ANALYSIS OF LEAD AND ARSENIC METAL CONTENT IN BARITO RIVER WATER AROUND THE BANJARMASIN CITY TIMBER FACTORY WITH ATOMIC ABSORPTION SPECTROPHOTOMETRY METHOD

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Abstract

Timber factories that dominate companies in Banjarmasin City have a negative impact in the form of aquatic waste. Wood factory waste comes from the wood washing process and adhesive machine (glue spreader) as well as production that is used dry or wet. The purpose of this study is to analyze the levels of lead and arsenic in the air of the Barito River around the wood mill with a specified distance and compare the threshold levels according to Permenkes No.32 of 2017. The methods used are qualitative and quantitative tests. The qualitative test for lead used KI, HCl and NaOH reagents, while arsenic used $AgNO_3$, $CuSO_4$ and KI reagents. Quantitative test using atomic absorption spectrophotometer. The results of the base metal content in the SPSS system to get a significant value. The results obtained are significant values, namely 0.833 for lead and arsenic 0.518 with a regression value (r) both 0.999 and there is only a lead concentration of 0.0076 mg/L so that the concentration of lead and arsenic levels does not exceed the threshold stipulated by the Minister of Health Regulation No.32 Year 2017. In conclusion, the concentration of lead and arsenic levels in the air of the Barito River around the wood factory does not exceed the threshold of Permenkes No. 32 of 2017.

Keywords: Atomic Absorption Spectrophotometer, River, Lead, Arsenic.

Introduction

Total area of Indonesia consists of a land area that reaches about 2,012 million km^2 and an ocean area that reaches 2.5 times the land area, which is about 5.8 million km^2. This has resulted in Indonesia being referred to as a maritime country where most of its territory is in the form of water, as well as residents living in coastal areas so that it is used as a livelihood. Water sources in Indonesia can be in the form of oceans, beaches, rivers, and others (Ramdhan et al, 2013: 141).

A river is a natural and/or artificial water channel or container in the form of a water drainage network and the water in it, from upstream to estuary, limited to the right and left by a border line (Peraturan Pemerintah RI No. 38, 2011). Rivers have great potential for water resources for residents so that they can help the wheels of daily life such as activities that can be carried out through the use of river water, among others, for irrigation sources, power plants, tourist sites, transportation and toilets (bathing and washing) (Depkes, 2011).

Activity is very commonly found in Banjarmasin City which is the capital city of South Kalimantan Province which is known as the "City of a Thousand Rivers". One of the main rivers that play an important role in

Banjarmasin City is the Barito River. The Barito River plays a role in cross-city rivers and inter-provincial liaisons or is referred to as the main river in Banjarmasin City (Badan Lingkungan Hidup Kota Banjarmasin, 2015).

According to the Central Bureau of Statistics of Banjarmasin City in 2019, there were 32 companies including medium and large manufacturing industries which were dominated by wood factories (Badan Pusat Statistik Kota Banjarmasin, 2019). Through this wood mill there are positive and negative impacts on the environment and the people in the area. The positive impact given is that the economy is increasing due to job opportunities for the surrounding community. Meanwhile, the negative impact obtained is the interconnectedness of the Barito River and wood factories so that industrial waste discharges directly into rivers which have the potential to contain heavy metals such as lead and arsenic (Quay, 2018).

Factors that cause waste from wood factories can come from the wood washing process and the machine for adhesives (glue spreader) as well as the production process used between dry or wet. Especially in the use of adhesives (glue spreader), which uses various chemicals such as urea formafehide whose basic ingredients are urea formaldehyde resin, industrial flour, kaolin, bardener, bassilium and others which if disposed of continuously will produce heavy metals that can accumulate in water. Industrial waste that enters the waters contributes to water pollution (Subari, 2012).

River water can be a negative impact on the health of people who use it for daily needs, especially if it is consumed as drinking water, it will enter the body such as lead metal which causes carcinogenic substances or can cause cancer, poisoning, disorders of various organ systems such as blood, etc. nervous system, kidneys, reproductive system and gastrointestinal tract and arsenic metal can cause symptoms of nausea, vomiting, abdominal pain, diarrhea, heart problems, liver disorders and kidney disorders (Muji R et al, 2018).

Based on a preliminary study that was carried out in November 2020 online using social networks to the head of the RT on Jalan Pembangunan Ujung, Kuin Cerucuk Village, West Banjarmasin District, RT. 39, RW. 03 on the banks of the Barito River, which is in the vicinity of the wood mill, it was found that almost all of them still use river water as a source of daily needs. The percentage of use of river water used for bathing, washing clothes and kitchen utensils, defecating / urinating as much as 90% of 150 households which is about 135 households, usage as transportation as much as 50% of 150 households which is around 75 households. water for drinking water as much as 10% of 150 households, namely 15 households.

Seeing this, research is needed to determine the metal content of lead and arsenic in river water. So researchers are interested in conducting research related to "Analysis of Lead and Arsenic Metal Content in Barito River Water Around the Banjarmasin City Timber Factory with Atomic Absorption Spectrophotometry Method".

Material and Methods

The research method used in this study is an analytical observational method with a cross sectional design. This study used a qualitative test and a quantitative test, where the qualitative test used the reagents HCl, KI,

$AgNO_3$, NaOH and $CuSO_4$, while the quantitative test used an Atomic Absorption Spectrophotometer (AAS).

a. Qualitative Test of metal Lead (Pb)

1) Pb Test with KI Reagent

Take 5 ml of the sample and put it in a test tube, then add 5 drops of KI solution and the solution will form a yellow precipitate if the sample is positive for lead (G. Svehla, 1985).

2) Pb Test with HCl Reagent

Take 5 ml of the sample and put it in a test tube, then add 5 drops of HCl and the solution will form a white precipitate if the sample is positive for lead.

3) Pb Test with NaOH Reagent

Take 5 ml of the sample and put it in a test tube, after that add 5 drops of NaOH solution and the solution will form a white precipitate if the sample is positive for lead (Hasrat, 2014).

b. Qualitative test of metal Arsenic (As)

1) As Test with $AgNO_3$ Reagent

Take 5 ml of the sample and put it in a test tube, then add 5 drops of $AgNO_3$ solution and a yellow precipitate will form if the sample is positive for arsenic.

2) As Test with $CuSO_4$ Reagent

Take 5 ml of the sample and put it in a test tube, then add 5 drops of $CuSO_4$ solution and the solution will form a green precipitate if the sample is positive for arsenic (G. Svehla, 1985).

3) As Test with KI Reagent

Take 5 ml of the sample and put it in a test tube, then add 5 drops of KI solution and add 1 ml of chloroform, a purple precipitate will form if the sample is positive for arsenic (G. Svehla, 1985).

c. Quantitative Test

Quantitative test in this research can be done using Atomic Absorption Spectrophotometry (AAS). The stages in the test are as follows:

1) Preparation of Standard Solutions of Pb and As 100 Ppm

Each standard solution of Pb and As with 1,000 ppm HNO_3 was taken as much as 10 ml and put into a 100 ml volumetric flask, then added with distilled water to the limit mark, so that a standard solution of Pb and As was 100 ppm.

2) Pb Standard Series Manufacturing

The standard series of Pb is made by making series of 0.4, 0.8, 1.2, 1.6 and 2 ppm which are pipetted as much as 0.1, 0.2, 0.3, 0.4 and 0.5 ml. put into a 25 ml volumetric flask, after that it was diluted with aquadest to the limit mark, then obtained a standard solution of Pb for standard curves of 0.4, 0.8, 1.2, 1.6 and 2 ppm.

3) As Standard Series Manufacturing

The preparation of the standard As series was carried out by making 0.1, 0.2 and 0.5 ppm series pipettes of 0.025, 0.05 and 0.125 ml which were put into a 25 ml volumetric flask, then diluted with distilled water to the mark. obtained standard solutions of As for standard curves of 0.1, 0.2 and 0.5 ppm.

4) Analysis of Lead and Arsenic Levels

The sample solution resulting from the destruction was measured for absorbance using Atomic Absorption Spectrophotometry (AAS), for lead metal (Pb) at a wavelength of 283 nm and for arsenic metal (As) at a wavelength of 193.7 nm. Quantitative analysis of 5 series of standard concentrations of lead and 3 series of standard arsenic were aspirated on atomic absorption spectrophotometry, so that the equation for the curve y = bx + a was obtained. After that, 10 ml of the sample was aspirated into the Atomic Absorption Spectrophotometer (AAS) and read the absorption at a wavelength of 193.7 nm for arsenic metal and 283 nm for lead metal (Aminah, 2017).

Result and Disscusion

A. Qualitative test

1. Based on the results of qualitative research that has been carried out, the results of lead compound data using KI, HCl and NaOH reagents are:

Table 1. Results of the identification of lead compounds using KI, HCl and NaOH reagents

No	Sample	Results		
		KI	HCl	NaOH
1	100 m	Negative	Negative	Negative
2	200 m	Positif	Negative	Negative
3	300 m	Negative	Negative	Negative

2. Based on the results of the qualitative test research that has been carried out, the results of the identification of arsenic compounds using $AgNO_3$, $CuSO_4$ and KI reagents are:

Table 2. Results of the identification of arsenic compounds using $AgNO_3$, $CuSO_4$ and KI reagents

No	Sample	Results		
		$AgNO_3$	$CuSO_4$	KI
1	100 m	Negative	Negative	Negative
2	200 m	Negative	Negative	Negative
3	300 m	Negative	Negative	Negative

B. Quantitative Test

Based on the quantitative test, the data obtained are as follows:

1. Determination of Absorbance of Lead Standard Solution

Table 3. Absorbance Measurement Results of Lead Standard Solutions

No	**Concentration**	**Absorbance**
1	0,4	0,0179
2	0,8	0,0332

3	1,2	0,0488
4	1,6	0,0659
5	2	0,0804

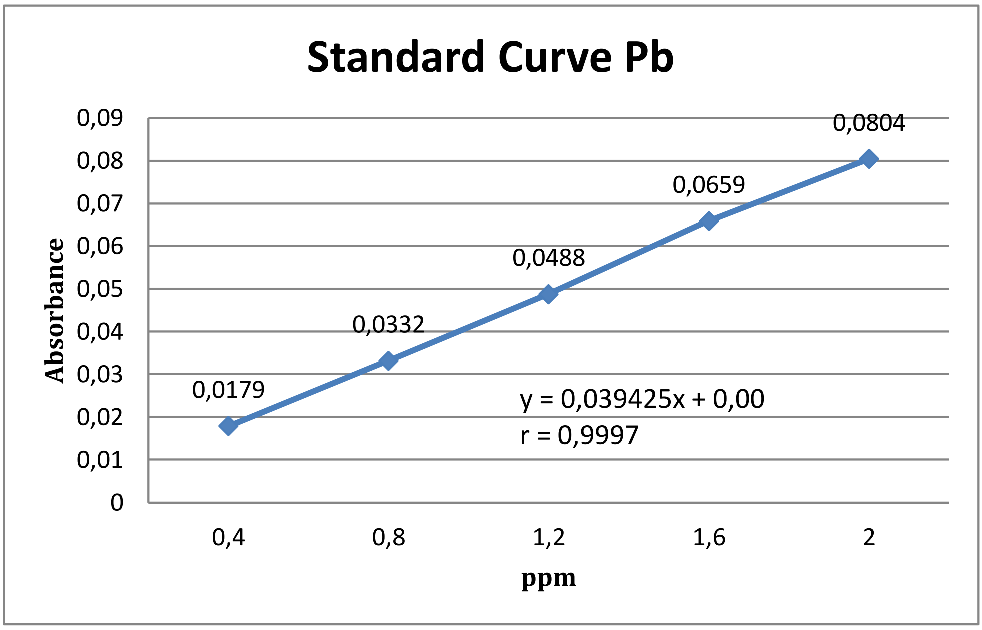

Figure 1. Lead Standard Solution Curve

2. Determination of Concentration of Heavy Metal Lead in Sample

Table 4. Measurement Results of Lead Sample Concentration

No	Distance	Absorbance	Concentration
1	100 m	-0,0008	-
2	200 m	0,0003	0,0076 mg/L
3	300 m	-0,0012	-

3. Lead Heavy Metal Multiple Linear Regression Data

Table 5. Results of Multiple Linear Regression for Heavy Metal Lead

ANOVA[a]

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	1344.835	1	1344.835	0.072	0.833[b]
Residual	18655.165	1	18655.165		
Total	20000.000	2			

Description: Based on Table 5, a significant result of 0.833 was obtained.

4. Determination of Absorbance of Arsenic Standard Solution

Table 6. Absorbance Measurement Results of Arsenic Standard Solutions

No	Concentration	Absorbance
1	0,0	0,0000
1	0,1	0,0016
2	0,2	0,0031
3	0,5	0,0074

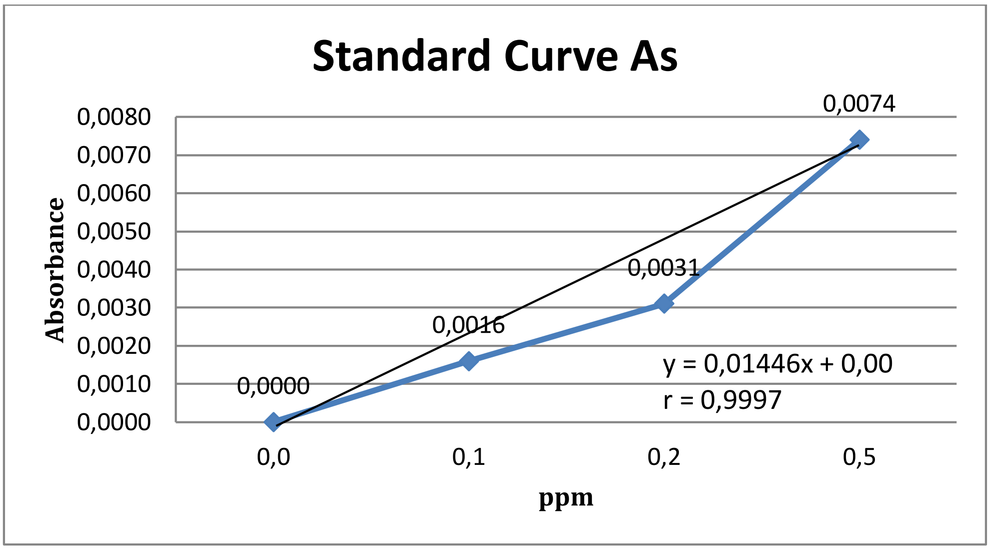

Figure 2. Arsenic Standard Solution Curve

5. Determination of Arsenic Heavy Metal Concentration in Sample

Table 7. Results of Measurement of Arsenic Sample Concentration

No	Distance	Absorbance	Concentration
1	100 m	-0,0075	-
2	200 m	-0,0048	-
3	300 m	-0,014	-

6. Arsenic Heavy Metal Multiple Linear Regression Data

Table 8. Results of Multiple Linear Regression for Heavy Metal Arsenic

ANOVA[a]

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	9446.639	1	9446.639	0.895	0.518[b]
Residual	10553.361	1	10553.361		
Total	20000.000	2			

Description: Based on Table 8, a significant result of 0.518 was obtained.

The results of qualitative identification of lead heavy metal using KI reagent at a distance of 200 samples showed a clear yellow precipitate and at a distance of 100 and 300 meters produced a clear solution in the test results. According to Vogel's 1985, when the sample is reacted with KI reagent it will produce a yellow precipitate which indicates that the sample tested positive contains lead heavy metal compounds. The reactions that occur are as follows:

$$PbNO_3 + KI \rightarrow \downarrow PbI_2 + KNO_3$$

The chemical reaction occurs because samples containing lead heavy metal when reacted with KI solvent will form yellow lead chloride. The addition of excess KI solution in samples that are positive for lead heavy metal if a precipitate occurs, there will be no change in the precipitate formed. This test indicates that the 200 meter sample is positive for lead heavy metal because a clear yellow precipitate solution occurs.

Identification results on samples of 100 and 300 meters obtained a clear solution. The results show conformity with the research from Hasrat which obtained the results of qualitative test samples of lead heavy metal in fish samples in several water locations forming a clear solution so that negative results were obtained which did not indicate the occurrence of yellow deposits in the test samples studied. (Hasrat, 2014).

Identification of lead heavy metal can use other substances, namely HCl reagent in the test sample with the addition of 5 drops of the solution, negative results are obtained with the presence of a clear solution in the test sample. Based on research from Vogel's 1985, if the sample is reacted with HCl reagent, a white precipitate will occur which indicates that the river water test sample is positive for lead heavy metal compounds. The reactions that occur are as follows:

$$PbNO_3 + HCl \rightarrow \downarrow PbCl_2 + HNO_3$$

Heavy metal lead when reacted with HCl solvent will result in a chemical reaction to form white lead chloride which is insoluble or can be in the form of a precipitate. The precipitate is soluble in hot water at 100^oC. Based on the results of the research that has been carried out, a clear solution was obtained which results showed conformity with research from Tika which showed the occurrence of a clear solution in the qualitative test of lead heavy metal using well water samples which indicated negative results because there was no white precipitate in the lead heavy metal test sample (Tika, 2021).

Another reagent that can be used for the identification of lead heavy metals is NaOH solution. The test sample was carried out with the addition of 5 drops of NaOH solution, the result was a clear solution. The sample when reacted with positive NaOH reagent contains lead heavy metal which is indicated by the occurrence of a white precipitate from Vogel's 1985 research. The reactions that occur are as follows:

$$PbNO_3 + NaOH \rightarrow \downarrow Pb(OH)_2 + NaNO_3$$

NaOH solvent will cause a chemical reaction between samples containing lead heavy metal resulting in the formation of lead hydroxide in the form of a white precipitate, but the precipitate can dissolve if added NaOH in excess. Based on the results of the research that has been carried out, the results obtained are clear solutions, the results obtained are in accordance with Kiki's research for the qualitative test of lead heavy metal which shows the results of clear solutions obtained from river water samples so that it indicates a negative result because there is no white precipitate formed in the test sample lead heavy metal (Kiki, 2020).

Furthermore, the results of identification of heavy metal arsenic with the addition of 5 drops of $AgNO_3$ reagent produced a clear solution in all test samples 100 meters, 200 meters and 300 meters. Research conducted by Vogel's 1985, when the $AgNO_3$ reagent is reacted with the sample will produce a yellow precipitate which indicates that the sample tested positive contains arsenic heavy metal compounds. The reactions that occur are as follows:

$$AsO_3^{3-} + 3Ag^+ \rightarrow \downarrow Ag_3AsO_3$$

This chemical reaction will cause the formation of silver arsenite in the form of a yellow precipitate when a sample containing heavy metal arsenic is reacted with $AgNO_3$ solvent. Based on the results of the research that has been carried out, the result is a clear solution, so it can be interpreted that the heavy metal arsenic is not contained in it because there is no yellow precipitate in the sample.

The next identification of heavy metal arsenic using $CuSO_4$ reagent as much as 5 drops in all test samples resulted in a clear solution. A green precipitate will be produced when the sample is reacted with $CuSO_4$ reagent from Vogel's 1985, stating that the sample tested positive contains arsenic heavy metal compounds. The reaction that occurs as $CuHAsO_3$.

A green precipitate of copper arsenite will be produced due to a chemical reaction between samples containing heavy metal arsenic and $CuSO_4$ solvent. Based on the results of the research that has been done, a clear solution is formed. The absence of a yellow precipitate means that there is no arsenic heavy metal content in the sample.

The results of the last identification of heavy metal arsenic using 5 drops of KI reagent plus 1 ml of chloroform resulted in a clear solution in all test samples. The sample was declared positive for containing arsenic heavy metal compounds because based on Vogel's 1985, the sample was reacted with KI plus 1 ml of chloroform to produce a purple precipitate. The reactions that occur are as follows:

$$AsO + 2H^+ + 2I^- \leftrightarrow \downarrow AsOI_2 + H_2O$$

Samples containing heavy metal arsenic will undergo a chemical reaction with KI solvent plus chloroform resulting in the formation of a purple precipitate produced by iodine. Based on the results of the research that has been carried out, the results are clear solutions. The absence of a purple precipitate indicates that a negative result does not contain arsenic in the sample. To strengthen the analysis of the heavy metal content of lead and arsenic in the sample, quantitative testing can be carried out.

Quantitative test in this study was carried out using atomic absorption spectrophotometry (AAS). The wavelength measurement for lead (Pb) is 283 nm and for arsenic (As) at a wavelength of 193.7 nm (Aminah, 2017). The results of the measurement of lead and arsenic based on the absorbance value of the curve obtained the value of the correlation coefficient (r) for lead metal of 0.9997 and for arsenic metal also obtained a value of 0.9997. The data obtained shows that the correlation coefficient value has met the requirements set by SNI, which is 0.97 (Ardhaningtyas, 2017).

Results of the absorbance data are then made a relationship curve between the concentration value (x axis) and absorbance (y axis). Through calculations using the formula y = bx + a, the results on the graph are obtained, namely the concentration of the standard curve forming a straight line equation. This shows conformity with the Lambert-Beer Law which states that the greater the concentration of the standard solution, the greater the absorbance (Tryvena et al, 2019).

Furthermore, at the quantitative test stage, the measurement of the absorbance value in the test sample using an atomic absorption spectrophotometer (AAS). The results showed that the lead metal content in the sample was only at a distance of 200 meters with a concentration concentration of 0.0076 mg/L. Furthermore, at a distance of 100 meters and 300 meters there is no lead metal in the sample which is indicated by the negative absorbance result. The metal content of lead is only found at a distance of 200 meters while at a distance of 100 meters and 300 meters there is no lead heavy metal can occur due to the influence of various activities that occur in the area such as domestic waste from the community because it is a crowded area of population and the existence of transportation such as boats. motors or commonly called klotok that leech in the waters because the heavy metal lead can be produced by the fuel used by the boat and the movement of waters by the wind also causes stirring and mass transfer of water to the metal content in it (Ade, 2018).

The results of the heavy metal content of lead from the three test samples did not exceed the threshold set by Permenkes No. 32 of 2017 on the quality standard of lead concentration in waters which must not exceed the threshold level of 0.05 mg/L. So that it can be interpreted that the level of lead metal in the Barito River water around the wood factory is still within safe limits.

Value of the heavy metal concentration of lead is entered into the SPSS system to determine whether there is a significant difference or not between the calculation of the concentration of heavy metal levels with a predetermined distance. Based on the results of the statistical test output on multiple linear regression, it was obtained a significant result of 0.833 for lead heavy metal. This means that the results obtained from the heavy metal lead are $H0 > 0.05$ and there is no significant difference between the distance of the river and the heavy metal content of lead in the water of the Barito River around the wood factory.

Results of the heavy metal content of arsenic obtained showed that the heavy metal was not contained in all samples of river water with a distance of 100 meters, 200 meters and 300 meters. The results of the heavy metal content of arsenic in the three test samples did not exceed the threshold set by Permenkes No. 32 of 2017 on the quality standard of arsenic concentrations in waters that do not exceed the threshold level of 0.05 mg/L, so that it can be interpreted that the levels of arsenic metal in Barito River water around the wood factory are still within safe limits and can support the life of a sustainable ecosystem. exist in the waters as well as the community as a daily necessity. Based on the results of the research obtained, it shows that the management of waste products from wood mills has been managed properly so that when testing is carried out the concentration results are still below the specified threshold.

The concentration value of arsenic metal content entered into the SPSS system from the output of statistical tests on multiple linear regression obtained significant results of 0.518 for heavy metal arsenic. This means that the value obtained from arsenic heavy metal is $H0 > 0.05$ and there is no significant difference between river distance and arsenic heavy metal content in Barito River water around the wood factory.

Conclusion

Results of the research that has been carried out can be concluded that the Barito River water in the vicinity of the Banjarmasin City wood factory which has identified the content of heavy metals of lead and arsenic with the result that the content of lead metal is only at a distance of 200 meters is 0.0076 mg/L. Meanwhile, the results on arsenic metal did not contain any content in river water samples. The results of the heavy metal content of lead and arsenic did not exceed 0.05 mg/L which is the threshold stipulated by the Minister of Health Regulation No. 32 of 2017 and there is no influence of the results of lead and arsenic heavy metal levels with the sampling distance of the river water under study. Research on the water of the Barito River which is around the wood factory is still within safe limits and can support the life of the ecosystem in the waters and the community as daily needs.

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Declaration of Interest Statement

The authors declare that they have no conflict of interests.

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