

## **Mercury Use in Small-Scale Gold Mining**

Adapted from the United Nations Environment Programme/Chemicals: Mercury Programme. Module 3: Mercury Use in Artisanal and Small Scale Gold Mining downloaded from [http://www.chem.unep.ch/mercury/awareness\\_raising\\_package/E\\_01-16\\_BD.pdf](http://www.chem.unep.ch/mercury/awareness_raising_package/E_01-16_BD.pdf).

### ***Overall:***

Recent and significant increase in the price of gold from US\$260 per ounce in March of 2001 to more than US\$1000 per ounce in March of 2008 has driven a “gold rush” among poverty-driven miners in many countries outside of the United States. This type of mining (artisanal and small-scale gold mining [ASGM]) can be a key income source in these areas, particularly rural areas where other alternatives for jobs are limited. ASGM is estimated to include 10–15 million people (likely increasing in numbers with the gold prices), an estimate that includes approximately 1 million children and 4.5 million women.

Mercury is very often used to extract the gold in this small-scale method of gold mining. The result is that ASGM causes the largest single “intentional-release” of mercury in the world. Because this type of mining is often unregulated, there arises a danger to the workers via mercury exposure as well as to the general local community due to mercury contamination of fish from nearby waterways, a situation to which children and women of child-bearing age are most at risk. The ecosystem contamination and environmental degradation that results can last decades after mining has stopped.

There are easy and cost-effective ways to reduce mercury exposure in ASGM, although some of the options have dangers themselves and need to be used cautiously (e.g., use of cyanide).

### ***What Is ASGM and What is the Relationship to Mercury?***

ASGM is the extraction of gold in small- to medium-sized operations. Techniques are usually rudimentary, using practices that do not require much financial investment. Yet it is a significant income source for the miners, especially in areas where jobs and other financial opportunities are limited. ASGM may be responsible for production of 20–30% of the world’s gold ( about 500–800 tonnes per year) and over 100 million people in 55 different countries rely on ASGM for their income.

With ASGM, mercury is often used to extract the gold from the ore. This can result in very unsafe conditions for both health and environment, especially as most of the people using mercury in ASGM are not aware of the risks and receive no training in its handling. The use of mercury has been on the rise as the price of gold has risen, even in countries that prohibit its use, likely as it is considered to be effective, relatively inexpensive, and easy to use.

Although large-scale gold mines have adopted other methodologies to reduce their mercury use, sometimes mercury may be generated as a byproduct in those types of mines as well.

### ***How Does the Process Work?***

When the ore is exposed to mercury, mercury will bind to the gold and form an amalgam, making it easier to separate the gold. The amalgam is then heated, and the mercury evaporates, leaving the gold behind.

- In Whole Ore Amalgamation, mercury is added to the ore during the crushing, grinding, or sluicing processes. Often only 10% of the mercury bonds with the gold, leaving the other 90% of the mercury to be released into the environment or removed from the mix and recycled. This method results in the greatest amount of mercury pollution in ASGM and is evidenced by the highest levels of mercury in the soil and fish, and severe health issues in miners and nonminers due to exposure to mercury.
- In Gravity Concentration (aka “panning”), the mercury is added to particles that are already slightly more concentrated in gold via panning. This process has a much greater success rate in forming amalgams, resulting in only 10–15% mercury *loss* with this procedure.

When the amalgams are heated to recover the gold, mercury is released into the air and can be inhaled by those nearby, particularly including, but not limited to, the miners, and resulting in global mercury emissions of about 300 metric tonnes/year. A way to reduce these emissions is to use something called a “retort,” a simple and inexpensive device (e.g., a bowl or similar vessel), which can be purchased or homemade and which captures the mercury vapor before it escapes. This reduces the amount of mercury in the air and allows the user to reclaim the mercury; over 95% of it can be recycled and reused in the amalgamation process. This simple technique can thus help reduce mercury emissions and avoid negative health and environmental effects, while allowing the miner to save money by reusing the mercury.

### ***Why Is Mercury a Problem?***

Methylmercury is a dangerous form of mercury that can cause significant neurological problems even at low doses. Exposure can occur via many venues: Inhalation of mercury vapor when burning the amalgam or absorption through the skin when touched directly. These amalgamation processes are often completed without protection (gloves and retorts) and without protective measures (when children are present or even in the home). Additionally, mercury affects not only the immediate processing area but the vapor (or the mercury dust on the miners’ clothes) can settle in nearby areas, including food preparation areas, homes, soil, and local waterways, sometimes traveling long distances via air or water. It can be passed along in breast milk to infants. Methylmercury bioaccumulates in the food chain and thus can return to humans in a more concentrated form when fish are consumed, particularly those fish high up in the food chain and those downstream from ASGM facilities. Health surveys have found that ASGM miners have high levels of mercury and may be exposed to levels that exceed by 50 times the public exposure limit recommended by the World Health Organization.

Areas that are particularly concentrated with metallic mercury are calling mining “hotspots.” They can be small or extend hundreds of square meters. They can have significant impacts on the mercury concentration in the connected aquatic systems and thus the thousands of people who live nearby, and contamination can last decades after the mining activities have been completed. Often the mercury-laden tailings are dumped near or into aquatic systems or sometimes the tailings can be washed in suddenly in large quantities when tailing dams fail due to floods or other severe weather events.

### ***What Can Mining Communities Do?***

Cost-effective alternatives exist to reduce or eliminate mercury use in ASGM.

- Use methods, such as panning or magnet sluice boxes, to obtain a preliminary concentration of gold within the ore, rather than using whole-ore amalgamation. This requires less mercury and creates less waste mercury.
- Use protective measures such as gloves and retorts to reduce skin exposure and inhalation.
- Where a greater financial investment is possible and technical expertise available, mercury may be phased out via fine grinding of the ore and further concentration of the individual gold particles.
- Gravity separation and other concentration methods can sometimes be used in the absence of mercury in certain geological situations (alluvial ore) where gold exists as a separate entity already (about 10% of current ASGMs have this type of gold).
- Cyanidation methods are also a possibility to replace mercury; however, it might not be technologically or financially feasible for all ASGMs. Additionally, cyanide not only presents its own health and environmental risks, but combining cyanide with mercury (which can help create methylmercury) can exacerbate health and environmental problems.

### ***Why Do Miners Still Use Mercury Methods for Extracting Gold?***

High gold prices and low mercury prices combine to support use of mercury-rich methods in the ASGM mining communities. Sometimes mercury is even provided free of charge from those purchasing the gold from the community. Even though mercury can be imported legally into countries for use in dentistry, much winds up being used in ASGM. Trading of mercury between countries is generally unregulated.

Difficulties have been noted in convincing miners in these communities, who often live in subsistence conditions, of the health or environmental concerns. Greater success has been found in communicating/training via community leaders (as opposed to those from outside the community) and demonstrating the economic benefits of recommended methods to the miners.

### ***What Can Be Done?***

Some stakeholders in this situation include the citizens of the affected community, health care workers that live in or visit the area, and the governments under which ASGM takes place.

**Citizens** should be aware of the dangers of inhaling mercury and letting it touch their skin. They should also avoid consuming fish found downstream of the ASGM facility. To help avoid exposure, they should make sure that mercury is used and stored far from their families and be sure never use cyanide and mercury within the same area.

**Health Care Workers** should take steps to educate the citizens about the dangers noted above and be able to recognize when mercury poisoning has occurred. They should inform authorities when instances of mercury poisoning are found so that other citizens can be evaluated for symptoms and the source of the problem identified.

**Governments** have the ability to help at various levels alleviate the issue of mercury poisoning and contamination in ASGM. These include assisting in the *outreach and education efforts* to inform miners/citizens about the dangers of mercury where it is being used, about better sources of fish to eat (those more likely to have low mercury levels rather than the fish higher on the food chain, which tend to have higher levels), and to work with the miners to find methods (and provide/subsidize the necessary equipment) that reduce the use of mercury and the incidents of releases of mercury to the local environment. Governments could also work to formalize, and be able to better regulate, ASGM at the national level, limit mercury supply, and build the capacity to sell cleaner gold. Joining the UNEP Global Mercury Partnership can help governments work towards cleaner ASGM.