Mercury Capture in Artisanal and Small Scale Gold Processing
Why focus on Gold Processing?

- Mercury-gold amalgam burned during gold purchasing – secondary processing of gold dorée which still has mercury content of 5 – 20%

- Typically little or no control of emitted airborne mercury

- Regional funnel points for ASM gold production

- Located in regional economic centers

- Located in regional population centers – high human exposure rates
Gold Shops are a common selling point for mercury in artisanal scale mining communities.
Amalgam or Doree (5-15% mercury)

Burned in the Gold shop

Purified Gold

Mercury Released to the Environment

Simplified ASGM gold shop processing cycle
Purified Gold

Amalgam (5-15 % mercury)

Burned in the Gold shop

Simplified ASGM gold shop processing cycle

Mercury Released to the Environment

Mercury Capture System

Purified Gold
Mercury Emissions Occur in High Population Areas in Brazil
Ambient Air Mercury Concentrations
Ambient air @ 1 block from gold shops, Puerto Maldonado, Peru

Reference Value: WHO maximum ambient air standard: 1 mcg/m³
Mercury levels in Gold Shops
Average values: 14 shops. Madre de Dios, Peru

Reference Value: WHO maximum occupational Air Standard OSM: 20 mcg/m³
Occupational Safety Improvements after Installation
Mercury Concentrations Inside shop - A & M Metals, Puerto Maldonado

Reference Value: WHO maximum occupational air standard OSM: 20 mcg/m³
Example Mercury Emissions Reduction Calculation

If a gold shop processes 100 kg of gold amalgam per year

and

Assuming the amalgam contains 10% mercury

then

Mercury emissions for this shop = 10 kg mercury per year
(100 kg x 10% mercurio = 10 kg)

With recommended installation and use, a Mercury Capture System running at 80% capture efficiency would result in

8 kg of mercury emissions prevented per year per gold shop
Designing a Mercury Capture System

Design Principles

1. Effective in capturing mercury vapor and aerosols to reduce environmental release and human exposure
2. Affordable for the majority of gold shops in developing countries
3. Easy to construct using locally available materials and local technologies
4. Low maintenance

With EPA funds, Argonne engineers developed a mercury capture system prototype using thermodynamic mercury aerosol simulation models.
EPA/ANL Mercury Capture System
The system contains a powerful extractor fan to create negative air pressure to draw exhaust into the System.

A series of baffle plates act as impaction surfaces for mercury aerosols to strike and coagulate.

The extractor fan and the baffle plates are joined in a single unit that is easy to transport and insert into a 200 liter drum.

Interior of the top cone showing the flow-smoothening vane.
Mercury Aerosol Particles Impinge on the Baffle Surface
Simple Construction
Modular Assembly
Flexible System Installation
Itaituba and Creporizao, Brazil
Pilot System Capture Efficiency
Field efficiency tests: 2007-2008

Mercury Concentrations in Exhaust
Mean of 6 tests runs burning 100% mercury samples

Exhaust without treatment: 1580 mg/m³
Exhaust with treatment: 330 mg/m³

>80% measured removal efficiency

Cost of system: Materials + Labor + Installation ~ US $450
Installation of Pilot Mercury Control System
Ananea, Puno
Installed Mercury Control System
Cooperativa Santiago. Ananea, Puno
November 2009
Madre De Dios – Return to See Mercury Capture System Replication

- Puerto Maldonado
- Masuko
- Huepetue
Gold shop: Golden Peru Oro

- Installed EPA Design system August 2009
- Owner purchased system from a local manufacturer and is now selling the systems to other gold shops in Madre de Dios
- The owner actively promotes system use, and is a source for information on more responsible use of mercury

Conclusion

- Private sector may promote the spread of appropriate technologies, if local markets are provided needed information to develop demand.
Masuko, Madre de Dios  
Ongoing Replication  

**Background**

- **Gold shop:** E +M Gold
  - EPA design system installed in June 2009
  - Owner purchased system from a local business in Puerto Maldonado
  - Reasons owner stated for buying system
    - Health of children
    - To reduce pollution of the environment
  - Owner also sold retorts and promoted use
Huepetue, Madre de Dios
Ongoing Replication
November 13, 2009

- **Gold shop:** Oro Yornet

- Installed EPA Design system May 2009
- System was donated by DREM (Regional Mining Agency) as a demo Pilot to incentivize use in Huepetue
- The owner actively promotes system use, and is a source for more responsible use of mercury in Huepetue

**Conclusion**
- If trained, agents can promote solutions multiplying efforts to disseminate appropriate technologies
EPA / Argonne Mercury Capture System
For ASM Gold Shops

Summary

Effective, low cost, field tested Hg reduction system for ASM gold shops

Base system reduces Hg emissions more than 80%

Add on filters in development to further reduce emissions

• Affordable - US$ 450 materials + labor (Brazil and Peru Amazon)
• Lightweight - 50 kg
  • Easily transportable
• Simple Construction:
  • Uses commonly available 200 liter drums
  • 1-1.5 days in a small metal shop
• Simple straight-forward installation
  • 3 hours labor (avg; Peru and Brazil)
• Mercury captured and retrieved through a spigot at bottom can be recycled