

Mercury (Hg) Concentration As Tailing From Illegal Traditional Gold Mining Activity In Tambang Sawah Lebong District

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Abstract

Illegal gold mining activity in Tambang Sawah Village Lebong District is a traditional mining inherited since Dutch colonialism managed by the community. Waste sediment (tailing) of community gold mining in Tambang Sawah Village contains mercury due to gold producing process with amalgamation method. Tailing thrown into the river causes river water environmental problem, specifically on Air Putih River sediment in the village. Tailing sampling method was performed following the Japan Public Health Association (JPHA) guide as the samples were taken from several drum brakes in Hamlet 1, Hamlet 2, and Hamlet 3 of Tambang Sawah Village. The mercury level analysis in tailing was based on NOAA (National Oceanic and Atmospheric Administration) by Hazard Quotient (HQ) = Exposure concentration / Reference Concentration (RfC). The mercury level in the tailing obtained from Hamlet 1 was among 2.3739 – 265.4301 ppm, Hamlet 2 was among 60.4512 – 79.2037 ppm, and Hamlet 3 was among 5.9485 – 240.0169 ppm. The mercury HQ level in the tailing from the respective hamlets was 13.64 – 1.525.46. The HQ was >10, which indicates in high risk and has potential to cause mercury pollution in Air Putih River water area.

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I. Introduction

The community of Tambang Sawah Village, Pinang Belapis Subdistrict, Lebong District performs gold mining activity in the former Dutch mining location which has been inherited since the Dutch colonialism left the village until these day. The community gold mining activity (aristanal mining) uses the amalgamation method. The amalgamation process is a mixing process of mining stone which contains gold and mercury metals by using a drum [1], that produces remaining sediment or tailing. Tailing is collected in a non-permanent collecting pond for further packing in sacks, followed by piling and preservation, and the tailing is then thrown to the Air Putih River that crosses the village.

Mercury (Hg) in the tailing is included in the Air Putih River water, which is altered by microorganism activity to methyl-mercury (Me-Hg) component as a toxic component with strong binding capability and high solubility, mainly in aquatic animal body. This condition causes the mercury accumulation either through the bioaccumulation process or biomagnifications process in the food chain and aquatic biota body tissue, which causes the mercury level reaches the dangerous level for aquatic animals and human health that consumes the catching product of those aquatic animals [2].

The tailing disposing activity to the river causes the high mercury level in the river sediment that across the Tambang Sawah Village as The Medical Geological Studies in 2011 reported that the river sediment mercury level in the Tambang Sawah Village was 0.292 ppm [3], which reached 114.37 ppm dry weight in 2020 [4], sediment that reaches Hg concentration more than 2 ppm can be said as contaminated sediment [5].

Based on the following explanation, an evaluation or a study about the mercury level in tailing before disposing to the river is required. The aim of this study was to identify the mercury level in tailing waste thrown to the Air Putih River due to gold mining activity with amalgamation process in Tambang Sawah Village. This study results are expected as an important information source related to the mercury level of Air Putih River sediment in Tambang Sawah Village.

II. Materials and Methods

The study was conducted in 2020, tailing sampling was performed on the temporary collecting containers or tailing sacks before disposing to the river. Samples were located around the community houses that use mercury in amalgamation process, namely in the Hamlet 1, Hamlet 2, and Hamlet 3 of Tambang Sawah Village. Sampling method was performed following the Japan Public Health Association (JPHA) [6], as

sediment was taken using a pipe at 10-15 cm from the surface. The sediment samples were separated from gravel, plant parts, or other objects, before being filtered using a 2-mesh size sieve, kept in a sealed bottle pack, preserved in the cool box, and sent to the laboratory. The tailing samples were analyzed in the laboratory of Padang Industrial Research and Standardization Center following the ASTM C1301-95(2001).



Figure 1. Sampling Point

III. Results and Discussions

Based on the study results, the heavy metal mercury (Hg) level measurement is shown in Table 1, 2, and 3.

Table 1. The Mercury Level Measurement and Risk Assessment in the Hamlet 1

Sample Code	Measurement result (mg/kg)	HQ Hg	Risk level
ST 1	20.86	119.93	High
ST 2	2.37	13.64	High
ST 3	63.42	364.48	High
ST 4	98.87	568.27	High
ST 6	265.43	1,525.46	High
ST 7	20.93	120.29	High
ST 8	15.61	89.75	High

Table 2. The Mercury Level Measurement and Risk Assessment in the Hamlet 2

Sample Code	Measurement result (mg/kg)	HQ Hg	Risk level
ST 18	79.20	455.19	High
ST 19	60.45	347.42	High
ST 20	65.36	375.64	High

Table 3. The Mercury Level Measurement and Risk Assessment in the Hamlet 3

Sample Code	Measurement result (mg/kg)	HQ Hg	Risk level
ST 9	5.94	34.18	High
ST 11	60.12	345.53	High
ST 12	25.69	147.64	High
ST 13	38.87	223.40	High
ST 14	7.57	43.53	High
ST 15	240.01	1,379.40	High
ST 16	58.52	336.32	High
ST 17	22.41	128.79	High

Following the National Oceanic and Atmospheric Administration (NOAA) of US Department of Commerce, the metal mercury maximum level in the sediment is 0.174 mg/kg, while according to Veiga, M. M. and J. A. Meech (1995) stated that sediment that has the Hg concentration more than 2 ppm can be said as contaminated sediment [5].

The mercury level in tailing samples at the Hamlet 1 was among 2.3739 – 265.4301 mg/kg, the Hamlet 2 was among 60.4512 – 79.2037 mg/kg, and the Hamlet 3 was among 5.9485 – 240.0169 mg/kg. These levels were higher than the standard quality or cited reference at 2 ppm. High mercury level in tailing can pollute the Air Putih River water at high risk as water body acceptor.

The ecological risk assessment results indicates that the environmental risk is categorized as a highly risk due to $HQ > 10$. If the tailing is continuously thrown to the river water, the human health either around the Air Putih River or upstream river water will be threatened.

The precipitated mercury in the sediment will have a negative impact for biota that live in the water base, such as fish, plants, and other organisms, and also can become a threat for human health through the food chain. When being consumed by humans, then the mercury in fish, shell, and other aquatic plant will enter to the human body through the digestive tract.

If the mercury is accumulated exceeding to the threshold level, it can cause health problems, such as affecting the nerve function, disrupting visibility, hearing, talking, and losing brain coordination [7].

IV. Conclusion

The mercury level in tailing samples from the Hamlet 1 was among 2.3739 – 265.4301 mg/kg, the Hamlet 2 was among 60.4512 – 79.2037 mg/kg, and the Hamlet 3 was among 5.9485 – 240.0169 mg/kg, which had the $HQ > 10$ and could highly pollute the river water, this condition proves that high mercury level in the Air Putih River at 114.37 ppm dry weight [4] is the impact of tailing disposing to the river by the community of illegal gold mining in Tambang Sawah Village.

To decrease the mercury pollution, a further study is required using the phytoremediation method. Australian pine tree, Phoebe plant, Malabar melastome plant, and *Simpoh Ayer* plant are plants that can absorb the mercury pollution and tolerant against the mercury pollution with good growth used as phytoremediation plants [8].

A further study is by studying the mercury level in the aquatic biota (fish, shrimp, shell, plant, and other biota) that live in the Air Putih River. This condition is to identify how far the biological impact caused by the gold mining around the Air Putih River. Therefore, community, government, and other stakeholders can gain complete and accurate information that can be used as a consideration material in Air Putih River potential management.

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