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Project Completion Report

Mercury-Free Technology: The Manado Method – Indonesia

Project Details

Location	Indonesia: Provinces of Central Kalimantan, Central Java, Jakarta, North Sulawesi; and Lombok and Sumbawa Regencies
Contaminant	Mercury
Project Duration	January 2013 – June 2014
Project Cost	$250,000, provided by the European Commission
Implementing Partners	Yayasan Tambuhak Sinta (YTS), Geological Survey of Denmark and Greenland (GEUS), and Emerald Mt.
Affected Population	43,000

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Background and Scope

This document summarizes the European Commission-supported project to reduce mercury emissions from artisanal and small-scale gold mining (ASGM) in Indonesia. Blacksmith Institute and its implementing partners have been heavily focused on finding ways to spread knowledge of the Manado Method to as wide a range of actors as possible.

In Indonesia, up to 300,000 small-scale miners rely on various methods for gold extraction and processing for income. Mercury-use has increased within the past 20 years, in part due to a process called “whole-ore amalgamation.” Capturing gold using mercury amalgamation is preferred among gold processors as the technique is relatively easy and can generate income quickly to cover miners’ daily expenses.

Blacksmith Institute and its implementing partners have introduced the ‘Manado Method’ of gravity concentration to ASGM communities throughout Indonesia. The Manado Method is a highly effective gravity concentration that eliminates the need for mercury during the gold extraction process. The method is relatively simple and can be learned through observation. The intervention process has included demonstrations of the method and health awareness campaigns. The Manado Method makes use of natural and abundant resources, namely sugar palm fibers, located within the region.

Local communities have long been aware of the unique properties of the sugar palm’s fiber, as the fiber has been used for gold concentration for decades, mostly in river mining. The tree itself offers sixty different products, making it remarkably useful. Gold miners in the districts of Manado and Gorontalo have used this method of gold concentration reliably. The method was used prior to the introduction of mercury to the region, and miners who are familiar with the method continue to use it in preference to using mercury.

Manado was the first region in Indonesia to adopt the whole ore amalgamation practice from mercury smugglers and gold dealers from the Southern Philippines. The goal of Blacksmith Institute and implementing partners has been to spread this practice as one solution to reducing mercury emissions.

Solution Implemented

The pilot project focused on three main components of development: technology, society/ community and political involvement. Solutions included the introduction of mercury-free technology in ASGM communities, community outreach and education, and capacity building among stakeholders and governments.

Field-level project implementation began in March 2013. Gadjah Mada University and the Islamic University in Yogyakarta hosted presentations on the following: project details, health and sustainability benefits to mercury mitigation, and existing barriers to intervention.

Mineralogical and geological investigations, in addition to rock, soil and tailings samplings, profiled ASGM sites. Transparency was a key component to the project implementation as

well; local authorities were included in investigations and awareness campaigns among miners were included as well.

Viability of borax method

Baseline work consisted of geological and mineralogical characterization of various gold ores in Java. Implementing partners investigated a selection of actively mined gold ores using representative sampling techniques and both ordinary light and scanning electron microscopes. The procedures included geological mapping and detailed mineralogical studies, including distribution of the ore minerals as well as distribution and size of gold grains throughout the ores. Understanding the occurrence of gold grains in the ores and their size distribution help to improve recovery by optimizing each step of the gold extraction process.

Secondary-level work tested the applicability of the borax method on gold ores. Collected gold ores were crushed, milled and concentrated. The team then analyzed the concentrated gold ore for mineralogy and grain size distribution. The borax gold smelting technique was then carried out on heavy mineral concentrates.

Some of the gold ores will respond positive to gold smelting whereas others will not. Mineralogical studies provide a key insight on how to circumvent problems with the gold ores where the borax smelting does not work. A detailed knowledge of the mineralogy and grain size distribution facilitates increasing recovery and hence income for miners.

Building Capacity to eliminate Hg in ASGM

Capacity building allows project solutions and lessons learned to continue after completion. Therefore, stakeholders at various levels have an essential role. It is the goal of the project to engage stakeholder participation throughout in order to ensure the prioritization of community needs and that channels exist to address these needs.

During the project implementation, the team introduced stakeholders to selected sites where the borax method was proven successful. Stakeholder groups convened at these sites to discuss project implementation and to gain community support.

Community Awareness and Technology Trainings

The project used existing materials from previous projects in Indonesia and supplemented materials from the Philippines, adapted to the local context to raise awareness regarding the health risks of mercury and to the benefits of mercury-free practices.

Training the Trainers (Primary Implementer: Emerald Mt): A teacher training and exchange program was established between Indonesia and the Philippines to ensure direct transfer of knowledge. At least five Indonesian teacher trainers were trained to teach fellow miners to implement the borax method. They underwent an intensive workshop training to prepare them to teach others. Emerald Mtn. provided Philippine trainers with both years of experience executing the method and experience training

other miners. These trainers conducted teaching sessions in Indonesia to ensure effective transfer of knowledge. In addition to the Indonesian miners, representatives from the Ministry of Environment, YTS and BPPT also attended the trainings to ensure in-depth knowledge and capacity building for national replication.

Implementing Miner Training (Primary Implementer: YTS): At selected sites, participating miners received a mercury-free set of equipment for processing. Indonesian teacher trainers implemented miner-training workshops. Emerald Mt., YTS and BPPT closely supervised the process (especially the first training sessions), assisted with troubleshooting and ensured the proper technique was used. After the trainings and two-three detailed demonstration runs, the local miners took over.

Monitoring Uptake of Borax Method and Tailings for Miner Adherence and Sustainability (Primary Implementer: YTS and BPPT): YTS and BPPT, with assistance from Blacksmith, conducted environmental and equipment monitoring throughout the process. The following technical indicators were carefully measured and documented: amount of ore processed, gold yield, quality of gold, processing time, and amount of mercury present in equipment and tailings. Follow up visits and interviews were conducted regularly to measure the social indicators: miners' reactions and willingness to change practices/adopt the new method, number of miners converting to the borax method, number of miners reverting to old practices and any reasons for reverting. Equipment and new tailings were sampled regularly to ensure they were not being contaminated by mercury and that the miners were not reverting to mercury use.

Project Results

Advantages and Disadvantages of the Manado Method

The Manado Method can be used in place of mercury to remove gold from amalgams, thus reducing mercury emissions. Yet, to appeal to miners and support livelihoods, campaigns are emphasizing the benefits of higher gold yields produced through the Manado Method. In addition, there are significant cost-savings on mercury. We have proven the method works excellently but proving it to the miners is more difficult – and it seems that they will not be easily convinced unless they adopt the process themselves.

Therefore, we must make it clearer to them that the method can be adopted easily without changing any of their current habits or processing requirements. The actual processing time for the concentration step is the same as using mercury, but additional processing time is needed to do the separation with the gold pan. This is the stage that processors lack confidence of. We find we need to continually emphasize that the fiber is extremely efficient at retaining extremely fine gold and much better than using carpet; and that the gold recovery is excellent compared to using mercury. Certainly, the advantages of our method far outweigh any disadvantages due to the enormous economic benefits they provide.

We recognize that there are some disadvantages to using the Manado Method. The greatest disadvantage is the labor-intensive gold panning, which takes time and skill. Yet, this challenge is easily overcome with training and practice. More problematic are

situations when the ore is simply not conducive to gravity separation. Although we do not really wish to promote mercury - there have been several instances where due to the nature of the mineralogy, mercury has given a much better level of gold recovery than gravity separation in the gold pan. For these ores, it may in fact be necessary for miners to proceed with the amalgamation of concentrates.

In such cases, mercury would continue to be used but only after the concentration has already been achieved. Studies show that mercury-loss can be minimized to a great extent in this way. Amalgamation of concentrates is a far better alternative to whole ore amalgamation.

Economic Benefits of the Manado Method

By the end of June, teams were able to get detailed and reliable gold recovery data from one shed that has already converted to the Manado Method. This operation is run by a small group of miners from Tasikmalaya. They provided the following information on their gold recovery:

Gold Recovery Process	Recovery Using Mercury	Recovery Without Mercury
Primary Process (Mercury)	0.3g Au per sack	1.2g Au per sack
Secondary Process (Cyanide)	1.6g Au per sack	3.6g Au per sack

From the data above, we can see that their primary gold recovery of gold has now increased to 400% of previous recovery. Considering that their profit margin was previously slim, the profitability of their gold mining activity has increased enormously as a result, perhaps by as much as ten times.

We can also see that their secondary gold recovery has more than doubled. This is a benefit that they share with the local owner of a cyanide facility with whom they have started a profit-sharing system.

Most of the participants at our demonstrations have been mill owners, and most have been positive about applying the Manado Method in future. Many have said that our process is more efficient than using mercury. They also consider the elimination of mercury to be an advantage from an economic point of view, as they believe the cost-savings on mercury will be significant. However, so far very few of them realize that the enhanced gold recovery will be far more beneficial than the cost savings from using no mercury – this is because they cannot make comparisons until they adopt the method.

One other factor that has considerable economic significance is the fact that miners can now process lower grade rock economically. The Manado Method has the added advantage of increasing the resource base available to the miners, as much of the formerly waste-rock can now be processed economically. Miners can now obtain a profit from ore at 5g per ton, whereas the previous cut-off was 10g.

Overcoming Barriers

Panning of Concentrates: The method has proved effective in capturing extremely fine

gold. However, the drawback of using a mercury-free method is that the gravity concentration step must be followed by a separation step to get the gold. Difficulties arise with ores that are rich in Galena or high in Pyrite. For these ores, miners may prefer to conduct amalgamation of concentrates rather than pan for the gold, as for some ore types it is impractical to conduct panning and recovery will be very low unless mercury is used. In truth, the miners are especially interested in using a mercury-free method on ores that have high galena and pyrite contents, as these ores consume very high rates of mercury leading to high processing costs. Thus, the best treatment for these problematic ores may be to conduct amalgamation of concentrates.

Amalgamation of Concentrates: The amalgamation of concentrates is an imperfect solution to the problem of mercury contamination, but it does provide an alternative finishing treatment that processors may be more comfortable about using as a transitional step if they lack panning skills. We believe that processors that adopt the Manado Method will have the freedom to choose whether they want to do amalgamation of concentrates or mercury-free processing. Therefore, the amalgamation of concentrates can be considered to be a fallback position both for the project and for processors who adopt the Manado Method.

Assisted Adoption: Providing Technical Support to Processing Bosses

At the end of the fifth quarter, the implementing team had identified seven processors that had expressed a serious interest in adopting the Manado Method: five in Lamunga and two in Lamuntet. However, none of these processors were ready to convert to mercury-free processing for a variety of reasons. Excuses ranged from being out of town, to being otherwise pre-occupied, to having no capital. Apparently, there is still insufficient realization of the enormous economic opportunity the method represents.

Unfortunately, although the one shed that has adopted the method has reaped enormous financial benefits as a result, this result has not been communicated to others. Rather, the team from Tasikmalaya has remained secretive about their new process. YTS has made efforts to break down this communication barrier by providing details about their success to other bosses; however, they may find it unbelievable unless they experience it for themselves.

Thus, it has been difficult to further the agenda of assisted adoption due to the reticence of the bosses and their general failure to react to the opportunity provided by the project. This kind of lethargy and ignorance is symptomatic of the lack of aspiration to achieve better processing methods or to make the effort to change the existing paradigm.

The implementing team will continue to assist any bosses that are interested in converting to use the new method. This starts with our method for cleaning residual mercury from contaminated grinding mills. This is the first step for those processors wishing to adopt the new method. Subsequently, the project will also ensure that a new sluice can be built and properly installed. In order to ensure full participation, we prefer that these will be shared costs.

The Way Forward: Effectiveness and Encouraging Adoption

It is becoming increasingly clear that the Manado Method is highly effective, and on a par with using expensive equipment such as centrifuges and shaking tables. This can be evidenced by the tremendous increases in gold recovery that have been documented at our adoption site, and by the potential that now exists for the miners to exploit lower grades of ore more economically. This added benefit has in fact increased the resource base for the artisanal gold miners. For, although the newly-built Indotan facility can benefit from a process line that uses sophisticated gravity separation equipment and an 'economy of scale' they nonetheless require the same grade of ore as the miners can process individually using the Manado Method.

Having observed the excellent results gained at our adoption site over the previous two months, we are very confident that we have a very beneficial intervention to promote to miners across Indonesia. The positive feedback from miners at our demonstrations, and the knowledge that the technology is effective, are both great sources of encouragement for our team. We shall therefore continue in our efforts to mobilize the processors to change their methods, and we shall be providing continual technical advice and material support to those who express an interest in adopting this method.

Health Awareness Raising with Government

Field Demonstrations at Lamunga Facility

Recommendations and Lessons Learned

- Less than one percent of the ASGM community actually has the capacity to change the processing system. It is these actors that can facilitate the change that is required, and in doing so the labor-reward system and working conditions for miners can be tremendously improved. It is our contention that it is far more important to work with the ore-processors than it is to work with the miners. If interventions are successfully conducted with processing bosses, they can affect the entire ASGM community.
    - Further steps should include encouraging processing bosses to build their own sluice installations and to apply the method at their own grinding sheds.