Mining Environmental Management

CODES OF PRACTICE

Use of Mercury

Guyana Geology and Mines Commission
Brickdam, Georgetown, Guyana

August 2010

Rev – 0

TABLE OF CONTENTS

1.0 Introduction

This Code of Practice for **Use of Mercury** in small and medium-scale gold and diamond mines is intended to provide environmental management guidance and promote the related best management practices. It is not a design manual[1].

1.1 Regulatory Authority/Mandate

The Mining (Amendment) Regulations 2005[2] were promulgated in 2004. Regulation 248 of the Mining (Amendment) Regulations 2005 stipulated that the Guyana Geology and Mines Commission (GGMC) prepare Codes of Practice for Mining Environmental Management prior to their incorporation into the Regulations.

The Codes of Practice were intended to provide critical environmental guidance to the Mining Industry, particularly small and medium-scale gold mines. The importance of the codes was even more enhanced by the development of the Low Carbon Development Strategy.

The following ten (10) provisions of the Codes of Practice for Environmental Management were indentified:

2.0 Use of Mercury
3.0 Tailings Management
4.0 Contingency and Emergency Response Plans
5.0 Mine Effluents
6.0 Mine Reclamation and Closure Plans
7.0 Mine Waste Management and Disposal
8.0 Environmental Effects Monitoring Program
9.0 Quarrying
10.0 Sand and Loam Mining
11.0 Use of Small Dams for the Control of Water/Tailings

1.2 Justification for the Use of Mercury Code of Practice

The Mining (Amendment) Regulations (2005) Articles 224, 237, and 248 stipulates that GGMC prepare a Code of Practice to provide further guidance for the Use of Mercury in small and medium scale mines.

Mercury use in Guyana gold-mining operations is both an environmental and an occupational health and safety (OH&S) issue. Because of the hazards mercury poses for both the environment and the health of persons exposed to it, priority must be given to addressing mercury and its use in precious metals beneficiation in a Code of Practice, as required in the Mining (Amendment) Regulations 2005.

[1] This document is **NOT** a design manual. Users of this document shall assume full responsibility for the design of facilities and for any action taken as a result of the information contained in this document.

[2] The Mining Regulations, made under the Mining Act (1989), was amended by the Mining (Amendment) Regulations 2005: Collectively they address all the important aspects of mining environmental management.

Mercury accumulation in humans in Guyana and the Amazon occurs via two main pathways:

1) Occupational exposure to vapours.
2) Methylmercury transferred by fish.

Recent studies carried out in Guyana have shown significant increases in mercury levels in indigenous carnivorous fish. Because mercury in its methylated form is assimilated rapidly and eliminated slowly, mercury levels in top predators are always higher than the mercury levels in their food, a process called biomagnification. People, who eat carnivorous fish as their main diet, become part of the food chain and biomagnify methylmercury, which accumulates mainly in the brain, causing the so-called "Minamata disease," which severely impairs the central nervous system. In addition, mine workers or goldsmiths who burn gold amalgam every day are greatly exposed to elemental mercury vapours, which jeopardize their health and, in the case of gold boards, the health of innocent people living in the vicinity.

Worldwide concerns about mercury pollution in developing countries have increased significantly over the last decade. Technological knowledge of how to prevent and mitigate the negative impacts of mercury on human health and the environment has expanded significantly and its dissemination has been made much easier through major collaborative projects, such as GAMA (Gestión Ambiental en la Minería Artesanal) in Peru, MEDMIN (Manejo Integrado del Medio Ambiente en la Pequeña Minería) in Bolivia and PMSC (Proyecto Minería Sin Contaminación) in Ecuador, all three funded by the Swiss co-operation agency COSUDE. The outstanding work done by Dr. Marcello Veiga of UNIDO on global mercury pollution abatement technologies has also been instrumental in communicating and disseminating information. These advances, combined with environmental accidents, such as the OMAI and Los Frailes tailings spills, and a better understanding of the concept of sustainable development (SD), have raised public awareness of environmental issues and prompted governments in Guyana and other countries to issue new environment-oriented mining regulations. This Code of Practice for the Use of Mercury in Guyana's Mining Industry is consistent with these developments.

This Code reflects sound management practices followed in the worldwide mining industry. Its principles and approaches are also taken from various sources. It is the result of a comprehensive literature review.

1.2 Administration of Codes and Responsibilities of Owners and Workers

A useful strategy for sustainable environmental management in the small and medium-scale gold and diamond mining is co-regulation by the various stakeholders including the GGMC, and the Miners, and Mining Industry.

GGMC's mandate or role as defined by the Mining Act 1989 and the Mining (Amendment) Regulations 2005 is to develop, administer and enforce the mining regulations. Specific responsibilities include:

- Development and upgrading of the codes of practice
- Consultations with the stakeholders in the mining industry including mining organizations and miners on the development, and utility of the Codes 0f Practice.
- Public education, orientation and training

- Enforcement of, and monitoring compliance with, the Mining (Amendment) Regulations 2005

The prime responsibility for the implementation of, and compliance with, the Mining (Amendment) Regulations 2005, and the application of sound environmental management practices rests with the Mine Owners and operators. Specifically, with the respect to the Use of Mercury, the Mine Owners and operators must:

- Manage their operations in compliance with the Mining (Amendment) Regulations 2005, the related Codes of Practices and Guidelines
- Provide their employees with required training and orientation on the Use of Mercury, and the related the regulations, best management OHS practices, codes and guidelines

2.0 Glossary of Terms

Amalgamation	The process by which mercury is alloyed with some other metal (mostly gold) to produce an amalgam.
Best practice	The best way of doing things. The objective of best practices is to prevent or (when that is not possible) minimize risks to human health, as well as adverse environmental, social and economic impacts.
Co-Regulation	The mechanism whereby a Community legislative act entrusts the attainment of the objectives defined by the legislative authority to parties which are recognized in the field (such as economic operators, the social partners, non-governmental organizations, or related industry associations).
Code of practice	Means the Environmental Code of Practice for the operation of mines that is published by the Commission and which shall be read as part of the Mining (Amendment) Regulations 2005. (A collection of rules and ethical principles related to a specific field of activity. A code of practice describes procedures and sets out standards considered to be best practices in the said field of activity. The code may be voluntary or mandatory)
Guidelines	A non-binding document, usually designed to provide users with information, explanations, guidance and help with respect to a specific topic. Guidelines are a tool frequently used to enforce new regulations. Users can be either the Regulator itself or the industry.
Medium-scale mine	A mine for which a mining permit has been issued and from which a volume in excess of 200m^3, but less than 1000m^3 of material, inclusive of any overburden, is excavated or processed as an aggregate in any continuous period of twenty-four hours.
Mine	Includes any excavation, processing facility and/or related facilities for the recovery of metal, mineral or quarriable material and excludes any excavation, processing facility or related facilities that excavate or process less than 20m^3 in any continuous period of twenty-four hours

Open circuit	Any process whereby the ore that has been in contact with mercury, the water used in processing or the mercury itself may enter a waterway or infiltrate into the soil. It also includes the vaporization of mercury into the atmosphere.
Regulations	A type of "delegated legislation" enacted by a state, or local government agency given authority to do so by the appropriate legislature Regulations are generally very specific and are also referred to as rules or simply administrative law. Regulations are official rules and must be followed.
Small-scale mine	A mine for which a claim license has been issued and from which a volume in excess of $20m^3$, but less than $200m^3$, of material, including any overburden, is excavated or processed as an aggregate in any continuous Twenty-four hour period.
STEL	**S**hort-**T**erm **E**xposure **L**imit
Sustainable Development (SD)	Development that meets present-day needs without compromising the ability of future generations to meet their needs.
TWA	**T**ime **W**eighted **A**verage
UNECA	**Un**it of Gold **E**xtraction and **C**ontrolled **A**malgamation. UNECA regional processing centers provide small-scale mining operations with processing services for gold gravity concentrates. The gold is extracted by trained technicians using environmentally friendly technology (closed-circuit amalgamation, special retorts, fume hoods fitted with charcoal filters, etc). These centers can also provide miners with advice on how to improve their production as well as information on health and safety measures. They also provide a place for educational and organizational activities and other purposes. There are UNECA centers in Venezuela and Zimbabwe.

3.0 Mission and Objectives

3.1 Mission Statement

The following is the Code's mission statement:

Promote sound mercury management practices in Guyana's small and medium scale gold mining industry so as to minimize impacts on workers, communities and the environment.

3.2 Objectives

1) Protect workers, indigenous and non-indigenous communities and the environment from mercury.
2) Ensure and promote proper mercury management in the Guyana gold mining industry.
3) Promote the Code's use by small-scale and medium-scale gold miners, goldsmiths and gold traders.
4) Raise the awareness of and educate all parties with respect to the effects of mercury.
5) Ensure that mercury management practices are flexible (applicable under changing conditions and scenarios) and dynamic over time.
6) Ensure that mercury management practices are credible and verifiable.

4.0 Scope

This Code of Practice is a mandatory code that applies to small-scale, medium-scale gold mining operations. It addresses all issues related to mercury management in the Guyana gold mining industry, namely:

- Occupational health and safety (OH&S);
- Health hazards for communities;
- The environment.

This Code is subject to the Mining (Amendment) Regulations 2005. The Code is intended to complement the regulatory requirements, not to replace them. Compliance with the rules, regulations and statutes is therefore required.

No guarantee is made in connection with application of the Code to prevent hazards, accidents, incidents or injury to workers and/or members of the public at any specific site where mercury is used for gold beneficiation.

5.0 Principles and Standards of Practice

(For further details on how the following principles may be implemented, the readers should refer to ***Section 6 Code Implementation***).

5.1 Storage, Handling and Transport of Mercury

Principle: Protect workers and their families, communities and the environment from mercury exposure and contamination during mercury handling, storage and transport activities.

Standards of practice

5.1.1 Ensure that all persons involved in handling mercury use appropriate safety equipment, such as approved gloves and respirators, at all times while handling mercury.

5.1.2 Ensure that mercury is properly stored in appropriate locations to prevent or contain its release into the environment and to prevent workers and their families and communities from being exposed to mercury

5.1.3 Ensure that mercury is stored accordance to regulations and codes (**Section 6.1.1 – 6.1.6)**

5.1.4 Implement prevention and emergency response measures for the safe transport and handling of mercury.

5.2 Amalgamation of Gold Particles

Principle: Protect workers, their families, communities and the environment from mercury exposure and contamination while ensuring an economically acceptable recovery of gold through sound and efficient amalgamation practices.

Standards of practice

5.2.1 Prohibit amalgamation in open systems where mercury can be discharged into the environment and promote the use of more effective, environmentally friendly alternatives.

5.2.2 Develop information material to make mine owners, operators, and workers, their families and communities more aware of the dangers of mercury to their health and the environment.

5.2.3 Promote the setting up of regional processing centers (UNECA centers) and their use by miners.

5.2.4 Ensure that all persons involved in amalgamation of gold particles use appropriate safety equipment, such as approved gloves, respirators, overalls and rubber boots at all times while handling mercury.

5.3 Disposal of Amalgamation Tailings

Principle: Protect communities and the environment from mercury exposure and contamination by developing and implementing proper amalgamation tailings disposal techniques.

Standards of practice

5.3.1 Promote the development and implementation of simple, effective technologies that is amenable to small-scale and medium-scale miners as determined by the regulatory bodies and ensure the safe disposal and containment of amalgamation tailings.
5.3.2 Develop site selection and design criteria for safe disposal and containment facilities for amalgamation tailings and ensure that these criteria are disseminated to miners.
5.3.3 When tailings containment is required, build tailings facilities in accordance with designs and plans.
5.3.4 Promote the setting up of regional processing centers (UNECA centers) equipped with appropriate tailings containment facilities.
5.3.5 Develop guidelines for handling and transport of amalgamation tailings from mining sites to regional processing/storage centers (UNECA).

5.4 Burning of Amalgam to Recover Gold

Principle: Protect workers, their families, communities and the environment from mercury vapours through the use of appropriate gold-mercury separation technology.

Standards of practice

5.4.1 Do not allow open-air burning of gold amalgam under any circumstances.
5.4.2 Promote the use of safe amalgam-burning devices, such as GGMC- certified retorts.
5.4.3 Enforce the Mining Regulations provision requiring the use of GGMC certified retorts.
5.4.4 Develop national standards and specifications for retorts.
5.4.5 Ensure that all persons involved in burning mercury use appropriate safety equipment and gears.
5.4.6 Promote the setting up of regional processing centers (UNECA centers), and their use by miners.

5.5 Burning of Residual Mercury to Purify Gold (in gold-refining facilities)

Principle: Protect workers, communities and the environment from mercury through the use of sound mercury vapour abatement technology.

Standards of practice

5.5.1 Implement mercury vapour abatement measures to prevent the release of mercury vapours into the atmosphere.

5.5.2 Ensure that the Gold Board or other gold-refining or smelting facilities such as goldsmiths and gold buyers are properly located so that local populations are not affected by mercury emissions into the atmosphere.

5.5.3 Promote the setting up of regional processing/refining centers (UNECA centers) and their use by miners.

5.6 Occupational Health and Safety Management and Environmental Monitoring

Principle: Protect workers, their families, communities and the environment from mercury exposure and contamination through the implementation of proper health management and environmental monitoring programs.

Standards of practice

5.6.1 Develop and implement OH&S and community health management programs in order to increase worker and community awareness and reduce response times in cases of mercury poisoning.

5.6.2 Provide appropriate training for workers.

5.6.3 Provide suitable safety gears and equipments for workers.

5.6.4 Develop and implement periodic monitoring programs in mining districts and their surroundings and in gold-refining facilities (e.g. Gold Board) and their neighborhood to measure the effectiveness of mercury intoxication prevention measures in humans.

5.6.5 Develop and implement environmental monitoring programs in mining districts and their surroundings and in gold-refining facilities (e.g. Gold Board) and their neighborhood to measure the effectiveness of mercury pollution prevention and mitigation measures, and protect surrounding and downstream communities.

5.6.6 Ensure accountability and traceability of mercury.

6.0 Code Implementation

The golden rule of implementation is to use mercury in such a way that it will not affect water bodies (surface or groundwater) or be released into the atmosphere or soil.

6.1 Storage, Handling and Transport of Mercury

Storage

6.1.1 Mercury should be stored in bottles and containers made of unbreakable material, such as plastic or steel. The containers should be airtight to reduce vapour formation and be clearly labeled. Mercury should be covered by water.

6.1.2 Flooring should have an impervious, smooth surface with adequate slope leading to impervious drains via traps at several points and should be laid out so that any spillage is collected in a water-sealed sump for proper collection and disposal. Concrete or HDPE membranes are examples of impervious materials that may be used for flooring). **(This article applies to medium-scale mines only).**

6.1.3 The storage area should be properly ventilated to avoid build-up of vapour concentrations.

6.1.4 Mercury should be stored away from food preparation and sleeping areas.

6.1.5 Mercury should be kept out of children's reach.

Handling

6.1.6 In cases of mercury spillage, the material should be washed away into impervious drains and collected in water-sealed sumps (see 6.1.2). Where it is suspected that small tiny droplets of mercury may remain after adequate washing with water, they can be collected with a syringe or, if the droplets are too abundant; the spilled area may be sprinkled with lime sulphur spray and swept after a period of time as an additional decontamination measure.

6.1.7 If spilled mercury has infiltrated into the ground, all the contaminated soil must be removed and washed and the mercury concentrated by panning or other gravimetric method.

6.1.8 Measures explained at articles 6.1.7 and 6.1.8 must be taken immediately when a mercury spill occurs in a living space, such as a house, because mercury, when exposed to air, evaporates slowly and contaminates the air in a closed environment.

Transport

6.1.9 Articles 6.1.1, 6.1.2, 6.1.3, 6.1.5, 6.1.6 and 6.1.7 also apply to mercury transport.

6.2 Amalgamation of Gold Particles

6.2.1 Mercury amalgamation should never be carried out in open circuit. Open circuit means that either the ore that has been in contact with mercury or the water used in processing may enter a waterway or infiltrate into the soil. See 6.2.3 c) for a closed-circuit amalgamation alternative.

a) Mercury should never be used in ball mills, rod mills or hammer mills. (See 6.2.3).
b) Mercury should never be used in sluice boxes.
c) Mercury should never be used in jigs, shaking tables or centrifuges or in any other gravimetric concentration device.
d) Mercury should never be poured directly onto the ore. Ore should be concentrated prior to amalgamation operations.
e) Amalgamation plates should never be used in open circuit.

6.2.2 The amount of material coming in contact with mercury should always be kept to a minimum.

a) Coarse-grain gold should always be separated from heavy minerals (black sands) prior to amalgamation. Only fine-grain ore should be amalgamated.
b) The concentrate should be enriched as much as possible.

6.2.3 Methods that minimize the production of mercury flour should preferably be used. Milling and amalgamation should never be combined

a) Manual amalgamation should be avoided wherever possible However, if there is no other alternative, amalgamate only a small amount of concentrate in a well-ventilated place and wear appropriate safety gears such as approved gloves, respirators, overalls and rubber boots.
b) The optimum time required for amalgamation should be determined and never exceeded.
c) Amalgamating drums should be preferably used for amalgamating gold particles. They should be operated at a low rpm so as not to over mill mercury.

6.2.4 Ensure maximum recovery of amalgam and non-amalgamated mercury from amalgamated concentrate. The amount of residual mercury in amalgamation tailings should be kept to a minimum.

6.2.5 Manual squeezing off of excess mercury from amalgamation should be avoided.

6.2.6 Excess mercury contained in the amalgam should be squeezed off using a proper device (filter press, centrifuge or under hot water) in order to recover as much mercury as possible. If hot water is used, it should be clarified before disposal so as to remove the mercury it contains.

6.2.7 Squeezed off mercury should be re-used in the process once it has been distilled in a retort.

6.2.8 See Sections 5.3 and 6.3 for standards for disposal of amalgam tailings

6.3 Disposal of Amalgamation Tailings

6.3.1 Amalgamation tailings still contain mercury, mainly as fine mercury droplets called "mercury flour."

a) No amalgamation tailings should be discharged into the general environment or be improperly accumulated.

b) Amalgamation tailings that cannot be sold as a by-product should be stored in a properly ventilated place under a roof and on an impervious floor in such a way that no mercury can be released into the air, the soil or a watercourse. This storage area should never be a living quarter such as a bedroom or a kitchen.

c) If amalgamation tailings undergo reprocessing, precautions should be taken to prevent the release of mercury into the air, the soil or a watercourse (see 5.2 and 6.2).

6.4 Burning of Amalgam to Recover Gold

6.4.1 Gold and mercury separation should be carried out so that maximum mercury recovery is achieved.

a) Gold amalgam should never be burned in open air because lost mercury cannot be recondensed and recovered and causes secondary exposure and contamination.

b) To burn amalgam, a mercury recovery device should be used, such as the following:

c) A retort, consisting of an airtight closed vessel fitted with a condensing tube to recover liquid mercury. Always use a GGMC certified-retort.

d) A GGMC-approved oven for amalgam burning equipped with a cooling and mercury fume condensation system.

e) Any other GGMC-approved condensation or filtering system that allows mercury recovery. Children should not be around when amalgam is burnt.

f) Amalgam should not be burnt in living quarters or enclosed areas.

6.5 Burning of Residual Mercury to Purify Gold (in gold-refining facilities)

6.5.1 The extraction of residual mercury from gold amalgam by burning releases mercury into the atmosphere. Proper mercury vapour abatement measures should be carried out at all times when gold is purified using this method.

a) Fume hoods fitted with a condenser and an activated carbon filter should be used when burning or smelting gold amalgam in the Gold Board or other gold-refining facility such as goldsmiths or gold buyers in order to prevent the operator or nearby residents from being exposed to mercury poisoning.

b) As much as possible, the Gold Board or other gold-refining facility such as goldsmiths and gold buyers should be located away from inhabited areas.

c) Technicians and workers at the Gold Board and other gold-refining facility such as goldsmiths and gold buyers should always wear personal safety gear when handling or burning amalgam.

6.6 Occupational Health and Safety Management and Environmental Monitoring

6.6.1 Training programs (including educational materials) should be provided to workers and communities on an ongoing basis to increase workers and communities' awareness.

6.6.2 Mercury levels in the blood and urine of employees (and practicing goldsmiths) should be determined at suitable intervals as well as prior to employment. Regular periodic medical examinations should be carried out on employees working in areas where mercury may be present. Proper records of such tests and examinations should be kept.

6.6.3 Periodic checks of air quality in areas where amalgam is burnt should be carried out by officers of regulatory bodies.

6.6.4 In the event that the workplace environment has a TWA higher than the accepted limit, workers should be immediately evacuated and the environment treated in order to reduce the level to within permissible limits. Workers who have been exposed to high levels should undergo a medical examination and hair, urine and blood tests to determine the mercury levels in their systems. Remedial action should then be taken as required.

6.6.5 Residents of communities located downstream from gold mining operations using mercury or living in the vicinity of gold-refining facilities (e.g. Gold Board or goldsmiths' shops) should undergo blood, urine and hair tests at suitable intervals. Monitoring of mercury content in water and fish downstream from gold mining operations should be carried out at the same frequency as the tests on people.

6.6.6 A protocol for the record keeping and traceability of mercury should be developed and implemented.

7.0 Monitoring and Surveillance

The monitoring and surveillance activities associated with the use of mercury and this related Code of Practice should be focused on the following results:

- Ensure that all persons involved in amalgamation of gold particles use appropriate safety equipment, such as approved gloves, respirators, overalls and rubber boots at all times while handling mercury.
- Prevent open-air burning of gold amalgam under any circumstances.
- Promote the use of safe amalgam-burning devices, such as GGMC- certified retorts.
- Ensure that all persons involved in burning mercury use appropriate safety equipment and gears
- Residents of communities located downstream from gold mining operations using mercury or living in the vicinity of gold-refining facilities (e.g. Gold Board or goldsmiths' shops) should undergo blood, urine and hair tests at suitable intervals. Monitoring of mercury content in water and fish downstream from gold mining operations should be carried out at the same frequency as the tests on people.
- Ensure that a protocol for the record keeping and traceability of mercury should be developed and implemented.

8.0 Emergency Measures

There are no additional emergency measures or considerations related to the implementation of this code of practice other than those defined by the Contingency and Response Plan Code of Practice.

9.0 References

Beak International Inc., Literature Review of Chemistry and Toxicity of Mercury, Cadmium, Selenium and Antimony in Metal Mining Effluents. *TIME*, *Network,* 142 p.*,* 2002.

Environment Australia, Best Practice – Environmental Management in Mining. Commonwealth of Australia, August 2002.

GENCAP Mining (2004), Draft Codes of Practice, Use of Mercury in Small and Medium Scale-Mines (Guyana), 2003

GENCAPD Mining (2000), *Workshop on Mercury Use in the Mining Industry in Guyana. Summary Report,* July 17, 2003.

GENCAPD Mining, *Workshop on Producing Environmental Codes of Practice for the Mining Industry of Guyana. Summary Report.* September 30, 2003.

Global Mercury Project, *Newsletter* No.1, January 2003.

Government of Guyana, *Regulations made under the Mining Act (No. 20 of 1989). Proposed Amendments, 2002.*

Guyana Forestry Commission, *Code of Practice for Timber Harvesting.* 92 p. (2002).

International Cyanide Management Institute, *International Cyanide Management Code for the Manufacture, Transport and Use of Cyanide in the Production of Gold.* May 2002.

Medina Cruz, G., *Mitigación del mercurio en la minería artesanal y pequeña minería aurífera del Perú.* Jornada Internacional sobre el impacto ambiental del mercurio utilizado por la minería aurífera artesanal en Iberoamérica., 9 p., 2001.

The Mining Association of Canada, *A Guide to the Management of Tailings Facilities.* Ottawa, Canada, 1998.

Veiga, M.M., *Introducing New Technologies for Abatement of Global Mercury Pollution in Latin America.* UNIDO, UBC and CETEM, 63 p., 1997.

Wotruba, H., Hentschel, T., Hruschka, F. and Priester, M., *Manejo ambiental en la pequeña minería*. Edición MEDMIN-COSUDE, La Paz, Bolivia, 302 p.,1998.

Web sites

http://rainbow.ldgo.columbia.edu/edf/text/mercury.html
http://www.gama-peru.org/jornada-hg/index.htm
http://www.hruschka.com/hg-net/
http://www.facome.uqam.ca/facome/home/home_e.html
http://planeta.terra.com.br/educacao/br_recursosminerais/meioambiente.html

http://www.casmsite.org/programs.html

Appendix A: Information on Mercury and Associated Hazards

A-1 Mercury is the only metal present in a liquid state at ordinary temperatures. In its elemental form, it is used in a number of instruments and equipments, such as thermometers, barometers, manometers, blood pressure instruments, direct current meters and mercury switches. Also, because mercury readily forms alloys with many metals, it is used in alkali manufacturing, extraction metallurgy and dentistry. Mercury vapour lamps and mercury arc rectifiers are some major applications of mercury.

A-2 Mercury forms both inorganic and organic compounds. Inorganic compounds are used in various chemical reactions. Organic mercury compounds, such as fulminate, are used in explosives, while alkyl mercury halides are used in seed treatment. **Mercury and its alloys are toxic.** The most extensive use of mercury in Guyana is in the gold extraction and processing industry.

A-3 Metals with which mercury readily forms alloys include sodium, potassium, aluminium, copper, silver, gold and zinc. Mercury metal alloys are generally called amalgams.

A-4 Properties of Mercury

- Atomic number: 80
- Atomic mass: 200.61
- Melting point: -38.9°C
- Density: 13,546 g/cm3 at 20°C
- Vapour pressure: < 0.01 at 20°C
- Description: Silvery white liquid metal
- Solubility in water: Practically insoluble

A-5 Health Hazards

A-5.1 Mercury is highly toxic, particularly as a vapour or when part of organic compounds. Unless properly managed, the use of mercury can be detrimental to the health of any workers close to where mercury is being used. Alkyl mercury compounds are readily absorbed through the skin.

A-5.2 Mercury gives off vapours even at room temperature (25°C). When equilibrium with the mercury source is at room temperature, the vapour concentrates are 200 times the threshold-limit value. Vapour pressure nearly doubles when the temperature increases by about 10°C.

A-5.3 The principal routes of entry of mercury are: (a) vapour into the respiratory tract through inhalation, and (b) ingestion of plant and animal material, including fish, that contain mercury. Mercury bioaccumulates and predatory fish are known to have some of the highest concentrations of the material if the aquatic system contains mercury. Mercury and many of its organic compounds may be absorbed through the skin on direct contact. If mercury-bearing

compounds are ingested, mercury may be absorbed through the alimentary tract. Serious exposure may occur if mercury-containing material is heated in an open or inadequately sealed vessel.

A-5.4 Acute local effects may include irritation, blistering and corrosion of the skin, resulting in dermatitis or eczematic rash.

A-5.5 Chronic *Toxicity.* Inorganic mercury poisoning affects the liver and kidneys, while organic mercury (or methylmercury) settles chiefly in the brain. Chronic exposure to organic mercury causes damage to the nervous system. Methylmercury poisoning, or "Minamata disease," has the following five classic symptoms:

- Visual constriction
- Numbness of the extremities
- Hearing impairment
- Speech impairment
- Walking impairment

With severe exposure, paralysis and death may result. The onset of symptoms of chronic mercury poisoning is insidious. The recovery is usually very slow.

A-5.6 *Acute toxicity*. Acute toxicity may be attributable to ingestion of inorganic mercury compounds, short-term exposure to organic mercury compounds, use of mercury containing foods, or inhalation of mercury vapour. Acute systemic effects may include kidney damage. Possible symptoms of exposure may include metallic taste, burning sensations, swelling, abdominal pain, diarrhea, ulceration, intestinal hemorrhaging, weakness, chills, nausea, coughing and vomiting. If acute exposure is suspected, immediate medical attention is recommended.

A-5.7 *Threshold exposure levels in air*: The recommended time-weighted average (TWA) for mercury is 0.01–0.05 mg/m3 of air for continuous exposure over an 8-hour workday and a 40-hour work week. The short-term exposure limit (STEL) for this material is 0.03–0.1 mg/m3 for 10 minutes. The provisional tolerable weekly intake is 1-5 µ/kg body weigh