



# A PRACTICAL GUIDE

## REDUCING MERCURY USE IN ARTISANAL AND SMALL-SCALE GOLD MINING





**1972-2012:**  
Serving People  
and the Planet



**University  
of Victoria**



**IUGS-GEM**  
Commission on Geoscience  
for Environmental Management

*Copyright © United Nations Environment Programme, 2012*

A UNEP Global Mercury Partnership document produced in conjunction with the Artisanal Gold Council and with assistance from UNIDO, University of Victoria, and the International Union of Geosciences Commission on geosciences for Environmental Management (IUGS-GEM); 2012.

The primary authors of this document are Kevin Telmer and Daniel Stapper of the Artisanal Gold Council (AGC). All of the photographs and images in the document with the exception of those specifically indicated are property of the Artisanal Gold Council and can not be used without permission.

This publication may be reproduced in whole or in part and in any form for educational or non-profit purposes with special permission from the copyright holder, provided acknowledgement of the source is made. UNEP would appreciate receiving a copy of any publication that uses this publication as a source. No use of this publication may be made for resale or for any other commercial purpose whatsoever without prior permission in writing from the United Nations Environment Programme.

#### Disclaimer

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the United Nations Environment Programme concerning the legal status of any country, territory, city or area or of its authorities, or concerning delimitation of its frontiers or boundaries. Moreover, the views expressed do not necessarily represent the decision or the stated policy of the United Nations Environment Programme, nor does citing of trade names or commercial processes constitute endorsement.

# Reducing Mercury Use in Artisanal and Small-scale Gold Mining

A Practical Guide



A UNEP Global Mercury Partnership document  
produced in conjunction with Artisanal Gold Council.  
[www.artisanalgoldcouncil.org](http://www.artisanalgoldcouncil.org)

# Table of Contents

## The Basics

Perspective .....	page 7
Who can use this document? .....	page 7
Why worry about mercury? .....	page 8
Worldwide mercury consumption and emissions .....	page 9
How is mercury used to capture gold? .....	page 10
Health risk to miners and families .....	page 12

## CHAPTER 1 - Mercury use in detail

1.1 Whole ore amalgamation .....	page 16
1.2 Concentrate amalgamation .....	page 18

## CHAPTER 2 - Solutions

2.1 Identifying appropriate solutions .....	page 21
Solutions chart - which solutions work? .....	page 22
2.2 Mining and concentration .....	page 24
Gold liberation .....	page 24
The importance of grain size .....	page 26
2.3 Improving concentration .....	page 28
Sluices .....	page 30
Centrifuges .....	page 32
Spiral concentrators .....	page 34
Votex .....	page 35
Shaking tables .....	page 36
Flotation .....	page 37
Magnets .....	page 38



2.4 Processing and refining . . . . .	page 40
Avoiding open air burning of amalgam . . . . .	page 40
2.5 Improving processing and refining . . . . .	page 42
Retorts . . . . .	page 42
Fume hoods . . . . .	page 44
Mercury activation . . . . .	page 46
2.6 Eliminating mercury use: zero-mercury processes . . .	page 48
Gravity only . . . . .	page 48
Direct smelting . . . . .	page 50
Chemical leaching as an alternative to mercury. . .	page 54
Model of a mercury-free processing plant . . . . .	page 56
2.7 Related topics . . . . .	page 60
Gold deposit type, exploration and planning. . . . .	page 60
Purifying gold - the quartering method . . . . .	page 61
Mercury use before cyanidation . . . . .	page 64
Waste management and contaminated sites . . . . .	page 66
Annex 1. Summary of the ASGM sector . . . . .	page 68
Annex 2. Relative costs of technical interventions. . . . .	page 69
Annex 3. UNIDO Technical Guidelines on mercury . . . . .	page 70

Pieces of 'sponge gold' in this photograph are the result of mercury amalgamation. Each piece of sponge gold represents a day of work for a group of miners. The large ball in the foreground, is 8 grams - worth 385 USD, at a price of 1500 USD/ounce.



Miners attending a training session in Mozambique

Artisanal and small-scale gold mining (ASGM) is an important development opportunity which can contribute directly to poverty alleviation and regional development. Although social and environmental problems are common in this sector, there is also an opportunity to transform mineral wealth into lasting local development.

# Perspective

1. Gold can represent an excellent method of transferring wealth to rural communities: small-scale producers often get 70% or more of international prices, even in remote areas. This is much higher than other products such as coffee, bananas, etc.
2. Artisanal and small-scale gold mining (ASGM) needs to be brought into the formal economy to maximize benefits and enable improvements
3. In order to comply with modern environmental standards, reducing mercury use is a key step in realizing ASGM development opportunities

## Who can use this document?

Policy makers, miners and civil society can use this document to learn about technologies and approaches for reducing and eliminating mercury use in artisanal and small-scale gold mining (ASGM).

### **Governments:**

- A simple educational and planning tool for technical aspects of intervention programs and policy considerations
- A decision tool to understand best practice options
- An explanation of the technical fundamentals that underpin and encourage formalization of the ASGM sector

### **Miners:**

- A graphic introduction of best practices
- A guide on how local conditions influence possible improvements in mining practices
- An explanation of barriers to be overcome to improve practices and reduce mercury use

### **Civil society:**

- An educational tool to better understand ASGM
- An explanation of barriers that mining communities face when trying to improve mining practices and reduce mercury use



# Why worry about mercury?

Mercury is a powerful neurotoxin that is harmful to people, but especially to developing fetuses, and young children. Once emitted, mercury can travel great distances through the atmosphere, causing global contamination of ecosystems, fish, birds, mammals, and the human food chain. Worldwide, consumption of mercury contaminated seafood puts billions of people at risk of mercury poisoning, which affects brain and nervous system development and function. Local exposures in mining communities that use mercury can be even more acute.



预览已结束，完整报告链接和二维码如下：

[https://www.yunbaogao.cn/report/index/report?reportId=5\\_14416](https://www.yunbaogao.cn/report/index/report?reportId=5_14416)

