

Project Completion Report

Promoting the recovery and responsible management of mercury in contaminated tailings from artisanal gold mining in Colombia



Fig. 1: Project closing event in Bogotá, Colombia.



Fig. 2: Miners in Santander learn to use the copper plates technology to clean mining tailings of mercury.



Fig. 3: Installation ceremony of Latin America’s first temporary mercury storage unit at CDMB facilities in Bucaramanga.

Project Details

Funder: US Department of State (DoS)

Location: Colombia

Contaminant: Mercury (Hg)

Project goal/objectives:

Outcome 1: Improve the government’s understanding of the most responsible mercury-recovery techniques and develop an ideal model based on these findings unique to the Colombian artisanal and small-scale gold mining (ASGM) context.

Outcome 2: Promote responsible tailings management practices for use by the Colombian government through the development of a technical protocol and an analysis of the regulatory framework that defines tailings ownership and identifies legal mechanisms that facilitate tailings treatment and legal commercialization of gold recovered from tailings.

Outcome 3: Promote responsible mercury handling and storage practices in the Colombian context by supporting the creation of a pilot interim mercury storage unit and developing administrative and technical guidelines to facilitate its continued use.

Total budget: \$733,574 (with one cost extension)

Start date: 9/24/2018

End date: 6/30/2023 (after extension)

Population affected: 280+ miners trained in tailings management & storage of recovered mercury

Implementation partner/s: INNOVA, CNPML, Geoconsultores, Duke University

By the numbers:

- 9 technical documents and protocols for tailings management & mercury storage

- 2 new national frameworks for mercury recovery
- 2 copper plates modules implemented to recover mercury
- 1 mercury storage unit installed
- 300 tons of tailings processed
- 84% of mercury recovered from tailings in ideal conditions using the copper plates
- 63 national agencies engaged on the issue of mercury contamination
- 5 innovative mercury precipitating reagents tested
- 3 international virtual dissemination workshops

Background and Scope

The project site was the country of Colombia, and the project team worked with many government entities under the framework of this project. More specifically, the team also worked in the mining communities at Juan Díaz Plant (in Yalí, Antioquia) and Las Mercedes Mine (in California, Santander), installing and training miners on the copper plates technology. The project team installed the first-ever mercury storage unit in Latin America at the facilities of the CDMB (local environmental authority in Bucaramanga, Santander).

ASGM is a traditional livelihood in Colombia, providing much needed income for many impoverished communities. An estimated 200,000–250,000 Colombians are engaged in ASGM activities. Currently, the prevailing method of ASGM in the country involves using large amounts of mercury to extract gold. A 2011 study conducted by the Colombian Ministry of Environment and Sustainable Development (MADS) found that for every gram of gold extracted in the ASGM sector, approximately 7.05 grams of mercury are released into the environment, with a total of 298,228.75 kilograms (328.74 tons) released over the entire year.

Mercury contamination from these activities leads to significant air, soil, and water contamination and severe health impacts on local communities. Those most at risk are the miners themselves who are exposed not only through direct dermal contact but also through inhalation. Populations in proximity to these mining activities are also at significant risk, particularly the miners' families and merchants involved in gold trade. If the use of mercury in artisanal mining does not decline, contamination will continue to poison generations of Colombians.

In collaboration with stakeholders from the government, civil society, private sector, and affected communities, this project supported national efforts to reduce the amount of mercury available for use in the ASGM sector as well as developed models to most effectively deal with mercury use and disposal.

Project Activities

- Identified responsible mercury recovery techniques and chose a technique (copper plates technology) based on the Colombian ASGM context. Implemented it in processing plants in Yalí, Antioquia & California, Santander.
- Developed a model for responsible and profitable recovery of Hg and gold from tailings based on experiences with a pilot processing center. The model included both a

technical description of the copper plates and an economic model for commercializing gold recovered from tailings.

- Developed a technical protocol that can facilitate responsible tailings management by the Colombian government, including the safe handling, transportation, and characterization of tailings & the storage and disposal of Hg and other ASGM waste.
- Developed an analysis of the regulatory framework that helped define tailings ownership and identified legal mechanisms that facilitate tailings treatment and legal commercialization of gold recovered from tailings.
- Developed an analysis of the regulatory framework that identified institutional and financial mechanisms for installation and maintenance of an interim mercury storage unit
- Promoted responsible mercury handling and storage practices in Colombia by establishing a pilot interim mercury storage unit and ensured its continued use through operational trainings, chain of custody protocols, and stakeholder buy-in.
- Prepared, organized, and conducted online workshops with relevant international experts and stakeholders from Colombia to discuss pressing issues including contaminated tailings management, Hg flows and recovery, (non-)adoption of technologies, and other topics.

Key Outcomes and Accomplishments

- ***Environmental assessments***

Assessed 4 zones in Marmato, Caldas for Hg in air, Hg in soil, Pb in soil, As in soil, and Cd in soil. Hg not found, but Pb, As, and Cd found. Exceeded Pb reference value in one zone and As reference value in all zones. Also found evidence of deforestation and rivers affected by local cyanidation plant discharge.

- ***Remediations***

2 copper plate modules for removal of Hg from ASGM tailings installed in mining communities (1 in the Juan Díaz plant in Yalí, Antioquia; 1 in the Las Mercedes mine in California, Santander run by mining association Calimineros).

300+ tons of contaminated tailings processed. More than 300 tons of mercury-contaminated tailings from different parts of the country with varying mineralogical compositions were processed with satisfactory mercury removal results (testing of the copper plate technology).

- ***Capacity building***

280+ miners trained in tailings management and recovered mercury storage. Implemented diverse trainings for mining communities to provide knowledge on relevant topics such as the impact of mercury on human health, mercury-free technologies, technologies to remediate mercury in the environment, and alternatives for tailings management.

- ***Major awareness-raising events***

3 virtual workshops on mercury topics with 90+ international participants (co-organized with Duke University).

1 closing event (29 attendees from key stakeholder entities, such as Ministry of Health, Ministry of Mining and Energy (MME), Ministry of the Environment, National Institute of Health, Attorney General's Office, US Embassy, USAID, US EPA, Alliance for Responsible Mining (ARM), universities, and others).

- **Publications**

No scientific publications. 9 technical documents on managing and storing recovered mercury:

1. [Technical Report on Mercury Recovery from Tailings \(English version\)](#)
2. [Laboratory Results of Tests of Mercury Recovery by Copper Plates Report \(English version\)](#)
3. [Interim Technical Report of Copper Plate Pilot Test Results, Phase I \(English version\)](#)
4. [Interim Technical Report of Copper Plate Pilot Test Results, Phase II \(English version\)](#)
5. [Interim Technical Report of Copper Plate Pilot Test Results, Phase III \(English version\)](#)
6. [Technical protocol for the responsible management of mercury-contaminated tailings in Colombia \(English version\)](#)
7. [Implementation and economic plan for the use of copper plates](#)
8. [Technical report – Results from tests to remove mercury in cyanidation processes](#)
9. Technical protocol of mercury in storage unit (in Spanish)

- **Conferences**

Conferences in which the project and project learnings were promoted:

- Minamata Convention. COP-3. November 2019. Promotional Boot
- Sustainathon. September 2021. Copper Plates
- EU-Latin America Convention on Raw Material. November 2021. Copper Plates
- Minamata Convention. COP-4. Side Event. November 2022. Copper Plates
- ODCE. International Forum. November 2022. Tailings Management
- UNEP Global Mercury Partnership Webinar. June 2023. Tailings Management
- Minamata Convention. COP-5. Side Event. October 2023. Mercury Storage Unit
- Minamata Convention. COP-5. Knowledge Lab. November 2023. Copper Plates
- International Conference of Mercury as a Global Pollutant (ICMGP). July 2022. Copper Plates

- **Signals of Support from key stakeholders**

2 new national legal frameworks created on managing and storing recovered mercury. These frameworks focus on proper management of mercury from a regulatory point of view, joining the efforts of authorities in charge of safeguarding seized mercury.

- **Any other important, project-specific indicators**

1 mercury storage unit – the first mercury storage unit of its kind in Latin America – organized and installed. The unit was delivered to the CDMB in conjunction with the Attorney General's Office and the Ministry of Environment to store the country's seized mercury.

During testing of the copper plates: up to 84% of mercury recovered in ideal conditions (tailings are not older than 10 years and the material is mostly sandy). 90% of gold recovered from 200 tons of treated tailings. With the adaptation of the plate module at the Juan Díaz plant, 90% gold recovery was achieved while removing gold from tailings.

63+ national and international agencies participated and collaborated in tailings management workshops. Many national and international, governmental and non-governmental, agencies supported Pure Earth from the beginning to the end of the project, demonstrating the high level of coordination and positive results that can be obtained through teamwork.

5 innovative precipitating materials tested during the cyanidation process: sodium sulfide, ground tire, lemon peel, *gulupa* peel, and banana peel. These materials were chosen for experiments because of their sulfide content and the relationship between sulfides and mercury, in which mercury precipitates with the presence of sulfides, decreasing mercury concentration in the environment.

Lessons Learned

- Implementation of an adequate silver-plating process for the copper plates was challenging, specifically in the implementation technique and costs associated with the technology.
- Another challenge in using the copper plates was the issue of lifespan and long-term efficiency following use. During the last tests, wear on the coating was evident.
- Due to safety and security concerns in the selected mining site and during field visits for contaminated site characterization, there is a need to confirm that illegal groups do not operate in the area, as this would pose risks for team members.
- The change of government during the project span hindered response times from some government entities.
- Quarantines and airport closures due to COVID resulted in activity delays throughout 2020.
- Coordination with the CDMB on the issue of the temporary mercury storage unit was lengthy due to internal laboratory protocols necessary to comply with certification to host the unit.
- There were differences in mercury measurement results among various methods and laboratories. A comparison of methods and labs was needed to ensure accurate results.
- The availability and transportation of supplies and equipment to the field to implement the copper plate modules in remote sites was a challenge – some equipment was difficult to transport due to its dimensions or weight, increasing costs. In addition, the availability of copper began to decrease towards project end, increasing its price.
- Finding a mercury storage unit that met all requirements was a challenge as many of the suppliers did not have options that met 100% of the checklist, or that met the estimated delivery time before project closure.
- Coordination among the various government entities was sometimes a challenge.

Recommended Follow-up

Although significant progress has been on a tailings management protocol, there are still gaps in the implementation model due to legal and technical restrictions. The government should define under what circumstances miners will be allowed to process tailings to recover gold and commercialize it as “legal gold.” Until this is resolved, it will be difficult to promote mercury recovery from tailings during the gold recovery process because there is no administrative clarity of the process, and acting on the issue can be seen in “legal voids.”