best served if the mercury price is high enough to discourage mercury demand.

Increase of price of mercury may tends to encourage more exports of mercury, which poses concerns over collection and handling of mercury for export purposes in terms of maintaining safety measures for both for human and environmental health and regulatory bindings. Probability of more mercury contamination of workers / people involve in mercury collections and business. Simultaneously, lack of education/understanding and regulation in handling of highly toxic elements like mercury may cause contamination of the environment through the release of mercury.

## 3.8 WASTE DEPOSITION/LAND FILLING AND WASTE WATER TREATMENT

| **Waste deposition / land-filling and waste water treatment** | |
|---|---|
| Controlled landfills/deposits | × |
| Diffuse disposal under some control | × |
| Informal local disposal of industrial production waste | ✓ |
| Informal dumping of general waste | ✓ |
| Waste water system/treatment | ✓ |

The category- waste disposal refer to any waste that going to disposal of at landfill or backyard. As indicated in the UNEP Toolkit, there are five type of waste deposition and waste water treatment sub-categories addressed including: controlled landfills/deposit, diffuse deposition under some control, informal local disposal of industrial production waste, informal dumping of general waste, and waste water treatment. In this regards and based on Bangladesh context, the waste deposition in Bangladesh can be addressed in three types; (1) waste water treatment, and (2) informal waste disposal.

**Waste deposition/land filling and waste water treatment.**

There is no proper land fill in the country however open land filling is available in every city. There are around five waste water treatment plants in Bangladesh.

[34]Minor Metal Prices, MinorMetals.com, December 2013, http://www.minormetals.com.

Current waste generation in Bangladesh is around 22.4 million tonnes per year or 150 kg/cap/year.[35] There is an increasing rate of waste generation in Bangladesh and it is projected to reach 47, 064 tonnes per day by 2025. The Waste Generation Rate (kg/cap/day) is expected to increase to 0.6 in 2025. A significant percentage of the population has zero access to proper waste disposal services, which will in effect lead to the problem of waste mismanagement.[36]

Bangladesh has minimal waste collection coverage which forces majority of the waste to be dumped in open lands. These waste are not disposed of properly, where general waste are often mixed with hazardous waste such as hospital waste.[37] In a report on solid waste management in Asia, the data showed that, in Dhaka, only about 42% of generated waste is collected and dumped at landfill sites, and the rest are left uncollected. As much as 400 tons are dumped on the roadside and in open space.[38]

| Categories | Waste generation | Input factor | Amount of mercury emission from waste |
|---|---|---|---|
| Waste deposition/land filling and waste water treatment | 224000 T/yr. | 5 g Hg/T | 1120 Kg/year |
| Waste water treatment | 675000 $m^3$/yr. | 2 mg Hg/$m^3$ | 1.350000 Kg/year |

** Input factor was taken from; Toolkit for Identification and Quantification of Mercury Releases; United Nations Environment Programme, 2013

## 3.9 CREMATORIA AND CEMETERIES

**Cremation** is the use of high-temperature burning, vaporization, and oxidation to reduce dead animal or human bodies to basic chemical compounds, such as gases and mineral fragments retaining the appearance of dry bone. Cremation may serve as a funeral or post-funeral rite that is an alternative to the interment of an intact dead body in a coffin or casket.

Though Bangladesh is a Muslim country it has a12.1% Hindu population (2, 01,19,966) in Bangladesh.[39] From the statistics, 2014 it was found that 5.64 people deaths/1,000 population.[40] So, it can be estimated that approximately 113476.61 Hindu people died per year in Bangladesh and they use cremation technique to dispose of their dead bodies.

According to an expert opinion 1.5 mg mercury vapors from the dead bodies through cremation. So, it can be estimated that 170214.915 mg or 0.170 MT mercury emits through crematoria and cemeteries in Bangladesh.

[35]"Waste Atlas. (2012). Country Data: Bangladesh.
[36]Alamgir M. & Ahsan. A. (2007). Municipal Solid Waste and Recovery Potential: Bangladesh Perspective. Iran. J. Environ. Health. Sci. Eng., 2007, Vol. 4, No. 2, pp 67 - 76
[37]"Enayetullah. I. (2006). Community Based Solid Waste Management Through Public-Private-Community Partnerships: Experience of Waste Concern in Bangladesh."
[38]"Bhuiya. G. M. J. A (2007). 1. Bangladesh. Solid Waste Management: Issues and Challenges in Asia, pg 28-32."

[39] https://en.wikipedia.org/wiki/Demographics_of_Bangladesh
40

https://en.wikipedia.org/wiki/Demographics_of_Bangladesh

# Miscellaneous mercury sources and Potential hots-pots

**TABLE 25. LIST OF MERCURY RELEASE SOURCES IN BANGLADESH THAT ARE NOT QUANTIFIED IN BANGLADESH**

| Miscellaneous mercury release sources |
|---|
| Combustion of oil shale |
| Combustion of peat |
| Biocides and pesticides with mercury |
| Geothermal power production |
| Production of other recycled metals |
| Production of lime |
| Production of light weight aggregates (burnt clay nuts for building purposes) |
| Chloride and sodium hydroxide produced from mercury-cell technology |
| Seed dressing with mercury chemicals |
| Infra-red detection semiconductors |
| Bougie tubes and Cantor tubes (medical) |
| Educational uses |

| Miscellaneous mercury release sources |
|---|
| Gyroscopes with mercury |
| Vacuum pumps with mercury |
| Mercury used in religious rituals (amulets and other uses) |
| Use of mercury as a refrigerant in certain cooling systems |
| Light houses (levelling bearings in marine navigation lights) |
| Mercury in large bearings of rotating mechanic parts in for example older waste water treatment plants |
| Tanning |
| Pigments |
| Products for browning and etching steel |
| Certain color photograph paper types |
| Recoil softeners in rifles |
| Executive toys |

Other intentional products use in this category is referring to various products. For Bangladesh context, mercury release from following sectors is primarily known but there is no available information and data, whether of origin and quantity imported, or where supplied to. Nevertheless, it is known that such product have been use in industrial sector, health cares or day to day life.

## 4.1 IDENTIFICATION OF POTENTIAL HOT-SPOTS

The potential hot-spots of mercury release identified by the UNEP Toolkit refer to post or abandon sites of chemical production, pulp and paper manufacturing, Chlor-alkali production, etc. which classified as the following:

- Closed/abandoned Chlor-alkali production sites
- Other sites of former chemical production where mercury compounds were produced or mercury or compounds were used as catalysts (cement production etc.)
- Dental clinics and hospitals (where cautionary measures are not in place)
- Gold manufacturing factories
- Closed production sites for manufacturing of thermometers, switches, batteries and other products
- Closed pulp and paper manufacturing sites (with internal Chlor-alkali production)
- Sites of relevant accidents
- Not included-CFLs used and indiscriminately dumping all over Bangladesh no management at any stage.

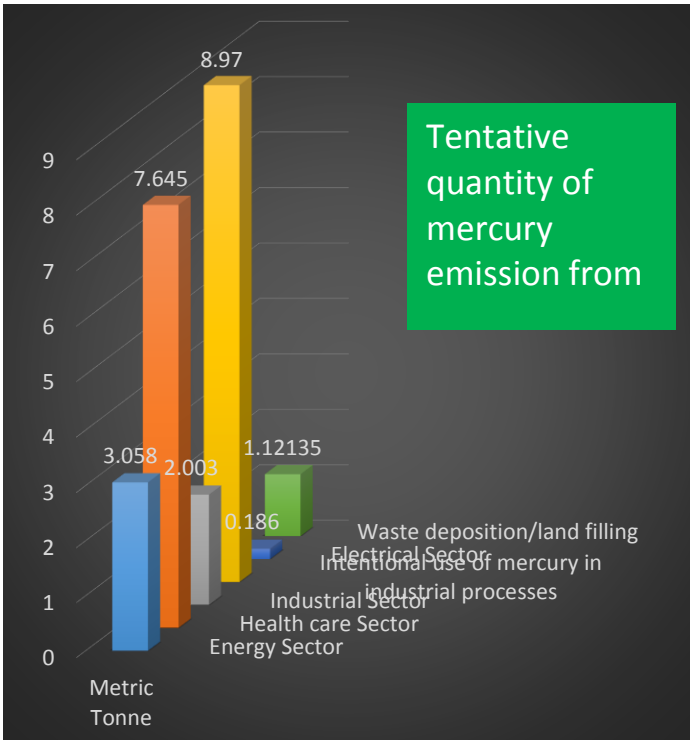
# MERCURY RELEASE AND EMISSION

# 5 MERCURY RELEASE AND EMISSION

Mercury is the naturally occurring heavy metal which remains in liquid form in room temperature. This naturally occurring elements is available in environment can be found deposited in the environment and in the flora and fauna. However, emission of mercury or release of mercury into environment may take places due to various anthropogenic uses of mercury. The increase of mercury due to emission or release of mercury into environment may pass into flora, fauna and human body or pollute environment. Humans may also be impacted by mercury through contamination of the food chain.

Previous sections described the sectors which contain mercury in Bangladesh and an increasing trend of using materials that contain mercury. Simultaneously, it has been observed that that there is lack of understanding/awareness, non-compliance with regulatory measures for curbing mercury contamination of both environment and human health. Vagueness exists in regulatory measures towards addressing mercury contamination. It is essential to define permissible level of mercury concentration and strong monitoring mechanism to be in place to control mercury contamination induced hazards.

Mercury emission or release occurs through using electrical and electronic devices, dental amalgam, health related measuring equipment, medicine, traditional medicine, gold jewelry production, cement production, production of caustic soda. However, there is no authentic data on mercury emission or release into air from these sectors in the country-wide context. The ESDO study has been able to figure out tentative quantity of mercury that emitted and release in above-mentioned sectors.



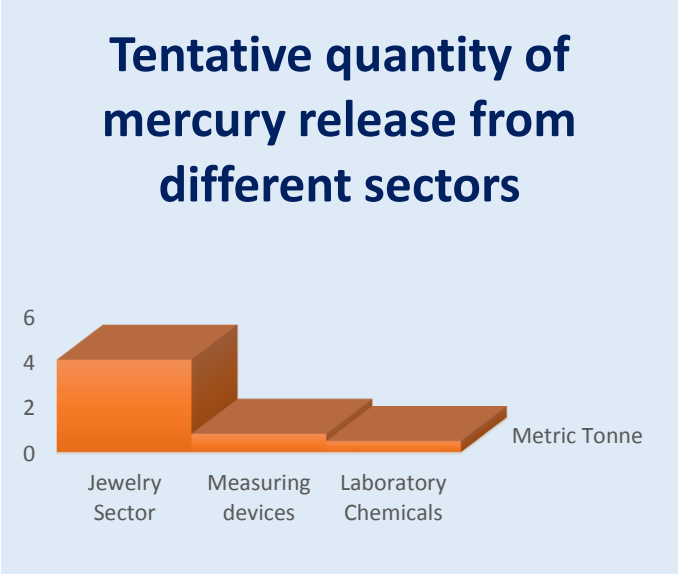



**Table 26. Tentative quantity of mercury emission from different sectors**

| Sectors | Mercury emission |
|---|---|
| **Energy sector (possible sources)**<br>Gas<br>Furnace oil<br>High Speed Diesel<br>Coal<br>Brick Burning Sector | **3.06 MT (possible emission)**<br><br><br><br><br>**0.06 MT** |
| **Health care sector**<br>Thermometer<br>Sphygmomanometers<br>Dental amalgam | **7.645 MT** |
| **Industrial sector**<br>Cement Industry<br>Aluminium Production<br>Steel Production | <br>**0.14 MT**<br>**0.011 MT**<br>**0.16 MT** |
| **Intentional use of mercury in industrial processes**<br>Chlor-alkali production | **4.49MT** |
| **Electrical sector**<br>CFL light bulb<br>Button cell batteries | **0.186 MT** |
| **Waste deposition/land filling and waste water treatment** | **1.12 MT** |

**Table 27. Tentative quantity of mercury release from different sectors**

| Sectors | Mercury release |
|---|---|
| **Jewelry sector** | **4.1 MT** |
| **Cosmetics** | **4653-3361 ppm** |
| **Measuring devices**<br>**Instruments used for devices(electrodes and probes)** | **0.625 MT**<br>**0.228 MT** |
| **Laboratory chemicals** | **538.263 Kg** |

In Bangladesh, apart from above-mentioned sectors, non-ferrous metal production, improper land filling and treatment of mercury containing waste, plants, pig iron and crude steel production, are also sources of mercury emission into atmosphere. Serious concerns and danger are associated with breakage of mercury containing products at domestic level as well as commercial level. Most people cannot identify that these products contains harmful elements while using the products, and they are also unaware of the correct procedure of disposal of these products. Therefore, vulnerability of users remains with exposure to mercury release and emission in daily life.

# Mercury waste management scenario in Bangladesh

# 6 MERCURY WASTE MANAGEMENT SCENARIO IN BANGLADESH

Mercury in wastes or sludge's cannot be destroyed with disposal. Rather, it will continue to persist in the environment. The majority of users of mercury are not aware of the importance of proper disposal of mercury wastes or mercury containing compounds. Neither have they had any large scale systematic disposal sites an in Bangladesh.

Our survey found that mercury wastes are disposed of in unplanned burial pits, landfilling, or simply dumped into roadside drains/waterways or they are stored, collected and moved offsite. Some of our respondents report that they collect wastes into three color coded bins.

## Bioavailability of Mercury in Soil

The valence state and complexion of mercury and/or its adsorption to soil mineral surfaces can significantly affect its bioavailability in soil.

### Methyl Mercury

Methyl mercury, the most toxic and bio accumulative form of mercury, which presents the greatest health risk to humans and wildlife, is mainly formed in aquatic environments through natural microbial processes.

Once mercury is deposited into lakes and streams, bacteria convert some of the mercury into an organic form called methyl mercury. This is the form of mercury that humans and other animals ingest when they eat some types of fish. Methyl mercury is particularly dangerous because it bio accumulates in the environment. Bioaccumulation occurs when the methyl mercury in fish tissue concentrates as larger fish eat smaller fish. Methyl mercury interferes with the nervous system of the human body and can result in a decreased ability to walk, talk, see, and hear. In extreme examples, high levels of methyl mercury consumption has resulted in coma or death. Many animals that eat fish also accumulate methyl mercury. Mercury can also interfere with an animal's ability to reproduce, and lead to weight loss, or early death.

### Elemental Mercury

Elemental (metallic) mercury and all of its compounds are toxic, exposure to excessive levels can permanently damage or fatally injure the brain and kidneys. Elemental mercury can also be absorbed through the skin and cause allergic reactions. Ingestion of inorganic mercury compounds can cause severe renal and gastrointestinal damage. Organic compounds of mercury such as methyl mercury are considered the most toxic forms of the element. Exposures to very small amounts of these compounds can result in devastating neurological damage and death. When mercury enters bodies of water, biological processes transform it to methyl mercury, a highly toxic and bio-accumulative form. For fetuses, infants and children, the primary health effects of mercury are on neurological development. Even low levels of mercury exposure such as result from mother's consumption methyl-mercury in dietary sources can adversely affect the brain and nervous system. Impacts on memory, attention, language and other skills have been found in children exposed to moderate levels in the womb.

**Mercury waste management scenario in CFL sector**

Currently Bangladesh is lacking adequate mechanism for CFLs management after the expiry dates when they become wastes. The government has yet to provide and implement guidelines for the safe disposal and recycling of CFLs which contain hazardous mercury. POWER CELL, MEP&MR prepared a guideline titled 'Environmentally Safe Disposal and Recycling Guidelines for Compact Fluorescent Lamps (CFLs)'. During preparation DoE worked closely with power cell. Very recently the guideline has been adopted by the Power cell and DoE have received that BSTI issues management system certificates, which are accredited by the Norwegian Accreditation Board.

1 cubic feet of soil can accommodate maximum 300 nanogram of mercury, so 1 CFL will require at about 15,000 cubic feet of soil! As such mercury content of CFL is hazardous. According to the researcher Professor Jafar Mahmood, "100 CFLs can contaminate approximately 8 acres of water.

Also breakage of a single CFL bulb in a room can result mercury vapor levels much higher than any international standard for prolonged exposure. However, to minimize the waste from the broken CFL bulb it can be recycled. Virtually all the component can be recycled- the metal end caps, glass tubing, mercury and phosphor power can all be separated and reused. The metallic portion can be sold as scrap metal, recycled glass can be remanufactured into other glass products and mercury can be recycled into new CFL bulb and other mercury containing devices.

The absence of proper CFL waste collection system, indifference of the manufactures, mismanagement of the breakage CFLs are important reasons for improper waste management. CFLs usually go into the household and municipal garbage to be ultimately dumped onto landfills or discarded amongst regular trash. Proper rules and guideline for environmentally sound management of CFLs and proper recycle of the bulbs should be implemented.

The majority of users of mercury are not aware of the importance of proper disposal of mercury waste or mercury containing compounds. There are also no systems for the large-scale disposal of mercury in Bangladesh. The mercury waste is released through common waste dump, land filling and through waste water drainage.

**Mercury Waste Management Scenario in healthcare sector**

Mercury containing medical devices (thermometers & sphygmanometer), mercury amalgam become part of the solid and liquid waste stream when archaic. Through bio-accumulation and bio-magnifications mercury wastes can contaminate the environment and endanger health when disposed of. Mercury waste is also generated from the effluents generated from hospitals, removals of old dental fillings that are ultimately disposed into water supplies, spillage of waste and breakages of products eventually land up in landfills.

Most hospitals collected all wastes together and dump in a common place. Those places were roadside, hospital surroundings, dustbin of city Corporation. Waste is placed in dustbin, re-sold or poured down drain to the main sewer.

There is no specific legislation pertaining directly to the handling, transportation or disposal of hazardous medical waste, especially mercury waste, in the Bangladesh Environmental Protection Act 1995. However,

they can be classified under Section 2 (1) which defines hazardous waste as "any liquid, solid and radioactive substance that is discharged, disposed, or dumped which may cause adverse/negative change to the environment."

The Ministry of Environment and Forest drafted the Hazardous Health Care Waste Management Rules 2003, which is yet to be notified. Officials of DGHS mentioned that some initiatives were taken for preparing few documents under the supervision of Director General of Health for hazardous medical waste (mercury, lead, cadmium, inorganic salts) management in hospitals; like, pocket books, research studies, strategic plans etc.

The City Corporation and Pourashava Ordinance, 1977 is the only local law that consists some idea for disposal of hazardous waste management in Bangladesh.

**Mercury waste management scenario in industrial sector**

In Bangladesh, pollution associated with industrial activities has been identified as a major environmental concern. Industrial and manufacturing processes, which use mercury or mercury compound as raw material, release mercury in the waste stream through effluents. This release finally gets into the soil, water and air, thus posing severe environmental challenge.

Bangladesh has a threshold value for mercury waste from industrial units. Under the Bangladesh Environmental Conservation Rules 1997 (updated in 2010) Ministry of Environment and Forest (MoEF) proposed the national thresholds limit for mercury waste. Which is given below,

**Table 28. Standards for Waste from Industrial units or Projects Waste**

| Parameter | Unit | Places for determination of Standards | | |
|---|---|---|---|---|
| | | Inland Surface water | Public sewerage system | Irrigated land |
| Mercury (Hg) | micro mho/cm | 0.01 | 0.01 | 0.01 |

In Bangladesh there is a need for proper technology to dispose of mercury waste. Short term and long term storage of mercury waste, treatment and recycling equipment, credit support systems, specific guideline for mercury waste handling is required for environmentally sound management of mercury from the relevant sectors.

The Government of Bangladesh is aware of the convention and ratification process but they have not taken any steps to support it. We need to influence and create public demand for early ratification of the convention, as the level of public awareness in our country is very low. That's why ESDO has taken a strategic approach to have a dialogue with the government of Bangladesh, civil society, other government and non- government organizations, both national and regional, public and private companies, particularly those industries where there is exposure to mercury. They are prioritized for formulating policy, and its proper implementation regarding products containing mercury and as a source of information dissemination to guide and assist them to understand the need of ratifying the Minamata Treaty. ESDO believes this report will foster this project and create awareness among the stakeholders and general public.


# Opportunities of substitution of mercury alternatives

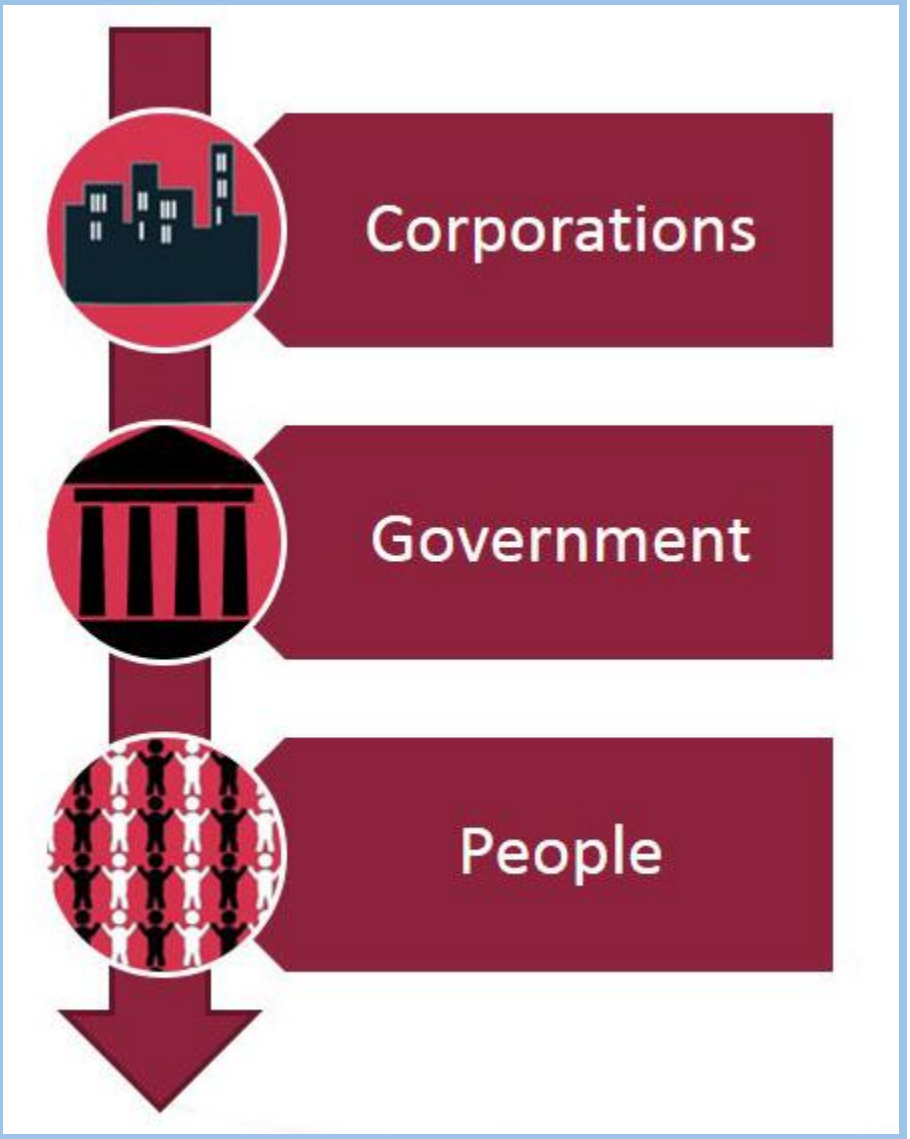
# 7 OPPORTUNITIES OF SUBSTITUTION OF MERCURYBY ALTERNATIVES

List of mercury free safer and reliable alternatives that can be used for mercury substitution are given below;

**Table 29. List of mercury free alternatives that can be substitute**

| **Products containing mercury** | **Alternatives to mercury** |
|---|---|
| Button cell batteries | Lithium zinc, low-mercury alkaline batteries, rechargeable mercury and cadmium free versions |
| Thermometers | Electronic, infrared, chemical strip, and gallium, indium, tin and alcohol/spirit thermometer. Expansion or aneroid devices (high temperature ovens) |
| Lamps: fluorescent, high intensity and ultraviolet | Light emitting diode (LED) lamp, ordinary glow lights; low sodium vapor tubes (yellow); optical, high-energy, long-lasting lights |
| Dental amalgam | Composite; ceramics, zirconomeretc. |
| Electrical equipment | Digital probe and indicators in electrical equipment's, fiber optics, solid state devices, mechanical switches |
| Sphygmomanometers | Aneroid or digital sphygmomanometers |
| Manometers | Replace with phthalate or other suitable liquid or aneroid and electronic manometers and analog gauges (vacuum gauges) |
| Mercury containing pharmaceuticals | 2-phenoxy-ethanol, zinc formalin; poly vinyl alcohol |
| Mercury compounds<br>Mercury (II) oxide<br>Mercury (II) chloride<br>Mercury (II) sulfate<br>Mercury iodide | <br>Copper catalyst<br>Magnesium chloride/sulfuric acid<br>Silver nitrate/potassium sulfate/chromium-(III) sulfate<br>Phenate method |

# Legislation and regulatory framework of the country



# 8 LEGISLATION AND REGULATORY FRAMEWORK OF THE COUNTRY

Currently there are no specific laws for limiting or banning the use of mercury in specific practices, processes and/or products. In Bangladesh. Overall hazardous toxic metal regulation was enacted in 1995 under sec 6A which was "Restrictions on manufacture, sale etc. of articles injurious to environment." Based on this regulation ESDO is lobbying with the government and concerned agencies to enact a specific regulation and standard for mercury containing products in Bangladesh. Moreover, under the Bangladesh Environmental Conservation Rules. 1997 (updated in 2010) the Ministry of Environment and Forest (MoEF) proposed the national thresholds limit for mercury in industry and drinking water which are given below:

| | Standard Limit | Unit |
|---|---|---|
| Mercury in Drinking Water | 0.001 | mg/L |
| Mercury particulate release from the Industries or Projects | 0.2 | mg/nm3 |

During revision of the Environmental Conservation Rules 1997, DoE have incorporated all the necessary standard limit value with respect to point source emission of mercury. Also during issuance of environmental clearances to the projects with mercury as raw material the obligations under the convention have been followed already. With the initiatives of DoE, SRDI under Ministry of Agriculture has taken a project to set up a laboratory to analyze specifically the Mercury level in the fertilizer and pesticides.

Recently MoEF has taken initiative to formulate the regulatory framework for E-waste Management and medical waste management. CFL's and other mercury contained waste management have been decided to incorporate in the proposed management activity.

Besides these, government wing- BSTI has Bangladesh Standards and Testing Institution Ordinance act, 1985 and BSTI (Amendment) Act 2003 to provide for the establishment of an Institution for Standardization, testing methodology, quality control, grading and marking of goods. BSTI has already decided the threshold value for mercury in cement, CFL light bulbs and cosmetics production. For, cosmetics the threshold value is 1ppm, for CFL light bulb the value is 2.5 ppm and for cement production the threshold value is suspended particulate matter (spm)<200 ppm.

# ABBREVIATIONS

| | |
|---|---|
| API | Active pharmaceuticals ingredients |
| BCIC | Bangladesh Chemical Industries Corporation |
| BSTI | Bangladesh Standards and Testing Institute |
| CFL | Compact fluorescent lamps |
| DDTC | Diethyldithiocarbamate |
| DoE | Department of Environment |
| EC | European Commission |
| ESDO | Environment and Social Development Organization |
| GDP | Gross Domestic Production |
| HID | High intensity discharge lamps |
| ICDDRB | International Centre for Diarrhoeal Disease Research, Bangladesh |
| LED | Light emitting diode lamp |
| MoH&FW | Ministry of Health and Family Welfare |
| MT | Metric ton |
| PPM | Parts Per Million |
| PVC | Poly vinyl chloride |
| SPM | Suspended Particulate Matter |
| UNEP | United Nation Environment Programme |
| VCM | Vinyl chloride monomer |

# Appendix

# 9 APPENDIX

## 9.1 APPENDIX 1.

### BRIEF ON MINAMATA CONVENTION ON MERCURY AND MERCURY PARTNERSHIP

In 2001, the Governing Council of the United Nations Environment Programme invited the Executive Director of UNEP to undertake a global assessment of mercury and its compounds, including information on the chemistry and health effects, sources, long-range transport and prevention and control technologies relating to mercury.

In 2003, the Governing Council took note this assessment and decided there was sufficient evidence of significant global adverse impacts from mercury. Governing Council specified the UNEP Global Mercury Partnership as one of the main mechanisms for the delivery of immediate actions on mercury during the negotiation of the global mercury convention.

In response to the Governing Council's request, UNEP has established a mercury program within UNEP Chemicals (UNEP Division of Technology, Industry and Economics), with the immediate objective to encourage all countries to adopt goals and take actions, as appropriate, for the identification of mercury-exposed populations, for the minimization of mercury exposure through outreach efforts and for the reduction of anthropogenic mercury releases.

In 2013 at Kumamoto and Minamata, Japan on 10 & 11 October Minamata Convention on Mercury was signed by 91 Governments. At present there are 128 signatories and 12 ratification and Bangladesh is one of them.

Mercury in the wastes, containing the free element and its compounds, and the equipment containing mercury, continues to harm the environment of Bangladesh many years after their disposal. Bangladesh has no effective regulation or guideline regarding the management of mercury wastes, or how to safely manage the uses of either products or equipment that contain mercury or mercury compounds

The evaluation of mercury emission, therefore, is required to assess new, potential and existing sources, of the mercury emission as results of the uses of mercury and mercury-containing products.

ESDO has also undertaken the project titled "Reduction of demand of mercury in mercury containing products in Bangladesh" in collaboration with UNEP to raise awareness and document mercury use and mercury added products in Bangladesh. This initiative also aims to support Bangladesh government towards ratification of Minamata convention.

In 2015, UNEP approved financial support for Bangladesh to study the mercury releases from all identified sources. In line with that from January- June, 2015, ESDO, has gone through field and desk survey to identify mercury sources, usages, products and hotspots in Bangladesh. Information was collected from different sectors, namely: energy sources, metal production, health care, electronics and electrical equipment, battery industry, cement, users of mercury chemicals, jewelry and beauty products consumer as well as consultations

with stakeholders. This study includes simultaneous discussion on the possibility of phasing out of uses of mercury and mercury contained products with indication of alternatives. The study report titled titled "Mercury added products: Country situation analysis in Bangladesh (Product inventory and emission source identification) has tried to quantify amount of mercury release and emission from the information on its primary and secondary sources.

Inventories for releases of priority hazardous substances constitute an important decision making tool in the process of mitigating environmental impacts from the pollutants in question. Such inventories are often vital in the communication with stakeholders such as industry, trade, manufacturers and the public.

The information on mercury pollution contained in this report can be used to determine which sources of mercury should be addressed in Bangladesh through release reduction initiatives. Moreover, baseline inventories and related information can be used to set effective approaches and further attention of the concerned government officials and stakeholders to take appropriate actions and measures.

## 9.2 APPENDIX 2. CONSULTATION WITH KEY STAKEHOLDERS

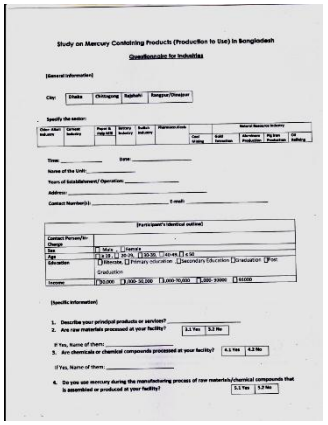
| Name | Designation | Organization |
|---|---|---|
| Prof. Abu Jafar Mahmmod | Professor (Retd.) | Department of Chemistry, University of Dhaka |
| MahmoodHasan Khan | Director (Air Quality Department) | Department of Environment |
| Dr. MohidusSamad Khan | Researcher | Chemical Engineering, BUET |
| Prof. Dr. Jasim Uddin Ahmed | Former President | Bangladesh Chemical Society |
| Md. Romisur Rahman | Additional Chief Chemist | Bangladesh Chemical Industries Corporation |
| Md. Asadur Rahman Khan | Vice President | BD Brick Manufacturing Owners Association |
| Md. Raisuddin | Second Secretary | National Board of Revenue |

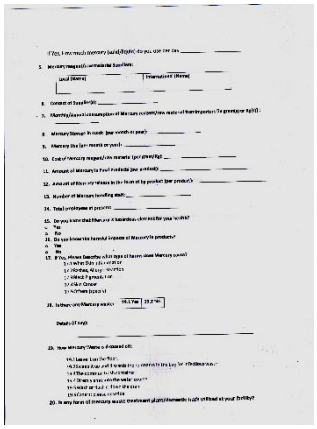
## 9.2 APPENDIX 3. SAMPLING POINTS FOR MERCURY INVENTORY IN BANGLADESH

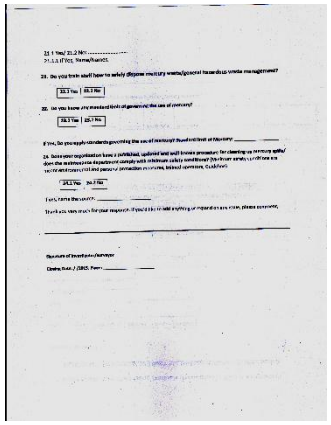
| Categories of sample | Sub categories | Location |
|---|---|---|
| Mercury Trade | Mercury import | B.K.B enterprise<br>M.B. Chemical &Bottol Supplier<br>AnawarUllah Chemicals<br>Salton Chemicals<br>Rony perfumes and Chemicals<br>M/S. Sajib chemicals |
| Production of others minerals and material mercury impurities | Cement Production | Shah Cement<br>Crown Cement<br>Holcim cement |
| | Pulp and paper production | Karnaphuli Paper Mills-Bangladesh<br>Hakkani Pulp & Paper Mills Ltd - HAKKANI GROUP<br>Bangladesh Paper Mills Ltd. |
| International use of mercury in industrial processes. | Chlor-alkali production | Samuda Chemical Complex Ltd.<br>Tasnim Chemical Complex Ltd. Global Chemical Industries<br>Asm Chemical Industries Ltd. |
| Consumer products with intentional use of mercury | Thermometers and sphygmomanometers | NIPSOM<br>Department of Health Service Salimullah Medical College<br>Chittagong Medical College<br>Rajshahi Medical College<br>Lab aid Diagnostic Center<br>Square Hospital |

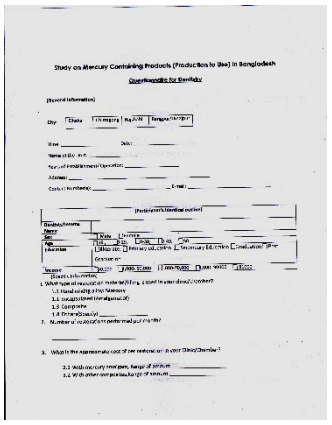
| | | |
|---|---|---|
| | Light source, batteries | Philips<br>Energy Pac Ltd.<br>Super Star Group<br>Transcom Ltd.<br>Rahimafrooz Renewable Energy Ltd.<br>General Battery Company<br>Olympic Industries Ltd.<br>QuasemDrycell Ltd. |
| | Jewelry | Tatibazar Area<br>Shopping Complexes<br>Jewelry Shops |
| | Cosmetics | Uniliver (BD) Limited-Bangladesh<br>Keya Cosmetics Ltd-Bangladesh<br>KOHINOOR CHEMICAL Ltd.<br>Millat Chemical Company Ltd.<br>Square Toiletries Ltd.<br>Lily Cosmetics Ltd. |
| Other intentional products and process use | Dental mercury amalgam | Bangladesh Medical College<br>Bangladesh Dental Society<br>Shorawardi Medical College<br>Pioneer Medical College<br>Mandy Dental College |
| | Pharmaceutical stores and companies | Square Pharmaceuticals<br>LazzPharma Ltd.<br>Prime Pharma<br>Meidicine Corner<br>Surgical Center<br>United Pharmacy |
| | Laboratory chemical and equipment | BCSIR lab<br>Hamdard Laboratories<br>Alfa Scientific Co.<br>Bangladesh Scientific & Chemical Mart<br>Digital medical systems ltd. |
| Waste Deposition/Land Filling and waste water treatment. | | Syadabaad Water treatment plant<br>Chadnighat water treatment plant<br>Matuail area<br>Industrial waste dumping area |

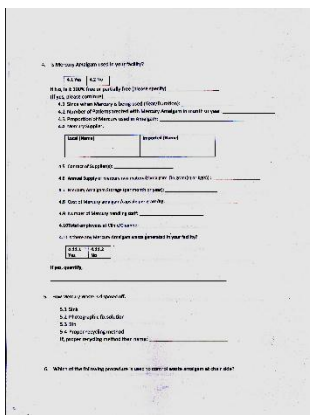
## 9.3 APPENDIX 4. SAMPLES OF SURVEY QUESTIONNAIRES

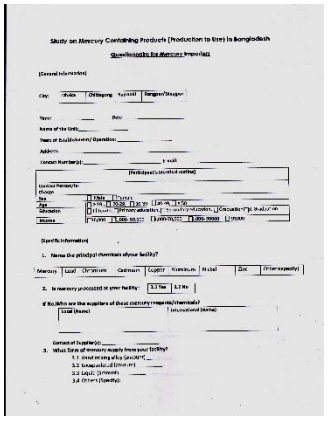


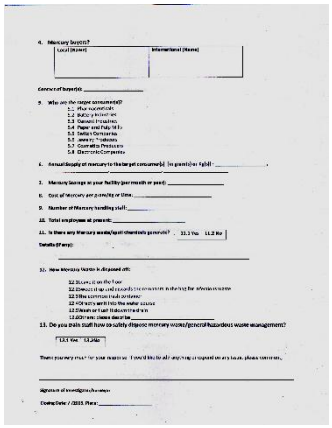


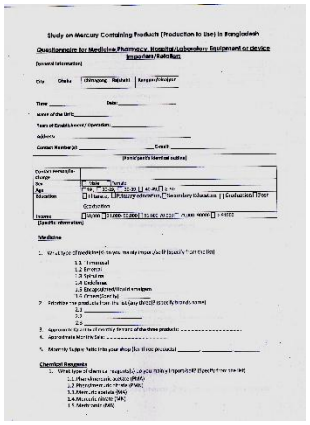


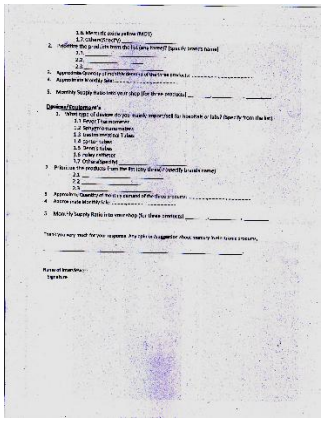


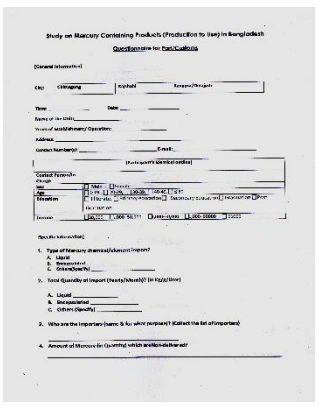


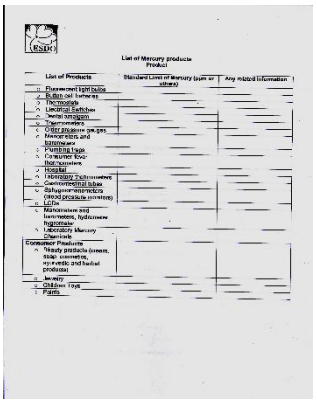


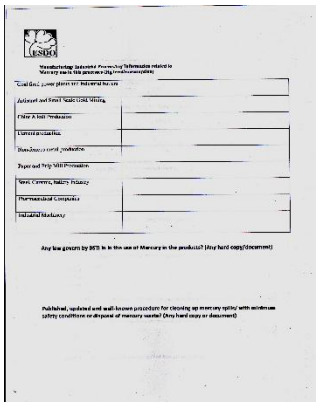












## 9.4 APPENDIX 4. PICTORIAL GLIMPSES OF MEETINGS, SURVEYS AND SAMPLING POINTS

**Project team Orientation program**


**Inception workshop on Reduction of demand for mercury in mercury containing products in Bangladesh**


**Stakeholders consultation on Reduction of demand for mercury in mercury containing products in Bangladesh**


## Pictorial Diagram of field study and sampling points