

Module 1

Mercury in Products and Wastes

Mercury in Products and Wastes

K E Y M E S S A G E S

- Due to its unique chemical properties, mercury has been used in a wide range of products over the years, but currently most of it is used in electrical and electronic devices, switches (including certain thermostats) and relays, measuring and control equipment, energy-efficient fluorescent light bulbs, batteries and dental amalgam.
- Smaller amounts of mercury are used in some laboratory equipment and in some cosmetics, pharmaceuticals, paints and jewelry.
- There are mercury-free alternatives to most products containing and processes using mercury and are now available in an increasing number of countries. Manufacturers, brand owners and retailers are encouraged to produce and sell mercury-free products.
- Mercury and mercury compounds cannot be destroyed, but only contained so that they do not circulate in the environment, endangering human beings and wildlife. When products containing mercury are discarded into the general waste stream, the mercury pollutes the environment – in waterways, wetlands, and the air – and endangers people both locally and globally.



W H Y I S T H I S I M P O R T A N T T O Y O U ?

Mercury is toxic. Being aware of the mercury content of products you currently use and in use around you is important to safeguarding your own health and that of your family.



W H A T C A N Y O U D O ?

✓ **For the Public**

- ✓ Seek out mercury-free products.
- ✓ Dispose of mercury-containing products separately, not with other trash.
- ✓ Do not dispose of mercury-containing products in trash that will be burned, since the mercury will vaporize and pollute the air.
- ✓ Bring the issue of the need for proper waste management to the attention of the leaders in your community and government authorities.

✓ **For Health Care Workers**

- ✓ Educate people about the risks of mercury poisoning, the mercury-containing products they use, and proper spill handling procedures.
- ✓ Assess blood or urine mercury levels in people you believe may have been exposed to excessive mercury.
- ✓ Module 4 for information on mercury use in health care settings.

✓ **For Governments**

- ✓ Promote public awareness about what products contain mercury.
- ✓ Encourage government agencies, institutions, hospitals, industry and retailers to choose and procure mercury-free products.
- ✓ Encourage municipalities to establish controlled disposal systems for mercury-containing waste. Establish national or regional safe containment facilities for mercury-contaminated waste.
- ✓ Regulate and monitor industries using mercury.
- ✓ Regulate the export/import of mercury and mercury-containing products.
- ✓ Take part in the UNEP Global Mercury Partnership. Go to www.chem.unep.ch/mercury/partnerships/new_partnership.htm for more information.

Mercury in Products

Where and why is mercury used in products and processes?

Mercury has been used in a vast range of products over the years. Mercury is a liquid at room temperature, and it expands and contracts very precisely in response to changes in temperature. These special properties have made it useful in a number of applications.

Mercury is very dense, and it maintains its volume in response to changes in atmospheric pressure. These properties make it useful in devices designed to measure temperature or pressure. In addition, there are a number of components (i.e., parts that perform a specific function in other products) that contain mercury, and these are used as switches and relays in electrical and electronic applications. Many of these devices contain 1000 mg or more of liquid mercury.

Many developed nations have prohibited the use of mercury in manufactured products. There has been a general shift of mercury product manufacturing operations (thermometers, batteries, e.g.) to developing nations, where there is often a lower level of awareness of the health and environmental benefits of shifting to mercury-free products and processes.

In certain parts of the world where women use cosmetic products, such as creams and soaps, that promise to lighten their skin, mercury is often put into these products as a common pharmacological compound (further information is provided specifically on this later in this module and in module 5).

What is the concern with mercury in products and processes?

When products containing mercury are discarded into the general waste stream, they often end up in the environment – in waterways, wetlands, roadside litter, landfills or open dumps, where they may be burned. The mercury they contain is ultimately released into the air, water, and soil.

Which products contain mercury?

Mercury is used in a number of products, including electrical and electronic devices, switches (including thermostats) and relays, measuring and control equipment, energy-efficient fluorescent light bulbs, batteries and dental amalgam and laboratory chemicals.

Below, there is a list of products known to contain mercury. They have been categorized as measuring and control devices, components and other products containing mercury, including batteries.

Measuring and Control Devices

- > Thermometers used to measure body temperature, environment temperature and certain industrial processes. Pyrometers that measure extremely high temperatures, such as in foundries.

- Certain thermostats to control temperature.
- Barometers and manometers used to measure pressure.
- Hygrometers to measure the moisture content of contained air or gas; psychrometers to measure outdoor humidity.
- Hydrometers to measure density or specific gravity of a liquid.
- Flow meters to measure the flow of gas, water, air and steam.
- Common medical devices, such as sphygmomanometers (which measure blood pressure), laboratory and patient-care thermometers and gastro-intestinal devices (see Module 4 for more detailed information).

Components

- Float and tilt switches are commonly used in automobiles, light switches, thermostats, irrigation pumps and certain industrial processes. Temperature and pressure switches are also employed in certain industrial processes.
- Relays rely on magnetic properties:
Displacement/plunger relays are used in high current, high voltage applications such as industrial process controllers, power supply switching, resistance heating, tungsten lighting, welding, high current/voltage lighting, flood lights, copiers, battery chargers, energy management systems and industrial ovens.
- Wetted reed relays are used in electronic devices for switching or signal routing, test, calibration and measurement applications.
- Mercury contact relays are used in certain electronic devices.
- Flame sensors or thermostat probes are sometimes used in gas appliances where mercury in the bulb of the sensor vapourizes and expands when the pilot light (flame) is on, causing the gas valve to open, and contract, closing the valve and stopping the flow of gas, when the flame goes out.

Other Products Containing Mercury

- Button cell batteries contain 0-25 mg of mercury (and sometimes more) and are often used in watches, hearing aids, calculators, toys and novelty items that light up or make noise. Other specialty batteries (especially mercury oxide or "mercury" batteries) use more than 25 mg of mercury and are often used in hospitals, military facilities and commercial applications.
- Lamps (long fluorescent, compact fluorescent, high-intensity discharge (HID), high-pressure sodium, metal halide, neon, mercury vapour) use mercury. 5-50 mg mercury as mercury vapour is used, which, when energized, emits ultraviolet energy. This generates visible light when it reacts with the phosphor coating on the inside of the lamp.
- In some countries mercury oxide is used in paints as a red pigment, and mercury is also sometimes used in paint as a fungicide, preservative and antimildew agent. Mercury continues to be used as a biocide in homes and industry (paints, glues, wood preservatives), leather industry (tanning solutions), agriculture (seed protectants) and in the wood pulp and paper industry.
- Certain cultural uses, such as jewellery or alloying of religious items such as

Parad in India (see Module 5).

- > Certain pharmaceuticals and soaps (as an antibacterial agent or antiseptic, covered later in this module), traditional medicines (see Module 4).
- > Dental amalgam, commonly referred to as “silver” fillings (see Module 4).
- > Mercury and compounds containing mercury are widely used in laboratory solutions, diagnostic reagents, catalysts, slide preparations and sample preservatives for conventional modern healthcare, veterinary medicine, schools and universities and industry.

How does the mercury in products get released?

Mercury in products can be released at various points in the product's lifecycle:

- > Emissions and wastes generated during the production of the mercury (whether mined, by-product, recycled, etc.) used in the product;
- > Emissions during the product manufacturing phase:
- > Release through normal product use, as in the case of dental amalgams, cosmetics containing mercury, etc.;
- > Release due to breakage during use (e.g., fluorescent lamps and glass thermometers);
- > Release due to breakage in the waste stream (e.g., fluorescent lamps) or through dumping;
- > Releases during the recycling process;
- > Releases associated with treatment and final disposal of mercury waste (whether through burial, incineration or reuse of waste materials (e.g., in cement).

How much mercury is released from products?

It is difficult to quantify the contributions from various sources. Much of the mercury used in products will eventually be released into the environment, either in dumps, open trash burning or when incinerated. In many parts of the world informal disposal allows toxins to enter the environment directly. Furthermore, even some of the mercury treated and disposed of under more controlled conditions, such as to designated landfills, may also be released to the environment over a longer period of time.

UNEP has posted a “Toolkit for identification and quantification of mercury releases” that is a great aid in the preparation of substance flow assessments for mercury. Releases from products via normal use, spills, breakage, scrap metal processing and disposal are generally expected to be significant sources of mercury releases.

What are the risks?

Occupational exposure risks are generally high for those who work in environments where mercury is used to manufacture products.

People are also exposed to elemental mercury when devices containing mercury

break. Mercury spills pose risks. The most common exposure routes are through inhalation or through contact with the skin.

Use of mercury products and devices can also affect the downstream environment. Waste containing mercury, including the remains of a cleaned-up spill, often ends up in aquatic environments and the atmosphere through improper disposal.

Are there alternatives to mercury in products?

There are commercially available mercury-free alternatives that can be purchased as substitutes for nearly all products containing mercury in an increasing number of countries.

Substitutions are generally cost-effective, and increasing demand will make them even more so over time. Furthermore, when considering the lifetime costs of the disposal of mercury-containing products, the cost-effectiveness of alternatives becomes even more convincing.

A useful starting resource is the 'Guide for Reducing Major Uses and Releases of Mercury' UNEP 2006. This document is available at the following web address: www.chem.unep.ch/mercury/Guidance-training-materials.htm

Lamps with mercury in them remain the standard for energy-efficient lamps. Industry efforts to reduce the amount of mercury in each lamp are on-going. As of July 2008, there were alternative lower-mercury lamps (3-5 mg of mercury instead of 20-40 mg). There are indications that economically feasible mercury-free alternatives will become available in the coming years.

What can governments do?

- > Substituting products without mercury for products containing mercury is one of the most powerful preventive measures for influencing the entire flow of mercury through the economy and environment. In some cases, the use of products with lower mercury content should be considered, or a system of separate collection of mercury products instituted– together with an awareness raising campaign to reduce mercury in the waste stream.
- > A national inventory of mercury in products can help governments target mercury-reduction efforts.
- > A government could regulate the manufacture, sale and/or trade of mercury in products. Sometimes a ban on mercury-containing products may not be politically or practically feasible (e.g., energy-efficient lamps) or implementation may not be well enforced.
- > Taxes imposed on products with mercury may be an effective effective way to

encourage a shift to alternatives. Labelling of mercury-containing products is another good way to raise awareness, improve proper handling and encourage use of alternatives. Product labelling has advantages and disadvantages, but has proven rather effective in combination with other measures. For example, in the case of consumer batteries, many consumers pay close attention to labels concerning the content of mercury and cadmium.

- > Government procurement officers have a tremendous opportunity to safeguard the environment by learning about alternatives to mercury-containing products that they purchase and seeking out mercury-free alternatives. A platform to share information interest to procure non-mercury alternatives is available at the following link: www.Informinc.org.

What about companies manufacturing, using and/or buying and selling these products?

General information for industries using mercury in their processes is included in Module 2: Mercury and Industry.

Companies that are selling mercury containing products should be aware of the mercury risks and share information about the alternatives to mercury containing products with their customers. Wherever possible, companies should aim to sell mercury-free products.

What are the barriers to adoption of mercury-free products?

There are often economic and social barriers to the adoption of new mercury-free products, for manufacturers, sellers and consumers. In most cases, the barriers can be overcome with the assistance of an appropriate government or local administration strategy or program of information and incentives.

Manufacturers may have concerns about the costs associated with changing their product or process:

- > Need for additional development and testing in order to ensure that the alternative product or component meets the necessary standards;
- > Concern that competitors may continue to produce and market mercury-containing products at a lower cost than the mercury-free alternative;
- > Knowledge of alternative techniques for producing mercury-free products;
- > International standards that require, or appear to require, the mercury-containing product;
- > Costs of packaging and marketing changes in the manufacturing process.

A switch to mercury-free alternatives for consumers can be made difficult by:

- > Lack of information and awareness of mercury's risks and the availability of alternatives;
- > Cost of replacement and/or higher cost of mercury-free alternatives;

- > Some mercury products are components embedded in other products, such as mercury-containing switches in electrical equipment;
- > Retailers' and consumers' lack of access to suppliers of mercury-free alternatives;
- > Scientific and medical labs may have significant barriers to change. Some of the present standards were developed around the use of certain mercury compounds, and they are sometimes considered necessary in order to reproduce reliably certain analyses. In addition, technicians tend to favour the procedures they know well and have long used.

Did you know that some skin care products contain mercury?

In certain parts of the world people, particularly women, use cosmetic products such as creams and soaps that promise to lighten the colour of their skin. Mercury is a common pharmacological compound used in skin lightening creams and soaps.

Regional Examples:

The use of skin lightening products in African nations is very common. Studies show that the percentages of women using such products regularly in Senegal, Mali, Togo, South Africa and Nigeria are 27%, 25%, 59%, 35%, 77%, respectively. Many women use these products for long periods, sometimes for as long as 20 years.

In 2004 more than one third (38%) of women surveyed in Hong Kong, Korea, Malaysia, the Philippines and Taiwan use skin lightening products, up from 34% in 2002. In a survey carried out in June 2004 61 percent of respondents in Hong Kong, Malaysia, the Philippines, South Korea and Taiwan said they felt they looked younger with a fair complexion.

What are the risks?

- > Mercury use in cosmetic products can have adverse effects including skin rashes (contact dermatitis and acne venenata), discolouring and scarring (post inflammatory dyschromia), and can reduce skin's resistance to bacterial and mycotic skin disorders.
- > Direct and prolonged exposure through the skin during repeated applications can cause damage to the brain, nervous system and kidneys.

What can you do?

- > The safest protection is to not use such products.
- > If you do use skin lightening products, only use those with labels that you understand and that do not contain mercury or mercury compounds. Check with local authorities to determine whether the labels are valid and correct.
- > Tell your family and friends about this problem and warn them.

What can governments do?

- > Skin care products known to contain mercury should be banned from manufacturing or import and removed from the market when found.
- > The health department should warn consumers about specific products known to contain mercury, by brand name and, if possible, with photographs of packaging.
- > Anyone using such a product should be advised to discontinue its use immediately and see a doctor for a medical evaluation.
- > The health department, healthcare organizations and consumer advocacy groups should jointly or separately educate consumers through consumer advisories in whatever media are most likely to reach the part of the population using skin lightening products (generally women).
- > Advisories should warn:
 - of the potential for mercury poisoning and the ramifications of continued use.
 - not to use skin lightening products containing mercury or any of its forms (quicksilver, cinnabaris (or mercury sulfide), calomel (or mercury chloride) or hydrargyri oxydum rubrum (or mercury oxide) and mercury iodide).
 - not to use products which do not list ingredients or whose ingredients are in a foreign language they cannot understand.

What are some examples of local government actions to protect consumers from these products?

The Indonesian Food and Drug Control Agency (BPOM) issued a warning in 2004 against 51 beauty care products containing mercury and a carcinogenic dye that were being imported. After surveying the population in all provinces, the BPOM found dozens more cosmetics containing dangerous chemicals, including mercury. Imports were not the only culprits, however. The police in Jakarta seized 200 boxes of cosmetic products containing mercury from a small manufacturing company in West Jakarta in January 2006.

The Kenya Bureau of Standards issued a public notice in the media in 1998-1999 to inform and educate consumers about the harmful effects of mercury, hydroquinone, and hormonal preparations and oxidizing agents contained in some cosmetic products available on the market. These products did not comply with approved standards and the products had been inappropriately used for skin lightening purposes. The prohibition/ban is aimed at protecting unsuspecting consumers and discourages dumping of these products in the Kenyan market. Products identified containing mercury and its compounds including: MOVATE, MEKAKO, JARIBU, TURA, ACURA, RICO, FAIR LADY, ELEGANCE, MIKI, JAMBO, PIMPLEX MEDICATED CREAM, NEW SHIRLEY MEDICATED CREAM.

In January 2005 the City of New York Department of Health and Mental Health issued a health alert recommending that New Yorkers immediately cease using all skin lightening creams and soaps that list mercury as an ingredient, as well as any

cosmetic products that do not have a list of ingredients on the label. At the time, the following products obtained from store shelves listed mercury among their ingredients: Miss Key Crema Blanqueadora, Santa Cream, Dermaline Skin Cream, Jabón Germicida (soap). These four products were all manufactured in the Dominican Republic, but the City of New York Health Alert notes that such skin lightening products are also manufactured in European, African and Asian countries.

The European Community Directive 76/768/EEU (and its amendments 2000/6/EU and 2000/11/EC) on the approximation of the laws of the member states relating to cosmetic products. This Directive stipulates that mercury and its compounds may not be present as ingredients in cosmetics, including soaps, lotions, shampoos, skin bleaching products, etc. (except for phenyl mercuric salts for conservation of eye make-up and products for removal of eye-make-up in concentrations not exceeding 0.007 percent weight to weight).

Waste disposal

Why is waste disposal an issue?

Inadequate or improper disposal of waste can result in the leakage of toxic material, such as mercury, into the environment where it endangers wildlife and humans. The way that the waste produced in the course of human activity is collected, handled, stored and disposed of can often negatively impact upon public health and the environment.

Issues of municipal solid waste management are of growing importance as more becomes known about the risks. Rapid population growth has overwhelmed the capacity of many municipal authorities to provide even the most basic waste management services.

What happens to the mercury in products that are disposed of?

When products containing mercury are disposed of and broken or burned and the mercury escapes from them, the mercury begins to circulate in the biosphere. Mercury can change forms, for instance from a liquid to gaseous form or from elemental mercury to methylmercury, but it cannot be decomposed, destroyed or broken down into less harmful forms because it is a natural element.

The mercury concentrations in the waste stream are directly dependent on the inputs of mercury to the waste, and will therefore likely vary greatly between different countries and circumstances. The mercury content in the general waste stream originates from three main groups of inputs of mercury:

- 1) intentionally used mercury in discarded products;
- 2) natural mercury impurities in high-volume materials (plastics, paper, etc.) and minerals; and,
- 3) mercury as a human-generated trace pollutant in high-volume (e.g., recycled) materials.

The mercury content of municipal solid waste will depend on the prevalence of mercury containing products in the waste, as well as the extent of specific collection systems for mercury containing waste products. Typical sources of mercury in municipal solid waste include, among others, batteries, discarded electrical equipment, fluorescent lamps, dental waste, paint residues, and so on. Depending on the life-time of the various products, the sources of mercury in the waste will reflect the use of mercury in different products a number of years before the mercury enters the waste stream.

Mercury released in a landfill may be exposed to the air and volatilize, or, unless the landfill is specially designed, may enter leachate and eventually reach the groundwater.

Municipal solid waste in many areas of the world is dumped in an uncontrolled manner, often into ravines or wetlands near residential areas or disposed of through open burning. Toxic releases and effluent enter ground water and bodies of water both nearby and downstream. In some places, periodic clearing of the wastes accumulated in open piles is accomplished with wheeled loaders and open trucks, which raise significant dust and aerosol exposure hazards. In other places waste is burned in the open, releasing toxic smoke.

The disposal of mercury and mercury-containing products is particularly problematic where waste is burned, as the mercury volatilizes and enters the air. Thus mercury should never be burned. Uncontrolled flue gases from waste incinerators, and open burning of waste releases mercury from mercury-added products into the air and falls back into our waterways and onto the land.

Volatilized gaseous mercury can be transported long distances in the air, but will eventually settle back to the earth. Mercury can also make its way into wastewater, particularly when mercury-containing laboratory chemicals, or products such as dental amalgam, are flushed down the drain, winding up in sewage sludge or passing along into the surface water system. When sludge is burned, the mercury is released to the air. If the sludge is spread on agricultural fields, the mercury escapes into the air, goes into soil and may be taken up by plants, or it may run off into surface waters, become methylated and be taken up by fish.

How should hazardous material in the waste stream be handled?

Hazardous material, which carries potential risks at all phases of handling and

disposal, should be identified and contained so that people who handle this waste will not be harmed, and hazardous materials, vapours and wastes will not enter the environment. Mercury is one example of such a waste. It is found in products discussed in this module and sometimes in waste resulting from cultural, medicinal or religious uses (see Modules 4 and 5).

The proper management of hazardous materials requires a combination of approaches involving technology, legislation, enforcement and funding. Developing a national or regional hazardous waste management system requires significant financial investment, both up-front and during operation. Up-front costs include site preparation, permitting, construction and equipment. Operating costs include labor, supplies, fuel for the machinery handling the waste, record keeping and reporting, and providing training and resources for employee safety and health. Even when a site is eventually closed, there are ongoing costs of monitoring and managing it, and meeting regulatory requirements.

Because of financial constraints, hazardous waste facilities have not yet been constructed in many countries, particularly in the developing world. Should there be insufficient resources to implement a full hazardous waste management process, priority should be given to the separation of hazardous and non-hazardous waste as well as proper storage of the hazardous waste.

In order to avoid or limit exposure due to mercury in wastes, various precautions should be taken:

- > Mercury containing products should be segregated from other waste before disposal;
- > If stored, the waste should be kept in closed containers in order to prevent any leaks or vaporization;
- > Mercury wastes may be recycled and the mercury recovered, as long as special precautions are taken that all mercury emissions from this process are below internationally agreed standards;
- > Very low concentrations of mercury in waste may be discarded to an approved landfill;
- > Other mercury wastes may be treated and then disposed of only in a special hazardous waste landfill, or in deep underground disposal;
- > Mercury-containing waste should never be burned or incinerated unless special flue gas controls are in place to capture the mercury.

What if mercury is spilled in the home or a public place?

Oftentimes elemental mercury is released in the home or in a healthcare facility when a mercury-added product or instrument is broken (e.g., fever thermometers, fluorescent bulbs, laboratory or medical instruments). When dropped, elemental mercury breaks into tiny beads that spread across the floor, and these can easily become trapped in small cracks. Elemental mercury does not readily absorb

through the skin, although it should not be handled, even with latex gloves. The primary health danger from a spill is the inhalation, over time, of vapour coming from mercury particles that are left scattered around a living area or workplace. Mercury spills are particularly hazardous in enclosed spaces, and especially to children, because mercury vapour is heavier than air and settles to the floor. It is therefore essential to manage mercury spills properly. Although mercury may look like small beads on the floor, it requires a special cleanup procedure so that the problem is not made worse.

Local health or waste management authorities should familiarize themselves with procedures for the clean-up of spills, and should work with the local authorities to publicize these instructions. Sample instructions are shown on the next page. Healthcare providers and the public ought also to have access to appropriate storage and disposal facilities for mercury-contaminated waste.



Guidelines for Managing a Small Mercury Spill **10 Steps to Manage a Mercury Spill - (e.g., a broken thermometer)**

- ❶ Remove people (particularly children) from the area of the spill.
- ❷ If there is mercury on shoes, take them off so they do not spread the mercury around. Do not allow children to help clean up. If a child spilled the mercury, assume their clothes are contaminated. Remove the clothes and put them in a sealed plastic bag.
- ❸ Open doors and windows to ventilate the living or working area. If possible, keep the temperature below 20°C to reduce the speed at which mercury volatilizes into the air.
- ❹ If there is broken glass, pick it up carefully using a glove. Put it into a sealable hard-sided container.
- ❺ Use cardboard or folded paper to make a small scoop to gather the mercury “beads.” DO NOT use a broom or a vacuum as these will merely spread the mercury around. Use adhesive tape, an eyedropper, or some shaving cream on a small paintbrush to pick up the smaller beads of mercury and seal them in a plastic container. Do this slowly and carefully so that the beads do not scatter.
- ❻ Use a flashlight to look for any additional mercury beads that may be sticking to the surface or in small cracked areas of the surface. Mercury can move surprising distances on hard-flat surfaces.

Other important considerations:

- ✦ Never pour mercury down a drain or put mercury-contaminated clothing in a washing machine. The mercury may get stuck in the plumbing and remain in the living or working space, slowly volatilizing. If discharged, it can pollute the local waterways.
- ✦ Keep windows open for a day to ventilate the area of the spill completely. Meanwhile keep people away from the area.
- ✦ Monitor anyone who may have been exposed for signs of exposure, such as tremors, pink disease or neurological symptoms. If you have concerns, consult a medical person. Doctors can identify exposure and health risks by measuring the amounts of mercury in blood, urine, breast, milk, fingernails and hair.
- ✦ Replace the broken device with a mercury-free alternative.

7 If the spill occurs on carpet or upholstery, cut out the affected area and seal it in a plastic bag.

8 If the mercury spills down the drain, take apart the plumbing and remove any mercury from “J” or “S” traps. If you leave it there, it will release toxic vapors into your living or working area.

9 If you have some, powdered sulfur makes the mercury easier to see and keeps it from volatilizing. If you sprinkle powdered sulfur in the spill area, and it turns brown, then there is mercury remaining. If you sprinkle it and it stays yellow, there is no mercury left. Remember that this sulfur will stain fabrics.

10 Dispose of contaminated clothing, carpeting, upholstery, etc., in sealed plastic bags and label them as hazardous waste. Place the bags outside and inaccessible to children and animals and ask the local authorities how to properly dispose of them. If there are no hazardous waste disposal options, dispose of the contaminated material in a way that minimizes exposures to people and the possibility that the mercury could be spread back into inhabited areas.

Source: This procedure has been adapted from the USEPA website
<http://www.epa.gov/mercury/disposal.htm>

What can governments do to reduce mercury exposure from the waste stream?

Governments can enact policies aimed at the reduction of mercury in the waste stream and can promote technical alternatives to the use of mercury in products. Both regulatory and technical measures may be considered.

REGULATORY MEASURES

Governments may choose to regulate the intentional use of mercury in products and processes as well regulate products containing mercury from being imported, marketed nationally and exported. For example, Sweden in 1993 banned or phased out the manufacture, import and sale of thermometers, barometers, manometers, tilt switches, float switches, pressure switches, thermostats, relays and other types of measuring instruments.

Regulations might be used to mandate and fund a mercury waste collection, management and storage programme whereby mercury waste is taken from hospitals, individual homes, industrial sites and elsewhere, and stored in a secure location (see surplus mercury management box). Mercury thermometer exchanges—where individuals exchange their mercury thermometers for digital devices—could form part of such a program.

Regulatory measures could include economic or financial incentives. For example, if all mercury-containing products are taxed because they embody potential hazards, then there will be some financial incentive to switch to mercury-free alternatives. If the proper disposal of hazardous wastes is expensive, it will encourage industries to decrease their generation of hazardous wastes. Funds generated from such measures could be used to promote the retirement and safe disposal of already-purchased mercury and mercury-containing products.

Governments could mandate an Extended Producer Responsibility for mercury containing products. Under Extended Producer Responsibility, manufacturers and/or importers of mercury-containing items would be charged advance fees that would be used to pay for spills and clean-ups, all of which would make mercury less economically desirable. Such schemes may also include product take-back policies, information and labeling requirements, and deposit / refund schemes.

Other potential regulatory measures are:

- > Require that any mercury contained in industrial process wastes be recovered.
- > Control the marketing and sale of recovered or recycled mercury.
- > Prohibit illegal dumping of wastes.
- > Require mercury-added products to be labeled and include information on proper disposal.
- > Require mercury-added products to be segregated in the waste stream and their mercury either recycled or disposed of as hazardous waste.

- > Put in place an environmental management strategy that includes responsible monitoring and enforcement of mercury regulations, tracking of all mercury movements (from raw material to process to product to waste), and periodic independent assessment.
- > Control and restrict cross-border transport of mercury and other hazardous wastes.
- > Require that any mercury containing waste or materials stored on-site by an industry or commercial operation must be in air-tight and waterproof containers, and that the organization must have complete records and a written plan and schedule for proper disposal of the materials.
- > Require industries manufacturing mercury products to prepare a mercury balance each year showing how much mercury entered the process and how much was emitted.
- > Require landfills to be licensed and equipped for the type of hazardous waste they accept.

TECHNICAL MEASURES

The Basel Convention on the Control of Transboundary Wastes and their Disposal has developed relevant technical guidelines on environmentally sound management of household waste that are a good starting point in addressing hazardous waste such as mercury. The following web-link provides a link to a number of Basel Convention technical waste guidelines:

www.basel.int/meetings/sbc/workdoc/techdocs.html

In general:

Put in place an environmental management strategy that includes responsible monitoring and enforcement of mercury regulations, tracking of all mercury movements (from raw material to process to product to waste), and periodic independent control.

Provide collection points where the public may easily take these separated products.

Pre-treatment measures for mercury waste may include prohibiting or limiting mercury releases to the environment by separating mercury and mercury-containing items from household waste, hazardous waste and medical waste.

Governments can play a role in assisting facilities to accept hazardous waste, such as installing membranes to prevent mercury from evaporating or leaching, collection and treatment of landfill effluent, routine and long-term testing of ground-water quality and air emissions for facilities.

Governments can consider a surplus mercury management facility designed

to prevent mercury release to the environment and exposure risks to humans where no final disposal facility exists nearby. There should be a well-ventilated, designated location for the storage of waste mercury collection drums. These steel drums must have liners and be placed on a concrete slab. Drums have to be protected from rainfall and be secured from theft and/or to protect against unauthorized opening. Broken and/or obsolete mercury medical devices may be placed in these drums along with mercury from clean-up operations (following facility mercury spill clean-up procedures). Such facilities should develop a waste mercury collection plan which includes procedures and outlines responsibilities. Before beginning there must be an established schedule for when the mercury will be removed for processing, proper management and disposal.

In addition, useful educational measures could include:

- > Educate the public about proper disposal of mercury containing products along with other hazardous waste.
- > Devise several key indicators and publicize the progress that is being made with regard to responsible management of mercury.

What about waste incineration?

Incineration is one of several centralized waste management approaches used throughout the world. A variety of categories of waste are incinerated, including municipal solid waste, medical waste, sewage sludge and hazardous waste. With its low boiling point, most of the mercury in wastes that are incinerated is thermally released during the combustion process, and will be emitted directly to the atmosphere and return to the earth through rain or dry deposition.

Medical waste is considered to be waste generated by a variety of medical and veterinary care facilities including hospitals, clinics, doctors' and dentists' offices, nursing homes, veterinary clinics, medical laboratories, and medical and veterinary schools and research units. Medical waste includes a great variety of disposable bandages, blood, pharmaceuticals and other materials and equipment used for the medical treatment of people or animals. To destroy viruses, bacteria, and pathogens effectively, this waste is often disposed of by incineration. Medical waste is sometimes incinerated in dedicated incinerators, and other times in selected municipal waste incinerators equipped for the purpose.

Available information indicates that medical waste incinerators can be significant sources of mercury emissions. The mercury content in the medical waste stream originates primarily from mercury in discarded products and chemicals, including thermometers, dental material with mercury amalgam, batteries, laboratory chemicals, pharmaceuticals, fluorescent lamps, high-intensity discharge lamps (mercury vapour, metal halide, and high-pressure sodium), special paper and film coatings, and pigments. Mercury sources ought to be separated from the waste

stream before incineration, if possible.

An issue of concern for both medical and municipal waste incinerators is the disposal of residual ash that may be high in mercury content, and the mercury that is captured by pollution control systems.

What can governments do regarding mercury released from incinerators?

Some emission control measures could include:

- > Require use of best available technology to reduce or prevent mercury releases
- > Ensure that mercury wastes are incinerated only at facilities equipped for hazardous waste, with best-available-technology (e.g., dust collectors and flue gas control).
- > Develop a facility (perhaps jointly with a neighbouring country) for final disposal or containment of mercury (and other) treated wastes that are so concentrated or hazardous over the long term that they cannot be responsibly disposed of in any other manner.
- > The existence of incineration emission legislation is a necessary step towards significant incineration emission controls. Alone, it is not sufficient to ensure compliance. A serious enforcement system must be in place as well where the authority not only has the power to enforce the relevant legislation adequately, but is also technically competent to understand the emission controls and measurement methods.

What are some other waste considerations for mercury?

Sewage Sludge

Much of the mercury in municipal wastewater (originating from various sources, but often dominated by dental amalgam wastes) ends up in sewage sludge. Sewage sludge is the product of any wastewater treatment processes, regardless of their origin (e.g., wastewater from municipal, agricultural or industrial activities) and is often incinerated or spread over land as a fertilizer. Knowledge of the mercury content in sewage sludge is important.

Hazardous Waste

The mercury content in the hazardous waste stream originates primarily from intentionally used mercury in discarded products and process waste. Some hazardous waste is incinerated as part of the treatment/disposal system. Hazardous waste refers to residues and wastes that contain hazardous materials in significant quantities. It is important to note that generally such waste with high concentrations of mercury should not be incinerated, and should preferably be sorted (if at all possible) and treated separately. Practically, however, this is not always possible. Therefore, when hazardous waste containing mercury must be incinerated, emissions controls should be in place as this could be a significant source of mercury releases.

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**CASE STUDY 5:
DENMARK MERCURY REDUCTION AND SUBSTITUTION IN PRODUCTS**

In recent years, the government of Denmark has determined to encourage substitutes for mercury products, including placing a ban on the sale and use of most mercury products. As in a number of other countries, a substantial decrease in mercury consumption for intentional uses has been observed. During the period 1983-1993 the annual consumption of mercury in intentional uses fell from about 16 metric tons in 1982/83 to 6 metric tons in 1992/93, and decreased further to 1.5 metric tons in 2000/2001. In the same period, releases to the environment declined from an estimated 6.9-9.9 metric tons in 1983, to 2.3-3.0 tons in 1993 (of which 0.3-0.8 tons originated from trace amounts of mercury in fuels and minerals). The deposits in controlled landfills have increased during the same period from 1.7-2.9 metric tons to 2.3-4.5 tons, most likely as a result of increased hazardous waste collection (reflecting the mercury content of used products, batteries, etc.) and improved filtering of waste incinerator emissions.

**CASE STUDY 6:
MASSACHUSETTS LOCAL AND REGIONAL EMISSION REDUCTIONS LEAD TO REDUCTIONS IN MERCURY LEVELS IN CERTAIN FISH**

In the northeast part of Massachusetts, an area where several waste incinerators operate that were large sources of mercury emissions in the 1990's, close to 100% of the tested bodies of water had fish with elevated mercury levels. Mercury deposition modeling performed in 1998 demonstrated that this northeast part of Massachusetts was a mercury deposition "hotspot," with the highest rate of mercury atmospheric deposition in the New England region (NESCAUM, 1998).

In order to address the environmental, public health and economic impacts attributable to mercury pollution, the New England Governors and Eastern Canadian Premiers adopted a regional bi-national "virtual elimination" goal for anthropogenic mercury and a Mercury Action Plan in 1998. Massachusetts adopted a statewide Zero Mercury Strategy in 2000. These comprehensive plans were based on scientific and policy assessments that delineated the scope of mercury's impacts and established regional and state inventories of mercury

sources. The plans established a long-range goal of virtually eliminating anthropogenic mercury pollution in the region and milestone reduction goals of 50% by 2003 and 75% by 2010.

Under these strategies, Massachusetts and the region as a whole have developed and are implementing some of the strongest programs to reduce mercury pollution and monitor environmental results in North America and perhaps the world. In Massachusetts programme elements include strict but achievable control requirements on the state's mercury sources. Regulations on trash incinerators, (Massachusetts and the region's largest source in 1998) took effect in 2000 and have reduced emissions from this category by more than 90%. Emissions from medical waste incinerators have been eliminated because health care facilities, facing stringent mercury and dioxin emission limits, shifted to alternative sterilization methods that do not emit significant amounts of mercury.

As a result of these and other comprehensive efforts, overall mercury emissions in Massachusetts have been reduced by about 70% statewide and by about 87% from sources located in the "hotspot" area noted previously. Emissions in many New England States are down by 60-70% and, regionally, by over 55%. Further reductions will occur as pending regulations (e.g., on coal burning utilities) are implemented.

Fish testing in the state has revealed substantial reductions of mercury levels in both of the freshwater species being evaluated. The most significant reductions were observed in the northeast part of Massachusetts; the "hotspot" area noted previously, where the largest reduction in mercury emissions has occurred. From 1999 through 2004 mercury concentrations in yellow perch from lakes in the "hotspot" area declined by an average of about 32%, and from lakes elsewhere in the state by about 15%. For largemouth bass the decline in the "hotspot" area averaged 24% and elsewhere in the state about 19%. These are encouraging results that suggest that local actions can result in relatively quick and significant improvements (<http://mass.gov/dep/toxics/stypes/hgtrend.doc>).

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Basel Convention web-site: <http://www.basel.int/>

Draft Wisconsin Mercury Sourcebook
<http://www.epa.gov/glnpo/bnsdocs/hgsbook/ed.pdf>

INFORM:

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