Tecnical solutions for safe amalgam burning within the cultural context of small scale miners

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Experiences of PMSC

PMSC: Ecuador 1993 - 1999

Amalgamation:

Low cost - high efficiency

Substitution:

Unrealistic (for small scale miners)

Prevention better than site cleaning

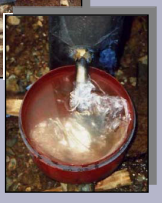
Similar situation in most small-scale mining areas

Usual prevention technology: Retorts

Different
models …
designs …
materials …
… same technical principle







Cheap technology
Quick amortization
Excellent recovery (95 … 99.5 %)

especially using hermetically closed systems...

… Usual gold shop's practice …

Purity of gold:
Bargaining (visual determination due to color) !

Shop owner's objective:
To pay lowest possible price

Usual practices:
Burn violently to bright red (max. 2 min for 100 g)

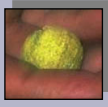
- to eliminate all mercury
- to cause "cracking" of bullet to detect fakes
- to cause splintering to "lose" weight

Argument poor quality of gold

Mercury vapor protection:
Usually none
In best case blower and ventilation tube


… Usual gold miner's practice ...

Miner's objective:



Obtain solid, yellow bullet, best for bargaining

Usual practices:

Burn carefully to dark red

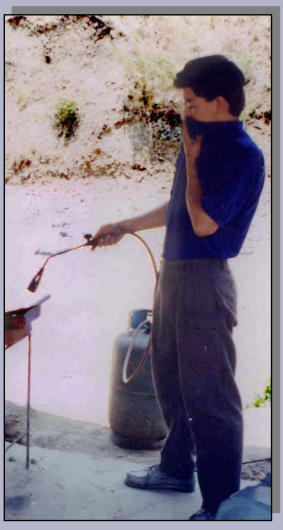
- to avoid "cracking" of bullet
- to avoid splintering

Visual control of burning process

Mercury vapor protection:

Most miners are aware of dangerous vapours

Most miners prefer burning amalgam at open air



miner's and gold trader's "arguments"

Gold will be lost	9	not true
Retorting is not hot enough	9	excess heat not necesary
Gold will not be burned well	9	not true if correctly burned
Some mercury remains	9	not true if correctly burned
Retorting takes too long	7	takes longer
Burning can't be observed	7	true for metal retorts
Glass retorts are too delicate	7	true for rough field use
Gold will deteriorate	7	sometimes true

DILEMA

Retort:

Best technical solution for mercury recovery

Miners:

In many cases don´t like and won't use retorts

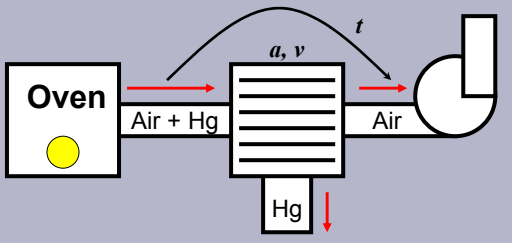
If miners accept retorts … ok
If not … other solutions must be provided !

Alternative solution: Amalgam oven

Basic idea:

Oven: open burning chamber with ventilation;

recover mercury from exhaustion gases



Design criteria:

Minimum airflow in oven: 50 cm/sec (safety for operator)

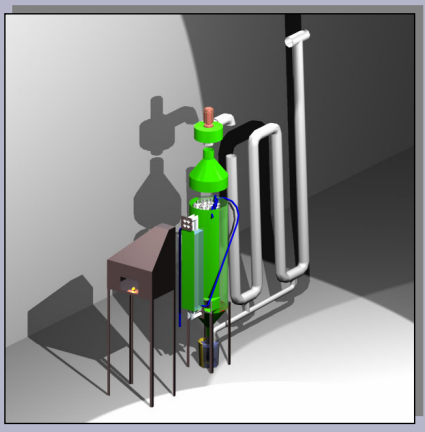
Maximization of $(a*t) / v$

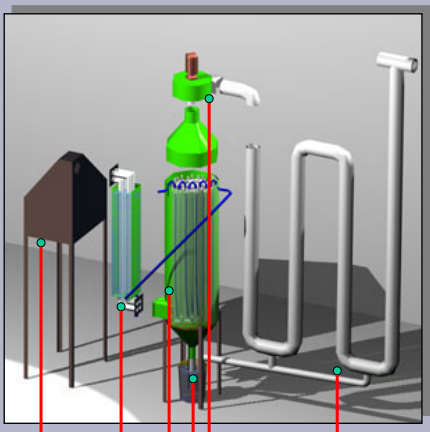
a … cooling surface
t … time gases spend in cooling system
v … volume of cooling system

Condensation increases with increase of cooling and condensation surface
Condensation increases with time, gases spend inside cooling and condensation system
Probability of condensation upon the surfaces decreases with increasing volume

User friendly design, according to practices of miners and traders

Design #1: semimobile amalgam oven

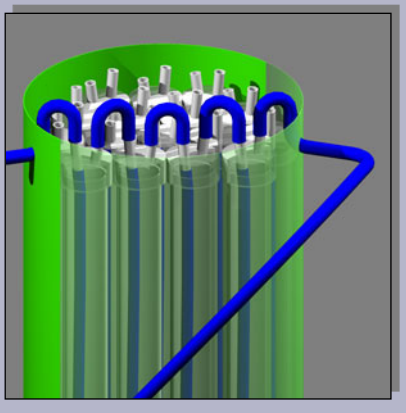


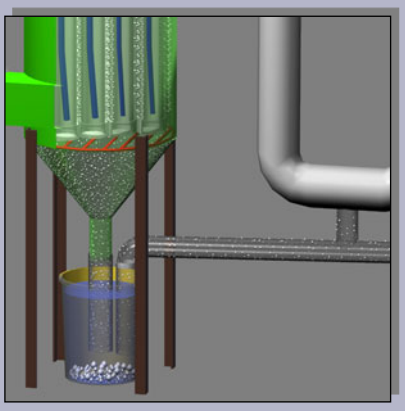


oven
cooler #1 (water cooled)
cooler #2 (water cooled)
recipient for recovered mercury
ventilator
condenser (extra surface for condensation)

Amalgam oven #1 (details)

Water cooled refrigeration tubes



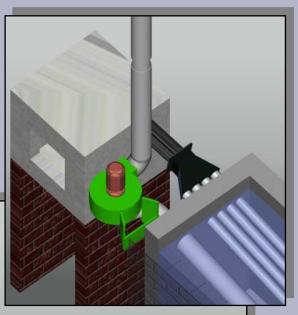


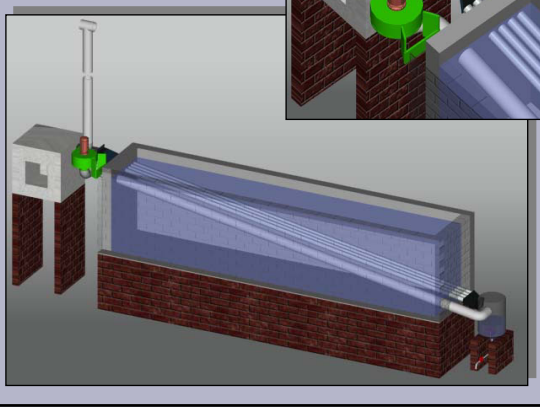
Local production costs (Ecuador)
US$ 400,-

Recipient for recovered mercury

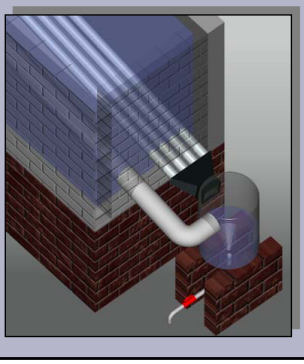
Design #2: stationary amalgam oven

Application:
Custom mills





Local production costs (Ecuador) US$ 250,-



Implementation

Example: Gold shop Portovelo (Ecuador)

(condensor missing in fotos made during instalation)

Data:

Hg-recovery:	estimated 75 %
Utilization:	average: 95 %
	(always when energy available)
Hg-"production":	4 - 6 kg / week
Investment:	450 US$
Amortization:	15 - 20 weeks

Conclusion and Recomendation

Retorts - when really used - are the best solution (95-99% recovery)
The recovery of amalgam ovens is lower (70-75% recovery)

In case of resistance against retort-technology, prefer
90% of the miners to recover 70% of mercury (= 63%), than
5% of the miners recovering 99% (= 4.9%)

Don't try to change habits to fit the technology
change the technology to fit the habits !

Don't simply copy the designs !

Study the miners habits,
use your brain and apply simple design criteria,
design site-specific devices according to habits and available materials