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TRENDS IN AMBIENT AIR QUALITY (NO2 AND SO2) IN TENGGARONG CITY, KUTAI KARTANEGARA DISTRICT. EAST KALIMANTAN

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Abstract:
This research aims to determine the concentration of ambient air quality NO2 and SO2, determine the trend in ambient air quality NO2 and SO2, and determine the Air Quality Value index for Tenggarong City, Kutai Kartanegara Regency, East Kalimantan. The data collection method used the 18-SPEKTRO-33/MU/SMM-AAS (Passive Sampler Spectrophotometry) method, then analyzed using environmental quality standards, government regulation number 22 of 2021. The research results show that the quality concentration of NO2 gas in Jam Bentong is between (5.23-19.85) µg/m3 and SO2 is between (3.75-38.55) µg/m3, in the Industrial Area NO2 is between (5.54-10.20) µg/m3 and SO2 is between (4.28 -10.41) µg/m3, while in residential locations NO2 is between (2.49-7.98) µg/m3 and SO2 is between (<2.57-10.60) µg/m3. The tendency for ambient air quality NO2 and SO2 at the Jam Bentong location to fluctuate is inconsistent, while the Industrial Location is almost the same as the Residential Location, with uniform quality. However, all quality concentrations are still below environmental quality standards. The Environmental Quality Index value at the Jam Bentong location is 79,618, which is included in suitable environmental conditions. Meanwhile, in industrial locations, it is 90,043; this value is included in superior environmental conditions. Meanwhile, in residential locations, the Environmental Quality Index value is 93,429; this value also falls into superior environmental conditions.

Keywords: Concentraion NO2 and SO2, Trends, Environmental Quality

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INTRODUCTION

Ambient air other than oxygen is a dangerous air pollutant gas. This gas impacts human health, especially the respiratory system, namely NO2 and SO2, such as in the Kalianak Surabaya area, which has a very high traffic density with approximately 1,500 vehicles busy. The results of laboratory tests show that the concentration of NO2 and SO2 parameters is 71.91 µg/Nm 3 and 61.42 µg/Nm 3. The results show that the community experiences respiratory problems (68.4%) consisting of people aged 46-55 years (31.6%), with a length of stay >20 years (47.4%), non-smokers (47.4%), with a normal growing Mass Index (36.8%). (Masito, 2018).

The quality of NH3 in the Kebayoran Lama area, South Jakarta, during the 2022 Covid mass, in the morning, the concentration was 0.20 ppm, while in the afternoon, the concentration was 0.10 ppm. On other days, the NH3 quality composition was 0.007 ppm to 0.002 ppm. The NO2 concentration is 0.33 µg/m3 to 0.36 µg/m3, while on other days it is 0.27 µg/m3 to 0.29 µg/m3. The

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SO2 concentration is 0.36 µg/m3 to 0.38 µg/m3, while on other days, it is 0.30 µg/m3 to 0.33 µg/m3 (Zahra, 2022).

The quality of SO2 in Cimahi City, Bandung, which has been carried out in eight locations, with 24-hour measurements results between 34 - 74 µg/m3, while the NO2 concentration is between 33-70 µg/m3 (Wardhani, 2019). Meanwhile, this is carried out in three locations in India: residential, commercial, and factory. The SO2 concentration for population locations from research from 2010 to 2019 was 9.3-20.30 µg/m3, while NO2 was 23.90 – 55.40 µg/m3. In commercial locations, the SO2 concentration is 8.10-22.60 µg/m3, while NO2 is 24.00 – 72.40 µg/m3. At industrial locations, the concentration of SO2 is between 9.60-27.20 µg/m3, while NO2 is 22.40 – 75.60 µg/m3 (Markendeya, 2020).

METHODS

Research sites. The locations studied were 1) Jam Bentong near the Regent's office and the Kutai Kartanegara Golden Gate Bridge with coordinates 0o 24' 7'' South Latitude and 116o 59' 3'' East Longitude. 2) Industrial location with coordinates 0o 21' 8'' South Latitude and 116o 58' 5'' East Longitude. 3) Housing location with coordinates 0o 24' 27'' South Latitude and 116o 59' 4'' East Longitude.

Data collection method. Taking environmental parameters for NO2 and SO2 gas samples using an impinger tool was carried out at one point during busy traffic hours with measurements three times, namely morning, afternoon, and evening, with the 18-SPEKTRO-33/MU/SMM-AAS method (Passive Sampler Spectrophotometry), then analyzed in the air laboratory of PT Anugrah Analiscepat Selamat One Line Laboratory Service. Jl Raya Jakarta Bogor Km 37, Cilodong, Depok, West Java. Next, the results of the analysis are compared with environmental quality standards.

Data analysis method. Air Quality Index in 2022. The parameters measured are SO2 and NO2 concentrations, using a passive sampler, which can be used to determine the Air Quality Index (IKU). This IKU calculation was obtained from the average SO2 and NO2 concentrations using a passive sampler at the research location. Measurements were carried out in Tenggarong City, Kutai Kartanegara Regency, East Kalimantan Province, with the concentrations of each SO2 and NO2 parameter. Next, the Air Quality Index calculation is carried out.

Calculating the NO2 and SO2 concentration quality index can be seen in the formula below:

$$I\,EU, NO2 \quad = \frac{(NO2)AVERAGE}{40}$$

$$I\,EU, SO2 \quad = \frac{(SO2)AVERAGE}{20}$$

$$I\,EU \quad = \frac{(IEU.NO2 + IEU.SO2)}{2}$$

IEU NO2 is the value of the Air quality index for the concentration of the element NO2, IEU SO2 is the value of the Air quality index for the concentration of the element SO2, IEU is the average value of the composite air quality index for the concentration of SO2 and NO2. Next, the Air Quality Index is calculated using the equation:

$$IKU \quad = 100 - \left(\frac{50}{0.9}\right) X\,(IEU - 0.1)$$

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IKU is the Tenggarong City Air Quality Index. Next, it is compared with the range of IKLH values as in Table 1.

Table 1. Environmental Quality Index PP 22 of 2021

No.	Range of Environmental Quality Index	Condition Values
1	X > 90	Superior
2	82 < X ≤ 90	Very Good
3	74< X ≤ 82	Good
4	66< X ≤ 74	Enough
5	58< X ≤ 66	Less
6	50< X ≤ 58	Very Poor
7	X < 50	Alert

RESULT AND DISCUSSION

In normal and clean air, there are four gas elements, namely approximately 78.09% N2, 20.95% O2, 0.93% Ar, and 0.032% CO2, while the concentration of other gases is minimal, such as NO2 and SO2 and others. However, If it exceeds the environment, it will affect human health.

Most of the air pollution comes almost entirely from mobile and stationary sources. The impact of these air pollution concentrations will appear in very varied forms and will be very bad for health. The most dominant air pollutant particles affecting human health include Sox Nox.

NO2 and SO2 Concentrations at the Jam Bentong Location. NO2 gas is a pollutant gas that will occur if there is combustion. This gas impacts human health, for example, respiratory problems, lung disease, and even death. Healthy people have no effect from exposure to low concentrations of NOx. Meanwhile, people with asthma or other respiratory diseases are more susceptible to the effects of NO2 gas. These compounds, which consist of NO and NO2 gases, are often produced from motor vehicle exhaust gases. The concentration of NO2 gas at this location from the laboratory analysis results in April 2022 was 19.85 µg/m3. In May 2022, it was 6.00 µg/m3. In August 2022 it was 5.23 µg/m3 and in September 14.00 µg/m3.

SO2 gas irritates the respiratory system, such as the throat, nasal mucous membranes, and airways in the lungs. This gas also has a worse health impact for people with asthma. This SO2 can also cause lung irritation, which causes difficulty breathing, especially for sensitive people such as asthmatics, children, and the elderly. The concentration of SO2 gas at this location from the laboratory analysis results in April 2022 was 6.09 µg/m3. In May 2022, it was 3.77 µg/m3; in August 2022, it was 3.75 µg/m3 and in September 38.55 µg/m3. The concentrations of NO2 and SO2 gas at the Jam Bentong location can be seen in Table 2.

Table 2. NO2 and SO2 Gas Concentrations at the Jam Bentong location, Tenggarong City, Kutai Kartanegara Regency, East Kalimantan.

No.	Location	Coordinate	Environmental Quality Standards Governing Law 22 of 2021		laboratory analysis results		Measurement Month of 2022
			NO2 (µg/m3)	SO2 (µg/m3)	NO2 (µg/m3)	SO2 (µg/m3)	
1	Jam Bentong intersection on Jl Mulawarman	S -0.4019 E 116.9680	200.00	150.00	19.85	6.09	April
2			200.00	150.00	6.00	3.77	May
3			200.00	150.00	5.23	3.75	August

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4	next to the Regent's office		200.00	150.00	14.00	38.55	Sept

NO2 and SO2 Concentrations at Industrial Locations. The concentration of NO2 gas at the Tenggarong City Industrial location, according to the results of laboratory analysis in April 2022, was 8.47 µg/m3; in May 2022, it was 5.54 µg/m3; in August 2022, it was 10.20 µg/m3 and in September 7.50 µg/m3. Meanwhile, the concentration of SO2 gas at this location from the results of laboratory analysis in April 2022 was 5.54 µg/m3; in May 2022, it was 8.59 µg/m3; in August 2022, it was 4.28 µg/m3 and in September it was 10.41 µg/m3. NO2 and SO2 gas concentrations at industrial locations can be seen in Table 3.

Table 3. NO2 and SO2 Gas Concentrations in Tenggarong City Industrial Locations, Kutai Kartanegara Regency, East Kalimantan.

No.	Location	Coordinate	Environmental Quality Standards Governing Law 22 of 2021		laboratory analysis results		Measurement Month of 2022
			NO_2 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	SO_2 (µg/m3)	
1	Ready mix industrial area/tofu factory	S-0.4280 E 116.9919	200.00	150.00	8.47	5.54	April
2			200.00	150.00	5.54	8.59	May
3			200.00	150.00	10.20	4.28	August
4			200.00	150.00	7.50	10.41	Sept

NO2 and SO2 Concentrations in Residential Locations. The concentration of NO2 gas in the Tenggarong City housing location, according to the results of laboratory analysis in April 2022, was 2.49 µg/m3; in May 2022, it was 4.14 µg/m3; in August 2022 it was 3.14 µg/m3 and in September 7.98 µg/m3. Meanwhile, the concentration of SO2 gas at this location from the results of laboratory analysis in April 2022 was 7.04 µg/m3; in May 2022, it was 5.84 µg/m3; in August 2022 it was 10.06 µg/m3 and in September <2.57 µg/m3. NO2 and SO2 gas concentrations at industrial locations can be seen in Table 4.

Table 4. NO2 and SO2 Gas Concentrations in residential locations in Tenggarong City, Kutai Kartanegara Regency, East Kalimantan.

No.	Location	coordinate	Environmental Quality Standards Governing Law 22 of 2021		laboratory analysis results		Measurement Month of 2022
			NO_2 (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m³)	SO_2 (µg/m3)	
1	Housing area Mangga 2 Ahmad Dahlan Street/ Mangkurawang	S -0.394 E 116.9858	200.00	150.00	2.49	7.04	April
2			200.00	150.00	4.14	5.84	May
3			200.00	150.00	3.14	10.6	August
4			200.00	150.00	7.98	< 2.57	Sept

Trends in Ambient Air Quality of NO2 and SO2 in Jam Bentong, Tenggarong City. The trend of ambient air quality NO2 and SO2 in Jam Bentong, Tenggarong City, based on the analysis

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of air samples at the research location, shows that the trend of ambient air quality NO2 and SO2 is almost the same. From April 2022 to May until August 2022, the concentration decreases, then increases again in September 2022, so the ambient air quality NO2 and SO2 trend are inconsistent but still below environmental quality standards. Trends in ambient air quality NO2 and SO2 in Jam Bentong, Tenggarong City, can be seen in Figure 1.

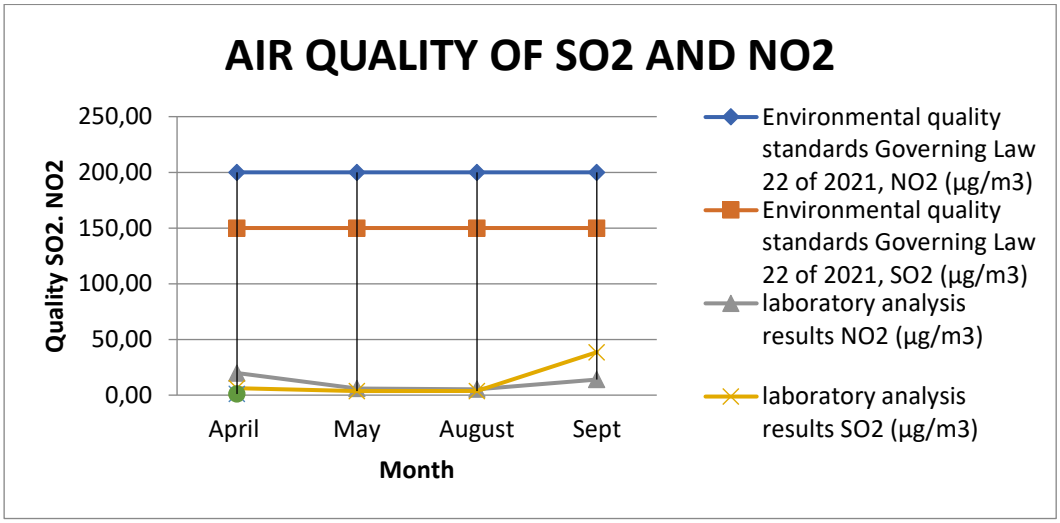

Figure 1. Trends in ambient air quality NO2 and SO2 in Jam Bentong, Tenggarong City. Kutai Kartanegara. East Kalimantan.

Trends in Ambient Air Quality NO2 and SO2 in Tenggarong City Industrial Locations. The ambient air quality NO2 and SO2 trends at the Tenggarong City Industrial Location differ from those at the Jam Bentong location. Based on the analysis of air samples at the research location, the ambient air quality NO2 and SO2 trends are almost the same. From April 2022 to September 2022, the concentration will not increase or decrease, so the ambient air quality NO2 and SO2 trend are relatively the same but still below environmental quality standards. Trends in Ambient Air Quality NO2 and SO2 in Tenggarong City Industrial Locations can be seen in Figure 2.

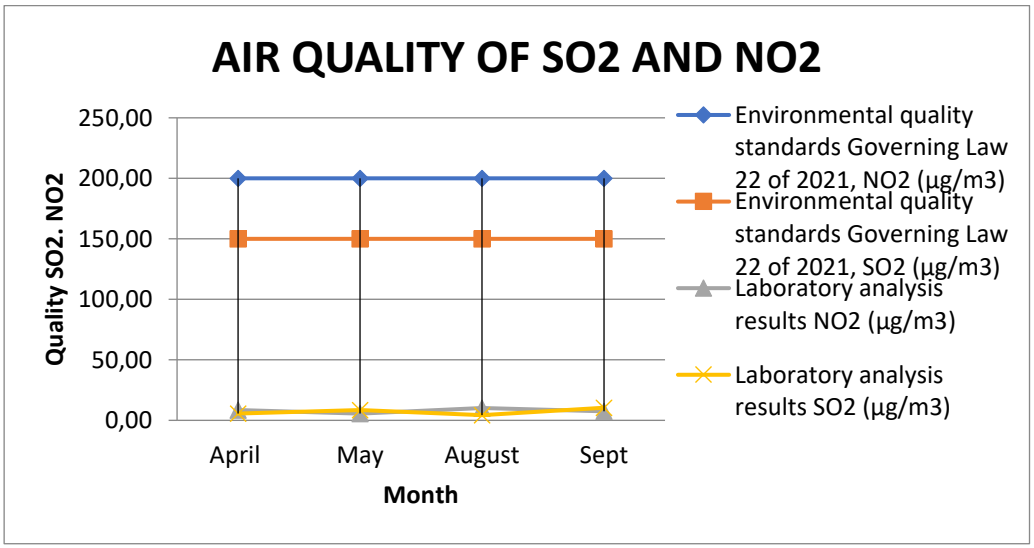

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Figure 2. Trends in ambient air quality NO2 and SO2 at the Tenggarong City Kutai Kartanegara Industrial Location. East Kalimantan.

Trends in Ambient Air Quality NO2 and SO2 in Tenggarong City Residential Locations. The ambient air quality NO2 and SO2 trends in the Tenggarong City Residential Location are almost the same as in the Jam Industri location. The levels of NO2 and SO2 in the ambient air are almost equal. From April 2022 to September 2022, the concentration does not increase or decrease, so the ambient air quality NO2 and SO2 trend are relatively the same but still below environmental quality standards. Trends in Ambient Air Quality NO2 and SO2 in Tenggarong City Industrial Locations can be seen in Figure 3.

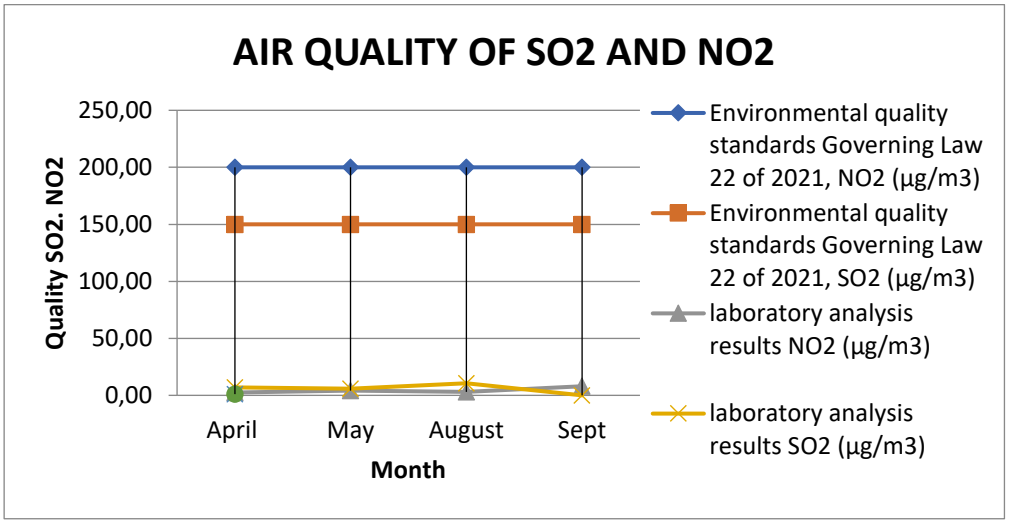

Figure 3. Trends in ambient air quality NO2 and SO2 at the Tenggarong City Kutai Kartanegara Industrial Location. East Kalimantan.

Air Quality Index Value for Tenggarong City, Kutai Kartanegara Regency, East Kalimantan. Air Quality Index Value for Tenggarong City, Kutai Kartanegara Regency, East Kalimantan. At the Jam Bentong location, the Environmental Quality Index value is 79,618; this value is included in suitable environmental conditions. Meanwhile, in industrial locations, the Environmental Quality Index value is 90,043; this value is included in superior environmental conditions. Finally, in the housing location, the Environmental Quality Index value is 93,429; this value is included in superior environmental conditions. The Air Quality Index value for Tenggarong City, Kutai Kartanegara Regency, East Kalimantan, can be seen in Table 5.

Table 5. Air quality index values based on element concentrations and air quality index values for SO2 and NO2 elements

No	Location	Air quality index value NO_2	element concentration Air quality index value SO_2	element concentration Air quality index value based on NO_2 and SO_2	concentration Environmental Quality Index value	Environmental conditions
1	Jam Bentong	0.025	0.652	0.467	79.618	Good
2	Industry	0.198	0.360	0.279	90.043	Superior

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3	Housing	0.111	0.326	0.218	93.429	Superior

CONCLUSION

Some conclusions that can be drawn from this research are as follows

- The quality concentration of NO2 and SO2 at the Jam Bentong, industrial, and residential locations still needs to be below the quality standards of government regulation no. 22 of 2021.
- Trends in Ambient Air Quality NO2 and SO2 in the three locations, only the Bentong hour location is different where the quality tends to go up and down. Meanwhile, the quality from April to September 2022 is almost identical in industrial and residential locations.
- Good Ambient Air Quality Trend Index NO2 and SO2 values for the Jam Bentong location. Meanwhile, residential and industrial locations are superior.

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