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| 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  Yudhiyono1), Jaya Alamsyah2), Mohamad Nurdin3)  Sekolah Tinggi Ilmu Pelayaran  *Jl. Marunda Makmur No. 1 Cilincing, Jakarta Utara. Jakarta 14150* |
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***ABSTRACT***

Marunda is an area located in North Jakarta, several Industrial and warehousing located in this area, as well as special port such as: Millitary port, coal and sand loading and unloading. As a Industrial and warehousing area, tranportation 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;Particullate 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.

1. **METHODE**

The methode 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.

1. **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 intu the lungs, numerous scientific studies linked Exposure PM 2.5 and PM 10 affect respiratory and cardiovasculer health system. ([www.epa.gov](http://www.epa.gov), 2022)

Nitrogen Dioxide is collorles, odorles and a highly reactive gasses, contain with Nitrogen and Oxigen 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](http://www.epa.gov), 2022)

Environmental Protection Agency of United State Goverment 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/m3 | PM 10  µg/m3 | NO2  (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 (Particullate Matter 2.5)**

Table 2. Statistical data of PM 2.5

|  |  |  |  |
| --- | --- | --- | --- |
| Pollutant | N | Mean | Dev |
| PM 2.5 (µg/m3) | 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 µg/m3 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/ug/m3 | 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

|  |  |  |
| --- | --- | --- |
| H0 | : | PM 2.5 Have Normal Distribution |
| H1 | : | PM 2.5 did not Have Normal Distribution |

H0 : 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 Parametersa,b | Mean | 47.10 |
| Std. Dev | 29.465 |
| Most Extreme Differences | Absolute | .093 |
| Positive | .093 |
| Negative | -.059 |
| Test Statistic | | .093 |
| Asymp. Sig. (2-tailed) | | .001c |

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 (Partuiicullate Matter 10)**

Table 5. Statistical data of PM 10

|  |  |  |  |
| --- | --- | --- | --- |
| Pollutant | N | Mean | Dev |
| PM 10 (µg/m3) | 185 | 70.44 | 41.615 |

Graphic 3. Daily Concentration of PM 10

Graphic 4. Daily Percentage of PM 10

Avarage 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 Unhealtthy 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 Parametersa,b | Mean | 47.10 |
| Std. Dev | 29.465 |
| Most Extreme Differences | Absolute | .093 |
| Positive | .093 |
| Negative | -.059 |
| Test Statistic | | .083 |
| Asymp. Sig. (2-tailed) | | .004c |

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 H0 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 cames from combustion process means that if coal loading unloading activities in “kawasan berikat Marunda” will not significantly increase Nitogen 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.

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

|  |  |  |
| --- | --- | --- |
| H0 | : | there is correlation between Nitogen dioxide concentration with PM 2.5 and PM 10 concentration. |
| H1 | : | there is no correlation between Nitogen dioxide concentration with PM 2.5 and PM 10 concentration. |

H0 rejected if value of sig > 0.05

Table 8 Partial Correlations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Correlations** | | | | |
|  | | PM 2,5 | PM 10 | NO2 |
| 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 |
| NO2 | Pearson Correlation | .818\*\* | .821\*\* | 1 |
| Sig. (2-tailed) | .000 | .000 |  |
| N | 185 | 185 | 185 |

Partial Correlations PM 2.5, PM 10 with NO2

1. Significance value partial correlation between Nitrogen dioxide concentration with PM 2.5 concentration are 0.000 < 0.05, resulting H0 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).
2. Significance value partial correlation between Nitrogen dioxide concentration with PM 10 concentration are 0.000 < 0.05, resulting H0 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.

1. **CONCLUSION**
2. 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, ruduce imune defense especially elderly or people wih cardiopulmonary disease. (Zhang X, 2018)
3. Average concentraion of PM 10 at moderate level means that it may increase health impact for some people with cardiopulmonary disease
4. 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.

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**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.

Tabel Pemeriksaan Isi Artikel

|  |  |  |
| --- | --- | --- |
| **No** | **Jenis Pemeriksaan** | **Tanda** |
| 1 | Abstrak : | |
|  | Latar belakang |  |
|  | Tujuan& manfaat penelitian |  |
|  | Metode |  |
|  | Kesimpulan |  |
|  | Kata kunci |  |
| 2 | Pendahuluan : | |
|  | Latar belakang permasalahan. |  |
|  | Review studi terdahulu. |  |
|  | Tujuan dan manfaat dari penelitian |  |
| 3 | Metode : | |
|  | Deskripsi objek penelitian. |  |
|  | Perlakuan pada objek penelitian.. |  |
|  | Metode / cara dan prosedur pemecahan yang digunakan untuk meneliti. |  |
|  | Alat dan/atau bahan yang digunakan dalam penelitian. |  |
| 4 | Hasil : | |
|  | Hasil penelitian |  |
|  | Penjelasan hasil |  |
|  | Komparasi hasil dari variabel yang berbeda |  |
| 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) |  |
| 7 | Daftar Pustaka : | |
|  | Minimal 10 acuan |  |
|  | Terdapat acuan primer (jurnal) |  |
|  | Format IEEE |  |