A guide for managing mercury waste at household and community level

A China MEP Project

Supported by

UNEP

Introduction

Minamata Town is a small fishing village along the shore of eastern part of Minamata Bay of Japan. In 1956, a very strange disease appeared there. The patients' brain center and peripheral nerves were damaged. In mild cases, they suffered from symptoms: such as slurred speech, stumbling walk, facial stiffness, paralyzed hands and feet, sensory disturbances, loss of vision, trembling, deformed hands and feet. In severe cases, symptoms included nervous breakdown, deep sleep, excitement, bent body, hysteria and eventual death. It was called the "Minamata disease", which shocked the whole world. It is one of the "Eight Social Pollution Nuisances". More than 10,000 patients were diagnosed as being affected by the disease, among which nearly 2,000 died.

Later it was found out that mercury was the chief culprit of this disease! A large volume of wastewater containing mercury from a local plant was discharged to the bay, formed methylmercury via bioconversion, and then accumulated through the food chain. Consequently these contaminated seafood was consumed by the local people, which resulted in "Minamata Disease".

After that, the need for mercury control was increasingly recognized. Mercury pollution has become a global environmental issue in recent years; however, awareness in families and communities is still weak. The most basic, important and difficult part of mercury pollution control is to let people know the mercury-containing products in daily life and corresponding treatments. It is also the purpose of our project, which is funded by UNEP, to develop a toolkit in order to raise awareness about managing mercury wastes at household and community level .

Controlling mercury pollution and protecting our environment require our reflection on the tragedy. Furthermore, it requires everyone's action. Let's make our best to avoid the reoccurrence of similar tragedies.

Menu

- Currently, the amount of mercury released into the atmosphere by human activities is close to 2,000 tons per year, among which fuel combustion accounts for more than 40%.
- One broken thermometer can make the mercury concentration in a 15 m^2 room 2,000 times higher than the safety standard for human beings.
- Careless splashing of 1 gram of liquid mercury into a river can make all fish residing within the water body of 34 m^3 or more fail to survive.
- One milligram of mercury penetrating the ground can contaminate about 360 tons of water. A waste fluorescent lamp without proper treatment may contaminate 90 to 180 tons of water and the surrounding soil.
- A 60 kg person is advised to eat no more than 30 grams of fish per day, based on American Safety Standards and the average mercury content in fish.
- It will take 15 years or more to reduce mercury contamination in fish to the level of environmental background, even after the industrial mercury pollution sources are thoroughly eliminated.
- The fetus is more sensitive to mercury than adults. The long term low dose accumulation of mercury in women can severely affect fetal growth.
- More than 10,000 patients are now officially identified as being affected by "Minamata Disease", among which nearly 2,000 died.

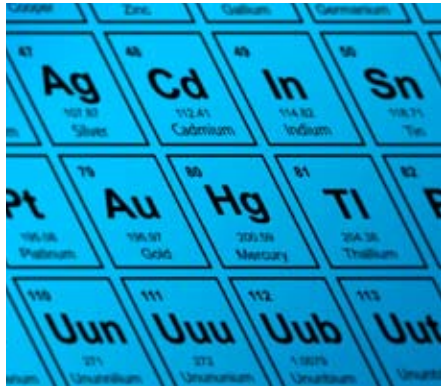
Do you know?

Properties of mercury

A Physical properties

Mercury, also called quicksilver, is volatile and hardly water soluble. It has the lowest melting point among various metals. It is the only metal that is liquid and flowing at room temperature. Mercury can evaporate at room temperature, forming colorless, tasteless and toxic mercury vapor.

Mercury is a fair conductor of heat and electricity and has high extensibility, density and surface tension. It is a good material used for multiple functions.



B Biotoxicity

Elemental mercury and its compounds are toxic to the reproductive and nervous systems. They can also affect the endocrine and cardiovascular systems.

C Long-distance transportation

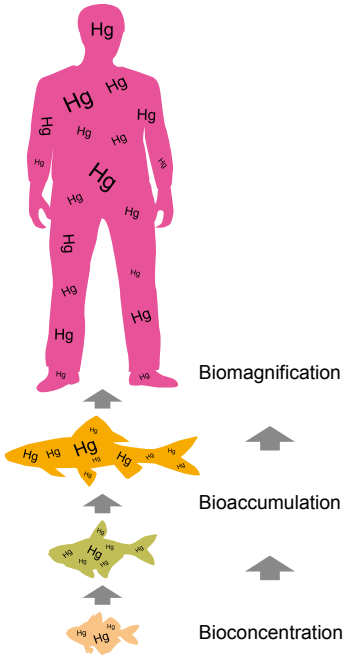
Mercury and its compounds can cycle globally through air, water bodies, soil, and the food chain, etc. It can be transported across a wide area, forming mercury pollution in the atmosphere, water bodies and soil etc.

D Persistence

Mercury and its compounds, which cannot be degraded, can persist in the environment for a long time. The re-emission of mercury from water bodies and soil significantly prolong their stay in the nature.

E Bioaccumulation

Mercury and its compounds can be accumulated in the food chain through different transmission pathways continuously increasing the mercury content in organisms.



Existing forms, exposure pathways and hazards of mercury

Mercury mainly exists in three forms: elemental mercury, inorganic mercury and organic mercury, among which organic mercury is the most toxic.

A Elemental mercury

This is mainly quicksilver, and is classified as liquid mercury and vapor mercury.

Liquid mercury

- Sources: Broken thermometers, etc.
- Characteristics: Only a little of the swallowed liquid mercury can be absorbed through the digestive tract with a slow process and less toxicity.

Mercury vapor

- Sources: Broken thermometers, fluorescent lamps, dental amalgams , and occupational exposure, etc.
- Characteristics: Easily absorbed, highly toxic, can easily damage the brain tissue through the blood and brain barrier.
- Hazards: Trembling, gingivitis, excitement, damage of central nervous systems and nervous or behavioral disorder.

B Inorganic mercury

- Sources: Food, skin whitening cosmetics and soaps, and some medical products.
- Characteristics: It cannot pass through the blood and brain barrier, but can cause kidney failure and intestinal stomach damage.
- Hazards: It can cause erythra and reddening of skin, sweating, allergy, jerking, weakness and high blood pressure.

C Organic mercury

Trace amounts of mercury-containing substances exist in the sediments on the base of rivers , converted into organic mercury and then ingested by aquatic organisms, which then enter the human body via the food chain after going through bioaccumulation process, affecting people's health. Organic mercury is the easiest form to be absorbed by organisms, among which alkylate (especially methylmercury) has a very strong toxicity.

- Sources: Contaminated fish, shrimp, crabs, shellfish and other seafood, especially predatory fish; fungicides, herbicides, and wood preservatives.
- Characteristics: Neuro-toxicity; can pass through the placenta, blood-brain barrier; more easily absorbed; slower in excretion; can pass to infants via breastfeeding.
- Hazards: It can cause headaches, weakness, amnesia, mental disorders; has negative impacts on the fetal brain development; adverse effects on cardiovascular system; it can cause cancer, sensory disturbance and speech disorders.

Sources of mercury pollution

A Natural sources

Mercury naturally occurs in the earth's crust, and could be possibly released by volcanic eruptions, geological deposition, evaporation from oceans, soil and water surface etc., and re-emission from contaminated water bodies and soil surface.

B Anthropogenic sources

- Fossil fuel combustion: coal-fired power plants, industrial boilers and cement production, etc.
- Mining and ore processing: mercury mining, small-scale gold and silver mining (amalgam process), etc.
- Intentional use: fluorescent lamps, image development processing, thermometers, manometers and the manufacturing of various mercury-containing products.
- Waste disposal and incineration: incineration of household wastes, medical and industrial wastes, etc.; industrial emission, leakage and discharge; waste landfill sites etc.

Mercury uses

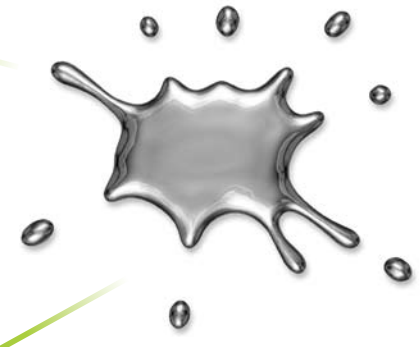
Mercury and its compounds can be used in more than 3,000 ways, in industry, agriculture, medicine and many other areas.

Metallurgical industry

Amalgamation process is often used to extract gold, silver, thallium and other metals.

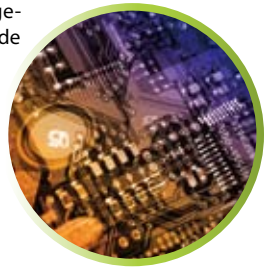
Medical industry

Some mercury compounds have the positive effects of disinfection, diuresis and pain relief, thus can be used for manufacturing pharmaceuticals; mercury is used as raw material for producing pharmaceuticals for treating boils and scabies in traditional Chinese medicine; amalgam is a dental material; mercury is often used in thermometers, barometers, diffusion pumps and other instruments due to its good thermal conductivity.



Chemical industry

Mercury is also one of the components of battery electrodes. Mercury-containing catalysts remain in large-scale commercial use in the manufacture of vinyl chloride monomer.



Electronic industry

Mercury is commonly used in switches because of its good conductivity and liquid characteristics. Also, mercury is used in computers, like circuit boards, electric switches and batteries etc.

Commodity manufacture

Fluorescent lamps contain mercury. The ultraviolet light generated by the mercury vapor can ignite fluorescent powders, producing artificial light; mercuric sulfide is a high-quality paint, often used for inkpads.

Mercury-containing products in daily life and treatment

A Thermometers, sphygmomanometers, temperature gauges

One commonly used bar or glass thermometer contains about 1 gram of mercury, and one mercury sphygmomanometer contains about 50 grams of mercury.

All the mercury evaporated and released from one broken thermometer can raise the ambient air concentration of mercury to 22.2 mg/m^3 in a room with an area of 15 m^2 and a height of 3 m. People will be immediately poisoned in an environment with mercury concentrations between 1.2-8.5 mg/m^3. The mercury content in one temperature gauge is enough to contaminate a whole fish pond with an area of 80,000 m^2.

We should:

1. Try to select mercury-free alternatives, such as digital electronic thermometers/ sphygmomanometers, and gallium-indium-tin glass thermometers, etc.
2. Pay attention to the information provided by the manufacturers or merchants, regarding the hazards prevention and first aid measures if mercury-containing products are selected for use.

Emergency treatment for the leakage of mercury from thermometers or sphygmomanometers:

- **Self protection** — Evacuate children, put on masks, remove jewelry from hands, and put on gloves
- **Cleaning mercury drops** — Scoop up the mercury with hard paper boards, suck up with suction tubes, or stick up with adhesive tape
- **Appropriate storage** — Inject mercury drop into a vessel filled with clear water, seal it and place it in the shade
- **Chemical treatment** — Drop iodine onto the spots contaminated with spilled mercury, to convert the mercury droplet via chemical reaction
- **Keep ventilation** — Open the windows, use small fan to blow out the mercury, and evacuate the people
- **Follow-up measures** — Sulfur powder can also be spread onto the spilled mercury, to clear away the invisible mercury drops
- The contaminated products should be air dried in the sun for a certain period of time before use after they are handled with the above-mentioned methods

We should not :

1. Sweep up the mercury drop on the ground with a broom, as this will increase the chances of mercury diffusion.
2. Use vacuum cleaners, as the heat from the machines can volatilize liquid mercury drops into vapor.
3. Wash the mercury-contaminated devices with water, as the mercury can flow into external environment with water.

B Batteries

Batteries can be classified by functions and reserve methods as primary cell (non-rechargeable), secondary cell (rechargeable), fuel battery, and reserve cell, etc.

Mercury mainly exists in disposable dry cells, which is one part of the components for battery electrodes.

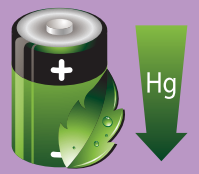
However, currently there are not many factories able to produce low-mercury and mercury-free batteries.

Meanwhile, many batteries commonly used in our daily lives, such as storage cells, mobile phone cells and button cells, etc., have a mercury content and can easily cause mercury pollution.

Besides, other heavy metals in waste batteries can also cause environmental pollution. Therefore, one should pay attention to the specialized recycling of waste batteries.

Solutions:

1. Select "low mercury" or "mercury free" batteries produced by formal manufacturers, complying with national standards.
2. Used batteries should be specially recycled, especially dangerous batteries such as storage cells, mobile phone cells, and button cells, etc. Casual litter should be strictly forbidden.



C Fluorescent lamps

The ultraviolet light generated by the mercury vapor can ignite fluorescent powders to give out light when fluorescent lamps are connected to electricity. The mercury sealed inside the light tubes cannot cause mercury pollution. However, when the lamps are broken, the released mercury vapor can pose a threat to human health. The mercury content in one lamp ranges from several milligrams to dozens of milligrams.

Solutions:

1. Try to select "low mercury" lamps when purchasing. Select the bent lamps instead of straight ones, and select thin tubes instead of wide tubes.
2. Attention should be given to specially recycling of the obsolete fluorescent lamps. Casual disposal is not acceptable.

How to recycle the fluorescent lamps?

Please do not casually throw out broken fluorescent lamps with household wastes, because if you do so, the mercury inside can leak into the soil at landfill sites. The correct handling procedure is as follows:

1. Put the fluorescent lamps into sealed plastic bags.
2. Check with the nearby Hazardous Wastes Treatment Center to confirm if they recycle obsolete fluorescent lamps.
3. If not, take the same approach as for batteries and other chemicals.

D Dental filling materials: dental amalgam

By weight, about 50% of dental amalgam is elemental mercury.
Usually the elemental mercury from the dental filling cannot cause health hazards, but harmful mercury vapor can result from materials migration. Very few people are allergic to mercury.

Solutions:

1. Try to select mercury-free alternatives when dental fillings are necessary.
2. Pregnant women, people allergic to mercury, and those with weak kidney function should avoid using mercury fillings.
3. Baby teeth should be filled with resins and other non-mercury materials.

E Skin-whitening cosmetics

Mercury have good bleaching effects for skin. Therefore, most of the cosmetics for lightening the color of skin or removing dark spots contain mercury. It is stipulated in national regulations that the mercury content in cosmetics should not exceed 1 mg/kg, however, many cosmetics are still overdosed with mercury.

Solutions:

1. Try to know more about the mercury content in cosmetics, and use it less.
2. Try to choose cosmetics with clear logo, hygiene license number and period of validity. Purchase in legal ways.
3. If the cosmetics you buy do not have the above labels, report to the administrative department for industry and commerce and stop using these immediately.

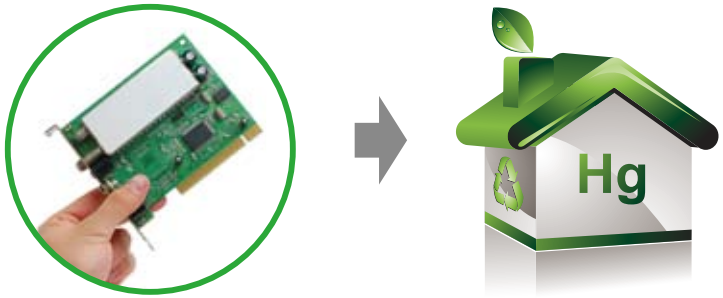
F Electronic products

Many common electronic products contain mercury, such as batteries, switches, measuring devices, equipments etc.

Because of conductibility and liquidity, mercury-containing switches are widely used. One small electric switch contains 3.5 grams of mercury, and one industrial switch contains as much as more than 8 pounds of mercury. Mercury is used in many computer components, such as circuit boards, electric switches and batteries, etc.

Solutions:

1. Check if electronic products contain mercury when purchasing. Try to select mercury-free alternatives, such as mercury-free tilt switches, mechanical switches, motor switches, and copper bead switches etc.
2. Electronic products that contain mercury need to be specially recycled and must not be disposed of casually.



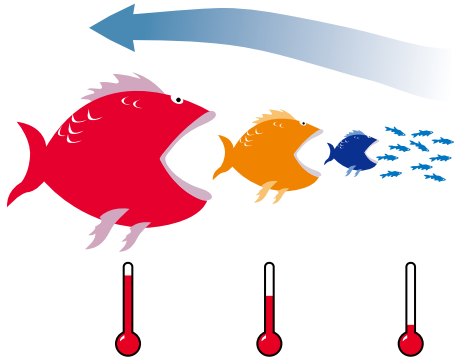
G Seafood:

Mercury can spread through air, ocean, soil, biological chains and other pathways once it is released. Methylmercury is the main substance causing mercury contamination in water. Therefore fish in a contaminated ocean have high mercury accumulation inside the body, and mercury concentration continuously accumulates throughout the food chain. People can easily suffer "mercury poisoning" by eating these fish.

Solutions:

1. Eat seafood appropriately and safely: refrain from eating the fish heads, skin or internal organs; try to eat smaller-sized fish; eat less "fish-consuming fish", as the mercury content in fish at upper end of the biological chain is higher.

2. Eat broccoli, tomatoes and other vegetables and fruits while consuming seafood.



Food tips to reduce exposure to mercury:

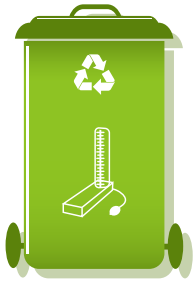
- Eat protein, especially animal protein. The methionine in protein can protect sulfhydryl enzyme from mercury harm.
- Vitamins. Vitamin B can help the recovery of the nervous system. Fresh vegetables and fruit rich in vitamin C can protect the oral mucosa. Vitamin E protects against methylmercury.
- Eat more selenium. Selenium has a protective function against methylmercury poisoning in the body.
- Pectin. Pectin can combine with mercury, helping expel the mercury from body, lowering the mercury content in blood.

Collection, transport and temporary storage of mercury-containing waste in communities

A Classification and collection of mercury-containing waste

Mercury from the mercury-containing waste can be released into the environment through land surface penetration and combustion, and should not be treated as common domestic waste. Instead, it should be separated from other refuse for recycling and be specially managed (for example, obsolete fluorescent lamps, batteries, barometers, and mercury-containing electronic elements etc.)

Mercury-containing waste in daily life can be collected mainly through one of three pathways at least. The general public can make choices depending on convenience.



1. Recycling management stations for urban solid wastes

- Specially recycled by designated recyclers;
- Put into unified containers, with clear marks.

2. Squares, libraries and other public places or shops

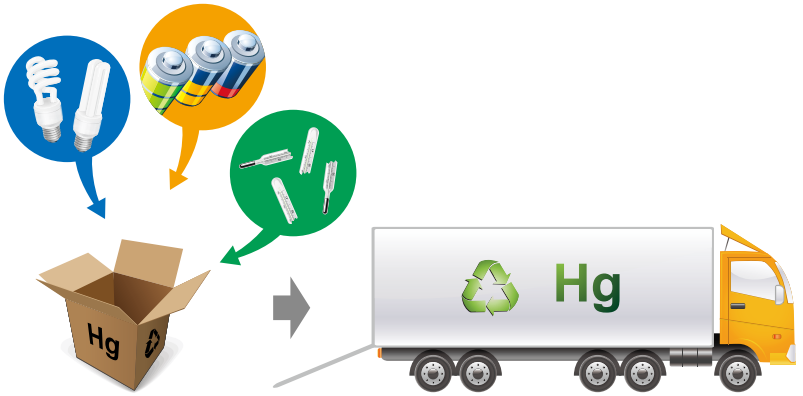
- Unified design and specially marked containers for recycling mercury-containing waste;
- Regularly monitor recycling containers.

3. Recycling in communities

- The government should establish legal rules and relevant subsidiary policies, and establish a set of systems;
- The general public should increase their environmental awareness, and do the classification and recycling proactively.

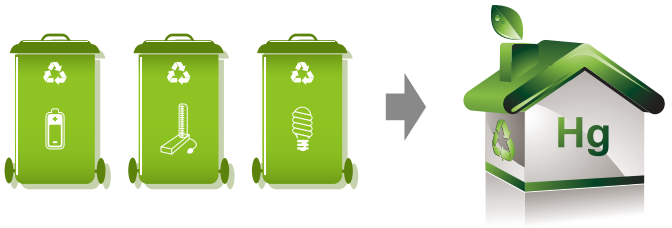
B Transport of mercury-containing waste

- Mercury-containing waste transporters should be specially certified and designated;
- Carriers should do careful checks on mercury-containing substances according to regulations and rules before transportation; pack appropriately and classify them with special marks;
- Transportation equipment should be equipped with emergency management devices for mercury pollution;
- Carriers should take precautions to prevent breakages of mercury-containing substances and avoid leakage of mercury into the environment during transportation.

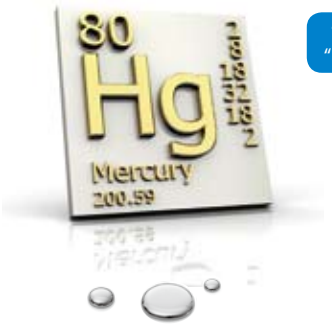


C Temporary storage of mercury-containing waste

- Facilities for recycling and storage of mercury waste should be specially designed;
- The storage facility should be regularly checked, and precautions taken to prevent damage and leakage;
- Sensitive areas, such as wetlands, groundwater, earthquake zones etc., are not suitable for temporary storage of mercury waste in order to avoid possible mercury release to the environment or human exposure. Meanwhile an early warning mechanism should be established.



Common mercury standards



Special limitation for air pollutants (coal-fired boiler): 0.03 mg/m^3 (China)

Maximum allowable atmospheric mercury concentration in residential areas: daily average 0.003 mg/m^3 (China)

Cosmetics: ⩽1 mg/kg (China)

"Low-mercury" batteries: <0.025% of body weight (China)
"Mercury-free" batteries: <0.0001% of body weight (China)

Domestic-potable water: <0.001 mg/L (China)

Vegetables: <0.01 mg/kg (China)

Food: ⩽0.02 mg/kg (China)

Methylmercury (in fish) ⩽0.10 mg/kg (international)

Weekly intake of methylmercury:
⩽1.6 ug/kg of body weight (international)
⩽0.7 ug/kg of body weight (U.S.)

Less mercury, better life

拒绝汞污染
生活更美好

LESS MERCURY BETTER LIFE

Our goal:
Let every community, every family and every citizen have better awareness of mercury pollution control

Controlling mercury pollution, we expect you to join us…

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This public information material was produced through the toolkit development project aimed at raising the awareness of mercury wastes management at household and community level funded by Norway and UNEP.

The information does not represent the views of UNEP nor the Chinese government.

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