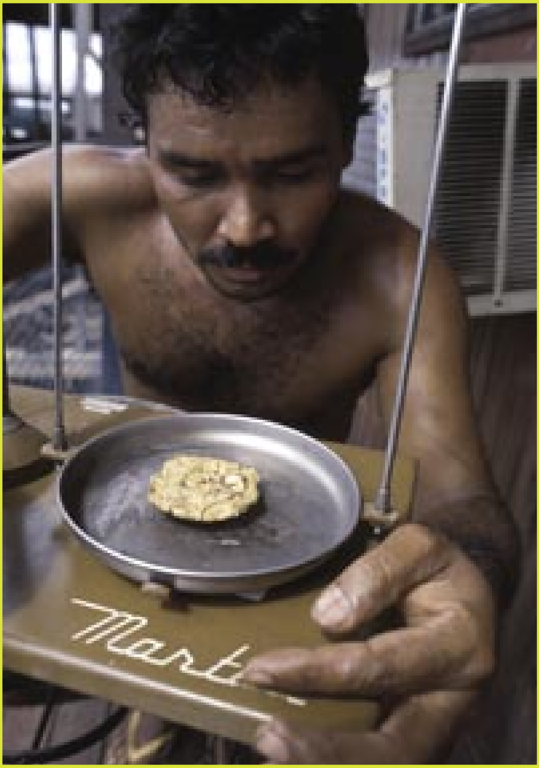
Introduction

The Mercury Issue



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Introduction

The Mercury Issue

Introduction to the Mercury Problem

KEY MESSAGES

- Mercury has been used in various products and processes for hundreds of years due to its unique chemical properties; namely, mercury is in liquid form at room temperature.
- Mercury and mercury-containing compounds are highly toxic and have a variety of significant adverse effects on human health, wildlife and the environment.
- In recent years, environmental mercury levels have risen.
- Once released, mercury can persist in the environment where it circulates between air, water, sediments, soil and biota in various forms. Atmospheric mercury can be transported long distances in the atmosphere, incorporated by microorganisms and may be concentrated up the food chain.
- Localized hot spots exist from the use of mercury in industrial processes, mining, waste sites and other air emission sources.
- Bacterial processes convert some of the mercury deposited in bodies of water into methylmercury, a form that can bioaccumulate up the food chain, becoming concentrated in larger, predatory marine mammals and fish, such as seals, swordfish, shark, marlin, mackerel, walleye, sea bass and tuna.
- In the human body, mercury damages the central nervous system, thyroid, kidneys, lungs, immune system, eyes, gums and skin. Neurological damage to the brain caused by mercury cannot be reversed. There is no known safe exposure level for elemental mercury in humans, and effects can be seen even at very low levels.
- The most common exposure to mercury is through ingestion of fish and other marine species contaminated with methylmercury. There are two general types of subpopulations particularly susceptible to mercury health effects from mercury in food: those who are more sensitive to the effects of mercury (the foetus, newborn babies and children) and those who are exposed to higher levels of mercury through their livelihood and/or culture (anglers, subsistence fishers).
- People may also be exposed to elemental or inorganic mercury through inhalation of mercury vapour during occupational activities or spills or through direct contact from mercury use.
- Over the past 50 years mercury's toxicity has been well documented and many countries have taken steps to reduce its uses and releases, and to protect their citizens from exposure to mercury.

What is mercury?

Mercury is a natural element. In its pure form, mercury is a shiny silver-white metal that is liquid at room temperature.

Where does mercury come from?

Trace amounts of mercury exist in air, land and water due to the weathering of rock and from volcanic activity. Pure mercury is rarely found in nature, but the pure metal is extracted from cinnabar.

Mercury has always been present in our environment from natural sources (such as forest fires and volcanic eruptions) and therefore in varying amounts in the foods we consume. Human activities, however, substantially contribute to the mercury in the environment and in the food chain.

Mercury has been used in a wide range of products and industrial processes over the years, but currently most of it is employed in:

- Industrial processes that produce chlorine (mercury chlor-alkali plants) and/or vinyl chloride monomer (for polyvinyl chloride (PVC) production, and polyurethane elastomers);
- Artisanal and small scale gold mining;
- Products such as electrical switches (including thermostats) and relays, measuring and control equipment, energy-efficient fluorescent light bulbs, batteries and dental amalgam;
- Mercury is also sometimes used in laboratories, cosmetics, pharmaceuticals including vaccines as a preservative, paints, and jewellery.

Mercury is also released unintentionally from other industrial processes, such as coal-fired power and heat generation, cement production, mining and other metallurgic activities such as non-ferrous metals production. Coal-fired power production is today deemed the single largest global source of atmospheric mercury emissions. Waste from products and industrial processes containing mercury can be a significant source of mercury release

Different forms of mercury travel different distances. Some forms deposit within a few kilometers of release, while others are transported throughout the hemisphere before they are deposited.

A BRIEF HISTORY OF MERCURY

Mercury was one of the first known metals and has been used since ancient times for reasons both practical and mystical. For example, mercury has been used as the mineral cinnabar (HgS) as a red pigment. Archeologists have found mercury in an Egyptian tomb dating from 1500 BC.

The Greeks knew of mercury and used it as a medicine, and as recently as the 20th century mercury compounds were used to treat syphilis. The dangers of mercury have become more widely acknowledged over the past several centuries. Mercury's neurological effects on hat-makers, who used mercuric nitrate to make felt for hats, were so widely recognized that it led to the expression, "mad as a hatter."

How are people exposed to mercury?

Most individuals are exposed to mercury through certain food sources. People are exposed to methylmercury mainly through their diet, especially from consumption of fish and other marine species. Elemental mercury carried in the atmosphere is eventually deposited and taken up in bacteria in aquatic environments and converted from elemental mercury into methylmercury. Methylmercury bio-accumulates up the food chain and is the primary source of mercury in our food.

In addition, people may be exposed to elemental or inorganic mercury through inhalation of ambient air. Approximately 80% of inhaled mercury vapour is absorbed by the body. Potential exposure routes include mercury spills, breakage of mercury containing products, occupational exposures and/or living close to a facility/industry that emits mercury in its processes.

Other potential exposures can come from:

- exposure to some products such as paints, pesticides or fungicides that contain mercury;
- other mercury products such as soaps or cosmetics that are applied directly to people's skin.

For examples of mercury exposure, see Case Studies 1 and 2 at the end of this booklet.

Who are at risk?

All humans are exposed to some low levels of mercury. The factors that determine whether or not adverse health effects will occur and how severe the health effects include: the chemical form of mercury; the dose; the age or developmental stage of the person exposed (the foetus is the most susceptible); the duration of exposure; the route of exposure - inhalation, ingestion, dermal contact.

In particular, individuals and communities who are directly exposed to mercury through their occupation or local industry may be at risk.

There are a few general types of susceptible subpopulations in terms of methylmercury found in food; those who are more sensitive to the effects of mercury and those who are exposed to higher levels of mercury:

- The foetus, the newborn and young children are especially sensitive to mercury exposure because of the sensitivity of the developing nervous system. In addition to in utero exposures, neonates can be further exposed by consuming contaminated breast milk. Thus, new mothers, pregnant women, and women who might become pregnant should be particularly aware of the potential harm of methylmercury.
- Individuals with diseases of the liver, kidneys, nerves, and lungs are at higher risk of suffering from the toxic effects of mercury.

- Other subpopulations may be at greater risk to mercury toxicity because they are exposed to higher levels of methylmercury due to high fish and seafood consumption such as recreational anglers and subsistence fishers, as well as those cultures that tend to regularly eat fish and other seafood.

What are the signs and symptoms of mercury poisoning?

The earliest effects of methylmercury poisoning in adults are non-specific symptoms such as paresthesia, malaise, and blurred vision. It can cause nausea, lack of appetite, weight loss, abdominal pain, diarrhea, skin burns and irritation, swollen gums and mouth sores, as well as drooling. With increased exposure, more severe symptoms appear such as numbness and tingling in the lips, mouth, tongue, hands and feet, tremors and lack of coordination, vision and hearing loss, memory loss, personality changes, respiratory distress and kidney failure.

Acute exposure to elemental mercury and vapour can result in acrodynia or “pink disease”, which is characterized by bright pink peeling palms, fingers, and soles of the feet, excessive perspiration, itchiness, rashes, joint pain and weakness, elevated blood pressure and heart palpitations.

Methylmercury readily crosses the placenta from mother to baby, and also the blood-brain barrier. Methylmercury can also cause mental impairments and learning disabilities, cerebral palsy, seizures, spasticity, tremors, and lack of coordination, along with eye and hearing damage in the unborn baby as a result of the mother's exposure. In addition, methylmercury can also pass into the mother’s breast milk, further exposing the newborn baby.

What is Minamata Disease?

Minamata disease is a form of severe methylmercury poisoning first identified in Minamata, a city on the island of Kyushu in southern Japan in 1956. Between 1932 and 1968, an acetaldehyde plant owned by the Chisso Corporation released effluents containing methylmercury compounds into Minamata Bay and subsequently into the Minamata River and the Shiranui Sea. The methylmercury bioaccumulated in the shellfish and fish that make up an important part of the local diet. More than 200,000 people were exposed to the contamination. This led to chronic poisoning in residents of the coastal areas of Kumamoto and adjoining Kagoshima prefectures. The local public health institute reported in 1960 that the median value of mercury in hair of 1,644 residents of the coastal areas of the Shiranui Sea was 23.4 ppm (range 0 - 920 ppm), while the median value for non-polluted Japanese was 2.1 ppm (range 0.1 - 8 ppm) (Doi and Matsushima, 1962).

Symptoms of Minamata disease include numbness in the hands and feet, muscle weakness, narrowing of the field of vision and damage to hearing and speech. Acute cases can include severe sensory disturbance, convulsions and even death.

How is human exposure to mercury being measured?

Mercury exposures of numerous populations have been monitored by measuring mercury in blood, cord blood, hair, urine and breast milk. The presence of mercury in blood indicates recent or current exposure to mercury. Mercury level in hair is an indicator of long term exposure. The presence of mercury in urine generally represents exposure to elemental mercury.

What can you do to protect yourself from harmful effects of mercury?

- Be aware of the risks of mercury and share this knowledge with your family and friends.
- Let your local government and industries know that you are concerned about your health and the well-being of the environment.

What can governments do to protect their citizens and environment?

- Understand mercury use and releases in your country or region through the development of a mercury inventory. The development of mercury use and emission inventories are a good first step in assessing the scope of the problem at the national level. UNEP has developed the 'Toolkit for identification and quantification of mercury releases' to assist countries in undertaking such work. The toolkit is available at the following web address: www.chem.unep.ch/mercury/Toolkit/default.htm.
- Find means to control the use, release and disposal of mercury in a country or region.
- Educate citizens, industry and health care workers on the risks of mercury.
- Work with industry, health care workers, citizens and NGOs to develop a mercury reduction strategy.
- The UNEP Global Mercury Partnership is open to new partners. Joining the partnership can be an excellent opportunity to network with experts and build capacity. To take part in the UNEP Global Mercury Partnership go to: www.chem.unep.ch/mercury/partnerships/new_partnership.htm

For an example of the need for national actions, see Case Study 3: A case for national actions on mercury in Peru.

Mercury in Food

- Fish is an important source of protein, vitamins, micronutrients, and the beneficial long-chain of polyunsaturated omega-3 fatty acids in the human diet. Nevertheless, it is important to be aware that fish can be a potential source of methylmercury.
- Methylmercury presents the greatest risks to developing foetuses, infants and children, and exposure can lead to neurodevelopment disorders.

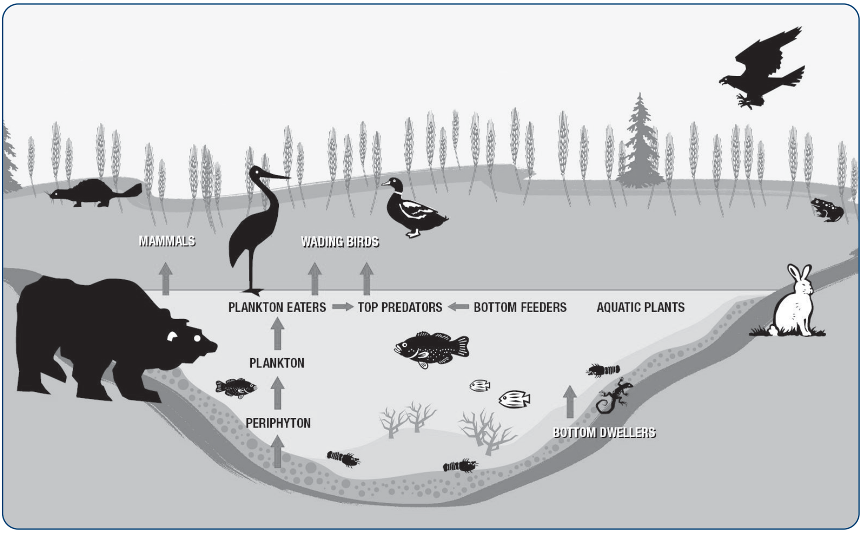
- Fish in and downstream of mercury hotspots – small scale gold mining operations, mercury cell chlor alkali plants, mercury product manufacturing facilities, metal smelters, coal-fired power plants and certain other industries – can contain high mercury concentrations, but fish in other regions – even the Arctic where there is little or no local mercury pollution – are affected as well.

How does mercury get into our food?

Elemental mercury carried in the atmosphere is eventually deposited and taken up in bacteria in aquatic environments and converted from elemental mercury into methylmercury. Methylmercury is what bioaccumulates in the food chain.

Bioaccumulation occurs as larger animals consume smaller ones in the food chain (the food web) (see Figure 1). Micro-organisms incorporate methylmercury into their systems, and it is concentrated up the food chain as larger fish eat smaller ones. This is known as biomagnification. Top-level predators in aquatic systems (such as that shown in Figure 1) can have levels of methylmercury built-up in their systems that are 100,000 times higher than the surrounding waters in which they live. Ingesting fish, waterfowl, or aquatic/marine mammals that have built up high levels of methylmercury passes their toxic burden along to those who consume them, including humans. Most (about 90 percent) of the mercury in fish is methylmercury and most (greater than 95 percent) of the methylmercury in fish ingested is readily absorbed into the body through the gastrointestinal tract

Figure 1: Mercury bioaccumulation



United States Environmental Protection Agency. The South Florida Mercury Science Program.

Due to long-range transport, anthropogenic mercury is found in remote areas far from industrial activity. For example, high mercury levels are observed in ringed seals, beluga whales, and in the indigenous peoples of the Arctic, far from any mercury sources of significance (see Case Study 4: Mercury levels in the Arctic).

What variables affect mercury concentration in fish?

Levels of methylmercury in fish, waterfowl and aquatic/marine mammals vary depending on many factors. While much is known about mercury bioaccumulation and biomagnification, the process is extremely complex and hard to predict quantitatively. In general, mercury levels in fish tend to increase with age and size as a result of the slow elimination of methylmercury and increased intake as fish grow to larger sizes. Therefore, older, larger fish typically have higher mercury concentrations in their tissues than younger fish of the same species.

Methylmercury accumulates in all fish tissue and organs. Most of the mercury present in fish is in the form of methylmercury. Elevated mercury levels have been measured in many freshwater and marine species throughout the world. Factors that influence mercury levels in the fish include age, size, weight, and length of the fish, and characteristics of the body of water (e.g., local contamination, pH, reduction-oxidation potential, and other factors). The mercury concentrations in fish generally range from about 0.05 to 1.4 milligrams of mercury per kilogram of tissue (mg/kg). The mercury concentrations are lowest in smaller, non-predatory fish and can increase many-fold on the way up the food chain.

Global climate change may have implications for the methylation of mercury and its accumulation in fish. Rising water levels, extreme weather events, and deforestation can create conditions that remobilize mercury in sediments.

What can you do?

Many fish consumers have little or no choice in the type or source of fish they consume, but in general it is important for people who eat a lot of fish to be aware that:

- Fish is an important source of protein, vitamins, and micronutrients in the diet;
- Smaller, younger or non-predatory fish will tend to have lower mercury levels than large, older predatory fish;
- Methylmercury in fish is bound to tissue protein rather than to fatty deposits, so that trimming and skinning of mercury-contaminated fish does not reduce the mercury content of the fillet portion. No cleaning or cooking methods are able to reduce the amounts of mercury present in animal or fish protein;
- Mercury intake depends not only on the level of mercury and the type of fish, but the amount consumed and the frequency of consumption as well.

There are two general types of susceptible subpopulations in terms of methylmercury found in food and should, in particular, be aware of this issue and consider measures to limit their intake of mercury through their food:

- New mothers, pregnant women, and women who might become pregnant should be particularly aware of the potential harm of methylmercury. Individuals with diseases of the liver, kidneys, nerves, and lungs are also at higher risk of suffering from the toxic effects of mercury;
- Other subpopulations may be at greater risk to mercury toxicity because they are exposed to higher levels of methylmercury due to high fish and seafood consumption such as recreational anglers and subsistence fishers as well as those cultures who tend to regularly eat fish and other seafood.

What can governments and health care professionals do?

- Government agencies can issue fish consumption advisories for susceptible populations (the sensitive and the most exposed subpopulations), and may sometimes do so for the general population, to limit or avoid consumption of certain fish and/or waterfowl from specific bodies of water. Advisories would inform the public that high concentrations of chemical contaminants (e.g., mercury and other toxics) have been found in local fish and wildlife. They include recommendations to limit or avoid consumption of certain fish and wildlife species from specified bodies of water or, in some cases, from specific types of waters (e.g., all inland lakes).
- The Joint Food and Agricultural Organization/World Health Organization Expert Committee on Food Additives (JECFA) has established a provisional tolerable weekly intake (PTWI) for total mercury at 5μg/kg body weight and for methylmercury at 1.6μg/kg body weight. The PTWI is the amount of a substance that can be consumed weekly over an entire lifetime without appreciable risk to health and is an endpoint used for food contaminants such as heavy metals with cumulative properties.
- Governments might first undertake an exposure assessment to determine the level of risk to a specific population. In doing so, consumption rates and dietary preferences need to be analysed for individuals and the community, as well as exposure to other contaminants and pathways.

- Take part in the UNEP Global Mercury Partnership: http://www.chem.unep.ch/mercury/partnerships/new_partnership.htm

CASE STUDY 1: MERCURY POISONING ACCIDENT FROM GRAIN TREATED WITH FUNGICIDE IN IRAQ 10

CASE STUDY 2: EXPOSURE FROM A MERCURY SPILL INCIDENT IN A SCHOOL IN THE PHILIPPINES 11-12

CASE STUDY 3: A CASE FOR NATIONAL ACTIONS ON MERCURY IN PERU 1»-14

CASE STUDY 4: MERCURY LEVELS MEASURED IN THE ARCTIC 15

CASE STUDY 1: MERCURY POISONING ACCIDENT FROM GRAIN TREATED WITH FUNGICIDE IN IRAQ

Methylmercury and ethylmercury poisonings have occurred twice in Iraq following the consumption of seed grain that had been treated with fungicides containing alkyl mercury compounds. The first incident occurred in the late 1950s, was caused by ethylmercury-treated grain, and adversely affected about 1000 people.

In 1971, a larger number of people in Iraq were exposed to methylmercury when imported mercury-treated seed grains arrived after the planting season and were then used to make into flour that was baked into bread. Because many of the people exposed to methylmercury in this way lived in small villages in very rural areas (and some were nomads), the total number of people exposed to these mercury-contaminated seed grains is not known. About 6,500 patients were hospitalized and 459 known deaths occurred, mainly due to failure of the central nervous system.

Toxicity was observed in many adults and children who had consumed the bread over a three-month period. Fourteen Iraqi patients who developed ataxia and "pins and needles" and could not walk heel-to-toe were examined for impaired peripheral nerve function (EPA, 1997). The predominant symptom noted in adults was paresthesia, and it usually occurred after a latent period of from 16 to 38 days. In adults symptoms were dose-dependent, and among the more severely affected individuals ataxia, blurred vision, slurred speech and hearing difficulties were observed (EPA, 1997).

The population group that showed the greatest effects was offspring of pregnant women who ate contaminated bread during pregnancy (EPA, 1997). Infants born to mothers who had eaten the bread exhibited symptoms ranging from delays in speech and motor development to mental retardation, reflex abnormalities and seizures (EPA, 1997). Some information indicated that male offspring were more sensitive than females. The mothers experienced paresthesia and other sensory disturbances but at higher doses than those associated with their children exposed *in utero.*

CASE STUDY 2:
EXPOSURE FROM A MERCURY SPILL INCIDENT IN A SCHOOL IN THE PHILIPPINES

On 19 February 2006, a 14-year-old boy with symptoms of numbness, redness, and pain of extremities after an exposure to elemental mercury three days earlier was presented to the University of the Philippines National Poisons Management and Control Center at the Philippine General Hospital in Manila. A mercury spill had allegedly occurred in the boy's science class three days earlier unknown to the school authorities.

Initial interviews revealed that 2 beakers filled with an estimated 100-200 grams of mercury were spilled in the science class during the week. Reports indicate that the total mercury spilled could be estimated at 326-408 g.

It is reported that while the teacher was writing the lessons on the board, the children played with the beaker and spilled some mercury in the room. The children then reportedly applied mercury to their skin, hair and other parts of the body. Some even brought some mercury samples to their homes as souvenirs. Eighty students, ages 13-14 years old and the science teacher were exposed to elemental mercury. The primary routes of exposure were dermal and inhalation. Initially, ten students were admitted to the hospital because of fever, itchy rashes, difficulty in breathing, chest pain and body malaise, with onset of symptoms 13-16 hours post-exposure. Other signs and symptoms were: headache, pruritus, cough/colds, weakness, muscle pain, dizziness, nausea, numbness, redness/swelling of upper extremities.

The school was closed during the clean-up. The Inter-Agency Committee on Environmental Health constituted by 14 national agencies met regularly to address and resolve health, environment, education and other concerns raised by the mercury spill. These meetings were transparent and participative in nature to ensure that all sectors, including the school representatives, were consulted in the decision-making process. It was evident that there were no existing guidelines for mercury clean-up in schools. The committee has since recommended the banning/phase-out of mercury in schools. Guidelines for the phase-out plan and disposition of available mercury in schools are being developed. The Department of Education is conducting an inventory of mercury (and possibly other chemicals) in schools.

On 26 May 2006, the school was reopened.

LESSONS LEARNED

① Prompt, appropriate and immediate clean-up of the mercury spill should be implemented to reduce or mitigate the impact.

② Decontamination procedures for all contaminated objects should be immediately implemented, as necessary, and preventive public health intervention measures implemented as soon as possible.

③ There is a need to review/improve/strengthen the Government's capacity to respond immediately and actively to chemical emergencies including rapid assessments. First response programs on chemical incidents in the various settings, i.e., homes, school, hospitals, industry, etc., should also be established. Risk assessment, management, and communication are all important in the chemical emergency response system.

④ There is a need to review school curricula involving hazardous chemicals.

⑤ There is a need to conduct information and education campaigns to raise the level of awareness of the various stakeholders on the effects of mercury.

⑥ Sampling methodologies should consider the characteristics of the most vulnerable population groups (e.g., breathing zones of children compared with adults is closer to the ground and measurements should be taken in this zone).

⑦ The coordinated approach through the Inter-Agency Committee on Environmental Health helped to harmonize and streamline efforts to implement immediate, coordinated, and strategic measures to protect human health and the environment.

ACKNOWLEDGEMENT

This case study was prepared by the Secretariat of the Toxic Substances and Hazardous Waste Sector, Inter-Agency Committee on Environmental Health in the Philippines.

CASE STUDY 3:
A CASE FOR NATIONAL ACTIONS ON MERCURY IN PERU

In June 2000 a truck with an open flatbed trailer containing nine flasks of elemental mercury (each weighing almost 200 kg), left a gold mine in northern Peru. The Yanacocha mine, operated by Minera Yanacocha S.R.L. (MYSRL) is located 600 km north of the Peruvian capital, Lima. The mercury, produced as a byproduct of the widely used cyanide heap-leaching technology employed in gold mining, was being trucked 600 kilometers to Lima where it was to be exported and sold for use in medical instruments.

The mine is the 4th largest gold producer in the world (around 1.75 million oz in 2000), the largest in Latin America and the world's largest heap leaching operation. As a result of the cyanidation operation, about 1.7 million ounces of silver and 48 tonnes of mercury are produced annually together with the gold. The mercury output has been increasing since the beginning of the operation in 1994 and it represents more than 50% of the mercury produced in Peru.

In Peru, there is no comprehensive set of regulations on the transportation of hazardous materials and the flasks of mercury were packed into the back of the truck with flasks of chlorine, one of which may have come untied and toppled over, damaging a flask of mercury. Unnoticed by the driver, an estimated 151 kg of mercury leaked from the flask, and was spread along a 42 km section of the road as it passed through three villages, San Juan, Choropampa and Magdelena. Where the truck stopped along its journey, larger quantities pooled. Before the spill was discovered and clean-up activities began, residents had found the mercury, children were playing with it, and some people were collecting it in pans and taking it home.

It is believed that some villagers collected the mercury because they thought they could derive economic value from it, by extracting gold and other metals they believed were associated with the mercury. Some residents may have burned the mercury in hopes of extracting gold. Other villagers may have collected the mercury for cultural or ritual use.

Vapours from the spilled mercury affected about 950 people at various levels of intensity. Within a few days, many villagers became ill from handling the mercury and were diagnosed with symptoms of acute mercury poisoning. Overall, 200-300 people were diagnosed as having some level of exposure and symptoms.

MYSRL spent US$16 million on a remediation program. The Peruvian Ministry of Energy and Mines requested an independent assessment of the results of the remediation activities. Scientists reviewed the mass balance for the 151 kg of mercury spilled. Soil samples were collected at intervals along the road along the predicted spill area and tested for mercury. The review team estimated that 140 kg of mercury (more than 90% of that spilled) had been removed and transported back to mine for disposal. According to mine officials, residents returned 54.9 kg of mercury in return for a reward of $35 per kilogram. However, mistrust and suspicion toward the company may have led some residents to hold onto the mercury they collected, despite warnings of its risks, in hopes of attaining future economic value from it.

Further measures, such as detailed monitoring programmes to locate additional hot spots on roadsides, were deemed costly and unlikely to succeed, and the risk of methylation of the spilled mercury (transformation to its most toxic form) was judged to be minor due to the success of the clean-up efforts and the environmental characteristics of the region. Nonetheless, it is believed that about 11 kg of mercury are still unaccounted for, of which at least 5 kg have already evaporated.

In the years since the spill, hundreds of people from the three villages reported skin, kidney, neurological, pulmonary, reproductive, respiratory, and vision problems and tested positive for mercury poisoning at area health clinics. The Peruvian government fined the company $500,000, and the company paid additional settlements to some residents and the medical insurance of others.

LESSONS LEARNED

① Regulations on the transport of dangerous goods should be implemented to prevent and limit the risk of such spills.

② Early detection of a spill helps to limit exposure.

③ Awareness about the hazards of mercury may have prevented the exposure of many individuals.

④ Good relationships between industry and the community can help with management of spills and accidents.

For more information, see:

Assessment of Mercury Contamination on Magdalena-San Juan Road, Peru
Marcello M. Veiga, MSc., Ph.D. and Jennifer Hinton, Geo Eng.
Vancouver, BC, Canada, for the Ministry of Energy and Mining, Lima, Peru

CASE STUDY 4:
MERCURY LEVELS MEASURED IN THE ARCTIC

The Arctic region may be considered a “hotspot” for mercury contamination, and many Arctic nations are particularly concerned about global mercury releases.

When mercury is volatilized and travels through the atmosphere, it tends to accumulate in colder regions making the Arctic a unique area for receiving and harboring globally distributed contributions of mercury. Studies indicate that approximately 200 tonnes of mercury are deposited north of the Arctic Circle each year, generally far from local sources.

As mercury accumulates up the food chain, the highest levels are found in top predators such as seals, toothed whales, polar bears and humans (NERI, 2004). Mercury levels in Arctic ringed seals and beluga whales have increased by up to four times over the last 25 years in some areas of Canada and Greenland.

Numerous studies have shown that the high level of mercury in Arctic fish and marine mammals has made its way into the human population. Generally, indigenous people rely on traditional diets, culture and lifestyle and have limited access to alternative imported food. Lower-income families tend to rely to an even greater extent on traditional diets and, as a result, are at even greater risk of exposure (Cone, 2005).

Over 50% of the Inuit population on Baffin Island, Canada are exposed to a far higher level of mercury than is considered a tolerable daily intake by the World Health Organization (Chan, 1997). Those consuming the most fish and wildlife have intake levels of mercury six times higher than the provisional tolerable weekly intake of mercury.

Guidance for Estimating Exposures to Mercury to Identify Populations at Risk
www.chem.unep.ch/mercury/Guidance-training-materials.htm

UNEP 'Toolkit for identification and quantification of mercury releases'
www.chem.unep.ch/mercury/Toolkit/default.htm

A calculator for determining mercury-exposure from fish consumption can be found at:
www.nrdc.org/health/effects/mercury/effects.asp

Pollution Probe: Mercury in the Environment, A primer:
www.pollutionprobe.org/Reports/mercuryprimer.pdf

USEPA mercury portal:
www.epa.gov/mercury

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Acknowledgements:

Mercury Policy Project
World Health Organization

NOTES

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Governments have agreed that there is sufficient evidence of significant adverse impacts from mercury and mercury compounds to warrant action on mercury. This publication was developed to raise awareness in certain countries and regions amongst stakeholders on the effects of mercury on human health and the environment. It is hoped that it will assist citizens, governments and health care workers to build support and the capacity to take action to reduce or eliminate mercury uses, release, and exposure to mercury.

This is the introductory booklet.

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