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Analysis of Air and Water Quality at Coal Harbor in Muaro Jambi Regency

Wahyu Prasetyo Agus Susanto[1]*, Mulya Gusman[1], Indang Dewata[1], Eri Barlian[1], Nur Efendi[1]

[1]Environmental Science Study Program, Postgraduate School, Universitas Negeri Padang, Padang, Indonesia

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Corresponding Author:
Wahyu Prasetyo Agus Susanto
dewapas77@gmail.com

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Abstract: Secondary data obtained from the Safety, Health and Environment Department of PT. Winner Prima Sekata (PT. WPS) in Kemingking Dalam Village, Taman Rajo District, Muaro Jambi Regency, in 2022 it was discovered that there were cases of Acute respiratory infections (ARI). Therefore, a study was carried out regarding the analysis of air quality and water quality at the coal port location in Muaro Jambi Regency to determine the extent of the environmental impacts resulting from coal loading and unloading and stockpile activities at the Talang Duku port, Jambi Province. The research was conducted using quantitative survey and descriptive methods. Data analysis is quantitative in nature with the aim of testing predetermined hypotheses. Dust measurement results obtained between 7.98 - 10.00 mg/m^3, The allowable dust threshold value is in accordance with the Minister of Manpower Circular Number. SE.01/MEN/1997 concerning the NAB of Chemicals in Workplace Air is 0.9 mg/m. So the dust level in the Muaro Jambi coal port working area exceeds the quality standards set by the Minister of Manpower. Results of calculating the output water pollution index pH and TSS at the PT Outlet point. The WPS of port locations in the period March – June 2023 in each month has a Pij value of 1.08, which means the average pH and TSS value of output water from PT. WPS is at status 1.0 < 1.09 < 5.0 with the description Lightly Polluted. Based on processing with SPSS version 27 using the One way Anova test, it was found that Fcount then H0 was rejected.

Keywords: Air pollution; Analysis; Water pollution

Introduction

Even though coal comes from nature, it can be called a source of anthropogenic pollution. If coal microparticles enter the marine environment, they will cause physical and toxic effects on organisms (Fitriyanti, 2015; Tretyakova et al., 2021). This increase in environmental impacts has encouraged most of the world's ports to make a commitment to develop proactive procedures for sustainable development by adopting an environmentally responsible approach in preserving and protecting the environment (Sumiyati et al., 2023; Zhao et al., 2020).

According to the Parepare City Environmental Service, the people around the port area are very disturbed by dust due to the impact of loading and unloading and coal transportation activities at Cappa Ujung Port, Parepare City, South Sulawesi (Faisal et al., 2022; Setiawan et al., 2018)(Faisal *et al*., 2022; sETIAWAN *et al*., 2018). Data from the local health center reveals that around 11,000 Marunda residents have been exposed to coal dust which has caused serious impacts on their health. One of the most dominant diseases in the area is Acute Respiratory Infections (ARI), and there are also other complaints such as skin problems, itching, coughs and colds. Mobile air quality monitoring stations placed around the Jakarta Maritime College, in Marunda, showed high levels of fine particle pollution (PM 2.5) in the area (Hidayati, 2022). PM 2,5 is known to be the most dangerous air pollutant that can cause various health problems, including asthma, stroke, heart and lung disease (Zebblon, 2021). This situation shows the need for immediate action to address the air pollution

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problem and protect the health of Marunda residents (Dewi, 2022; Farah et al., 2020).

Port environmental problems also occur in the ports of Jambi Province. Based on data from the Directorate General of Sea Transportation, Directorate of Ports dated 12 June 2022, Jambi Province has 3 Special Terminals (Tersus) and 59 TUKS consisting of 2 Tersus at KUPP Class III Kuala Mendahara, 1 Tersus and 46 TUKS at the Harbor Master's Office and Talang Duku Port Authority , 11 TUKS at the Kuala Tungkal Harbormaster and Port Authority Office and 2 TUKS at the Muara Sabak Harbormaster and Port Authority Office. If we look at each business sector, especially the mining business sector, there are 20 consisting of 1 Tersus and 19 TUKS (David, 2003; R, 2017).

The existence of a coal stockpile on the banks of the Batanghari river also has an impact on agriculture. Since the existence of the stockpile, in the rainy season the rice fields in Kunangan are flooded and in the dry season many rice fields dry out and burn out. The Head of the Muaro Jambi Agriculture Service expressed his concern about the construction of a port in Kunangan Village which has the potential to disrupt irrigation channels and water gates that have been built by the Muaro Jambi Public Works Department (Merico et al., 2021).

According to the Jambi Central Statistics Agency, public health data in Muaro Jambi Regency in 2022, there were 22 cases of pulmonary tuberculosis and 44 people of pneumonia. Secondary data obtained from the Safety, Health and Environment Department of PT. Winner Prima Sekata (PT. WPS) in Kemingking Dalam Village, Taman Rajo District, Muaro Jambi Regency, in 2022 it is known that the average number of cases of acute respiratory infection (ARI) is 8 cases (Higginbotham et al., 2009).

Method

Research regarding analysis of air quality and water quality at the Muaro Jambi Regency coal port location was carried out using quantitative survey and descriptive methods (Sugiyono, 2018). Research and observation activities, primary and secondary data collection in the field were carried out in the period March – June 2023.

Sampling techniques are generally carried out randomly, data collection uses research instruments, data analysis is quantitative. Data collection techniques obtained through direct observation (observation) at the research location. Sampling of air quality, water quality and implementation of environmental management was carried out at the TUKS PT coal port. FSW in Kemingking Dalam Village, Taman Rajo District, Muaro Jambi Regency.

River water quality parameters analyzed include physical and chemical parameters such as pH, TSS, Fe and Mn. The results of the river water quality analysis are compared with river water quality standards for ports based on Government Regulation no. 22 of 2021 concerning the Implementation of Environmental Protection and Management which is assessed by its pollution status. Analysis of air quality data will be analyzed using One Way Anova Test statistics using SPSS version 27.

Results and Discussion

Research Place

The research location is at Muaro Jambi Coal Harbor TUKS PT. WPS can be reached by plane from Jakarta directly to Jambi, with a travel time of ± 60 minutes. From Sultan Thaha Airport to Jambi Harbor you can use the road with a 4 (four) wheeled vehicle + 1 hour.

Figure 1. Location of Research Area
Source: TUKS PT. Winner Prima Sekata

Air Quality Analysis

To analyze the air quality around the Muaro Jambi Coal Port area, air quality measurements were carried out at the activity location in the Muaro Jambi Coal Port area. Measurements are first made and the measurement location and number of points to be measured are determined. The results of the research on pollutant aspects can be seen in Table 1.

Table 1. Results of Dust Measurements in the Muaro Jambi Coal Port Area

Location	Dust Measurement Results (mg/m^3)
Port Entry Route	0.06 -0.57
Harbor Area	7.63 - 10
Port Exit Route	1.24 - 4.25

Table 1 shows that the results of dust measurements in the Muaro Jambi Coal Port area have an average above the specified Threshold Limit Value (NAB). The allowable dust threshold value is in accordance with the Minister of Manpower Circular Number. SE.01/MEN/1997 concerning NAV of Chemicals in Workplace Air is 0.9 mg/m3.

Air Quality Analysis and Testing will be analyzed regarding the relationship between changes in air quality due to dust produced by mining activities on the health of workers (Sun et al., 2021). Carried out through analysis of influence modeling according to the One Way Anova Test using the SPSS 27 program. Health research on mining workers who are affected by dust (X), health problems (Y) and as a control variable for length of service (Z) was carried out through One Way Anova Test analysis. One Way Anova Test analysis was carried out on a computer using SPSS version 27 software (Cristopher, 2019).

Table 2. Normality Test Using SPSS Version 27

Years of service		Tests of Normality					
		Kolmogorov-Smirnov			Shapiro-Wilk		
		S	df	Sig	S	df	Sig
Disturbance health	5	0.308	5	0.136	0.751	5	0.063
	5-10	0.291	20	0.000	0.793	20	0.054
	>10	0.291	15	0.001	0.782	15	0.082

If the Sig value is > 0.05 then the data is normally distributed. For a work period of 0 – 5 years, the Sig value is 0.063 > 0.05, so the data is normally distributed. For a work period of 5 – 10 years, the Sig value is 0.054 > 0.05, so the data is normally distributed. And for work periods > 10 years, the Sig value is 0.82, so the data is normally distributed.

Table 3. Homogeneity Test Using SPSS Version 27

		Levence Statistics	df.1	df2	Sig
Disturbance health	Based on Mean	0.003	2	37	0.997
	Based on Median	0.000	2	37	1.000
	Based on Meidan with adjusted df	0.000	2	36.611	1.000
	Based on trimmed mean	0.000	2	37	1.000

From the homogeneity table, a Sig value > 0.05 is obtained. This means that the homogeneity test in the One Way Anova test is fulfilled.

Table 4. Test One Way Anova SPSS Version 27

					ANOVA
	Sum of Squares	df	Mean Square	F	Sig
Between nGroup	248367700	2	124182.350	3.370	0.933
Within Group	66052210.400	37	1785194.876		
Total	66300575	39			

If Sig > 0.05, then the averages are significantly the same. If Sig < 0.05, then the means are significantly different. From the anova table above, it is known that the sig value = 0.933, where the sig value is > 0.05. So it can be concluded that the data groups are significantly the same or not different.

Work Period Group 0-5 Years

Table 5. Descriptive Statistics Group 1

Parameters	N	Mean	Std. Deviation
Dust Level	5	757.90	56.171
Disturbance Health	5	1.786.00	1.301.09
Valid N (listwise)	5		

Work Period Group 5-10 Years

Table 6. Descriptive Statistics Group 2

			Descriptive Statistics
Parameters	N	Mean	Std. Deviation
Dust Level	20	837.13	58.404
Disturbance Health	20	1.806.40	1.350.64
Valid N (listwise)	20		

Work Period Group > 10 Years

Table 7. Descriptive Statistics Group 3

			Descriptive Statistics
	N	Mean	Std. Deviation
Dust Level	15	862.20	60.787
Disturbance Health	15	1.948.20	1.386.68
Valid N (listwise)	15		

From the average value for each group of years of service, it can be seen that group 3 > group 2 > group 1.

Water Quality Analysis

Quality of PT.WPS Outlet Points

Results of measuring the quality of PT Outlet arrangement points. WPS Location of Muaro Jambi Coal Port.

Table 8. Average Value of Outlet Point Water Quality

Month	pH		TSS		Fe		M N	
	B.M	O	B.M	O	B.M	O	B.M	O
March	6-9	6.35	300	98.76	7	-	4	-
April	6-9	6.21	300	102.5	7	-	4	-
May	6-9	6.56	300	56.74	7	1.47	4	0.50
June	6-9	6.50	300	69.56	7	-	4	-

Information: BM: Quality Standards, O: Outlet

Source: Field Calculation Results, 2023

Table 9. River Water Quality Standard Parameters.

Parameter	Unit	Quality Standards
Smell	-	Odorless
TSS	Mg/1	100
pH	-	6-9

Source: PP No. 22 of 2021.

Because the price of pH quality standards has a range, the determination of C3/L3X is done by:Average L3X = (6 + 9) / 2 = 7.5. So the average value for the water quality standards used is 7.5, which can be seen in Figure 2.

Next, an analysis of the Pollution Index calculation is carried out based on river water quality standards for the port area. This pollution index is obtained from determining water quality status using the pollution index method based on Sumitomo and Nemerow (1970). Based on the Pij value, the categories of pollution that occur in water quality can be categorized as in table 9 below (Muslim & Helmy, 2020).

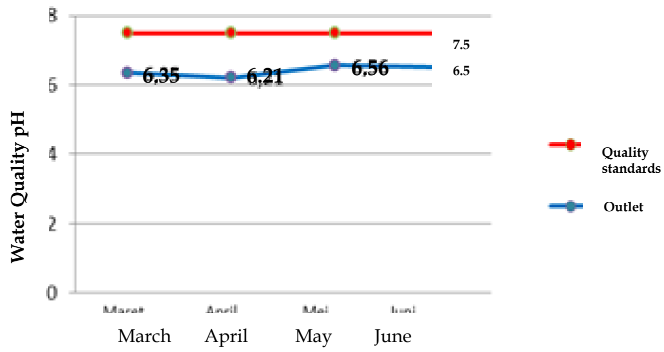

Figure 2. Average Results of Water pH Quality Measurements at Outlet Points March – June 2023

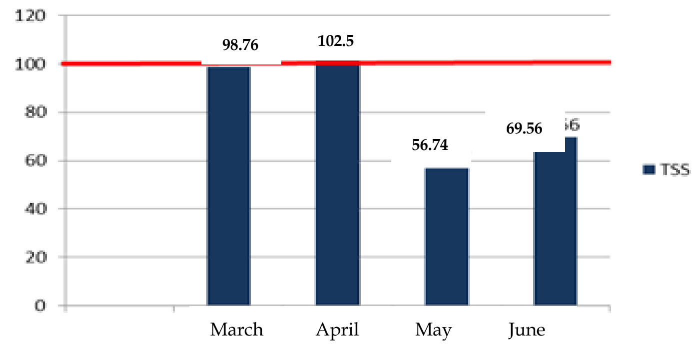

Figure 3. Average results of measuring TSS values at outlet points for March – June 2023

Table 10. Water Pollution Level Categories.

Pij value	Information
0.0 < Pij < 1.0	Meet Quality Standards
1.0 < Pij < 5.0	Lightly Polluted
5.0 < Pij < 10.0	Moderately Polluted
Pij > 10	Heavily Polluted

Source: Pollution Index (IP) (Nemerow & Sumitomo, 1970)

If the Ci/Lij value for each parameter has been calculated, then calculate the value: PIj Ci/Lij Max: 1.28 (each parameter). Average Ci/Lij: 6.99 / 8 = 0.87.

$$PIj = \frac{\sqrt{(Ci/)2\ M + (Ci/lij)2\ R\ 2}}{2} \quad (1)$$
$$PIj = \frac{\sqrt{(1.28)2\ M + (0.87)2\ R\ 2}}{2}$$
$$PIj = \frac{\sqrt{(1.6384) + (0.7569)}}{2}$$
$$PIj = 1.09$$

From the results of calculating the output water pollution index pH and TSS at the PT Outlet point. WPS at port locations for the period March – June 2023 each month has a Pij value of 1.08, which means the average pH and TSS value of output water from PT. WPS is at status 1.0 < 1.09 < 5.0 with the description Lightly Polluted.

Quality of PT.WPS Outlet Points

Analysis of river water quality at port locations at Station 1 and Station 2. The results of measurements of river water quality at port locations at station 1 and station 2 can be seen in tables 11 and 12.

Because the pH quality standard price has a range, C3/L3X is determined by: Average L3X = (6.5 + 8.5) / 2 = 7.5. So the average value for the water quality standards used is 7.5, which can be seen in Figure 4.

Table 11. Results of River Water Quality Measurements at Port Locations.

Month	Average pH Value		
	Quality standards	Station 1	Station 2
March	6 – 9	8.12	8.23
April	6 – 9	7.98	8.03
May	6 – 9	8.32	8.45
June	6 – 9	8.2	8.32

Table 12. River Water Quality Standard Parameters.

Parameter	Unit	Quality Standards
Smell	-	Odorless
TSS	mg/l	100
pH	-	6 - 9

Source: PP No. 22 of 2021

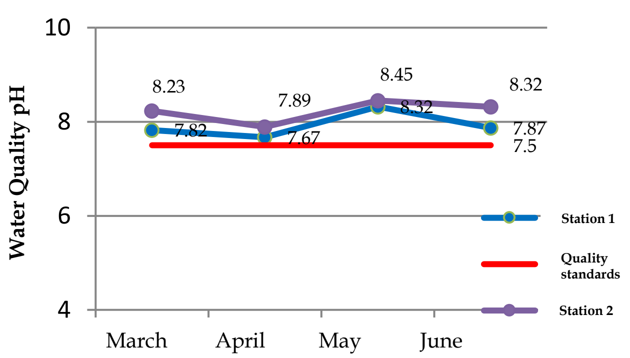

Figure 4. Measurement of the Average pH Quality of Harbor River Water

In Figure 4 it can be seen that the average pH value of river water quality at station 1 and station 2 at the coal port location each month is above the quality standard for river water quality at the port location based on the quality standards set by Government Regulation No. 22 of 2021 concerning the Implementation of Environmental Protection and Management (Rahmawati, 2018).

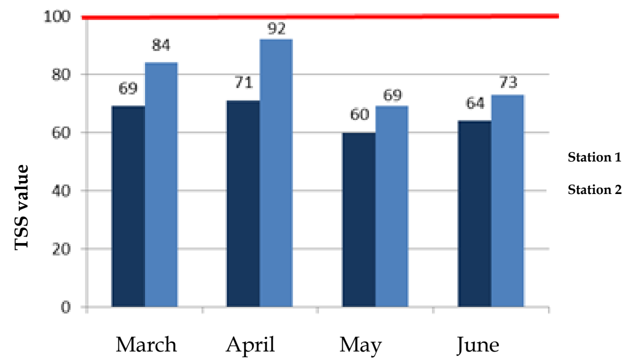

Figure 5. Average Results of Harbor Sea Water TSS Measurements.

In Figure 5, the results of measuring TSS values at Station 2 (Downstream) from March to June have not passed the quality standards.

Discussion

Coal loading activities carried out at the Muaro Jambi coal port are part of mining activities which cause environmental impacts in the form of coal dust produced and noise from the mobility of equipment operating during the activity (Salim & Sylvan, 2015; Supriyanto, 2013). Various negative impacts such as noise or air pollution, road damage caused by activities such as transporting loading purposes such as heavy equipment also have a negative impact on the physical conditions in the port location area (Delya et al., 2003).

Dust is a material that is often referred to as particles floating in the air (Suspended Particulate Matter/SPM) with a size of 0.1 microns to 500 microns. In the case of air pollution both inside and outside buildings (Indoor and Outdoor Pollution) dust is often used as an indicator of pollution which is used to indicate the level of danger both to the environment and occupational health and safety (Nurdyana et al., 2013). From the results of measurements and analysis that have been carried out on the quality of output water from mining activities of PT. WPS, where the quality of the output water at the outlet point is categorized as lightly polluted (Nasution, 2019; Rozi, 2018). Turbidity that occurs in the outlet water is caused by mud carried by the outlet water when there is high rainfall, so that the mud carried with the water causes turbidity in the water (Oliveira et al., 2022; Putra, 2018).

The parameters for TSS quality used are Government Regulation no. 22 of 2021 concerning Implementation of Environmental Management and Protection. The TSS quality standards used are based on PP No. 22 of 2021 has 4 class categories, namely:

Table 13. River Water Quality Parameters

Parameter	Unit	K 1	K 2	K 3	K 4
TSS	mg/l	40	50	100	400
pH	-	6-9	6-9	6-9	6-9

Description: K: Class
Source: PP No. 22 of 2021

From the results of research that has been carried out on the quality of output water at the PT Outlet point. WPS and river water quality at PT port location. WPS, it is categorized that the water quality at the location cannot be used for raw drinking water for people who live around the port location, as well as the use of water for other purposes such as water infrastructure facilities (Sorte et al., 2018). This is because the quality of the turbidity in the output water and the quality of the river water at that location exceeds the quality standards that have been determined based on the Class I and Class II categories in Government Regulation No. 22 of 2021 concerning Implementation of Environmental Management and Protection (Imami & Syakira, 2022).

Based on processing with SPSS version 27 using the One Way Anova Test, it was found that Fcount > Ftable, so H0 was rejected, meaning there was a relationship between workers' health problems and changes in air quality due to dust at the Muaro Jambi coal port (Ahmadi et al., 2016). The allowable dust threshold value is in accordance with the Minister of Manpower Circular Number. SE.01/MEN/1997 concerning the NAV of Chemicals in Workplace Air is 0.9 mg/m3 and the renewal of Government Regulation of the Republic of Indonesia Number 22 of 2021 concerning the Implementation of Environmental Protection and Management (ambient air quality standards), explains that it is mandatory Mine workers wear appropriate dust protection equipment (Shipei & Bin, 2020).

Conclusion

Based on the results obtained from the research, dust measurement results were obtained between 7.98-10.00 mg/m^3, the results of calculating the pH and TSS water pollution index every month had a Pij value of 1.08 which was at a status of 1.0<1.09<5.0 with the description of being lightly polluted. Meanwhile, based on processing with SPSS version 27 using the One Way Anova Test, it was found that Fcount > Ftable, so H_0 was rejected, meaning there was a relationship between workers' health problems and changes in air quality due to dust at the Muaro Jambi coal port.

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Auhor Contribution

W. P. A. S: preparation of original draft, results, discussion, methodology, conclusions; M. G, I. D, E. B and N. E: analysis, review, proofreading and editing. W. P. A. S, M. G, I. D, E. B and N. E; Visualization, and T. R.and R. A. E. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interst

The authors declare that there is no conflict of interest regarding the publication of this paper.

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