



Using Retorts to Reduce Mercury Use, Emissions, and Exposures in Artisanal and Small-Scale Gold Mining

A PRACTICAL GUIDE

Version 1.0



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One of the purposes of the guide is to help with the implementation of the Minamata Convention obligations as specified in Article 7; Annex C. In particular the guide addresses the following four elements from Annex C that must be included in National Action Plans:

- (b) Actions to eliminate (ii) Open burning of amalgam in residential areas;
- (e) Strategies for promoting the reduction of emissions and releases of, and exposure to, mercury in artisanal and small-scale gold mining and processing, including mercury-free methods;
- (h) A public health strategy on the exposure of artisanal and small-scale gold miners and their communities to mercury. Such a strategy should include, inter alia, the gathering of health data, training for health-care workers and awareness-raising through health facilities;
- (i) Strategies to prevent the exposure of vulnerable populations, particularly children and women of child-bearing age, especially pregnant women, to mercury used in artisanal and small-scale gold mining.

Who is this document for?

This document has been designed to help guide the training of Artisanal and Small-Scale Gold Miners (ASGM) on retort use and mercury exposure reduction. This guide is not meant as an exhaustive document on all retort types and their uses. It provides guidance for individual miners and mining communities, and for agencies implementing retort distribution programs or retort training.

One of the key messages in the guide that has not often been clearly described is that retorts - although they are simple technology - have complex operational and handling requirements that must be strictly followed to avoid causing increased human exposure to users and community members. We have seen many instances where retorts reduce mercury emissions to the environment but have actually increased local human exposure due to improper use or handling and location. We therefore view them as a technology that should be used on the path towards the transition to zero mercury use rather than as a permanent feature of the ASGM sector.



How mercury is used in artisanal & small-scale gold mining



a. Rocks or sediment with gold (ore) are collected



b. Ore is crushed to free gold particles



c. Mercury is added to the ore and binds with gold particles to form an amalgam of mercury and gold



d. The ball of amalgam is separated from other materials



e. The amalgam is burned to evaporate the mercury



f. Sponge gold (porous) is left behind

How can people be exposed to mercury in ASGM?

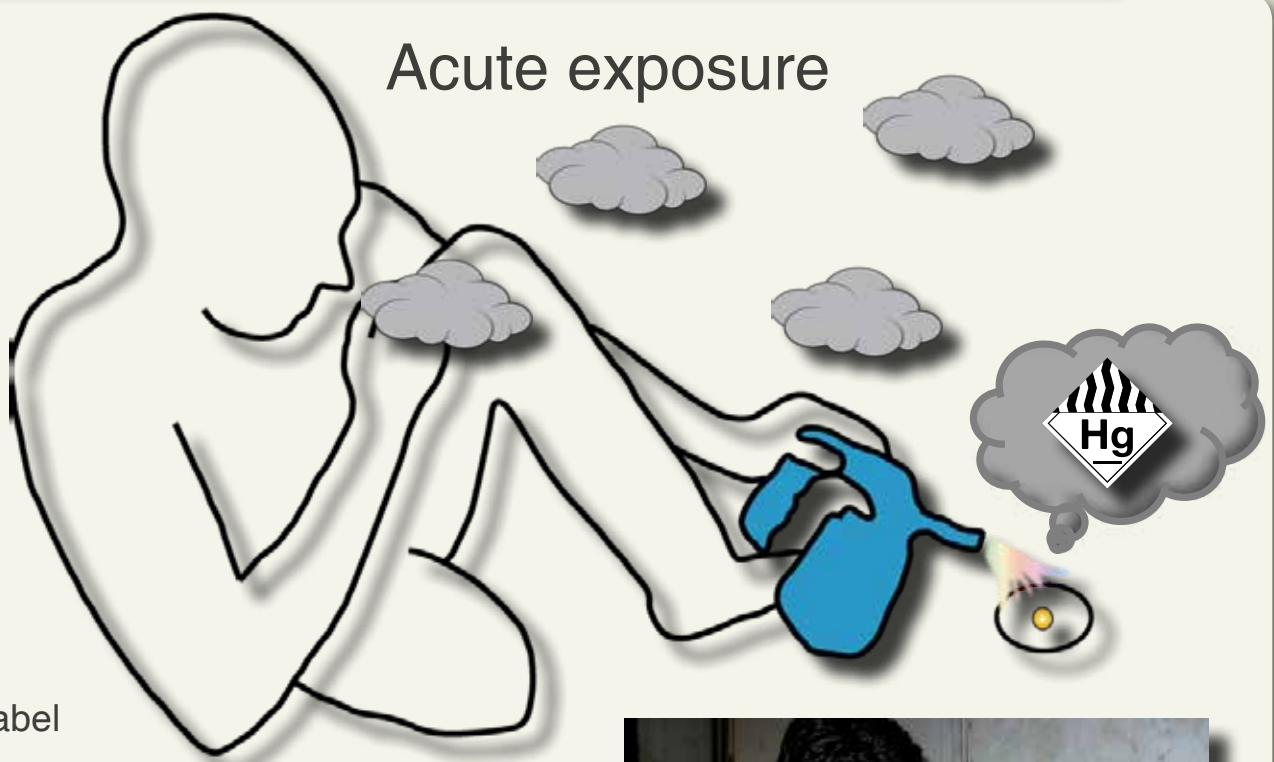


1. If the person touches the mercury or amalgam some mercury can go through the skin and get into the blood. When he burns the amalgam in open air he breathes in the mercury vapours which then get into the blood. The mercury vapours have no odour and can't be seen

Acute exposure



Mercury
Chemical Label



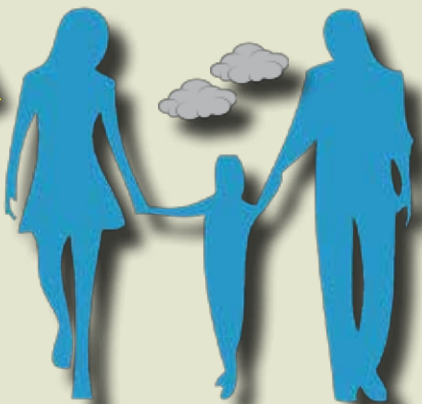


2. The mercury vapour goes into the air and sticks onto the surfaces of everything nearby (for example the walls, floors, and clothing).

3. The mercury vapours that stick onto the surfaces are later released into the air.



4. The mercury vapours spread through the community with the wind.



5. People in the community get exposed by breathing in the mercury vapours from the burning or when they enter the place where the amalgam was burned, even if it is a long time after the burning took place.

6. Contaminated clothes and other objects that workers bring home can expose their families and friends to mercury and contaminate their houses for long periods of time.



7. When mercury enters rivers and lakes, it can be taken up by fish. When people eat the contaminated fish or seafood, the mercury enters their body.

Effects of mercury



Mercury affects mainly the brain and the nerves. It can also affect the kidneys and heart. People exposed to mercury can have these symptoms:

Lack of Balance

Headache

Loss of memory

Trembling

Lack of coordination



Women and children



Mercury is especially dangerous for unborn babies and children because their brain and nervous system are still developing. Babies and children are very vulnerable to damage from mercury, which can be permanent. Mercury must always be kept away from children and pregnant women and women of child bearing age (women that could be pregnant). This includes keeping them away from mercury contaminated work clothes, spaces (where the amalgam is burned) or objects (such as retorts).

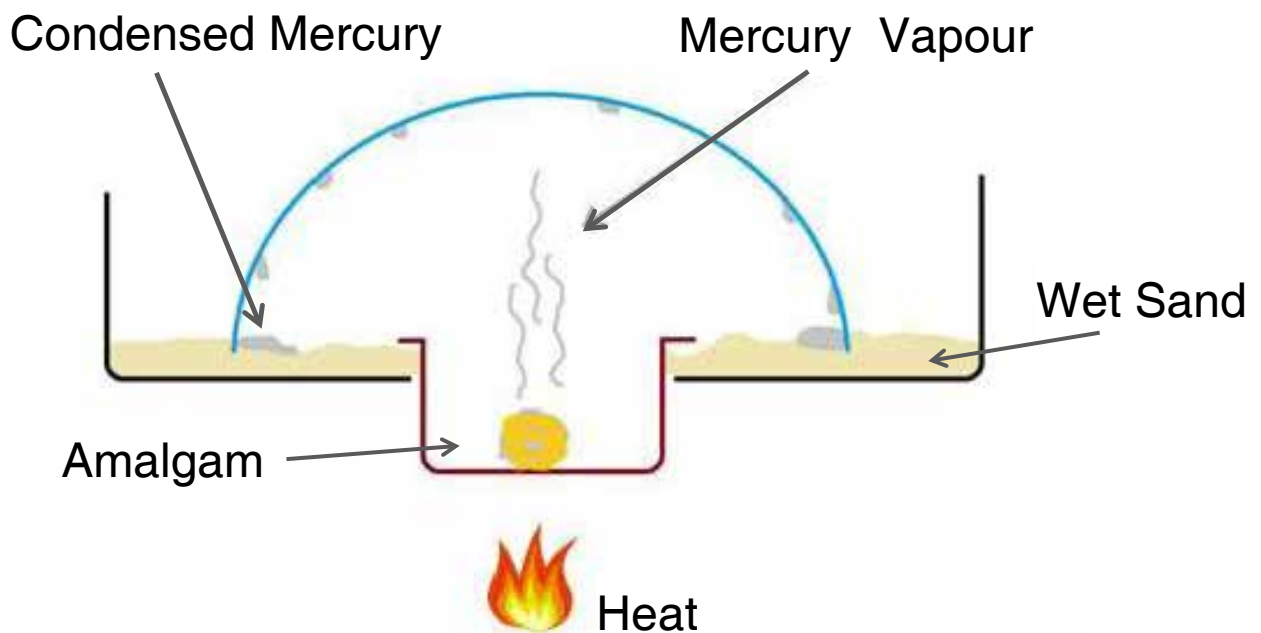
What is a retort?



A retort is a simple device used to capture invisible mercury vapours and turn them back into liquid mercury. This mercury can be reactivated and reused, or it can be safely stored or disposed of according to proper protocol.

Retorts can help prevent breathing the dangerous mercury vapours, but they are not perfect and do not collect 100% of the mercury.

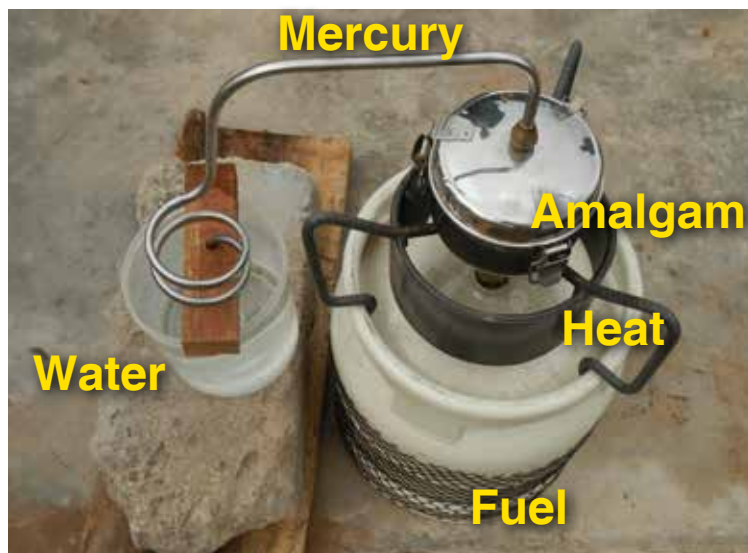
Key message: Even the best field retort will let some vapour escape (typically 5-20%). If not used properly, retorts will not protect the user and may even increase exposure. If retorts are operated or stored indoors (such as a house or car), or people are very close to them when they are operated, exposures can increase.



How does it work?

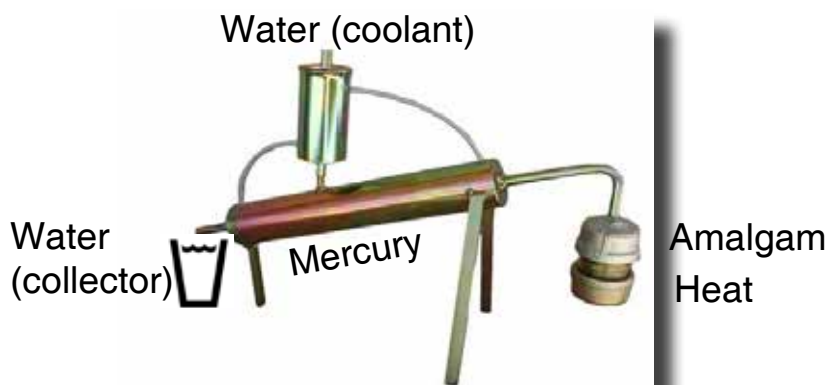
1. The amalgam is placed in the retort.
2. The amalgam is heated.
3. The mercury turns into vapours.
4. The retort cools and condenses the vapour into liquid mercury.
5. The liquid mercury drips down into wet sand.
6. Mercury can then be recovered.

Retorts come in many designs



Fauzi retort (Indonesia, locally-made): the mercury is collected into water.

Simple bowl retort (Mozambique, CASM project, locally-made): the mercury is collected into wet sand.



Pipe retort (South America, locally-made): the mercury is cooled by a water jacket surrounding the pipe and collected into a separate water vessel.

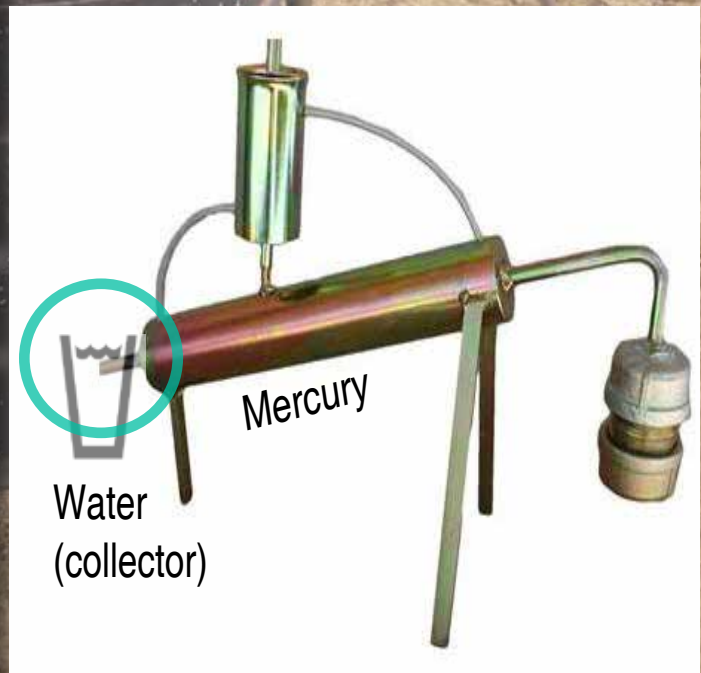
How to use a retort safely?



Instructions:

Set-up your retort as demonstrated by your instructor. This will vary depending on the retort design.

- 1 Place the retort in the designated area for its use. This should be in a non-residential area, outdoors and well ventilated. If burning indoors, an exhausted fume hood must be used.
- 2 Place the retort above heat source.
- 3 If you are using a type of retort that collects mercury into a water bowl, place the end of the retort pipe under water. Make sure to keep the heat constant or water could be sucked up the pipe and cool the retort.
- 4 Heat the amalgam until all of the mercury is evaporated (the time varies - depending on heat source, size of amalgam, etc).
- 5 Wait for the retort to cool. Quenching (cooling it with water) is okay, but don't open the retort while it is still hot. If you do, mercury vapours will escape and contaminate you.
- 6 Check your sponge gold color to guess if all the mercury is gone. If not, then use the retort again.



Retorts DO's and DON'Ts



DO use a retort outdoors to avoid vapours depositing on indoor surfaces. If it is used inside a retorting centre, limit the time you spend inside that facility as it will be contaminated.

DO use the retort far away and downwind from the villages or residences.

DO store the retort in a dedicated place - outside the house, and away from women and children.

A retort **MUST NOT** be used by women or children.

DO NOT store a retort and the clothes of the user indoors (unless it is a retort centre).

DO NOT open a retort before it is completely cool to the touch, or mercury vapour will escape. Note that there will always be some mercury vapour that escapes when a retort is opened but these will be minimized by cooling the retort.



Locate the retort centre far from the village, and downwind from it.

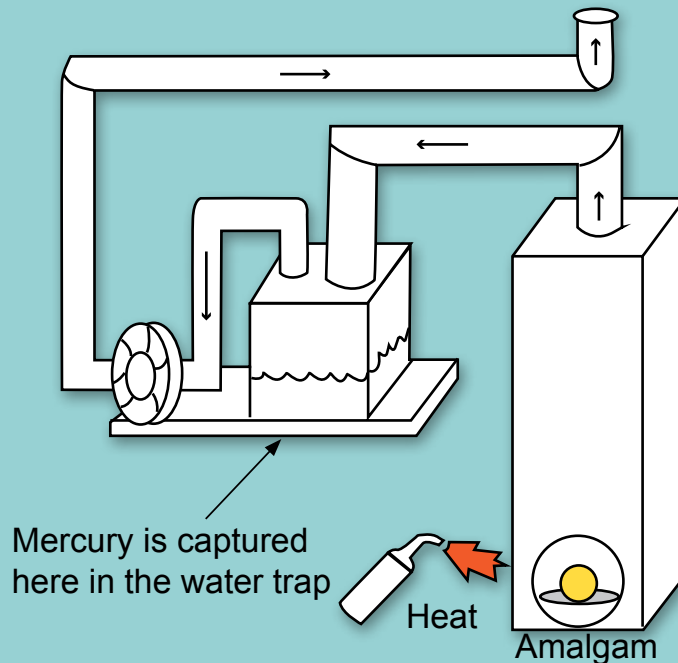


Fume Hoods

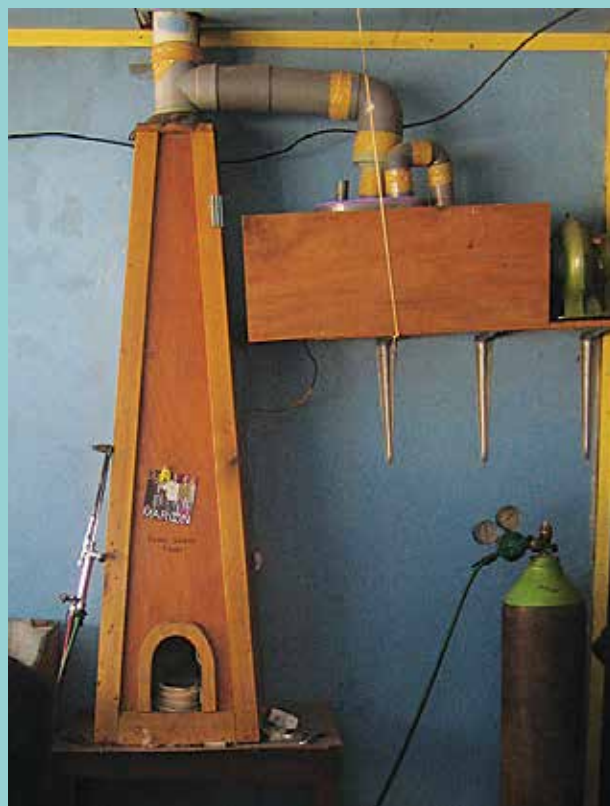


Sometimes, people will burn their amalgam indoors, especially in gold shops. In this case, a simple retort will not be enough to protect against mercury vapours. A fume hood is used to capture and exhaust vapours from the indoor area. However, these locations should never be located in residential areas.

A fume hood with a mercury capture system can reduce the mercury in the air and human exposure. A simple and inexpensive system can typically capture up to 80% of emissions. More expensive and complicated systems can capture more. Two different fume hood types are presented here.



example *The waterbox mercury condenser is an inexpensive and easy-to-manufacture add-on to exhaust chimneys used in many gold shops. Mercury vapour from amalgam burning is pushed through water by a fan where it cools. This causes the mercury to condense as liquid mercury and sink below the water.*



Fume Hoods



example This fume hood design by the USEPA uses common fuel drums, impactor plates and a fan to trap mercury. The drum is attached to the fume hood exhaust system of a gold shop. Mercury collects inside the drum.



Other precautions



Mercury should never be used by or near women of child bearing age, pregnant women, or children.



Mercury should be stored in a solid bottle or jar with a tight fitting lid and a layer of water on top. This will help prevent vapours from escaping. It should be clearly marked as Mercury and as Toxic and should be stored on a solid surface like concrete in a secure location unreachable by children.

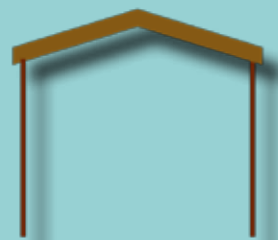
Wear gloves when handling mercury or amalgam or even when stirring it manually with a stick.



If you can find an activated charcoal respirator, use it! It is the only one that works to prevent you from breathing mercury vapours. Dust masks and fabric do not stop you from breathing mercury just as they do not stop you from breathing air.

http://www.xyleneonline.com/sections/com-pounds/air/air/index.php?file=product_info/productPath=1_00&product_id=1000014

It is a good idea to create an amalgamation centre for retort use in a non-residential area. Work clothes and materials can be securely stored there so they are not brought home, where they can expose others to mercury. The centre will become contaminated so time spent inside it should be as limited as possible.



Future solutions...



Although retorts can reduce the amount of mercury that people breathe and the amount of mercury that gets into the environment, they are not perfect and must be used correctly everytime. Areas where retorts are used will always ultimately become contaminated. Mercury is persistent and very difficult and expensive to clean up.

The use of mercury is easy but it is actually not very good at capturing gold compared to some other methods. For economic and health reasons it is a good idea to start investigating mercury-free methods now and to try to switch to them as soon as possible. In the meanwhile use retorts properly and protect yourself, your community and the environment.

Some ideas on mercury-free methods are shown in the Practical Guide on Reducing Mercury in Artisanal and Small Scale Mining. This is a publication sponsored by the United Nations Environment Program (UNEP) and the United Nations Industrial Development Program (UNIDO). You can find a version of it in English, French or Spanish at the following website:

www.artisanalgold.org

A three minute video of an operating mercury free artisanal gold production system and training centre in Burkina Faso that is simple, intuitive and inexpensive can be seen on the Artisanal Gold Council's Youtube channel in English and French (www.youtube.com/user/ArtisanalGoldCouncil).



Partnership Africa Canada (PAC) and the Artisanal Gold Council (AGC) collaborating on the development of a mercury-free artisanal gold mining site in the Democratic Republic of the Congo (DRC). Photo of the executive director of the AGC, Kevin Telmer taken by Shawn Blore of PAC.



Artisanal Gold Council (AGC) mercury-free artisanal gold production system and training centre in Burkina Faso.

If you have a mercury reduction project underway or know something about mercury use in ASGM in your country or community, you can add it to the www.mercurywatch.org or go to the site and write to mercurywatch to explain the information you would like to contribute and you will be assisted.

The Artisanal Gold Council has produced other practical guides that contain related material. Our Health Guide may be of interest. We also produced UNEP's Practical Guide on Reducing Mercury in ASGM. These publications can be found at the following website:

www.artisanalgold.org



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