

## An update roadmap to Mercury Avoided in Six (6) Project's Sites

### Introduction

One of the GOLD-ISMIA objectives is to avoid 15 tonnes of mercury through the introduction of Best Environment Practices (BEP), Best Available Technology (BAT) and socially and environmentally sound Artisanal and Small-scale Gold Mining (ASGM) practices where the Project will establish 1 mercury-free processing plant and 5 small-mobile plant. The decision of implementation BEP and BAP at each of mining site will be depending upon the result of socio-economic baseline survey (including collection of sex-disaggregated data) and mercury/gold mass balance inventories.

The establishment of mercury-free processing plant is therefore a key point in development of a roadmap on calculating the 15 tonnes of mercury avoided. As stated in the project document, collaboration with the existing processing plants and partnership with training centers owned by the Government of Indonesia (GoI) shall be taken into con.

### Government Regulations as an in-kind support

The Government of Indonesia has undertaken significant steps toward the elimination of mercury in ASGM through:

1. on 10 October 2013, signing the Minamata Convention.
2. on 9 March 2017, the President of Indonesia released an instruction to ban the use of mercury in the ASGM sector. To implement this instruction, the Coordinating Ministry for Maritime Affairs through the Deputy for Infrastructure Coordination was mandated to eliminate the use of mercury by cutting the production and distribution lines of mercury, prosecuting illegal mercury export and coordinating the closure of the mercury-producing cinnabar mine.
3. on 20 September 2017, the ratification of the Minamata Convention through the issuance of Law No. 11 Year 2017.
4. on 22 April 2019, the President of Republic Indonesia signed a Presidential Decree No. 21 Year 2019 regarding National Action Plan on Mercury Reduction and Elimination.
5. on 18 October 2019, to implement the Presidential Decree, the Ministry of Environment and Forestry issued a Regulation No. P.81/MENLHK/SETJEN/KUM.1/20/2019 providing guidance to the Sub-National Government in development, monitoring and evaluation, and reporting of Sub-National Action Plan on Mercury Reduction and Elimination.

Following the regulations mentioned above, elimination and reduction of mercury used in ASGM has become a national priority target in which provision of alternative mercury-free and environmental friendly processing technologies are offered as solution. In 2019, a total of seven (7) mercury-free processing plants were built by the Ministry of Environment and Forestry (MoEF) in 7 provinces. In addition, the Agency for Assessment and Implementation of Technology (BPPT) established one (1) mercury-free processing plant in Kulonprogo District, Yogyakarta.

Furthermore, BPPT has recommended the application of a manageable leaching-cyanidation as a mercury-free technique to recover gold from primary ore. Since 2017, as consequences to the GoI's formal ban on the use of mercury and commitment to reduce/eliminate mercury used in ASGM sector by 2025, there is an increasing number of cyanidation processing plant built by miners at project sites, also in other mining sites around Indonesia. This is an indication that due to very limited access to mercury supply, the miners have been shifting to a mercury-free technique to sustain their livelihood as a gold miners.

## Mercury avoided calculation

A fundamental question in calculating the avoid mercury used is “How much mercury has been used by the miners?”, to which the Project conducted a field assessment and data collection at three (3) project sites. The results of data collection was cross-checked and elaborated with the similar data from national and international publications and it is concluded that “each troy ounce processing 10 kg of ore is fed with 250 gram of mercury, and this equals to 25 kg of mercury feed per 1 ton of gold ore”. Based on this ratio, it is further calculated that “99,35% of mercury feed is recovered for reusing, and thus 0.65% mercury loss to environment”.

The above concept of mercury avoided is applied when:

1. *the technique used is shifting from mercury to mercury-free technique means ore is sequentially processed not by amalgamation anymore then cyanidation.*
2. *per ton of ore processed, 25 kg feeding mercury is used and 0.65% of which loss to environment, meaning that 0.16kg mercury avoided/ton gold ore.*

Within the above calculation and in consideration that the Project will establish 5 (five) small-mobile plants and 1 (one) mercury-free ore processing training plant, it is predicted that the amount of mercury avoided from the Project’s processing plants will be lower than the project target (i.e., 15 tonnes of mercury by 2023). It is therefore necessary for the Project to utilize the existing processing plant owned by both the GoI and the miners.

In light of the above, the Project’s strategy in calculating mercury avoided is to utilize the:

1. existing processing plants owned by the GoI (i.e., MoEF and BPPT);
2. existing processing plants owned by the miners;
3. new processing plants owned by the miners through the Project’s interventions; and,
4. Project’s processing plants.

## The results

1. Utilizing the existing processing plant owned by the miners. Learning from the 3 project sites that have implemented cyanidation system (Table 1). **The table showed that that miners are able to avoid 19.47 tonnes mercury used through leaching system.**
2. Utilizing the new processing plants owned by the miners. The newly established processing plants are the results of the Project’s influence through funding assistance mechanism wherein the miners’ cooperatives are capacitated to apply for loans for mercury-free processing equipment/investments. The funding assistances are intended to: (i) enhance the capacity of their members; (ii) strengthen the cooperatives’ capital capacity to keep up with the volatility of gold price; (iii) increase their bankability; and, (iii) provide the members with financial insurance for their health and work safety (Table 3 and 4).
3. Utilizing the processing plant owned by the Project through a Grant. In parallel project has developed a set of module training which miners can have access obtaining and learning the information through a module that content information for supporting the miners formalization, such as to designing processing and waste management (including tailings storage or sale to responsible processing facilities) plans that comply with national laws and environmental standards; to obtain permits to establish/operate a processing plant and Personal Protective Equipment in mining.

Table 1. Calculation the mercury avoided loss to environment from 3 project sites.

Location	Anggai, South Halmahera				Tatelu dan Talawaan, North Minahasa				Buwun Mas, West Lombok				Total			
	2019	2020	2021	2022	2019	2020	2021	2022	2019	2020	2021	2022	2019*	2020	2021	2022
Number of cyanidation tank	20	18	17	12	30	53	70	81	24	30	36	46				
Average tank capacity (tonnes)	5	5	5	5	5	5	5	5	6	6	6	6				
Number batch processed per month	2	2	2	2	5	6	6	6	3	3	3	3				
Total tonnes ore processed per month	200	180	170	120	750	1590	2100	2430	432	540	648	828				
Total tonnes ore processed per year	2400	2160	2040	1440	9000	19080	25200	29160	5184	6480	7776	9936				
Total Hg feed (tonnes) per year	60	54	51	36	225	477	630	729	129.6	162	194.4	248.4	414.6	693	681	1013.4
Total Hg avoided loss to environment per year (tonnes)	0.39	0.35	0.33	0.23	1.46	3.10	4.10	4.74	0.84	1.05	1.26	1.61	2.69	4.5	4.42	19.47
Total mercury-free gold produced (tonnes)	0.06	0.05	0.05	0.03	0.21	0.45	0.60	0.69	0.12	0.15	0.18	0.24	0.39	0.66	0.64	2.83

Furthermore, from those three (3) project sites, the project has identify that Batu Emas cooperative from Tatelu is the only cooperative which has a simple but complete book keeping and recording system and well organize for monitoring the amount of ore dig out and collected to be processed by the cooperative members. The cooperative is recording the number of sack per day is taken out from their legal community mining area. Thus, the project is using the data from Batu Emas cooperative to calculate the amount of mercury avoided from this location to apply those formulas (Table 2).

Table2 . Calculation of total Hg feed and avoided loss to environment contributed by Batu Emas mining cooperative.

Timestamps	Total ore processed per month (tonnes)	Total Hg avoided feed per month (tonnes)	Total Hg avoided loss to environment per month (tonnes)	Total gold produced per month (kg)
	A	$B = A * 0.025$	$C = B * 0,65\%$	$D = C / 6.857 * 1000$
Jan-19	74.64	1.87	0.01	1.77
Feb-19	56.00	1.40	0.01	1.33
Mar-19	79.60	1.99	0.01	1.89
Apr-19	51.08	1.28	0.01	1.21
May-19	49.88	1.25	0.01	1.18
Jun-19	0.00	0.00	0.00	0.00
Jul-19	477.32	11.93	0.08	11.31
Aug-19	1996.68	49.92	0.32	47.32
Sep-19	232.32	5.81	0.04	5.51
Oct-19	1706.60	42.67	0.28	40.44
Nov-19	1888.44	47.21	0.31	44.75
Dec-19	1760.12	44.00	0.29	41.71
Jan-20	574.48	14.36	0.09	13.61
Feb-20	1052.12	26.30	0.17	24.93
Mar-20	1242.32	31.06	0.20	29.44
Apr-20	2220.96	55.52	0.36	52.63
May-20	1890.36	47.26	0.31	44.80
Jun-20	1867.52	46.69	0.30	44.26
Jul-20	1966.56	49.16	0.32	46.60
Aug-20	1616.96	40.42	0.26	38.32
Sep-20	2205.48	55.14	0.36	52.27
Oct-20	2132.96	53.32	0.35	50.55
Nov-20	2119.16	52.98	0.34	50.22
Dec-20	2233.88	55.85	0.36	52.94
<b>Total</b>	<b>29495.44</b>	<b>737.39</b>	<b>4.79</b>	<b>699.00</b>

From the table it can be seen that by shifting the technique used from mercury to mercury-free, the Batu Emas cooperative has contributed to the total Hg avoided feed from January 2019 to December 2020 reached 737.29 tonnes that lead to an avoidance 4.79 tonnes of mercury loss to environment. There was 699 kg of gold produced only from this spot which can be claimed as a responsible gold which is produced with no-mercury, ore comes from designated community mining area, the miners is joining mining cooperative, the mining cooperative holds community mining permit.

The newly established processing plants are the results of the Project's influence through funding assistance mechanism. From the grant scheme, the project is able to calculate the amount of mercury avoided from Matuari Mandiri Cooperative (Table 3) and from Permata Obi Raya cooperative (Table 4). The cooperative is also implementing a book keeping and recording system for monitoring the amount of ore processed on their facility.

Table 3 . Calculation of total Hg feed and avoided loss to environment contributed by Matuari Mandiri mining cooperative.

No	Date	Miners	Ore (sack)	Total ore processed per month (kg)	Total Hg avoided feed per month (kg)	Total Hg avoided loss to environment per month (kg)
			A	B = A x 40 kg	C = B x 0,025	D = C x 0,65%
1	3-Jan-22	Christin Mantiri	100	4,000	100	0.65
2	10-Jan-22	Donny Lumewan	110	4,400	110	0.72
3	17-Jan-22	Jaksen Dipau	90	3,600	90	0.59
4	24-Jan-22	Victor	250	10,000	250	1.63
5	5-Feb-22	Isak Wenny	100	4,000	100	0.65
6	28-Feb-22	Paat John	130	5,200	130	0.85
7	12-Mar-22	Lausan Delfina	250	10,000	250	1.63
8	15-Mar-22	Ngangi	195	7,800	195	1.27
9	23-Mar-22	Ronny	150	6,000	150	0.98
10	26-Mar-22	Kevin	150	6,000	150	0.98
<b>Total</b>			<b>1,525</b>	<b>61,000</b>	<b>1,525</b>	<b>9.91</b>

Table 4 . Calculation of total Hg feed and avoided loss to environment contributed by Permata Obi Raya mining cooperative.

No	Tanggal	Nama Penambang	Produksi Batu (koli)	Total ore processed per month (kg)	Total Hg avoided feed per month (kg)	Total Hg avoided loss to environment per month (kg)
			A	B = A x 40 kg	C = B x 0,025	D = C x 0,65%
1	15-Jun-22	Koperasi Permata Obi Raya	350	14,000	350	2.28
2	27-Jun-22	Koperasi Permata Obi Raya	300	12,000	300	1.95
<b>Total</b>			<b>650</b>	<b>26,000</b>	<b>650</b>	<b>4</b>

## Conclusions

1. The largest portion of total mercury avoided loss to environment is expected from the existing mercury-free processing plants owned by the miners at the project sites. This highlights the double roles taken up by the miners in mercury reduction efforts: as the main actors causing mercury pollution/emission and as the frontiers in environmental protection through shifting to mercury-free technologies. The existing regulations has ushered the miners to take up the latter role (i.e., as the frontiers). **The project is able to reach the targeting avoiding mercury by 19.47 MT out of targeting amount in project document which was 15 MT mercury avoided. In result 2.83 kg mercury-free gold produced from miners mercury-free processing plants.**
2. **By utilizing the processing plants established through Project Grant which led to 133.81 kg mercury avoided and 19.5 kg mercury-free gold produced.**
3. In total 19.57 MT mercury was avoided and 2.84 tons mercury-free gold produced.
4. The Project will be playing an important role on facilitating the government to support the implementation of banning mercury by, among others, (i) supporting licensing of ASGM activities, and, (ii) providing relevant trainings and campaign raising awareness on the dangers of mercury, the importance of formalization, and the economic benefits of mercury-free techniques.

## Recommendation

Monitoring the amount of rock processed by the miners' equipment is the key to calculating avoidable mercury at the national level. Moving forward from the results of field researches, the Project will develop a mobile application and a web portal database through which the estimation of the mercury avoided from the mercury-free processing units within the project locations can be monitored in a systematic way and on regular basis. The mobile application will allow the Project collects the site-specific variables from the owners of processing units on a daily basis, by using certain variables such as number of tank, average tank capacity, number batch processed and gold produced per tank. Meanwhile, the web portal database will assist the Project estimate the total mercury avoided from a specific site or region (i.e., at the levels of extraction unit, processing unit, ASGM site, region or country). Both the mobile application and web portal database are expected to be launched in 2021.

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