



MARUNDA AIR QUALITY INDEX BASED ON CONTENT OF PM 2.5 AND PM 10 ACCORDING TO THE CRITERIA DETERMINED BY ENVIRONMENTAL PROTECTION AGENCY OF UNITED STATE OF AMERICA

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disubmit pada : 12/07/23

diterima pada : 13/07/23

ABSTRACT

Marunda is an area located in North Jakarta, several Industrial and warehousing located in this area, as well as special port such as: Military port, coal and sand loading and unloading. As a Industrial and warehousing area, transportation marunda dominated by Container Truck and heavy Equipment. Main source of energy for industrial area came from coal and petroleum, and main source of energy for transportation activity came from petroleum, this is the main cause of air pollution in Marunda. Indication of high levels of air pollution can be seen by amount of dust (fine particles) that scattered on the floor. Based on existing studies has been known that air pollution has negative impact for human health. In this articles will be discussed level of air pollution in marunda based on the content of particulate matter 2.5, particulate matter 10 and Nitrogen Dioxide in the air.

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Keyword : Air Quality;Particulate matter, Nitrogen Dioxide

1. INTRODUCTION

Environmental problems are issues that receive special attention from world leaders, environmental issues are one of the priority issues discussed at the G 20 forum which was held in Bali on 29 – 30 August 2022. In the G 20 forum the Deputy for The Environment Deputies meeting and Climate Sustainability Working

Group/EDM-CSWG which was attended by 211 delegates offline and online resulted in three priority issues, one of which was "enhancing land- and sea-based actions to support environment protection and climate objectives". Climate problems are of particular concern because they have an impact throughout the world. Climate change affects human health (Velentova A, 2021), food supply security which includes the

availability of food, access to food, use of food and food stability (El Bilali et al, 2020), drought and availability of surface water and water soil (Petpongpan et al, 2020)

According on existing studies, one of the causes of climate change is due to the use of fossil fuels as the main energy source in industrial and transportation activities. The use of fossil fuels produces pollution in the form of carbon dioxide, nitrogen dioxide, fine particles (Kusumaningtyas, 2018). Air pollution levels that contain high levels of pollutants and exposure for a long time will have an impact on human health.

Marunda as one of the areas in North Jakarta, which has a strategic location and is relatively close to the main port of Tanjung Priok makes Marunda an area that has profitable potential as an industrial and warehouse area. Industrial and transportation activities from warehousing activities where most of the energy sources came from fossil fuels make the air quality in Marunda very bad (Kusumaningtyas,2018). For this reason, it is necessary to measure air quality in Marunda to find out how high the level of pollution is in Marunda and how high the impact is caused by this level of pollution. Likewise, policy makers at Sekolah Tinggi Ilmu Pelayaran can make policies related to the daily activities of cadets, especially activities carried out in the open area.

2. METHODE

The method used in this research is take to take secondary data on Marunda Air Quality. The pollutant contetnt measured was the concentration of PM 2.5 and Concentration of PM 10. The measured pollutant level is categorized in health classification according to hazardous level

determined by Environmental protection Agency of United State of America.

Processing Data from pollutant measured using SPSS and Microsoft Excel Software.

3. RESULT AND DISCUSSION

Perticulate Matter 2.5 (PM 2.5) and Particulate matter 10 (PM 10) are small particles with diameter less than 2.5 Micrometer (PM 2.5) and small particles with diameter less than. When people inhale air contain PM 2.5, this particles can get deep into the lungs, numerous scientific studies linked Exposure PM 2.5 and PM 10 affect respiratory and cardiovascular health system. (www.epa.gov, 2022)

Nitrogen Dioxide is colorless, odorless and a highly reactive gasses, contain with Nitrogen and Oxygen atom in varying amount. Commonly came from fossil fuels burning at high temperature. Breathing Nitrogen Dioxide with high concentration make irritation in human respiratory system. (www.epa.gov, 2022)

Environmental Protection Agency of United State Government classify amount of pollutant in the air into Pollutant Specific Sub Indices and cautionary statement for Guidance on the Air Quality Index as shown as the following table.

Table 1. Pollutant Index values

Index values	Pollutant		
	PM 2.5 µg/m ³	PM 10 µg/m ³	NO ₂ (Ppm)
Good	0-12	0-54	0-35
Moderate	12.1- 35.4	55-154	36-75
Unhealthy for Sensitive Group	35.5- 55.4	155- 254	76-185

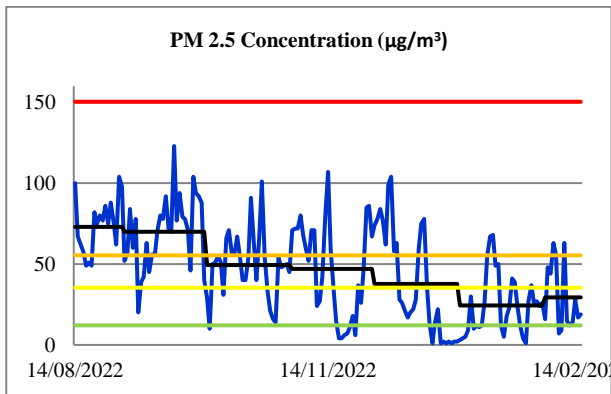
Unhealthy	55.4- 150.4	254- 354	186- 304
Very Unhealthy	150.5- 250.4	353- 424	305- 604
Hazardous	250.5- 500.4	425- 604	605- 1005

3.1 PM 2.5 (Particulate Matter 2.5)

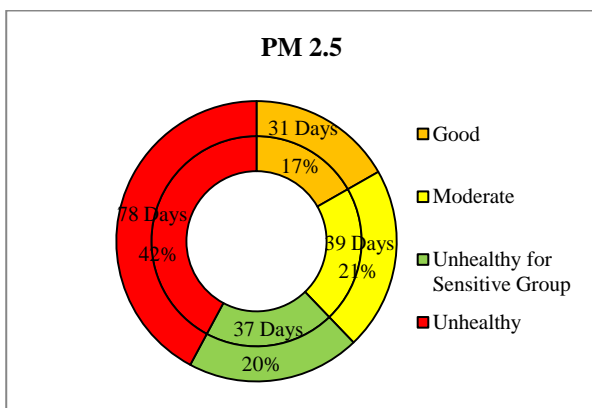
Table 2. Statistical data of PM 2.5

Pollutant	N	Mean	Dev
PM 2.5 ($\mu\text{g}/\text{m}^3$)	185	47.10	29.465

Graphic 1. Daily Concentration of PM 2.5



Graphic 2: Daily Percentage of PM 2.5



The number of days with PM 2.5 Concentration at the Unhealthy lever was 78 days out of 185 (42%), daily average concentration of PM 2.5 reached $47.01 \mu\text{g}/\text{m}^3$ at the Unhealthy level for sensitive Group. PM 2.5 concentrations were

successively at the Good level, occurring from 25 December 2022 to 4 January 2023. Decreasing levels of the PM 2.5 pollutant due to rainy days (Tian X et al, 2021) and holiday seasons, which resulted decrease in Industrial and Transportation Activity

Table 3. PM 2.5 Concentration

Date	PM 2.5/ $\mu\text{g}/\text{m}^3$	Weather
25 December 2022	1	Rain
26 December 2022	2	Rain
27 December 2022	1	Overcast
28 December 2022	2	Rain
29 December 2022	1	Rain
30 December 2022	2	Rain
31 December 2022	2	Rain
01 January 2023	3	Rain
02 January 2023	4	Overcast
03 January 2023	5	Overcast
04 January 2023	9	Thundershower

Source : <https://www.timeanddate.com/>

Normality test Concentration of PM 2.5

Hypothesis for Normality Test Kolmogorov

Smirnov PM 2.5 are as follows

H_0 : PM 2.5 Have Normal Distribution

H_1 : PM 2.5 did not Have Normal Distribution

H_0 : rejected if the value of Sig < 0.05

Table 4. PM 2.5 Normality Test

One-Sample Kolmogorov-Smirnov Test		
		PM 2,5
N		185
Normal Parameters ^{a,b}	Mean	47.10
	Std. Dev	29.465
Most Extreme Differences	Absolute	.093
	Positive	.093
	Negative	-.059

Test Statistic	.093
Asymp. Sig. (2-tailed)	.001 ^c

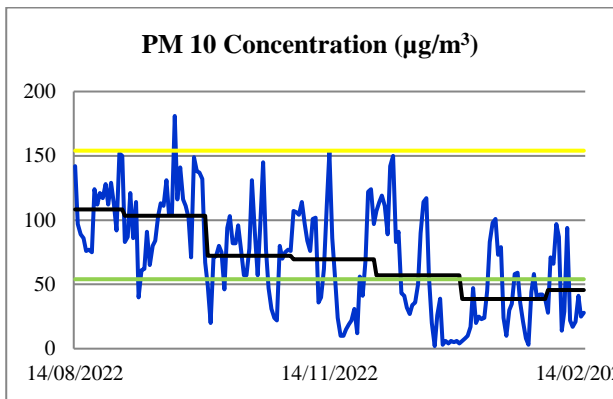
Value of Significance One sample Kolmogorov Smirnov Normality test for PM 2.5 are 0.001 < 0.05 means that H₀ rejected or Concentration of PM 2.5 did not have a Normal distribution data.

3.2 PM 10 (Particulate Matter 10)

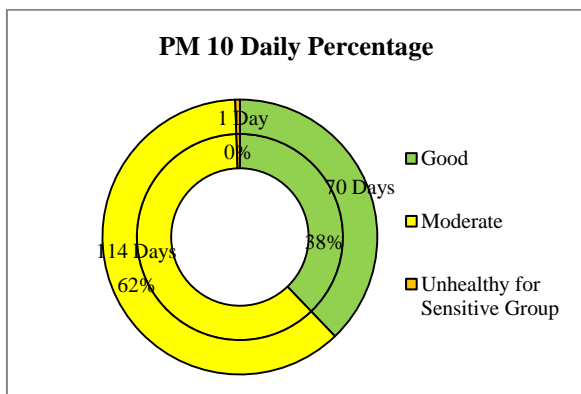
Table 5. Statistical data of PM 10

Pollutant	N	Mean	Dev
PM 10 (µg/m ³)	185	70.44	41.615

Graphic 3. Daily Concentration of PM 10



Graphic 4. Daily Percentage of PM 10



Average concentration level of PM 10 are 70.44 µg/m³ at moderate level. Number of days which moderate level is 114 days from 185 (62%). Number of days which categories Unhealthy for sensitive group are 1 days.

Normality Test for PM 10

Hypothesis for Normality Test Kolmogorov

Smirnov PM 10 are as follows

H₀ : PM 10 Have Normal Distribution

H₁ : PM 10 did not Have Normal Distribution

H₀ : rejected if the value of Sig < 0.05

Table 6. PM 10 Normality Test

One-Sample Kolmogorov-Smirnov Test		
		PM 10
N		185
Normal Parameters ^{a,b}	Mean	47.10
	Std. Dev	29.465
Most Extreme Differences	Absolute	.093
	Positive	.093
	Negative	-.059
Test Statistic		.083
Asymp. Sig. (2-tailed)		.004 ^c

One sample Kolmogorov Smirnov Normality test show that the result of Significance are 0.004 < 0.005, means that Concentration of PM 10 did not have a Normal distribution data (H₀ rejected).

Correlation of PM 2.5 and PM 10

Hypothesis Correlation test between PM 2.5 Concentration and PM 10 Concentration

H₀ : there are Correlations between concentration of PM 2.5 and concentration of PM 10

H₁ : there are no Correlations between concentration of PM 2.5 and concentration of PM 10

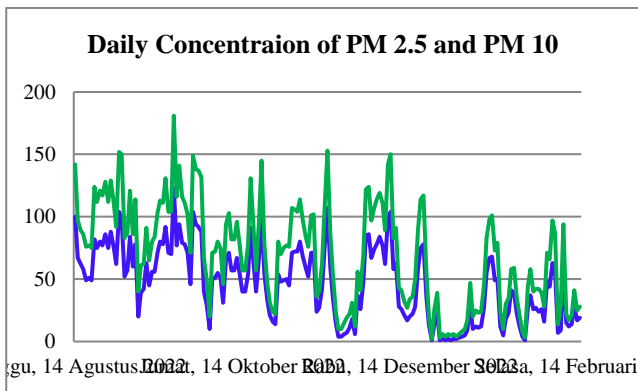
H₀ rejected if value of Sig > 0.05

Table 7. Pearson Correlation Test

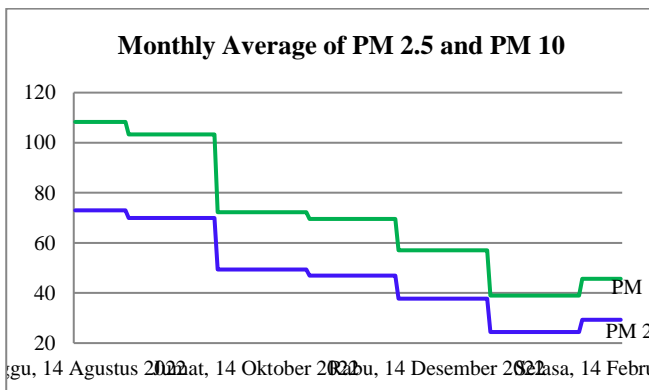
Correlations			
		PM 2,5	PM 10
PM 2,5	Pearson Correlation	1	.998**
	Sig. (2-tailed)		.000
	N	185	185
PM 10	Pearson Correlation	.998**	1
	Sig. (2-tailed)	.000	
	N	185	185

Significance value for Pearson Correlation test between Concentration of PM 2.5 and concentration of PM 10 are $0.000 < 0.05$, which means H_0 accepted, or there Correlations between concentration of PM 2.5 and concentration of PM 10, with correlation coefficient are 0.998. which means there are strong correlation between concentration of PM 2.5 and Concentration of PM 10.

Graphic 5 Concentration PM 2.5 and PM 10



Graphic 6. Average of PM 2.5 and PM 10



Graphs of Daily Comparison PM 2.5 and PM 10 and Graph of Monthly Average of PM 2.5 and PM 10 showing a trend that is nearly the same pattern.

3.3 NO₂ (Nitrogen Dioxide)

Nitrogen dioxide came from combustion process of fosils fuel. Nitrogen dioxide is harmful gases a colorless and odorless. To find out source of PM 2.5 and PM 10 whether it comes from coal loading unloading activities or the other source.

Nitrogen dioxide comes from combustion process means that if coal loading unloading activities in “kawasan berikat Marunda” will not significantly increase Nitrogen Dioxide concentration because there is no combustion process in coal loading and loading activities. The combustion process occurs in the use of heavy equipment that used during loading unloading coal activities. Means that if Concentration of PM 2.5 and PM 10 increase and not followed by increasing concentration of Nitrogen Dioxide, then loading unloading coal activities may the main source of pollution in Marunda. Or if Concentration of PM 2.5 and PM 10 increase and followed by increasing concentration of Nitrogen Dioxide, then loading unloading coal activities in “kawasan berikat marunda” may not the main source of pollution in Marunda.

Partial Correlation Nitrogen Dioxide With PM 2.5 and PM 10

Purpose of partial correlation test Nitrogen dioxide with PM 2.5 and PM 10 is to find out whether the increase of concentraion PM 2.5 and PM 10 increases concentration of Nitrogen dioxide.

Hypohthesis of Partial Correlation Nitrogen Dioxide with PM 2.5 and PM 10 as a follows:

H_0 : there is correlation between Nitrogen dioxide concentration with PM 2.5 and PM 10 concentration.

H_1 : there is no correlation between Nitrogen dioxide concentration with PM 2.5 and PM 10 concentration.

H_0 rejected if value of sig > 0.05

Table 8 Partial Correlations

		Correlations		
		PM 2,5	PM 10	NO ₂
PM 2,5	Pearson Correlation	1	.998**	.818**
	Sig. (2-tailed)		.000	.000
	N	185	185	185
PM 10	Pearson Correlation	.998**	1	.821**
	Sig. (2-tailed)	.000		.000
	N	185	185	185
NO ₂	Pearson Correlation	.818**	.821**	1
	Sig. (2-tailed)	.000	.000	
	N	185	185	185

Partial Correlations PM 2.5, PM 10 with NO₂

a. Significance value partial correlation between Nitrogen dioxide concentration with PM 2.5 concentration are $0.000 < 0.05$, resulting H_0 accepted, which means there is correlation between concentration of PM 2.5 and Concentration of Nitrogen dioxide, with value of correlation 0.818 (strong correlation).

b. Significance value partial correlation between Nitrogen dioxide concentration with PM 10 concentration are $0.000 < 0.05$, resulting H_0 accepted, which means there is correlation between concentration of PM 10 and Concentration of Nitrogen

dioxide, with value of correlation 0.821 (strong correlation).

According *a* and *b*, Nitrogen dioxide concentration have a strong correlations with PM 2.5 and PM 10 concentration. Because Nitrogen dioxide have a strong correlation with PM 2.5 and PM 10 concentration then Loading unloading coal activities in “kawasan berikat marunda” may not main source concentration of PM 2.5 and PM 10.

4. CONCLUSION

1. Average concentration of PM 2.5 at level *Unhealthy for sensitive group*, which will have a health impact on some people who are sensitive to air pollution. The average concentration of PM 2.5 on August and September 2022 reach at a unhealthy level which can increase the risk of heart and lung disease, reduce immune defense especially elderly or people with cardiopulmonary disease. (Zhang X, 2018)
2. Average concentration of PM 10 at moderate level means that it may increase health impact for some people with cardiopulmonary disease
3. Nitrogen dioxide concentration have a strong correlations with PM 2.5 and PM 10 concentration, means Loading unloading coal activities in “kawasan berikat marunda” may not main source increasing concentration of PM 2.5 and PM 10.

REFERENCES

[1] El Bilali, Hamid & Bassolé, Imael & Dambo, Lawali & Berjan, Sinisa. (2020). Climate change and food security.

- [2] Valentova A, Bostik V. (2021) Climate change and human health, Military Medical Science Letters (Vojenske Zdravotnicke Listy) Journal Vol 12 Issue 2.
- [3] Petpongpan C, Ekkawatpanit CK, Kositgittiwong D (2020). Climate change impact on surface water and groundwater recharge in northern Thailand, Water (switzerland) Journal 2020 Vol 12 Issue
- [4] Kusumaningtyas S, Aldrian E, Wati T et al (2018). The recent state of ambient air quality in Jakarta, Aerosol and Air Quality Research.
- [5] Tian, X., Cui, K., Sheu, H.L., Hsieh, Y.K., Yu, F. (2021). Effects of Rain and Snow on the Air Quality Index, PM_{2.5} Levels, and Dry Deposition Flux of PCDD/Fs. Aerosol Air Qual. Res. 21, 210158. <https://doi.org/10.4209/aaqr.210158>
- [6] Meng J, Martin RV, Li C, van Donkelaar A, Tzompa-Sosa ZA, Yue X, Xu JW, Weagle CL, Burnett RT (2019). Source Contributions to Ambient Fine Particulate Matter for Canada. Environ Sci Technol. 2019 Sep 3;53(17):10269-10278. doi: 10.1021/acs.est.9b02461. Epub 2019 Aug 21. PMID: 31386807.
- [7] Zhang X, et al. (2018). [PM2.5 meets blood: In vivo damages and immune defense](#). DOI: /10.4209/aaqr.2017.05.0167
- [8] Department for Environment Food & Rural Affairs. (2016). [Public health: Sources and effects of PM2.5](#).
- [9] <https://www.epa.gov>, 2022.
- [10] Environmental Protection Agency United State of America, "Guidelines for the Reporting of Daily Air Quality- the Air Quality Index (AQI)" 2006

- [11] Fisher M, Marshall A, 2009. Understanding Descriptive Statistic, Australian Critical Care, DOI 10.1016/j.aucc.2008.11.003

Tabel Pemeriksaan Isi Jurnal

Bagian ini tidak termasuk dalam isi artikel. Bagian ini adalah bantuan untuk penulis dan juga editor jurnal untuk memeriksa isi jurnal. Sampai jurnal ini dinyatakan diterima, tidak diperbolehkan menghapus tabel ini. Silahkan beri tanda *check list* (√) jika item tersebut **ada di dalam artikel**. Selanjutnya kualitas dan kedalaman isi dari masing-masing jenis pemeriksaan akan diperiksa oleh reviewer. Tabel ini hanya untuk memastikan setiap jenis pemeriksaan sudah ada di dalam isi artikel.

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1	Abstrak :	
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	Tujuan & manfaat penelitian	√
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	Kesimpulan	√
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	Perlakuan pada objek penelitian..	√
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	Penjelasan hasil	√
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5	Kesimpulan :	√
6	Format :	
	Ukuran kertas (A4)	√
	Margin (20 mm)	√
	Jarak antar kolom (12,5 mm)	√
	Font (Times New Roman)	
	Persamaan matematika (2 kolom no border tabel, menggunakan equation editor, equation di center, nomor eq. di sisi kanan)	√
	Gambar (center, in line with text, Nomor urut dari 1, Judul di bawah gambar, Huruf kapital di awal kata)	√
	Tabel (center, in line with text, Nomor urut dari 1, Judul di atas tabel, Huruf	√

kapital di awal kata, Label ditulis
tebal)

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	Minimal 10 acuan	√
	Terdapat acuan primer (jurnal)	√
	Format IEEE	
