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Quantitative Analysis of Mercury on Marine Life in Various Depth Level using Spectrophotometric Method

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Abstract
This research analyzed and determined pollution level of mercury (Hg) in Sumberagung Village waters in Pesanggaran – Banyuwangi of Indonesia. The method used was experimental observational. Purposive sampling technique was used for sediment and water sampling in various depth levels of sea was following the calculation of completely randomized design formula. Atomic absorption spectrophotometer (AAS) was used to analyze the sediments, water and marine biota. Standard equation of Hg standard is y = 0,9823x + 0,048. The analysis result of the sediments quality on sea water estuary showed that the mercury (Hg) level was 0.0314 ppm, the sediment with depth of 10 meters from the sea surface showed 0.0134 ppm and depth of 20 meters is 0,0101 ppm. The analysis results of mercury levels (Hg) in the sediments of Pesanggaran waters did not fulfill the Quality Standards in accordance with government regulation number. 82, 2001, which said that class 1 is 0.00 mg/L, class 2 is 0.002 mg/L, and class 3 is 0.002 mg/L. Analysis of water quality in Sumberagung waters at tidal sea level depths showed that the mercury level (Hg) was 0.00035 ppm; at the level of shallow sea water, the mercury (Hg) was 0.00015 ppm; and at the depth of the sea water, the mercury (Hg) was 0,00011 ppm. The mercury (Hg) concentration in Pesanggaran waters was below the threshold limit value of quality standard based on Indonesian National Standard (SNI 7387: 2009). Maximum limit of heavy metal contamination in food for natural mineral water is 0.001 mg/L.

Keywords: *Pollution; Mercury (Hg); Sediment; Sea Water*

1.0 INTRODUCTION

Pesanggaran Sea is located in Banyuwangi Regency of Indonesia. One potency owned is the fish resources. It has become the main source of livelihood for the surrounding community, even the area has been equipped with Fish Auction and the community makes fish as the main source of protein so that the fish consumption is relatively greater. However, this area also has mining locations conducted by local residents illegally (Unlicensed Gold Miners). This potential gold mining has the risk of triggering environmental pollution. Gold mining tends to use toxic chemicals, xenobiotic substances, certain compounds such as heavy metals. One of the heavy metals which has the potential to pollute the environment is the mercury metal (Hg) (Sumantri, 2014).

Toxic heavy metals or dissolved essential that are soluble in water will contaminate both fresh and sea water. Pollution in waters by heavy metals, chemical monitoring has been developed by determining the levels of each pollutant in water and sediment Darmono, (2008). Scattered mercury (Hg) is suspected to sediment at various levels of sea water depth (Saleh et al. 2014) where each level of sea water depth will be inhabited by different biota. This research was conducted in Sumberagung village, Pesanggaran, Tumpang Pitu Banyuwangi. The results showed that all respondents had mercury (Hg) concentrations in urine below the threshold of ≤ 4% µg / l was relatively good. According to World Health Organization (WHO) and United Nations Environment Program (UNEP) normal mercury (Hg) level in the blood ranges from 5-10% µg / l, in hair ranges between 1-2 ppm, whereas in urine is an average of 4% µg / l.

Based on the background above, the problem formulation in this study is as follows: Analyzing mercury (Hg) levels in marine biota (fish) at various levels of sea water depth in Pesanggaran waters, Banyuwangi by using atomic absorption spectrophotometer.

2.0 RESEARCH METHOD

The analysis of marine biota quality was conducted in ULPFFUA laboratory at the second floor of LDB building, Campus B Unair Dharmawangsa Dalam Street Surabaya. Analysis of Mercury (Hg) levels used Atomic Absorption Spectrophotometer (AAS). This research used an experimental observation of Notoatmodjo (2012). The sampling technique followed the formula of complete random design, random group or factorial. The location of Pesanggaran marine sampling was in Banyuwangi. Mercury (Hg) levels analyzed were in marine sediments and sea water at various depth levels.

3.0 RESULT AND DISCUSSION

This research described the exposure of mercury (Hg) levels in the aquatic environment, especially in marine life because of the existence of an unlicensed gold mine in Sumberagung village, Pesanggaran - Banyuwangi. This research was conducted on water and sediments. Hg levels were analyzed by using spectrophotometric methods with the help of Atomic Absorption Spectrophotometer (AAS). Determination of Hg levels was carried out using a standard equation generated from Hg standard curve solution. Determination of Hg levels is done using a standard equation that is result from the standard curve of Hg solution as shown in Figure 1 with the standard equation is y = 0,9823x + 0,048.

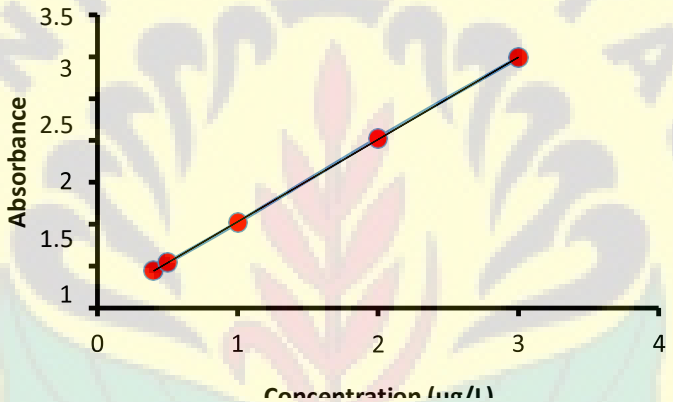

Figure 1. Standard curve of mercury

3.1The Analysis of Mercury (Hg) Levels on Sediments, Depth of 10 Meters and 20 Meters from Sea Level

Based on the results of sediment analysis obtained from marine waters the sediment consists of mud, sand and rocks. The mercury (Hg) content in estuarine sediments was greater than in sediments with depth of 10 meters. The value of mercury levels in estuary sediments, in depth of 10 meters and 20 meters can see at the Table 1. Mercury levels obtained in sediments both at the estuary and at depth of 10 meters were still below the threshold of 0.2 ppm (US EPA). Mercury levels at higher estuaries were suspected to be affected by the river flow that become waste dumps from PETI (Unlicensed Gold Miners) directly flow into the sea.

Table 1. The mercury levels of sea level

Sea Level	Mercury Level (ppm)
Sediments	0,0314
Dept of 10 Meters	0,0134
Dept of 20 Meters	0,0101

Mercury (Hg) in the water settled on sediments at the bottom of the water flow in the estuary and the seabed. The difference levels of mercury (Hg) in estuary sediments and sea water sediments with depth of 10 meters also occured due to the different mercury dissolution processes. Aerobic conditions in the water caused mercury to react with sulfides to form complex compounds which was insoluble in water so that the compound will be easier to settle at the bottom of the estuary and to the seabed and mercury (Hg) has greater density than sea water so it will be easier

to settle on the seabed. If there is a disruption to the water conditions in the river or sea, with the wind, heavy rain, differences temperature on day and night, it will affect the size of the ocean waves which caused the sediment stirred, carried along with sea water and will cause mercury compounds dissolved in the water (Mukhatasor , 2007). The stirring process that occurred naturally in sediments at the bottom of the waters allowed the differences of mercury content in each sediment.

Chen, et al., (2012) stated that the amount of Mercury (Hg) contained in sediments increased the amount of pollution for water bodies. This caused the concentration of contaminants in the sediment increased higher from day to day. Heavy metals that enter the waters experience deposition, dilution and dispersion, then they were absorbed and eaten by organisms that live in these waters.

3.2 The Analysis of Mercury (Hg) Levels on Tidal Sea Water, Shallow Sea Water and Deep Sea Water

The analysis of tidal sea water was showed in the Table 2. The concentration of mercury heavy metals in tidal sea water was still below a predetermined threshold of 0.001-0.5 ppm (US EPA) and the mercury concentration in sea water in the depth of 25 meters was below a predetermined threshold of 0.001- 0.5 ppm (US EPA).

Table 2. The mercury levels of sea water

Sea Water	Mercury Level (ppm)
Tidal Sea Water	0,00035
Shallow Sea Water	0,00015
Deep Sea Water	0,00011

The waters can be categorized as good and low level of pollution if the dissolved oxygen level is <5 ppm. Mercury levels will begin to settle at pH (Potential Hydrogen) 6 so that with an increase of pH (Potential Hydrogen) in water conditions, it will be followed by an increase of the settled mercury. Mercury compounds found in water-base deposits were changed by the bacterial activity into Hg2+ and Hg. The stage of change begins with the change in dimethyl mercury ((CH3) 2Hg) into methyl mercury ion (CH3Hg+). Methyl mercury ions will easily evaporate into the air due to physical factors, namely light, which will decompose again into methane (CH4), ethane (C2H6) and Hg metals. In addition, methyl mercury ions are very soluble in water and are easily eaten by marine biota along with the food chain system in marine waters.

4.0 CONCLUSION

Analysis of sediment mercury (Hg) level in estuaries, depth of 10 meters and 20 meters of the sea surface was still below the threshold. Analysis of mercury (Hg) level in water samples using the AAS method, in tidal waters, shallow and deep waters, the mercury levels (Hg) at various depths of the sea water were still in the normal category because they were below the specified Quality Standards.

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