Quantifying Hg loss from amalgamation and potential Hg reduction with Hg-free processing

Field research conducted by the GOLD-ISMIA project team in Bwun Mas and Kedaro villages at the Sekotong field location investigated the mass balance of Hg during amalgamation in a rod mill.

Mass-balance for Hg use during amalgamation

The project team recorded the mass of Hg added to a gelondong during amalgamation, and the amount recovered for reuse. Total Hg loss from the system was 8 gram. This was 0.65% of the mass of Hg added: 99.35% of the Hg added was recovered for reuse. 2.10 g of this Hg was accounted for in the amalgam ball: this was the mass lost during burning of the amalgam to generate the metal bullion.

The project assumes that the ore is ground in rod mills prior to cyanidation in tong. The project assumes that all ore in these locations is processed by amalgamation and then cyanidation.

Using the number of tong, their capacity, and knowledge of the number of batches processed per month, the total tonnes of ore processed in each location can be calculated. All of this ore will have been milled in gelondongs prior to cyanidation.

The project assumes that an average mass of 25 kg of Hg is used for amalgamation per tonne of ore milled. This figure allows the total mass of Hg used to be calculated. For the four locations this is 852.6 tonnes per year. However, based on our mass balance calculations, 99.35% of this Hg is recovered and re-used.

5.54 tonnes Hg is lost to the environment

Calculation of total Hg losses across four project locations

Four GOLD-ISMIA project locations (Anggai, Tatelu, Penangan and Bwun Mas) have been surveyed by the project team to record the number of tong operating, and the capacity of each tong.

Correlation of Hg loss with mass of gold produced

The mass of gold produced by tong across the same four locations was also surveyed by the project team.
Total gold produced was 0.87 tonnes, from 34,104 tonnes of ore processed, for an average gold grade of 25.4 g/tonne.

The ratio of Hg released (5.54 tonnes) to gold produced (0.87 tonnes) is 6.875 to 1. This means that for every gram of gold produced, nearly 7 grams of gold is released to the environment.

The data analysis reported in this Fact Sheet agrees with internationally published case studies. Veiga et al. (2009)\(^1\) based on field observations in Indonesia stated ‘when Hg is used inside ball mills to amalgamate the whole ore, the amount of Hg lost is at least 10 times the amount of gold produced’.

**Realising the GOLD-ISMIA target for Hg reduction**

Technical data shows that amalgamation is inefficient for gold recovery from Indonesia primary gold ores. Cyanidation has been proven to yield substantially greater gold.

However, amalgamation is an important pre-processing step for cyanidation. The rod mills used for amalgamation grind the ore for subsequently cyanidation. Miners sell sacks of amalgamation tailings for cyanidation.

Ore grinding with the rod mills is therefore an important part of the gold recovery process. However, Hg use during grinding must be stopped and achieving this change is a key target for GOLD ISMIA. Rod mills should be used for grinding not amalgamation.

*A key assumption of this Fact Sheet is that Hg is currently being added to all ore milled at the surveyed locations.*

To achieve this reduction, miners must be incentive to stop using Hg. Their economic position can be no worse off than with Hg use.

A premium price paid per sack of Hg-free ore paid by tong operators may be a suitable incentive.

Technical interventions to increase the technical capability of both micro-scale gelondong operators and small-scale tong operators must also be considered.

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\(^1\) Mill Leaching: a viable substitute for mercury amalgamation in the artisanal gold mining sector? Journal of Cleaner Production. 17: 1373-1381.