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International Mercury Treaty Enabling Activities Program (IMEAP)

Following the signing of the Minamata Convention on Mercury (the ‘mercury treaty’) in 2013 and the release of the IPEN Minamata Declaration on Toxic Metals, IPEN expanded its Mercury-Free Campaign and developed a broad program of treaty-enabling activities to be implemented in conjunction with IPEN Participating Organizations (POs). The International Mercury Treaty Enabling Activities Program (IMEAP) is geared toward raising awareness about the mercury treaty while generating data on key thematic elements of mercury pollution to help enable countries to implement the Minamata Convention.

IPEN launched IMEAP in early 2014 and continues to mobilise resources for IPEN POs to conduct activities that support implementation of the mercury treaty¹.

The key objectives of the IPEN IMEAP are:

1 Preparing for Treaty Ratification & Implementation: Creating synergies between NGOs in developing countries with ongoing UN agency or government-led mercury activities and NGO priority-setting.

2. Enabling Activities to Prepare Countries for Treaty Ratification & Implementation: Support to NGOs to carry out national and thematic mercury treaty activities.

3 Communication of Issues Related to Mercury and Treaty Ratification & Implementation: Global dissemination of project results & south-south collaboration.

The following project forms part of the overall IMEAP activities and contributes to the greater global understanding of mercury pollution issues while providing information that may contribute to Minamata Initial Assessments (MIA) and raise public awareness in preparation for early ratification of the Minamata Convention on Mercury.

¹ IPEN would like to acknowledge the financial contributions from the governments of Germany, Sweden and Switzerland, and the Swedish public development co-operation aid through the Swedish Society for Nature Conservation (SSNC) and other donors. The views herein shall not necessarily be taken to reflect the official opinion of any of these donors, including SSNC or its donors.

IPEN Mercury Treaty Enabling project

Name of NGO: Environment and Social Development Organization- ESDO

Date: 25 May, 2015 (IMEAP: 2014 Phase)

NGO: Environment and Social Development Organization- ESDO

Country: Bangladesh

Title of project: *“Mercury Country Situation Report- Bangladesh”*

Summary

The Bangladesh-based Environment and Social Development Organization (ESDO) has completed a comprehensive initial assessment of mercury sources and products containing mercury in Bangladesh to contribute to national inventory development and further the initiatives towards national ratification of the Mercury Treaty. This activity includes data gained through in-field interviews with major stakeholders in the manufacturing, industrial, health and commercial sectors as well as desktop analysis of available literature. The result is a detailed and insightful account of the major sources of mercury releases in Bangladesh and quantification estimates for many of those sectors where data was available through interviews, databases and existing literature. This IMEAP project is relevant to Articles 4, 5, 8, 9, 11, 16, 17, 18 and 19 of the Mercury Treaty.





MERCURY COUNTRY SITUATION REPORT

Study on assessing country situation of Mercury sources, uses and emission in Bangladesh



Acknowledgment

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

Sincere thanks go to the IMEAP for providing funding support. We express our gratitude to IPEN for its counsel and guidance in the writing and review of this document.

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Section A

INTRODUCTION

ESDO has conducted the study to identify mercury sources and products containing mercury to support proposed guidelines and national policy formulation since 2012. ESDO believes that there is an emerging need to compile and streamline the information on mercury usage in various products in Bangladesh to help government to advance the ratification and implementation of the Minamata Convention. Moreover, it will also help to raise awareness in Bangladesh and in the region.

Before conducting the study, ESDO has identified all the sources of mercury emissions, processes, concepts and techniques regarding data gathering and analysis. For determining the released sources based on locally available information and data including the IPEN guide “AN NGO INTRODUCTION TO MERCURY POLLUTION AND THE MINAMATA CONVENTION ON MERCURY” ESDO decided to focus the survey work for primary data on selected sources including:

- Industrial Sector
- Health sector (hospital, health care, and clinic) for mercury contained in products (thermometer and amalgam filling)
- Consumer products (Beauty, baby products, jewellery)
- Electronic and Electrical equipment (batteries; switches, relays, fluorescent lamps, bulbs)

Besides undertaking field surveys for primary data production, the ESDO had undertaken a desk study on the possible sources of mercury releases including:

- Energy/fuel sources
- Primary metal production
- Statistics of relevant companies
- Waste incineration (industrial and medical waste)

Major source categories and subcategories of mercury release are listed in following table. The table also shows the possible mercury sources existing in Bangladesh. Due to limitations in data availability and constraints of time and budget, it has not been possible to quantify all mercury release sources present in Bangladesh. However the table shows those sources that have been identified as part of this study.

Table 1: Classification of known and possible sources of mercury release

No.	Categories and sub-categories of mercury release courses	Sources
	Possible/Tentative Sources	
1	Manufacturing/ Industrial Process	
1.1	Coal fired power plants and industrial boilers	✓
1.2	Natural gas – extraction, refining and use	✓
2	Primary metal production	
2.1	Gold and silver extraction with mercury amalgamation processes	✓
2.2	Aluminum extraction and initial processing	✓
2.3	Non-Ferrous metals – extraction and processing	✓
	Existing Sources	
3	Production of minerals and materials with mercury impurities	
3.1	Cement production	✓
3.2	Chloral-alkali production	✓
3.2	Pulp and paper production	✓
3.3	Iron and Steel production	✓
4	Intentional use of mercury in industrial processes	
4.1	Chloral-alkali production with mercury-technology	✓
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	Cosmetics and related beauty, baby products with mercury	✓
5.6	Jewellery	✓
5.7	Thermostats	
5.8	Antiques (Clocks, Mirror)	✓
5.9	Paint	✓
6	Other product/process use	
6.1	Dental mercury-amalgam fillings	✓
6.2	Sphygmomanometers	✓
6.4	Laboratory chemicals and equipment with mercury	✓
6.5	Mercury metal use in herbal/ayurvedic medicine	✓
7	Waste incineration and disposal	
7.1	Incineration of municipal/general waste	✓
7.2	Incineration of hazardous waste	✓
7.3	Incineration of medical waste	✓
7.4	Sewage sludge incineration	✓
7.5	Informal waste incineration	✓
7.6	Open dumping/burning	✓

The mercury treaty clearly identifies the products that contain mercury. Many are scheduled for phase-down and phase-out and some are exempted. With the guidance of the Mercury treaty ESDO can provide decisive role in raising

awareness about the hazards of mercury added products and the benefits of mercury free products, thereby breaking down cultural, political and economic barriers to acceptance of alternatives in Bangladesh. It can be done, under articles of the mercury treaty by;

- Taking action to ensure mercury-added products are rapidly phased-out
- Taking action on products subject to 'phase-out'
- Taking action on products subject to 'phase-down'
- Taking action on 'Exempted' and 'Proposed' mercury added products

Section B

B.1 Mercury in the Market

Usually mercury supply in Bangladesh occurs in three forms based on requirement of different industrial and manufacturing sectors. These are: encapsulated, liquid and compound forms.

However, in the market there are a variety of mercury containing products available to consumers as listed below:

- Thermometers, Sphygmomanometers
- Dental amalgam
- CFL light bulb
- Button cell batteries, electrical switches
- Thermostats
- Beauty Products (fairness cream, cosmetics), baby products
- Jewellery
- Measuring devices (barometer, hydrometer, manometers)
- Other electronic items (computer, laptop, mobile phones, scanner, printer etc.)
- Mercury in medicine, herbal/ayurvedic medicine vaccine
- Metal toys
- Thermometers with mercury
- Electrical switches and relays with mercury
- Light sources with mercury
- Batteries with mercury
- Cosmetics and related beauty, baby products with mercury
- Jewellery
- Other product/process use
- Laboratory chemicals and equipment with mercury
- Paints
- Antiques (Clock, Mirror)

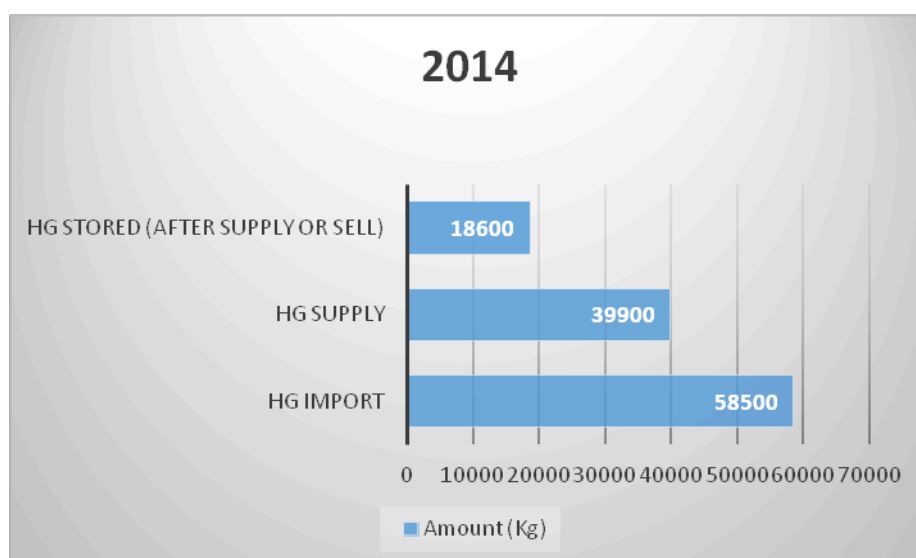
B.2 Mercury Import and export

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:**

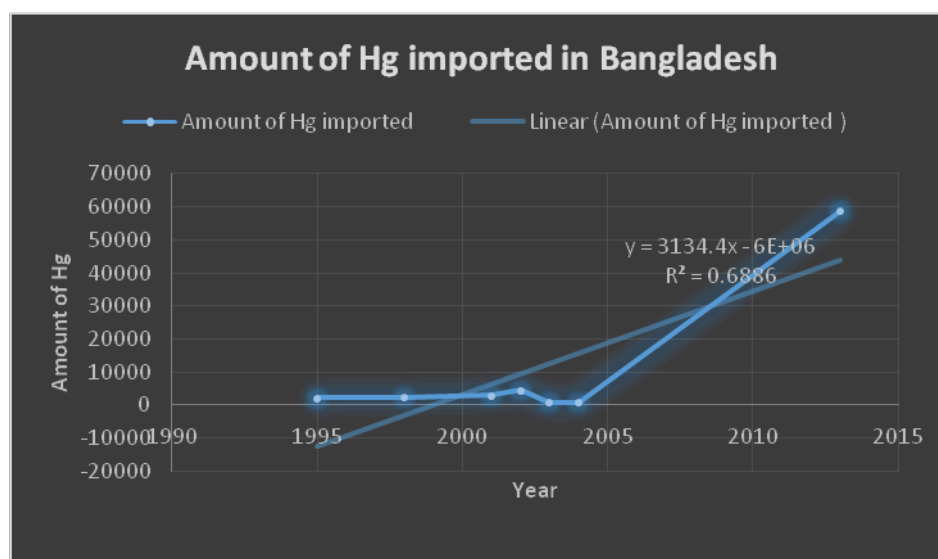
Figure 1: Mercury supply and import in 2014



- 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 2: Graphical representation of amount of Mercury imported in Bangladesh up to 2014



Besides 2014 information, 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 Apr 2006)

Section C

C.1 Mercury Exposure

Mercury has been used in a vast range of products over the years. The major sources of mercury exposure in Bangladesh are the;

- Industrial Sector
- Health care sector
- Energy Sector
- Electrical Sector
- Mercury added products
- Manufacturing processes using mercury/mercury compound
- Personal beauty care products
- Jewelry Sector
- Waste deposition / land-filling and waste water treatment

C.2 Human Sources of Mercury pollution:

Human activities that release mercury into the environment varies from a wide range of industrial to smaller-scale production sectors. These includes a variety of activities:

- Mercury release during the manufacturing/ industrial Process
 - Extraction and use of fuels/energy sources
 - Chlor Alkali production
 - Cement production

- Paper and pulp production
 - Battery, CFL bulb Industry
 - Manufacturing of gold jewelry
 - Primary metal production
 - Production of other minerals and materials with mercury impurities
- Release during improper production, import, trade and use of consumer products. Like, mercury in Health care sector, Electrical and electronic equipment, beauty products (cream, soap, cosmetics, ayurvedic and herbal products), jewelry, children products (toys etc.).
 - Release due to breakage during use (e.g., fluorescent lamps and glass thermometers and other measuring devices).
 - Inappropriate disposal of mercury containing (if any) municipal waste, medical waste or open dumping/burning

C.3 ASGM:

There is no significant Artisanal and Small Scale Gold Mining in Bangladesh.

C.4 Levels of Mercury Exposure:

Based on information and data gathered from the survey and desk study, the estimated amount of mercury use and release in Bangladesh will be discussed by each category set under UNEP Toolkit summarized under the following sectors.

In Bangladesh, the major contributor of mercury emission to atmosphere in the near future will be coal burning in power plants. Apart from this, mineral oils, natural gas, fossil fuel extraction are also some of the tentative sources of mercury emission to the atmosphere.

C.4.1 Mercury Exposure from Electrical and Energy Sector

Possible mercury by-product emissions from anthropogenic sources in Bangladesh (in kg) was estimated using the default Input factors of UNEP tool-kit inventory for mercury emissions², details are given in the following table:

² Toolkit for Identification and Quantification of Mercury Releases; United Nations Environment Programme, 2013

Table 2. 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

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

C.4.2 Mercury Exposure from Industrial Sector

➤ C.4.2.1 Production of materials with mercury impurities

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 3 Production and Actual Consumption of Cement p/a

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%

Gypsum= 0-5%

Other (Slag, Lime Stone, Slage) = 6-20%

In Bangladesh, eight companies have clinker and cement manufacturing facilities³. 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

³Bangladesh Cement Traders' Association (BCTA)

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 globally⁴

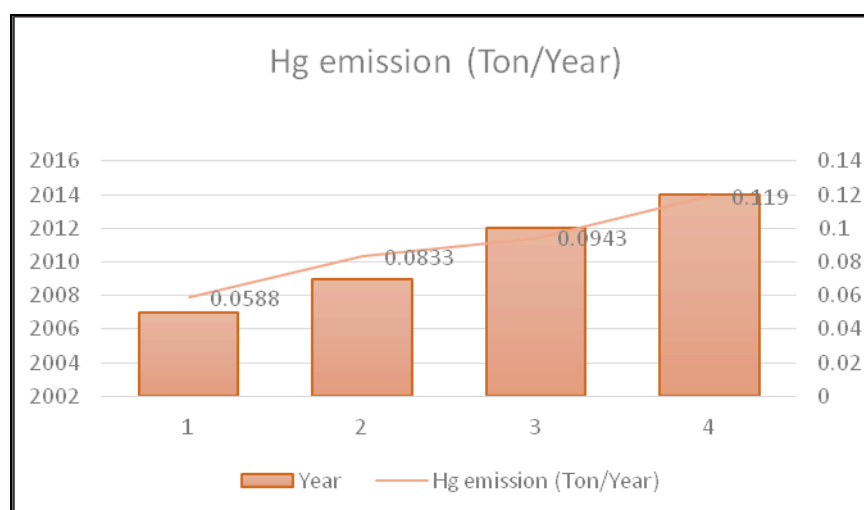
Considering the average mercury released into air and land from one factory is 0.0035 g/MT, this means that the total amount of mercury release from one industry is 0.01705 MT per year. On the basis of consideration that 0.01705 MT mercury release from one industry, it can be estimated that release of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

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

Trend of Hg emissions from the surveyed industries

The survey revealed that Hg emissions from cement industries are increasing significantly during last five years. The survey found that in 2014 releases of Hg from 7 cement industries was 0.119 Tons which is very much higher compared to release in 2012 (0.0943 MT), 2009 (0.0833 MT), 2007 (0.0588 MT).

Figure 3. Trend of Hg emission from the surveyed cement industries



⁴ <http://www.wbcsdcement.org/pdf/MercuryReport.pdf>

Table 4. Mercury Emissions from the surveyed seven industries

Year	Hg emissions (MT/Year)
2007	0.0588
2009	0.0833
2012	0.0943
2014	0.119

➤ **C.4.2.2 Intentional use of mercury in industrial processes**

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

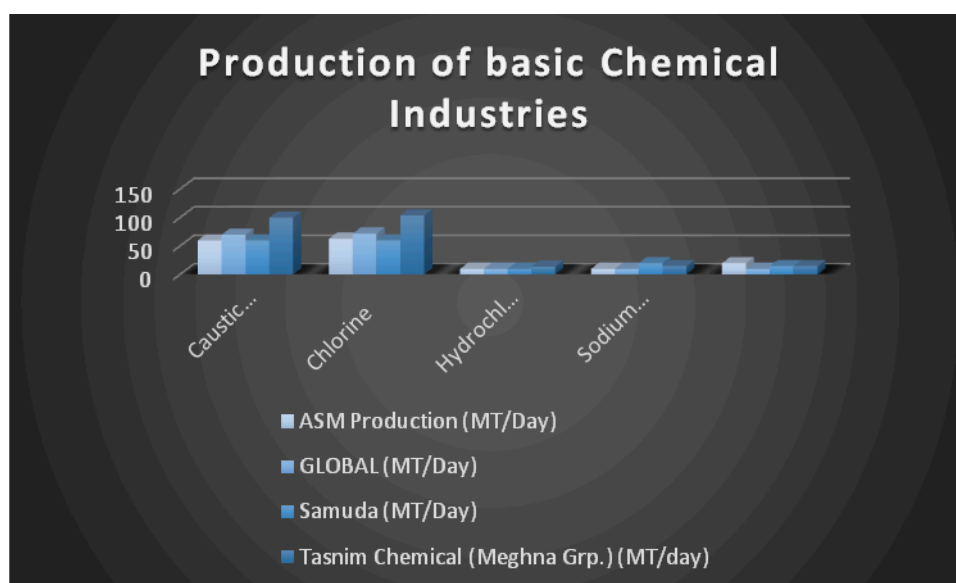


Table 5: Market Demand and Comparative Study of Different Basic Chemical Industries (reported from the survey)

Product name	ASM Production (MT/Day)	GLOBAL (MT/Day)	Samuda (MT/Day)	Tasnim Chemical (MeghnaGrp.) (MT/day)	Total Production from 4 industry (MT/Year)
1.Caustic Soda (NaOH)	60-100	70	60	100	87,000
2.Chlorine	63	72	60	104	89,700
3.Hydrochloride Acid (32% HCL)	10	10	10	14	24,000
4.Sodium Hypochlorite (Naocl)	10	10	20	15	16,500
5.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
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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.

C.4.3 Mercury Exposure from Health Care Sector

Mercury use in medical apparatus and products are 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 the number of functional beds (in MOHFW and registered private hospitals) are 91,106⁵ 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 landfill 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; it may ultimately end up back on our dining table.

⁵http://hpnconsortium.org/admin/essential/HB_2013_final_-_Full_version_1March14.pdf

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 Bangladesh⁶

Table 6: Mercury containing medical devices in healthcare sector in Bangladesh

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

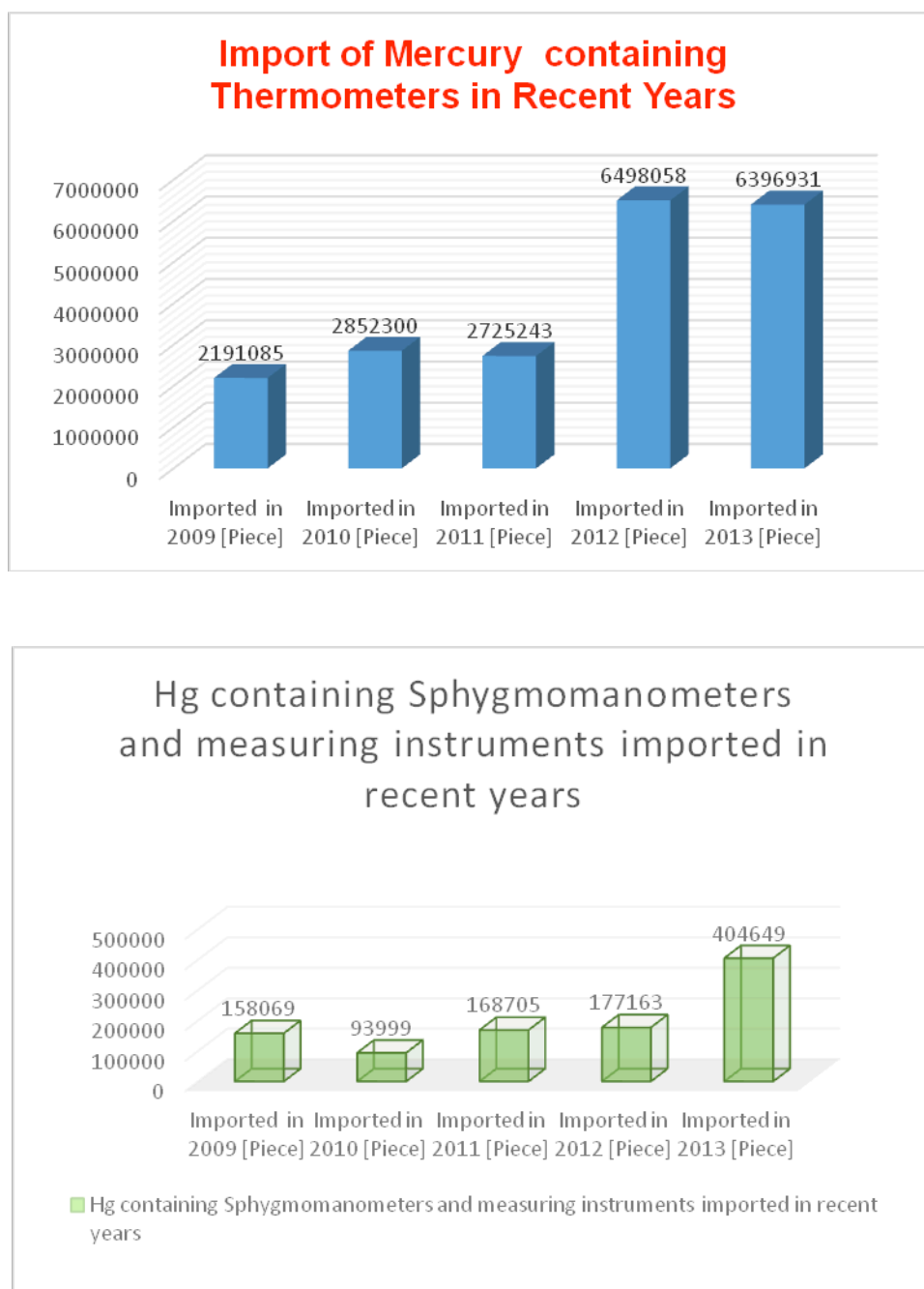
Table 7: Thermometers and Sphygmomanometers imported in Bangladesh in 2013-2014⁷

Product Label	Imported in 2009 [Piece]	Imported in 2010 [Piece]	Imported in 2011 [Piece]	Imported in 2012 [Piece]	Imported in 2013 [Piece]
Thermometers	2191085	2852300	2725243	6498058	6396931
Sphygmomanometers and instruments for measuring the flow/level/pressure of liquid/gas	158069	93999	168705	177163	404649

⁶ Situation of Mercury Sources and Hotspots in Bangladesh, June, 2012. ESDO

⁷ Source: Annual Report of Ministry of Commerce, 2013-2014

Figure 5. Import of Hg containing thermometers and Sphygmomanometers in Bangladesh



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). The total number of thermometers and sphygmomanometers used in each healthcare setting was recorded. Import and supply of these mercury

containing devices was also noted. Moreover, secondary information was collected from a literature review (this included books, magazines, govt. reports, Ministry of health and family welfare data, journals, internet searches). The collected data was analyzed using MS Excel.

Table 8: List of Govt. and private medical college, hospital, clinic, surveyed during the study in Dhaka city

Name of the city corporation	Gov. 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 actual number of thermometers and sphygmomanometer were identified and are listed below;

Table 9: Number of thermometers and sphygmomanometers recorded during the study in Dhaka city

Facility/Instrument	Gov. Hospital & Medical College	Private Hospitals & clinics	Private diagnostic centers
Thermometers	654	150	10
sphygmomanometers	160	62	5

Table 10: Estimated number of thermometers, sphygmomanometers based on the calculation of medical devices for hospitals and clinics;

Facility	Total No. of thermometers	Total No. of sphygmomanometer
Gov. Hospitals & Medical 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, health care institutions from union to capital level used an estimated 887,472 of thermometers per year and ratio of the broken thermometers is about 37.8% or 552007 units per year. The estimated number of sphygmomanometers used per year is 305926 and ratio of the broken sphygmomanometers is about 10% or 275,333 units. According to the survey/study and expert opinion, one fever thermometer contains 0.5g – 2.0g mercury and sphygmomanometers contain 80-160g mercury. So, annual mercury storage in thermometers are estimated at 1109.34 Kg or 1.2 MT and sphygmomanometers are 3671.1kg or 3.67 MT.

Table 11: Estimation of mercury emission per year based on survey data and calculation

Devices	Total no. of usage	Total no. of break up	Total amount of Mercury emission (in g)	Total amount of Mercury emission (in MT)
Thermometer	887472	552007.6	690009.5	0.69001
Sphygmomanometers	305926	275333.4	3304008	3.304008

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

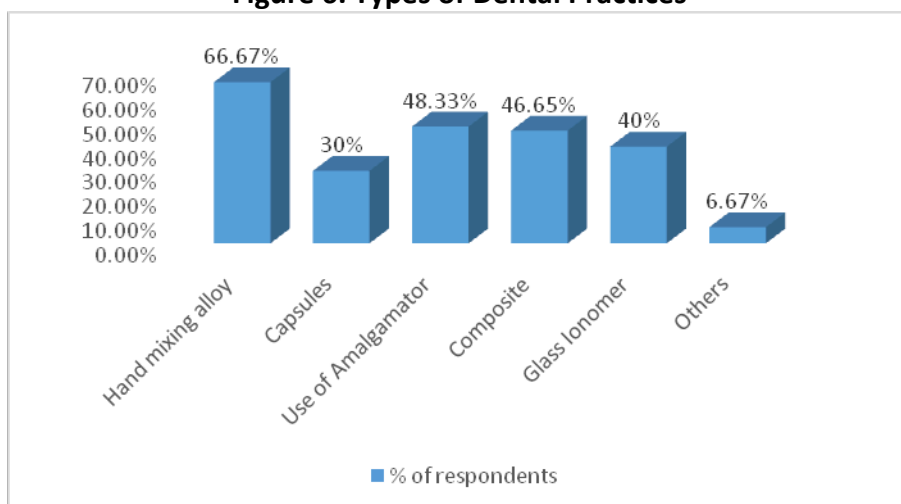
Mercury emission from thermometer breakage is 0.69 tons
Mercury emission from sphygmomanometer breakage is 3.3 tons

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. The survey was intended to assess their occupational exposure to mercury from day to day use of mercury based dental fillings and removal as well as lack of any proper waste handling process.

The major findings of the survey have been classified and discussed under relevant headings. 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%).

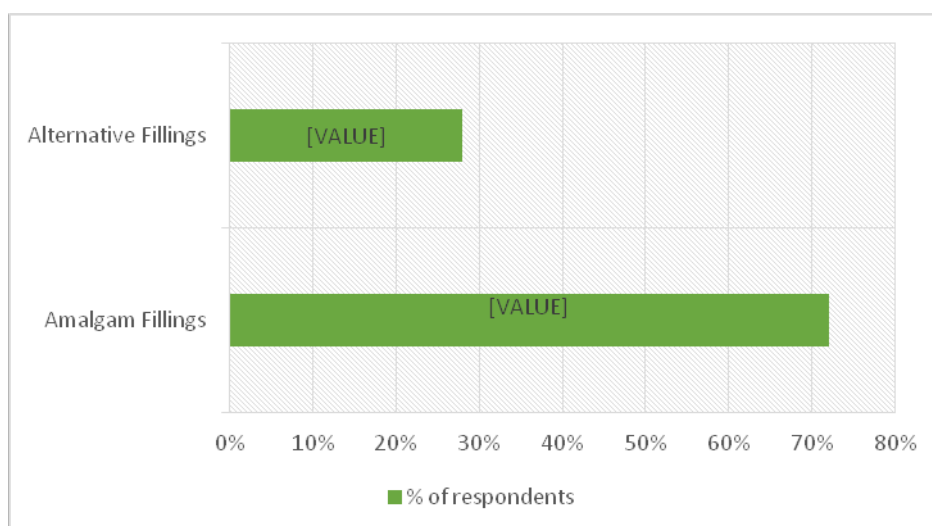
Figure 6. Types of Dental Practices



Dental Practices	% of respondents	
Hand mixing alloy	66.67%	40
Amalgam Capsules	30%	18
Use of Amalgamator	48.33%	29
Composite	46.65%	28
Glass Ionomer	40%	24
Others	6.67%	4

Amalgam Restorations Performed Per Year

Figure 7. Types of restorations performed



Type of restorations performed

According do the survey it was found that approximately 72% of dentists performed amalgam fillings and the rest (28%) performed other fillings. Out of

60 respondents 43 respondents performed 8350 amalgam restorations per month. If it is consider yearly basis, then number of restorations performed are 100,200.

Mercury content and emissions 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 capsules, trituration placement and condensation of amalgam, polishing and removal of amalgam, and vaporization of mercury from contaminated instruments.

If it is considered, that a person with amalgam dental fillings absorbs, on average, between 3 and 17 micrograms of mercury vapor into his or her blood each day and so then in one year it is between 1095 mg and 6205 mg. Considering this amount it can be calculated that 1.09 MT to 6.22 MT of 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 emitted from mercury amalgam fillings
--

C.4.4 Mercury Exposure from Electrical Sector

The study shows that metallic and inorganic mercury are released into the environment from the breakage of CFL light bulbs and batteries.

Electrical and electronic items are predominantly imported in Bangladesh and this sector is one of the growing sectors in Bangladesh and it is highly likely there will be an increased demand and supply of electrical and electronic items containing mercury. Considering the energy efficiency and longer life of mercury containing bulbs, lamps and the variety of switches that are in abundant use in Bangladesh. This equipment is locally produced as well as imported from outside however, an authentic inventory of such items remains non-existent in the country.

Generally among the variety of mercury containing items, compact florescent light bulbs (CFL), batteries, switches and mercury-containing electrical items are predominantly used 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

CFL Light Bulbs

In an energy deficient country like Bangladesh, people are encouraged to use low-energy bulbs or compact fluorescent lamps (CFL) that consume less electricity. There has 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 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.

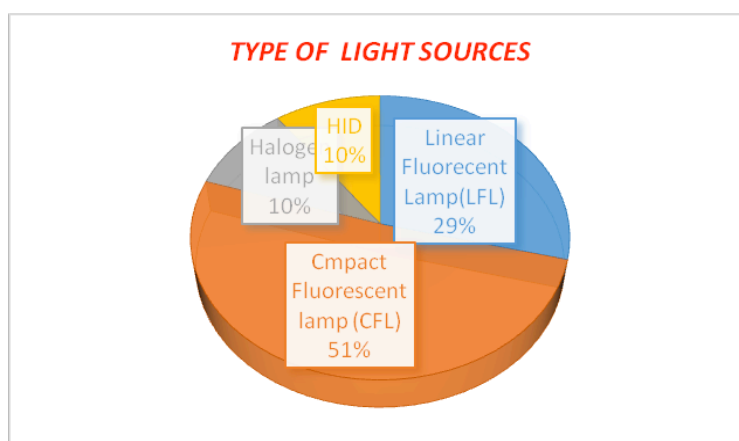
However, certain environmental and public health concerns have been raised in relation to the use and disposal of CFLs because the bulbs contain mercury, which poses a serious risk to health and safety. In a report by the European Commission (EC), children and babies in the womb are the most vulnerable 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 are ending 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 stakes people’s health at great risk, as CFLs must be disposed of safely to avoid contamination and poisoning.

ESDO surveyed on a random sampling basis 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 electrical equipment markets of Dhaka city.

According to the survey, among 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



In addition we conducted random sampling at different CFL bulb manufacturing companies for a questionnaire survey and data collection. All of these companies produce a variety of lighting products namely, GLS, CFL, LED and Tubes etc. The companies were Superstar, Philips, and Transtec. The study design is descriptive in nature. So, specific information and some personal information has been collected from the retailers, wholesalers, employers, importers and consumers also.

According to an expert opinion, total production of CFL light bulbs in Bangladesh usually increased 35% 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 bulbs are usually dumped into the waste bin as rejected bulb or due to breakage every year from the companies. During the manufacturing phase.

ESDO conducted a field survey with three companies associated with production of mercury containing CFL bulbs and an online survey stated the production quantity per year as below:

Name of the companies	Yearly production/unit		Yearly generated waste/unit	Mercury emission 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	4 910,750	6,629,512	4 616 104.8	78,752,388.8 mg Or, 0.079 MT
Energy Pac	2 460,375	3 321,506	11,169,752.4	
Transcom	3 200,000	4 320,000	3 008 000	
Other companies (remain nine companies)	993,600	1 242,000	894 240	
Total	11,564,725	15,513,018	19,688,097.2	

[Calculation is based on data collection and online information⁸]

A 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 uses 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. So, 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 emission during land filling(1 CFL light bulb contain 3-5 mg Hg)
Household Sector	3 679 532	11 038 596	8 278 947-11 038 596	39 390 939 mg
Industrial Sector	35 993	107 979	80 984.25-107 979	Or, 0.039 MT
Total		11,146,575	9 847 734.75	

According to the census 2014; there are 3 679 532 households in town and cities and 35 993 industrial establishment in Bangladesh.⁹

From the total process including data gathering and data analysis, calculation of mercury emissions in Bangladesh per year can be summarized like this; Mercury release from the CFL Bulb industrial sector is 0.079 MT per year and from consumer use is 0.039 MT. So, in total mercury emission from CFL light bulb is 0.118 MT per year.

Mercury emission from CFL light bulb is 0.118 MT

Apart from CFL light bulbs, a number of lamps are in market also containing mercury. Many of them are considered high-intensity discharge lamps (HID). These are¹⁰,

Name	Mercury quantity
Metal halide lamps	10 mg to 1,000 mg
Ceramic metal halide lamps	<10 mg to <50 mg

⁸ <http://archive.thedailystar.net/newDesign/news-details.php?nid=86641>

⁹ <http://203.112.218.65/WebTestApplication/userfiles/Image/National%20Reports/Union%20Statistics.pdf>

¹⁰ Ibid

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, lack of well-controlled recycling operations some factories that produce lamps release large quantities of mercury vapors to the indoor or outdoor air. Some 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 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).¹¹

¹¹ 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>.

Battery

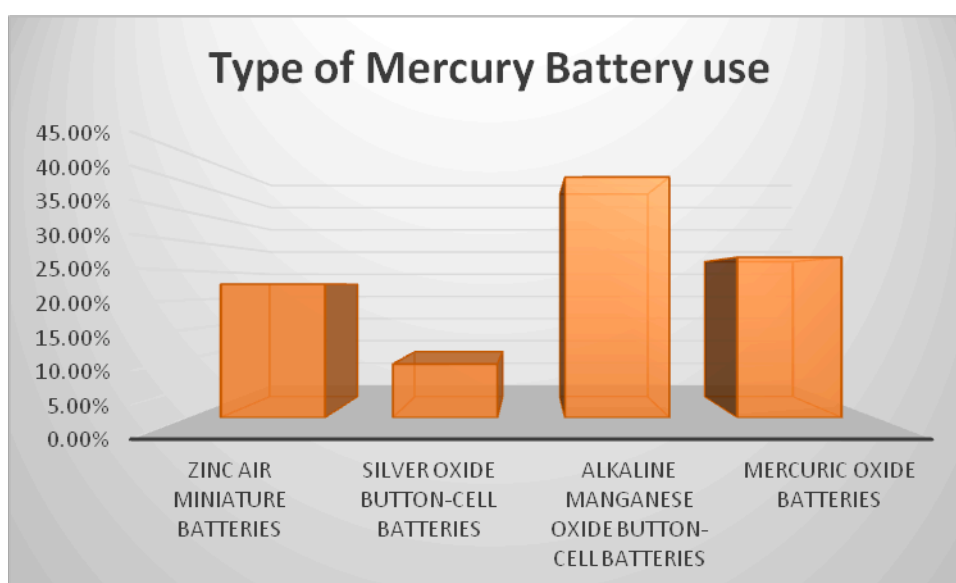
According to the report “Mercury Sources: Products and Hotspots in Bangladesh” prepared by ESDO in 2012, there are a variety of button-cell batteries that contain mercury, including zinc air, silver oxide, and alkaline manganese oxide batteries. Button-cell batteries are small, thin, energy cells that 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.

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 conducted with 90 different stores in different markets. According to the survey, among 90 retailers, 44 respondents (48.89%) that mercury containing batteries are used for hearing aids, watches, calculators, electronic cameras, toys, remote controls and other personal electronic items requiring a small battery in Bangladesh. Among 44 respondents 40.91% retail or supply Alkaline Manganese Oxide button-cell batteries, followed by Mercuric Oxide batteries (27.27%) and Zinc Air miniature batteries (22.72%) [Figure 2]

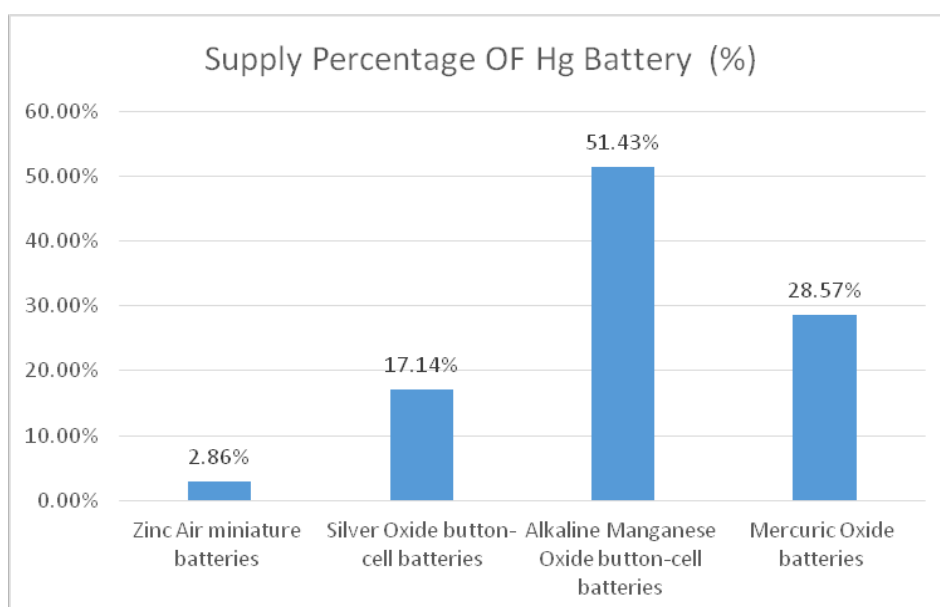
Figure 9. Types of Mercury Batteries use in Bangladesh



Gas can form in all of these types of 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.

At present Bangladesh has many battery industries mostly situated in Dhaka, Narayongonj, Chittagong. On the basis of random sampling ESDO selected 5 battery industries and conducted a questionnaire survey with 5 industries. All of these industries produce dry cell, automotive, motorcycle, and appliance batteries, Industrial (stationary, deep cycle, traction, VRLA) batteries, IPS and UPS batteries, and rectifiers. The industries are, Rahimafrooz Battery Ltd., Quasem Drycells Limited, Olympic Industries Limited, Navana Batteries Limited, Hamko Group.

Figure 10. Mercury Containing Batteries in Bangladesh



The survey was conducted among 90 battery retailers/suppliers. Out of 90 respondents 35 respondents indicated that 51.43% of the suppliers supply alkaline manganese oxide button-cell batteries followed by mercuric oxide batteries (28.57%).

The company's manufacturing plants produce a range of products – button cell, automotive, motorcycle, and appliance batteries, Industrial (stationary, deep cycle, traction, VRLA) batteries, IPS and UPS batteries, and rectifiers.

Among 5 companies 2 companies provided information regarding their production of button cell batteries. According to them annual production of the companies of button cell battery (besides other batteries) are 2 000 000 piece

per annum. So, in total 10 000 000 individual button cell batteries are usually produced from the 5 industries per annum. According to the industry 20% of production is usually dumped into the waste bin as rejects or spoiled batteries every year from the manufacturing companies. It is known that a button cell battery contains 0-25 mg of mercury, so, total mercury release from the companies per year is 50 000 000 mg or 50 Kg or 0.05 MT.

A Consumer Survey was also conducted in Dhaka, Chittagong, and Rajshahi region. 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, one 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. So, total release of mercury from the household and industrial sector can be estimated as follows;

Category	Number	No. of used Button Cell Batteries	Number of spoiled Button Cell Batteries sent to landfill/year	Mercury emission during land filling(1 button cell battery contain 0-25 mg Hg)
Household Sector	3 679 532	7 359 064	6 991 110.8	17 837 702 mg
Industrial Sector	3 5 993	71 986	143 970	Or, 0.0178 MT
Total		7 431 050	7 135 080.8	

According to the census 2014; there are 3 679 532 households in town and cities and 35 993 industrial establishments in Bangladesh.¹²

From the total process (including data gathering and data analysis) the calculation of mercury release in Bangladesh per year can be summarized like this; mercury release from Button Cell Battery companies are 0.05 MT per year and from consumer use is 0.0179 MT. So, in total mercury release from button cell batteries in Bangladesh is 0.068 MT per year.

<p>Mercury emission from button cell batteries in Bangladesh are 0.068 MT</p>
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¹²<http://203.112.218.65/WebTestApplication/userfiles/Image/National%20Reports/Union%20Statistics.pdf>

C.4.5 Waste Deposition/Land Filling and waste water treatment

There are no modern, engineered land fill in the province. However open land filling is available in every city. There are also 5 waste water treatment plants in Bangladesh.

Current waste generation in Bangladesh is around 22.4 million tonnes per year or 150 kg/cap/year.¹³ 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.¹⁴

Bangladesh has minimal waste collection coverage which forces the majority of the waste to be dumped in open lands. These wastes are not disposed of in an environmentally sound manner, where general waste is often mixed with hazardous wastes such as hospital waste.¹⁵ 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 is left uncollected. As much as 400 tons are dumped on the roadside and in open space.¹⁶

Categories	Waste generation	Input factor	Amount of mercury emission from waste
Waste deposition/land filling and waste water treatment	224 000 T/yr.	5 g Hg/T	1120 Kg/year
Waste water treatment	675 000 m ³ /yr.	2 mg Hg/m ³	1.350 Kg/year

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

People may be exposed to metallic mercury vapour if they come into contact with broken thermometers, fluorescent light bulbs, thermostats or barometers. Handling contaminated soil may also be a potential source of exposure to mercury. Occupational exposure to mercury can occur in a number of work places that use mercury, such as in factories, industries. Dentists may be exposed to metallic mercury vapour whilst making fillings.

¹³ ["Waste Atlas. \(2012\). Country Data: Bangladesh."](#)

¹⁴ 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

¹⁵ ["Enayetullah. I. \(2006\). Community Based Solid Waste Management Through Public-Private-Community Partnerships: Experience of Waste Concern in Bangladesh."](#)

¹⁶ ["Bhuiya. G. M. J. A \(2007\). 1. Bangladesh. Solid Waste Management: Issues and Challenges in Asia, pg 28-32."](#)

Mercury emission occurs through a variety of processes. However, there is no authentic data on mercury emission into air from these sectors in terms of country context. The ESDO study was able to figure out a tentative quantity of mercury is in use in above-mentioned sectors but rate / calculation of emission was not possible. ESDO collected all the information by using UNEP inventory methods and UNEP tool kits. All data were analysed using SPSS software and MS Excel.

Table 12. Tentative Quantity of mercury emission from different sectors

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

Table 13. Tentative quantity of mercury release from different sectors

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

C.5 Levels of Mercury Release

C.5.1 Jewellery Sector

Mercury containing chemicals are used during gold ornaments manufacture, and cleaning. People, who are involved in manufacturing process of gold ornaments, are directly exposed to mercury through inhalation. In the case of Bangladesh mercury containing bi-products are disposed of to adjacent land and water bodies and it not only contaminates adjacent water but it is circulated through other areas downstream. During the survey it was found that there are approximately 120 jewellery workshops in Bangladesh that use mercury during the alloy mixing process and re-collect the gold from the waste. It was estimated that approximately 40896 Kg or 4.1 MT mercury is used in Bangladesh in the gold jewellery production sector. Information was also found on white gold and gold-plated jewellery. The main raw material in white gold is mercury and it was estimated that annually 340.91 kg mercury-containing white gold jewellery is imported by per jewellery store from other countries (mainly from Italy).

C.5.2 Personal care Products

According to the report “Mercury Sources: Products and Hotspots in Bangladesh” prepared by ESDO in 2012, ESDO has collected 12 fairness beauty products (skin lightening creams etc) that have high consumer demand. 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 Hg concentrations in each product.

It is very alarming that all consumer fairness beauty products that ESDO has analyzed contains harmful mercury. The highest level of Hg recorded (4653 ppm) was in Garnier, on the other hand, the lowest (3361 ppm) in Shumons Aroma. Moreover, Hg 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. The rest of the fairness products contain Hg lower concentration but above 3000 ppm. It can be said from analysis that all products contain Hg 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

C.5.3 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 following¹⁷:

Table 14. 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

Mercury Use in Measuring Devices

Table 15. Total mercury containing devices import and sold in Bangladesh in 2014 based on survey data.

Total mercury containing devices import in Bangladesh in 2014				
Importers	Measuring Devices	Total Quantity of devices import	Total mercury contain in the devices (g)	Total mercury contain in the devices (Kg/MT)
Laboratories (2) Local Importers (20)	Barometers	66.25	33 787.5 g	62.526 Kg or 0.062526 MT
	Thermometers	978	26 650.5 g	
	Hydrometers	396	1 980	
	Psychrometers, Flow meters and other measuring devices	24	108 g	
			Total= 62 526 g	

During the survey of 20 local importers and 2 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 8 laboratories and approximately 50 local importers in Bangladesh. So, the

¹⁷ http://www.newmoa.org/prevention/mercury/imerc/factsheets/measuring_devices_2014.pdf

annual (2014) sold and imported mercury in measuring devices is total 0.6253 MT.

Measuring devices containing around 0.6253 MT of mercury are annually purchased by laboratories (Schools, Colleges, Universities, others) to be used with parts like mercury electrodes in voltammetry and metering devices for determining the softening point. These devices in general 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.

Table 16. 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 Hg 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 be refilled with mercury regularly and amount of mercury purchased for the instruments (electrodes and probes) were found to be in total 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

C.5.4 Switches

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

However, import of mercury containing switches are in an increasing trend. Electric switch vendor are exposed to mercury during handling of switches in case of break up. This broken/end-of-life electric equipment's are dumped in open places. Management of this equipment is not done properly due to lack of awareness of mercury hazards and non-compliance of strict 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 imports tilt switches (37.50%), some electrical switches (35%), some float switches and relays. According to the survey the details are given below in the table:

Table: Hg containing switches in Bangladesh

Types of Switches	% of Supply	Sale per month (in Pieces)	Mercury Content per unit	Use of Mercury in Switches per month
Tilt switches	37.50%	200-300	500 mg- 4 kg	12.5 kg- 1000 kg
Float switches	12.50%	150-240	100 mg- 67 kg	1.95 kg- 13,065 kg
Relays	18.75%	120-180	100 mg-40 kg	1.5 kg - 6000 kg
Electrical Switches	35%	300-350	up to 50 Kg	16,250 kg

So, from the calculation it was found that, 12.5 kg- 1000 kg Hg used in tilt switches per month; 1.95 kg- 13,065 kg Hg is used in the float switches per month; 1.5 kg - 6000 kg Hg is used in the relays per month; approximately 16,250 kg Hg is used in the electrical switches per month.

Section D

The main exposed population groups

The main exposed population groups are workers in the industries and other work places and consumers that are buying and using the mercury containing products. Particularly consumers are the major groups of mercury exposure because of the long term use of mercury containing products in day to day life.

List of the exposed population group are given below:

Exposed Group	Causes of Exposure
Worker handling elemental / lequed mercury in the supply chain	<input type="checkbox"/> Directly exposed to mercury emission and physical contact
Employers and workers in Industrial Sector	<input type="checkbox"/> Employers exposed to mercury emissions and wastes generated during the production of the mercury (whether

<ul style="list-style-type: none"> • Coal fired power plants • Chlor Alkali Production • Cement production • Gas field, oil production • Paper and Pulp Mill • Battery Industry • Electrical and electronics sector 	<p>mined, gas field, coal fired plants by- product, etc.) used in the product.</p> <ul style="list-style-type: none"> <input type="checkbox"/> Occupational exposure to mercury can occur in a number of work places that use mercury, such as in factories making electrical equipment or thermometers or chemical processing plants <input type="checkbox"/> During the product manufacturing phase (Like; jewellery, cement, chemical production) <input type="checkbox"/> Release through normal product use as in the use of cosmetics containing mercury. <input type="checkbox"/> Release due to breakage in the waste stream or through dumping. <input type="checkbox"/> Release due to breakage during use.
<p>Dentist , Technician and students in Dental Sector</p> <ul style="list-style-type: none"> • Health Professional • Patients • Hospital/ Chamber workers • Interns/students in medical colleges or chambers • Technicians • Lab technicians 	<ul style="list-style-type: none"> <input type="checkbox"/> Dentists may be exposed to and inhaled metallic mercury vapor while making fillings. <input type="checkbox"/> Occupational exposure during the handling, breakage of mercury containing devices and instruments. <input type="checkbox"/> Release of uncontrolled mercury vapor in the workplaces during the use and management of mercury chemicals, liquids, wastes in laboratories and research places.
<p>Consumers of mercury added products, like,</p> <ul style="list-style-type: none"> • Electrical products (Batteries; switches, CFL light Bulbs) • Beauty products • Jewelry • Children products (toys etc.) • Household products etc. 	<ul style="list-style-type: none"> <input type="checkbox"/> Major group of exposed pollution <input type="checkbox"/> All products ultimately reach consumers for their intended use and eventual disposal. Some products create exposure during use, like as beauty products, jewellery , children's products and others can exposed through damaged or destroyed products and at the end of life as waste.
<p>Employers and workers in waste handling and informal management sector</p> <ul style="list-style-type: none"> • Waste Pickers • Informal -formal recycling workers 	<ul style="list-style-type: none"> <input type="checkbox"/> Handling contaminated wastes, sewage sludge, and by-product may also be a potential source of exposure to mercury <input type="checkbox"/> Release during the recycling process. <input type="checkbox"/> Releases associated with treatment and final disposal of

	<p>mercury waste (whether through burial or reuse of waste materials).</p> <p><input type="checkbox"/> Emission from burning wastes of thermometers, batteries or electrical switches, municipal wastewater and by-product of the manufacturing processes.</p>
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Section E

References of information sources

Primary information was collected from different sectors namely; health care, electronics and electrical equipment, battery industry, cement, chemical, and jewellery and beauty products and consumers based on targeted sampling. Secondary information was collected from online sources, key informant interviews, workshops with key stakeholders, expert opinion and data analysis. Name of the sources are:

1. ESDO (2012) "Mercury Sources: Products and Hotspots in Bangladesh".
2. UNEP (2013) Toolkit for Identification and Quantification of Mercury Releases, Guideline for Inventory Level 1, April 2013.
3. IPEN (2014), AN NGO INTRODUCTION TO MERCURY POLLUTION AND THE MINAMATA CONVENTION ON MERCURY, 2014.

Section F

Damage caused by Mercury:

Mercury (Hg), a potential contaminant of the environment is of global concern because of its toxic nature, transboundary movement and its ability of bioaccumulation.

- It is readily absorbed through skin and reaches the brain crossing over skin and blood brain barrier.
- It may be fatal if inhaled and harmful if absorbed through skin.
- It causes harmful effects to the nervous, digestive, respiratory, immune systems, kidneys and lung damage.
- Exposure to it may result in tremors, impaired vision and hearing, paralysis, insomnia, emotional instability.
- It also causes developmental deficits during pregnancy and childhood (WHO, 2005).
- A single drop of mercury is enough to cause contamination of a pond of 8 hectares resulting in mercury accumulation beyond the acceptable level for fish.

Section G

G.1 Laws currently regulating mercury:

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/nm ³

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.

G.2 Efforts to Deal with Mercury:

Though Bangladesh signed on the “Minamata Convention on Mercury” the government has not taken yet any effective action in terms of proposing guidelines and national policy formulation to reduce mercury exposure.

Recently, Department of Environment (DoE) had a meeting with ESDO team for drafting a regulation and frame under the mother law of constitution. Once the draft regulation will be finalized it will send to Ministry of Law to enact.

G.3 Storage:

There is no separate storage section for mercury and mercury compounds in our country right now.

Section H

Mercury wastes:

As mercury is an element and cannot be destroyed, mercury containing waste or sludge cannot be destroyed with disposal. Rather its continues to persist in environment. Majority users of mercury for relevant sectors, industries not aware of importance of proper disposal of mercury waste or mercury containing compound have no systematic disposal in place on a large scale in Bangladesh.

Our survey found that as per information by workers associated with the different sectors of mercury that they use burial pits, incinerators, landfilling, or dump into roadside drains/waterways or store, collect and move offsite. Some of them reported that they collect wastes into three color coded bins.

Bangladesh has a threshold value for mercury waste. 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,

Standards for Waste from Industrial units or Projects Waste

Parameter	Unit	Places for determination of Standards		
		Inland Surface water	Public sewerage system connected to treatment at second stage	Irrigated land
Mercury (Hg)	micro mho/cm	0.01	0.01	0.01

Section I

Ratification of the Mercury Treaty

Government 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. We belief this country situation report will foster this project.

Section J

Project Outcome

Literature Review

- Overview on journals, research papers, official website, online information
- Analysis of secondary information, existing international standard regulatory framework, media clipping, market study, case study around the world.
- Documentation on secondary information on mercury emissions and releases from industrial, health& dental care, beauty products manufacturing processes.

Baseline Survey on mercury containing products (production to uses) to assess the situation and its environmental impacts and products inventory

- Orientation of the project and volunteers for conducting the baseline survey
- Preparation of questionnaire for manufacturers, importers, retailers and general population
- Filed testing
- Contact with respective authority for permission and appointment
- Workshop and consultation sessions for opinion and recommendations.
- Conduction of Filed Survey
- Data input and analysis
- Develop of message and dissemination of information
- Development of Report.

Engagement of and impact on Target Groups:

A very good number of people actively participating with us in our ongoing activities and we will organize consultations, meetings with the target groups to engage them with the possible impacts like,

- ☐ Raising awareness and strategic approach for setting national objectives for minimizing mercury use and establishment of national or regional safe containment facilities for mercury contaminated waste.
- ☐ Setting agenda for government programs in favor of mercury free products.
- ☐ Encouraging government to promulgate laws, standards, and regulations that would prohibit or restrict import of mercury containing products.
- ☐ Support the development of mercury free dentistry curriculums in dental colleges and universities in Bangladesh to promote mercury free dental restorations.
- ☐ Encouraging municipalities to establish controlled disposal systems for mercury containing waste.

Impact on target policies:

The target policy is advancing on the ground efforts to implement the Minamata Convention and reduce global and local mercury pollution. Activities on the target policy are;

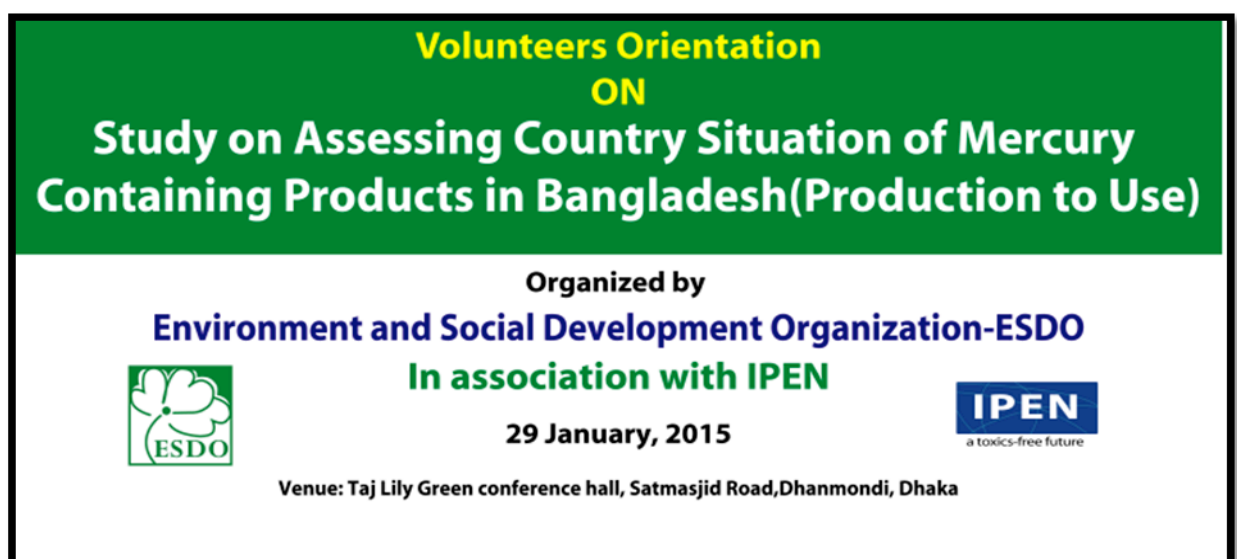
- ☐ Preparing reference for national policy formulation.
- ☐ Preparing reference for media advocacy and policy lobbying towards implementation of the Minamata Convention.
- ☐ Consultation with government wings to enact specific legislation.
- ☐ Promoting research and academic study
- ☐ Media and Public awareness campaign.

Outreach to Stakeholders:

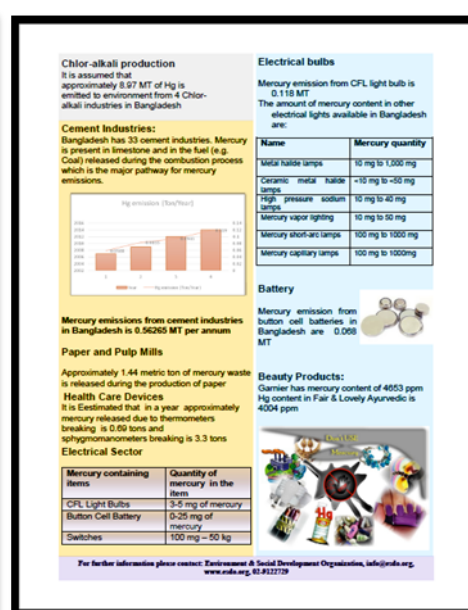
ESDO has formed key rapport /alliances with Government Ministries (MoC, MoH&FW, MoEF), government departments (DoE, BSTI), manufacturers, importers and buyers of different products and goods, dentists, cement and pharmaceuticals industries, agro-industries and coal based power plants. Moreover, they are positive about reduction of mercury from every possible source and they expressed assurance towards providing support and documents, reports or data. But awareness and proper regulations are necessary to encourage them.

Deliverables, outputs and/or products:

- a) A fact sheet on Mercury Containing Products- Uses and Impacts.
- b) Banner for the orientation of the volunteers for the field survey.
- c) Report on the “Mercury Country Situation Report”.



Banner



Factsheet

Communication Efforts:

- Press conference, one-on-one meetings with reporters, media personnel.
- Apart from these, ESDO has made use of social media and ESDO's website. ESDO uploaded the press release, news on Facebook, Twitter, green page and our official website.





Communication with National or Local Authorities:

- ESDO has conducted field surveys in different sectors where mercury is being in use to collect primary information. As well ESDO carried out informant interview with a few people those who are involved in the manufacturing trades where mercury is in use for production, collected expert opinion and information.
- Workshop and Stakeholder Consultation with professionals from government, academia, and health sectors, NGOs, Media
- Consultation with Department of Environment (DoE) on the current situation of mercury containing products in Bangladesh.



Figure 11. Project team orientation



Figure 12. Pictorial Diagram of field Testing and field survey

Section K

Mercury Treaty Focal Point:

Director General, Department of Environment (DoE), E/16, Agargaon, Sher- E -Bangla Nagar, E/16, Dhaka-1207, Bangladesh under the Ministry of Environment and Forest (MoEF) of Bangladesh Government.

E-mail: dg@doe.gov.bd

Tel: +880-2-8181800

Section L

Recommendations, from a public interest, NGO perspective, on reducing and eliminating human sources of mercury:

To prevent hazards from mercury pollution and contamination it is essential to plan immediate ratification of the Minamata Convention on Mercury and develop an implementation plan.

- Plan and political will towards step by step phasing out of mercury use ,
- Replacing mercury with alternatives in mercury containing products/ equipments,
- Increase public awareness on mercury hazards and
- Review of existing rules/ regulations in connection with mercury hazards. Need to ensure appropriate rules , regulation and guidelines are enforced as well as
- NGO GO collaboration for effective implementation of the convention
- Monitoring system in place.
- Prohibits the sale of mercury containing thermometers, thermostats, sphygmomanometers, switches and relays.
- Prohibits the sale of toys or novelty products containing mercury.
- All mercury-added consumer products sell must be labeled.
- Waste products containing mercury may not be incinerated.

Waste products containing mercury must be managed separately from other solid waste. It was found from study that there is no effective treatment facility in surveyed sectors due to absence of policy on Hg. Therefore, it is urgent need to review of policy for Hg use and disposal for reducing Hg pollution and hence to improve environmental conditions human health hazards.

Section M

Resources on mercury: Please list websites, databases, reports, academic researchers, laboratories, etc. that you are familiar with.

1. Annual Report of Ministry of Commerce, 2013-2014. <http://www.mincom.gov.bd/index.php>
2. BSEC, Ministry of Industry, 2014. <http://www.moind.gov.bd/>
3. "Mercury Sources: Products and Hotspots in Bangladesh", 2012.
4. Toolkit for Identification and Quantification of Mercury Releases, Guideline for Inventory Level 1, April 2013.
5. http://ipen.org/sites/default/files/documents/ipen-booklet-hg-update-v1_6-en-2-web.

6. Mahmood Hasan Khan, Director (AQM), Department of Environment (DoE)
7. Dr. Sultan Ahmed, Director, Department of Environment (DoE)
8. Dr. Md. Abul Hashem, President of Chemical Division, Bangladesh Standards and Testing Institution (BSTI)
9. Dr. Abu Jafar Mahmood, Retd. Professor of Chemistry Department, University of Dhaka
10. Dr. Jasim Uddin Ahmad, President , Bangladesh Chemical Society
11. Mr. Mizanur Rahman (Mesbah), President, Bangladesh Chemical Importers and Merchants Association
12. Mr. Abul Bashir Miah, Former Director, Bangladesh Chemical Industries Corporation
14. 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>
15. http://hpnconsortium.org/admin/essential/HB_2013_final__Full_version_1March14.pdf
16. <http://comtrade.un.org/>
17. <http://www.unep.org/chemicalsandwaste/Portals/9/Mercury/Documents/Publications/HgSupplyTradeDemandJM.pdf>