TRANSPUBLIKA INTERNATIONAL RESEARCH IN EXACT SCIENCES (TIRES)

IDENTIFICATION OF MERCURY CONTENT IN SMALLHOLDER GOLD MINING WELL WATER IN THE WORKING AREA OF UPTD PUSKESMAS UJUNG PADANG RASIAN, SOUTH ACEH DISTRICT

Lensoni[1*], Yuni Agnes Lubis[2], Heri Setiawan[3], Mhd. Hidayatullah[4], Alifya Zuriva Naira[5]
[1-5]Public Health Study Program, Universitas Abulyatama
E-mail: [1)] soni@abulyatama.ac.id

Abstract

According to the WHO, large amounts of mercury pollution can have adverse health effects. Mercury, with the symbol Hg and atomic number 80, is often used in gold processing as a binding agent. Observations in Pasie Raja Sub-district, South Aceh District, showed that gold processing there still uses amalgamation techniques involving mercury, which is toxic and harmful to health. This experimental study was conducted in the UPTD Puskesmas Ujung Padang Rasian, South Aceh District, in June 2023, with a focus on analyzing the surrounding wastewater. Samples were taken from 14 well points around the gold processing site. Laboratory analysis results showed no detection of mercury in the water samples. However, this may be due to the mercury concentration being very small and undetectable by the equipment. Based on these results, the mercury content in the well water samples is still in accordance with the quality standard set by Government Regulation No. 82 of 2001, with a threshold of 0.001 µg/l. Thus, well water in the working area of UPTD Puskesmas Ujung Padang Rasian was not detected to contain mercury because the concentration was too small to be detected by the instrument.

Keywords: *Mercury, Gold Mine, Well Water, Community*

1. INTRODUCTION

According to the World Health Organization (WHO), mercury pollution in large amounts can cause health impacts (Hiola et al., 2022). Mercury is commonly used in gold processing, namely in the amalgamation process, to separate gold from rocks. Lack of supervision on the use of mercury in traditional gold mining has led to pollution of the surrounding environment caused by the disposal of gold processing waste into the environment (river) without going through a treatment process (Hiola et al., 2022). This causes mercury to contaminate river ecosystems, fish, and transform into methylmercury and accumulate in aquatic organisms. Therefore, mining activities contribute to the increase of mercury pollutants in the environment and adverse effects on aquatic habitats. (Hiola et al., 2022).

Mercury (Hg) is a toxic material that can have harmful effects on humans and the environment. It is widely used in the gold mining process which serves to purify the precious metal. Gold processing using amalgamation techniques is known to damage the environment and pose human health risks. Mercury is released into the atmosphere in the form of mercury vapor generated from the amalgam combustion process. (Kamil & Karma, 2022). Mercury is a chemical element with the symbol Hg has an atomic number of 80 and has an atomic weight of 200.59 and in the periodic table is located in group IIB. Mercury can be used in gold processing which functions as a material to bind gold (Gundo

et al., 2020). However, mercury is a dangerous and toxic heavy metal because it has a high level of toxicity that is harmful to health and the environment polluted by the substance. Therefore, everyone is prohibited from disposing of waste (B3) into environmental media including river bodies, this is contained in article 69 in Law Number 32 of 2009 concerning Environmental Protection and Management (Lensoni et al., 2021). Mercury is one of six other heavy metals that have the highest toxicity effects on human health and the environment (Sugiana et al., 2023).

Mercury can enter the human body through the consumption of fish and other aquatic products as well as through airborne exposure and direct skin contact (Sugiana et al., 2023). Length of service is one of the factors that can influence the incidence of mercury poisoning in workers. This is related to the frequent exposure of workers to mercury in the work environment which leads to increased cumulation of mercury in the body. From the results of bivariate analysis, the risk of mercury poisoning is greater for workers who have a longer working period than those who do not. The longer a person works, the more exposure to hazards posed by the workplace (Sumantri, 2015).

According to Palar (1994), metal mercury and mercury vapor are included in inorganic mercury. Some of the mechanisms of action of mercury in the human body are Absorption, namely, Mercury enters the body mainly through the lungs in the form of vapor or dust. About 80% of inhaled mercury vapor will be absorbed. Absorption of ingested metallic mercury from the gastrointestinal tract in negligible small amounts while water-soluble mercury compounds are easily absorbed, Biotransformation of absorbed elemental mercury is rapidly oxidized to Hg2+ ions, which have an affinity for sulfhydryl groups (-SH), and bind to substrates rich in these groups. Mercury 19 is found in the kidneys (bound to metallothionines) and liver. Mercury can pass through the blood to the brain and placenta. About 90% of blood mercury is found in erythrocytes. The metabolism of mercury compounds is similar to the metabolism of metal mercury or its inorganic compounds. Phenyl and methoxyethyl mercury compounds are rapidly converted to inorganic mercury while methyl mercury is metabolized very slowly, Excretion of elemental mercury and its inorganic compounds are eliminated more through the urine than the feces (Gordon, 2003).

In general, more than 80% of Hg on the soil surface comes from atmospheric inputs through wet and dry deposition, directly onto the soil or indirectly through plant surfaces via waterfalls (Ballabio et al., 2021). The main sources of Hg contamination in European soils are 1) current and past mining activities, 2) industrial legacy contamination and 3) coal combustion (Ballabio et al., 2021). Mercury and its compounds are widely distributed in nature. Starting from rocks, water, air and even in the bodies of living organisms. The spread of mercury is influenced by geological, physical, chemical and biological factors (Rianto, 2010).

Mercury re-release into the environment can lead to a progressive increase in the amount of natural mercury, which can enter the air, soil, and water distribution cycles, where it can remain in the environment for many years. Mercury poisoning due to mercury exposure can have a variety of toxic effects, depending on the chemical form and route of exposure. The main routes of human exposure to methylmercury (MeHg) are mostly through the consumption of mercury-contaminated fish, seafood, and wildlife through the consumption of low-level contaminated organisms (Adlim et al., 2023)

Mercury enters the body mainly through the lungs in the form of vapor or dust. About 80% of inhaled mercury vapor will be absorbed. Absorption of ingested metallic mercury from the gastrointestinal tract is only in negligible amounts, while water-soluble mercury compounds are easily absorbed. Some organic and inorganic mercury compounds can be absorbed through the skin. Biotransformation of absorbed elemental mercury is rapidly oxidized to Hg2+ ions that have the affinity to bind to substrates rich in these groups. Mercury is found in the kidneys (bound to metallothioneers) and liver.Mercury can cross the blood-brain and placenta.

Methyl mercury has a strong affinity for the brain. About 90% of blood mercury is found in erythrocytes. The metabolism of alkyl mercury compounds is similar to that of metal mercury or its inorganic compounds. Phenyl and methoxyethyl mercury compounds are metabolized slowly. Mercury in the urine occurs because it has undergone the absorption process and continued with the excretion process. Elemental mercury and its inorganic compounds are eliminated more through the urine than feces, because the excretion process is strongly influenced by time. The time required for excretion is almost half of the levels present in the body. The half-life of mercury is about 60 days, and the excretion of mercury in the form of urine has a half-life of 40-60 days (Sonata et al., 2021).

Mercury poisoning is the result of exposure to mercury compounds of various toxic effects depending on the type and form of the chemical as well as the route of exposure. Mercury can cause serious health problems in the community when exposed to the heavy metal. In this case, the most dangerous is methyl mercury (MeHg). The production of MeHg from the amalgamation process is released into the environment in the form of metal and vapor. Such releases can be detrimental to residents or workers and communities residing near mining sites and can penetrate the nervous system as the main target for causing acute or chronic neurological disorders. In addition, symptoms of acute and chronic poisoning can also appear in the form of headaches, muscle cramps, coughs, and aphthous ulcers.

Acute toxicity includes mood swings, headache, hearing loss, speech impairment (dysarthria), while chronic toxicity is detected, e.g. tremor, cerebral ataxia, decreased hearing and vision, tingling from mouth to hands, impaired memory, impaired sensation, and sleeplessness (Kamil & Karma, 2022). Mercury pollution in coastal and marine environments has a huge impact on people's lives and the sustainability of marine ecosystems. Therefore, it is necessary to implement effective strategies to reduce or eliminate mercury pollution (Bouty et al., 2022). Mercury has a harmful impact, therefore it is necessary to supervise and control the use of these materials. In addition, the mercury waste treatment system before entering the environment must be carried out in an appropriate and environmentally sound manner so that it is not harmful to the surrounding community. One way to handle this waste is with the absorption process. Absorption is an absorption of liquid or gas material by solid material due to the attractive force between atoms in a solid and liquid material.

With absorbent media, which is a substance that absorbs or binds a molecule on the surface and has a greater tendency to react in hollow solids. The properties that must be possessed by the absorbent to be able to absorb waste materials, including not reacting with the absorbent, the absorbent surface is broad and active and pure. Wastewater or soil treatment can use re-organic absorbents as ion exchangers for both cations and anions

(Pangestu et al., 2020). However, the use of the above materials is relatively more expensive.

Effects of mercury contaminants on the environment include physical, economic, vegetation, animal life and aesthetic conditions. Other effects, namely on human health in general, can be in the form of illness (acute and chronic), disruption of physiological functions (nerves, lungs, sensory abilities), sensory irritation and accumulation of hazardous materials in the body. Various impacts caused by human activities can take the form of positive changes or negative changes. Changes in environmental conditions that are negative can also affect humans themselves and as a result humans themselves will suffer losses (Rianto, 2010).

2. LITERATURE REVIEW

From the results of observations, it is known that gold processing activities carried out in Pasie Raja District, South Aceh Regency still use amalgamation techniques, namely using mercury in the processing process. The impact of mercury can cause annual diseases because mercury is toxic so it is not good for health. For this reason, researchers want to see the identification of disease symptoms caused by gold mining workers caused by mercury.

3. RESEARCH METHODS

This study is an experimental study. This research was conducted in the UPTD Puskesmas Ujung Padang Rasian work area, South Aceh Regency, Aceh Province, Indonesia in June 2023. This location was chosen based on the consideration that gold processing has been running for more than 5 years. This study focused on analyzing wastewater around the UPTD Puskesmas Ujung Padang Rasian work area. The population in this study was divided into 14 samples. Samples were taken at the location and surroundings of gold mining in the UPTD Puskesmas Ujung Padang Rasian Work area. Sampling was carried out at 14 points in the surrounding well water in the UPTD Puskesmas Ujung Padang Rasian Working area. Analysis of mercury levels in well water and wastewater samples was carried out at the Environmental Quality Testing Engineering Laboratory of Syiah Kuala University, Banda Aceh.

4. RESULTS AND DISCUSSION

4.1. Research Results

4.1.1. Lab Test Results

Based on the results of the analysis conducted in the laboratory, it can be seen that the data obtained from water samples at 14 points show that no mercury was detected in the water samples. However, the non-detection of Hg levels does not always mean that there is no Hg content in the water body, but it could be caused by concentrations that are too small to be detected by the tool. Measuring instruments have limitations, namely only being able to detect values above 0.001 µg/l. Based on this value, it can be said that the mercury content in the well water samples is still in accordance with the quality standards set by Government Regulation No. 82 of 2001 concerning Water Quality Management

and Pollution Control, where the allowable mercury threshold for category I water is 0.001 µg/l.

4.2. Discussion

Based on the results of the research that has been carried out can be seen in table 1. Mercury levels did not reach the maximum limit. Based on the quality standard of PP No. 82 of 2001, the mercury level limit is 0.001 µg/l, so the levels obtained do not reach the quality standard threshold (Suoth et al., 2020). There was no mercury content at any of the study sites. Based on table 1, we can see that no mercury content was detected. One of the things that affects the quality of well water is the distance to the pollutant source (Wahyudi et al., 2021). ccording to Sirait (2010) cited in Boky et al (2015) states that the pollution of dug wells is influenced by several factors including geographical conditions, hydrogeology, soil topography, season, groundwater flow and physical building construction of dug wells.

According to Entjang (2000), the allowed distance of chemical pollution source to well water is 200 meters. In Iha and Luhu villages, there are 4 community dug wells located <200 meters from the illegal cinnabar stone mining site. But the well water is still safe within the safe limit to be used for daily purposes except for 1 dug well located close to the illegal cinnabar stone mining site which has a distance of 10 meters which is not safe for daily use. This is because all wells have walls made of concrete that are watertight as deep as 3 meters so as to reduce pollution to clean water.

Mercury (Hg) has a negative impact on health when a highly toxic heavy metal when mixed with enzymes in the human body will cause the loss of the enzyme's ability to act as a catalyst for body functions. The toxic effects of heavy metals are able to block the work of enzymes, thus disrupting metabolism in the body, causing allergies that are mutagens, teratogens or carcinogens for humans and animals. While mercury levels in 2017 according to the article produced by Syahrul Purnawan, Rifki Rahman, Sofyatuddin Karina there were results of mercury levels of 0.76 mg / kg while in 2019 mercury levels have decreased. The mercury levels resulting from the examination of the Chemistry Analysis and Study Unit Lab of Syiah Kuala University obtained an average of 0.00024842 ppm.

5. CONCLUSION

Based on the results of the analysis carried out in the laboratory, it can be seen that the data obtained from well water samples at 14 points show that no mercury was detected in the well water samples. However, the non-detection of Hg levels does not always mean that there is no Hg content in the water body, but it could be caused by concentrations that are too small to be detected by the tool. The measuring instrument has a limitation that is only able to detect values above 0.001 µg/l. Based on the value of the analysis, it can be said that the mercury content in well water samples is still in accordance with the quality standards set by Government Regulation No. 82 of 2001 concerning Water Quality Management and Pollution Control, where the allowable mercury threshold for category I water is 0.001 µg / l. So the result of this study is that well water in the working area of the UPTD Puskesmas Ujung Padang Rasian South Aceh does not detect mercury levels due to concentrations that are too small to be detected by the instrument.

REFERENCES

Adlim, M., Kamil, H., & Karma, T. (2023). Identification and Correlation Test of Mercury Levels in Community Urine at Traditional Gold Processing Locations. *Journal of Ecological Engineering*, *24*(3).

Ballabio, C., Jiskra, M., Osterwalder, S., Borrelli, P., Montanarella, L., & Panagos, P. (2021). A spatial assessment of mercury content in the European Union topsoil. *Science of the Total Environment*, *769*, 144755.

Boky, H., Umboh, J. M. L., & Ratag, B. (2015). perbedaan kandungan merkuri (Hg) air sumur gali berdasarkan jarak dari sumber pencemar di wilayah pertambangan rakyat desa tatelu I. *Jikmu*, *5*(1).

Bouty, A. A., Riogilang, H., & Mangangka, I. R. (2022). Analisa Potensi Pencemaran Merkuri Pada Sungai Ongkag Dumoga Akibat Kegiatan Pertambangan Emas Tanpa Izin (PETI). *TEKNO*, *20*(82), 537–544.

Entjang, I. (2000). Ilmu Kesehatan Lingkungan. *Penerbit PT. Citra Aditya Bakti*, *Bandung*.

Gundo, I. S. D., Polii, B. J. V, & Umboh, J. M. L. (2020). Kandungan merkuri pada penambang emas rakyat. *Indonesian Journal of Public Health and Community Medicine*, *1*(3), 13–18.

Hiola, T. T., Warow, N., Ali, I. H., & Suleman, R. (2022). Pemanfaatan karbon aktif untuk menurunkan merkuri pada limbah pertambangan emas tradisional. *JMM (Jurnal Masyarakat Mandiri)*, *6*(3), 2070–2077.

Kamil, H., & Karma, T. (2022). Description of Mercury Poison Clinical Symptoms in Workers and Communities Around the Small-Scale Gold Processing Area. *Proceedings of Malikussaleh International Conference on Multidisciplinary Studies (MICoMS)*, *3*, 34.

Lensoni, L., Syahputra, M., & Riezky, A. K. (2021). Proses Adsorbsi Merkuri Pada Limbah Cair Pertambangan Emas Dengan Menggunakan Ampas Kopi. *Jurnal Aceh Medika*, *5*(2), 105–111.

Palar, H. (1994). Pencemaran dan toksikologi logam berat. *Jakarta: Rineka Cipta*, *148*.

Pangestu, W. I., Pralano, Z. S. P., & Anggraeni, R. D. (2020). Efektivitas Pengaplkasian Zeolit Dengan Menggunakan Metode Tyler Sieve Astm, Up Flow, Dan Catu Dalam Upaya Penurunan Kadar Merkuri Pada Limbah Pertambangan Emas Rakyat. *Prosiding Temu Profesi Tahunan PERHAPI*, 201–208.

Rianto, S. (2010). *Analisis faktor-faktor yang berhubungan dengan keracunan merkuri pada penambang emas tradisional di desa Jendi Kecamatan Selogiri Kabupaten Wonogiri*. Universitas Diponegoro.

Sonata, H., Thressia, M., & Shinta, D. Y. (2021). Toksisitas Merkuri (Hg) Pada Penambang Emas di Nagari Koto Tuo Sijunjung Sumbar. *SEHATI: Jurnal Kesehatan*, *1*(1), 33–38.

Sugiana, I. P., Putri, P. Y. A., & Munru, M. (2023). Pencemaran Merkuri di Pesisir dan Laut: Dampak, Strategi Pemantauan, Mitigasi serta Arah Penelitian di Indonesia. *ULIL ALBAB: Jurnal Ilmiah Multidisiplin*, *2*(9), 4221–4232.

Sumantri, H. (2015). *Metodologi penelitian kesehatan*. Prenada Media.

Suoth, A. E., Masitoh, S., Hariandja, A. H., Junaidy, E., & Purwati, S. U. (2020). Kandungan Merkuri Dalam Beberapa Media Sekitar Penambangan Emas Skala

Kecil (Pesk) Di Kalimantan Tengah. *Ecolab*, *14*(1), 43–52.
Wahyudi, R., Kadaria, U., & Jumiati, J. (2021). Analisis Pengaruh Kadar Merkuri Terhadap Kualitas Air, Ikan dan Pekerja Peti di Sungai Sepauk Kabupaten Sintang. *JURLIS: Jurnal Rekayasa Lingkungan Tropis Teknik Lingkungan Universitas Tanjungpura*, *2*(1), 141–150.

Copyrights