AIR QUALITY MONITORING AND ANALYSIS IN TASIKMALAYA CITY

Nurcholis Salman[1]* , Fadhila Muhammad Libasut Taqwa[2] , Alimuddin[2] , Andri Arthono[3]

[1]Environmental Engineering Study Program, Muhammadiyah University of Tasikmalaya, Indonesia
[2]Civil Engineering Study Program, Bogor Ibn Khaldun University, Indonesia
[3]Civil Engineering Study Program, Al-Kamal Institute of Technology, Indonesia

Abstract

Within the national scope, based on Government Regulation no. 47 of 1997 concerning the National Spatial Plan, the City of Tasikmalaya which is included in the East Priangan Region is included in the mainstay area. Where Tasikmalaya City functions as a Regional Activity Center (PKW) city. One result is the increased volume of traffic in the area. One of the impacts of motor vehicle traffic activity is air pollution. Air pollution is defined as the contamination of the atmosphere by gases, liquids or by-products in such concentrations and periods that can harm human health/life, and or create discomfort. The method used in conducting the research was in the form of monitoring ambient air parameters which were carried out at 10 points, spread across community activity centers in Tasikmalaya City. Based on the research that has been done, it can be concluded that the parameters Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Oxidants (O_3), Dust (*TSP*), Ammonia (NH_3) and Hydrogen Sulfide (H_2S) at 10 the testing location still meets the required quality standards based on PP RI No. 41 of 1999. Meanwhile, the results of noise level measurements have exceeded the noise level quality standards, so that treatment is needed in the form of implementing sound emission rules and localizing industrial pollutant sources.

Keywords: *air pollution, ambient air, city air quality, vehicle emissions, noise levels*

Introduction

Tasikmalaya City was inaugurated as an autonomous region on October 17, 2001, containing a logical consequence of demands for increased government services to the community. This is in line with the objective of forming the Tasikmalaya Autonomous City which is stated in Law Number 10 of 2001 concerning the formation of the Tasikmalaya City (Salman, 2021).

As an autonomous region, Tasikmalaya City has autonomous authority in planning and implementing development according to its needs and potential. This also includes environmental management and protection, one of which is air quality in Tasikmalaya City (Kuncoro et al, 2020).

According to Government Regulation no. 41 of 1999 concerning Air Pollution Control, the definition of ambient air is free air on the earth's surface in the troposphere which is within the jurisdiction of the Republic of Indonesia which is needed and affects the health of humans, living things and other elements of the environment.

The activities of living things cause the composition of natural air to change. If the change in natural air composition exceeds a

*)Corresponding Author:
E-mail: nurcholissalman@umtas.ac.id

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certain concentration which causes the ambient air to be unable to fulfill its function, then the air is said to be polluted.

In an effort to maintain the quality of the ambient air so that it can provide a carrying capacity for living things to live optimally, prevention and/or control of air pollution and restoration of air quality are carried out.

Air pollution is the entry or inclusion of substances, energy and/or other components into the ambient air by human activities, so that the quality of the ambient air drops to a certain level which causes the ambient air to be unable to fulfill its function (Kadyarsi, 2006). Today's air pollution is increasingly a cause for concern, along with the increasing activities of transportation, industry, offices and housing which contribute quite a lot to air pollution (Pariyanto, 2015), (Catleya et al, 2021), (Mulyatna et al, 2019). Polluted air can cause health problems, especially disorders of the lungs, blood vessels, and eye and skin irritation. Air pollution due to dust particles can cause chronic respiratory diseases such as bronchitis, pulmonary emphysma, bronchial asthma and even lung cancer. Air pollutants in the form of gases can directly enter the body to the lungs and be absorbed by the circulatory system (Latif et al, 2006).

Ambient Air Parameters indclude Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Oxidants (O_3), Particulate and Noise. Air pollution by Sulfur Oxide (SO_x) is mainly caused by two colorless sulfur oxide gas components, namely Sulfur Dioxide (SO_2) and Sulfur Trioxide (SO_3). SO_2 has a characteristic sharp odor and is not flammable in air, while SO_2 is a non-reactive gas.

SO_x pollution causes irritation of the respiratory system and eye irritation, and is harmful to the health of the elderly and people with chronic cardiovascular respiratory system diseases. Besides affecting human health, $SOx_{pollution}$ is also harmful to animal health and can damage plants.

SO_2 is the main contributor to acid rain. Once in the atmosphere, SO_2 undergoes conversion to SO_x which then becomes H_2SO_4. At night or in humid conditions or during rain, SO_2 in the air is absorbed by the alkaline water droplets and forms sulfate in the droplets. Burning fossil fuels, such as oil and coal and other materials containing sulfur will produce both forms of sulfur oxides; SO_2 is always formed in large quantities, while the SO_3 that is formed varies from 1 to 10% of the total SO_x (Rizqiyah and Rosyida, 2021).

Nitrogen Dioxide (NO_2) and nitrogen monoxide (NO) are the most widely known groups of nitrogen oxides (NO_x) as air pollutants. NO is an odorless and colorless gas, while NO_2 has a sharp odor and is reddish-brown in color. Nitrogen oxides such as NO and NO_2 are harmful to humans. NO_2 is toxic, especially attacks the lungs, which causes difficulty breathing in asthma sufferers, coughs in children and the elderly, and various respiratory system disorders, and reduces visibility.

Nitrogen oxides are also major contributors to smog and acid deposition. Nitrogen oxides react with volatile organic compounds to form ozone and other oxidants such as *peroxyacetylnitrate* (*PAN*) in photochemical *smog*, and with rainwater to produce nitric acid and cause acid rain. Wet (acid rain) and dry acid deposition (when NOx_{gas} forms nitrate aerosol particles and is deposited on the earth's surface) can harm plants, agriculture, aquatic ecosystems and forests. Acid rain can flow into lakes and rivers and leach heavy metals from the soil and change the chemical composition of the water. This can eventually degrade and even destroy aquatic life.

Oxidants are compounds that have oxidizing properties, their effect on health is interfering with the respiratory process and can cause eye irritation. Apart from causing adverse impacts on human health, ozone pollutants can cause

economic losses due to wear and tear of materials (textiles, rubber, wood, metal, paint, etc.), decreased agricultural yields and damage to ecosystems such as reduced biodiversity. Airborne oxidants include ozone (more than 90%), Nitrogen Dioxide, and Peroxyacetylnitrate (*PAN*). Because most of the oxidant is ozone, ambient air monitoring is expressed as ozone levels.

Particulates are solids or liquids in the air in the form of smoke, dust and vapor with very small diameters (ranging from <1 micron to 500 microns), which can stay in the atmosphere for a long time. Besides disturbing aesthetics, small particles in the air can be sucked into the respiratory system and cause respiratory disorders and lung damage.

Particles that are sucked into the respiratory system will be set aside depending on their diameter. Large particles will be stuck in the upper respiratory tract, while small particles that can be inhaled (*inhalable*) will enter the lungs and remain in the body for a long time. Inhalable particles are particles with a diameter below 10 microns (PM_{10}), which are known to increase mortality due to heart and respiratory diseases, at concentrations of 140 µg/m^3 can reduce lung function in children, while at concentrations 350 µg/m^3 can aggravate the condition of patients with bronchitis. The toxicity of *inhalable particles* depends on their composition.

Inhalable particles can also be secondary particulates, namely particles formed in the atmosphere from combustion gases that undergo physical-chemical reactions in the atmosphere, for example sulfate and nitrate particles which are formed from SO_2 *and* NOx_{gases}. Generally the secondary particles are 2.5 µ or less in size. The major proportions of $PM_{2.5}$ *are ammonium nitrate*, ammonium sulfate, sodium nitrate and secondary organic carbon. These particles are formed in the atmosphere with a slow reaction so they are often found as transboundary air pollutants that are transported by wind movements to places far from their sources. $PM_{2.5}$ secondary particles can cause a more dangerous impact on health not only because of their size which allows them to be inhaled and penetrate deeper into the respiratory system but also because of their chemical nature (Rivaldi, 2021), (Mulyono et al, 2019).

The noise level is known through the results of direct measurements in the field. Noise is unwanted sound or sounds that can cause harm to human health and environmental comfort. Noise can also be defined as unwanted sound, annoying sound or annoying sound (Syaiful, 2015), (Syaiful, 2020). Noise level is a measure of sound energy expressed in units of decibels A, abbreviated as dB(A) (Wahyuni et al, 2019).

Pollutant sources that have the potential to increase noise parameters include (Kusuma, 2002):

a. Moving sources , namely the exhaust sound of 2- wheeled and 4 -wheeled motorized vehicles .
b. sources , namely small and large industrial activities,
c. Daily community activities (markets, households).

Research Methodology

The research was carried out by taking direct samples 2 (two) times. in 10 (ten) locations spread across the Tasikmalaya City area, shown in Figure 1 and Table 1. The data collection flowchart is shown in Figure 2.

Table 1. Air Quality Monitoring Locations

No.	Location	*Sampling* Point	Coordinate
1	Jl. KHZ. Mostofa (A)	In front of Asia Plaza Mall	07°20'35.9"S 08°13'02.6"E
2	Jl. KHZ. Mustafa (B)	Home Yogya Dept. Store	07°19'52.4"S 108°13'10.1"E
3	Jl. Hospital (C)	In front of SMA Negeri 1 Tasikmalaya	07°19'56.3"S 108°13'25.0"E
4	Jl. Brigadier General Wasita Kusumah (D)	In front of Permata Bunda Hospital	07°17'14.8"S 108°11'46.2"E

No.	Location	*Sampling* Point	Coordinate
5	Jl. Yudanegara (E)	In front of Hotel Santika	07°19'33.4"S 108°13'01.8"E
6	Jl. Otto I Scandardinata (F)	In front of SMP Negeri 1 Tasikmalaya	07°19'35.3"S 108°13'24.3"E
7	Jl. Siliwangi (G)	In front of Siliwangi University	07°20'56.3"S 108°13'20.2"E
8	Jl. RE Martadinata (H)	In front of SMA Negeri 2 Tasikmalaya	07°18'07.36"S 108°12'12.38"E
9	Jl. Ir. H. Juanda (I)	In front of the Budiman Pool	07°18'24.4"S 108°12'12.7"E
10	Jl. Dr. Sukardjo (J)	In front of the Word Meatballs	07°19'12.9"S 108°13'12.6"E

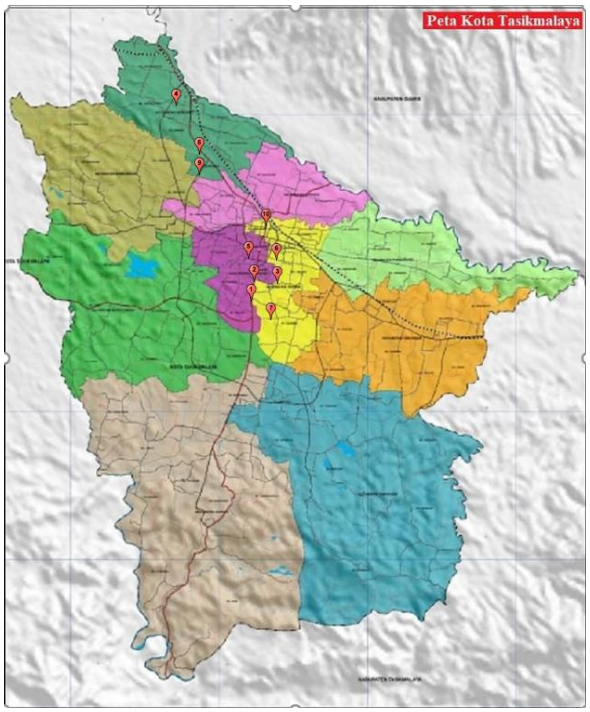

Figure 1. Distribution of Sampling Points in the City Taikmalaya

Results and Discussion

Results of Air Quality Monitoring

Air quality monitoring is carried out at 10 (ten) *sampling points* . The conditions at the time of measuring air quality and noise were on sunny days without rain, the temperature ranged from 29 ºC - 31 ºC. At the sampling location there is a lot of mobility of motorized vehicles carried out by the community and there is also a lot of potential for dust because the sampling is done during the dry season (Kusminingrum and Gunawan, 2008), (Listyarini, 2021).

All monitoring results are shown in the Tables 2-11. The test results explained that the value still met the allowable air quality standards. Even so, at almost all noise inspection points exceeding the quality standard, it is hoped that all people will continue to pay attention to both environmental conditions and the use of transportation facilities, as well as the good condition of motorized vehicles, so that the problem of exhaust emissions due to traffic will not occur.

Table 2. Results of Air Pollution Laboratory Tests on Jl. KHZ. Mostofa (A)

No.	Parameter	Unit	Test result		Quality standards	Reference Method
			Period I	Period II		
Chemistry						
1	Nitrogen Dioxide (NO_2)	µg/Nm^3	3.56	3.69	400	SNI 19-7119.2-2005
2	Sulfur Dioxide (SO_2)	µg/Nm^3	1.91	1.82	900	SNI 19-7119.7-2005
3	Oxidants (O_3)	µg/Nm^3	8.53	7,26	235	SNI 19-7119.8-2005
Physics						
1	Dust (TSP)	µg/Nm^3	88	85	230	*Direct Reading*
Odor						
1	Hydrogen Sulfide (H_2S)	Ppm	2.8 x 10^{-6}	2.6 x 10^{-6}	0.02	JIS K-108
2	Ammonia (NH_3)	Ppm	0.16	0.15	2	SNI 19-7119.2-2005
Noise						
1	Noise	dB	73.2 ^	72.5 ^	70	Kep-48/MENLH/11/1996

Table 3. Results of Air Pollution Laboratory Tests on Jl. KHZ. Mustafa (B)

No.	Parameter	Unit	Test result		Quality standards	Reference Method
			Period I	Period II		
Chemistry						
1	Nitrogen Dioxide (NO_2)	µg/Nm ^{3}	6,72	6,60	400	SNI 19-7119.2-2005
2	Sulfur Dioxide (SO_2)	µg/Nm ^{3}	5.95	6,84	900	SNI 19-7119.7-2005
3	Oxidants (O_3)	µg/Nm ^{3}	2.36	2.49	235	SNI 19-7119.8-2005
Physics						
1	Dust (TSP)	µg/Nm ^{3}	108	110	230	*Direct Reading*
Odor						
1	Hydrogen Sulfide (H_2S)	Ppm	2.5 x 10 $^{-6}$	2.7 x 10 $^{-6}$	0.02	JIS K-108
2	Ammonia (NH_3)	Ppm	0.095	0.091	2	SNI 19-7119.2-2005
Noise						
1	Noise	dB	74.1 ^	73.8 ^	70	Kep-48/MENLH/11/1996

Table 4. Air Pollution Laboratory Test Results on Jl. Hospital (C)

No.	Parameter	Unit	Test result		Quality standards	Reference Method
			Period I	Period II		
Chemistry						
1	Nitrogen Dioxide (NO_2)	µg/Nm ^{3}	3.38	3,24	400	SNI 19-7119.2-2005
2	Sulfur Dioxide (SO_2)	µg/Nm ^{3}	1.85	1.65	900	SNI 19-7119.7-2005
3	Oxidants (O_3)	µg/Nm ^{3}	8,17	6,22	235	SNI 19-7119.8-2005
Physics						
1	Dust (TSP)	µg/Nm ^{3}	88	85	230	*Direct Reading*
Odor						
1	Hydrogen Sulfide (H_2S)	Ppm	2.7 x 10 $^{-6}$	2.5 x 10 $^{-6}$	0.02	JIS K-108
2	Ammonia (NH_3)	Ppm	0.23	0.18	2	SNI 19-7119.2-2005
Noise						
1	Noise	dB	**73.0 ^**	**72.0 ^**	70	Kep-48/MENLH/11/1996

Table 5. Laboratory Test Results for Air Pollution on Jl. Brigadier General Wasita Kusumah (D)

No.	Parameter	Unit	Test result		Quality standards	Reference Method
			Period I	Period II		
Chemistry						
1	Nitrogen Dioxide (NO_2)	µg/Nm ^{3}	2.72	2.69	400	SNI 19-7119.2-2005
2	Sulfur Dioxide (SO_2)	µg/Nm ^{3}	2.82	2.88	900	SNI 19-7119.7-2005
3	Oxidants (O_3)	µg/Nm ^{3}	5.79	5,51	235	SNI 19-7119.8-2005
Physics						
1	Dust (TSP)	µg/Nm ^{3}	62	66	230	*Direct Reading*
Odor						
1	Hydrogen Sulfide (H_2S)	Ppm	2.9 x 10 $^{-6}$	2.8 x 10 $^{-6}$	0.02	JIS K-108
2	Ammonia (NH_3)	Ppm	0.087	0.075	2	SNI 19-7119.2-2005
Noise						
1	Noise	dB	69,2	**70.5 ^**	70	Kep-48/MENLH/11/1996

Table 6. Air Pollution Laboratory Test Results on Jl. Yudanegara (E)

No.	Parameter	Unit	Test result		Quality standards	Reference Method
			Period I	Period II		
Chemistry						
1	Nitrogen Dioxide (NO_2)	µg/Nm ^{3}	6,82	7,49	400	SNI 19-7119.2-2005
2	Sulfur Dioxide (SO_2)	µg/Nm ^{3}	3.61	3.68	900	SNI 19-7119.7-2005
3	Oxidants (O_3)	µg/Nm ^{3}	3.71	3,33	235	SNI 19-7119.8-2005
Physics						
1	Dust (TSP)	µg/Nm ^{3}	95	88	230	*Direct Reading*
Odor						

1	Hydrogen Sulfide (H_2S)	Ppm	3.1×10^{-6}	3.8×10^{-6}	0.02	JIS K-108
2	Ammonia (NH_3)	Ppm	0.17	0.16	2	SNI 19-7119.2-2005
Noise						
1	Noise	dB	**73.8 ^**	**71.1 ^**	70	Kep-48/MENLH/11/1996

Table 7 Air Pollution Laboratory Test Results on Jl. Otto I Scandardinata (F)

No.	Parameter	Unit	Test result		Quality standards	Reference Method
			Period I	Period II		
Chemistry						
1	Nitrogen Dioxide (NO_2)	µg/Nm ^{3}	4.82	4.80	400	SNI 19-7119.2-2005
2	Sulfur Dioxide (SO_2)	µg/Nm ^{3}	5,15	5,68	900	SNI 19-7119.7-2005
3	Oxidants (O_3)	µg/Nm ^{3}	7,22	7,16	235	SNI 19-7119.8-2005
Physics						
1	Dust (TSP)	µg/Nm ^{3}	64	68	230	*Direct Reading*
Odor						
1	Hydrogen Sulfide (H_2S)	Ppm	2.7×10^{-6}	2.3×10^{-6}	0.02	JIS K-108
2	Ammonia (NH_3)	Ppm	0.15	0.19	2	SNI 19-7119.2-2005
Noise						
1	Noise	dB	**75.0 ^**	**80.2 ^**	70	Kep-48/MENLH/11/1996

Table 8. Air Pollution Laboratory Test Results on Jl. Siliwangi (G)

No.	Parameter	Unit	Test result		Quality standards	Reference Method
			Period I	Period II		
Chemistry						
1	Nitrogen Dioxide (NO_2)	µg/Nm ^{3}	5,25	4,17	400	SNI 19-7119.2-2005
2	Sulfur Dioxide (SO_2)	µg/Nm ^{3}	4.88	4.56	900	SNI 19-7119.7-2005
3	Oxidants (O_3)	6.85	8,17	6,32	235	SNI 19-7119.8-2005
Physics						
1	Dust (TSP)	µg/Nm ^{3}	75	86	230	*Direct Reading*
Odor						
1	Hydrogen Sulfide (H_2S)	Ppm	2.5×10^{-6}	2.8×10^{-6}	0.02	JIS K-108
2	Ammonia (NH_3)	Ppm	0.21	0.18	2	SNI 19-7119.2-2005
Noise						
1	Noise	dB	**73.2 ^**	**74.3 ^**	70	Kep-48/MENLH/11/1996

Table 9. Air Pollution Laboratory Test Results on Jl. RE Martadinata (H)

No.	Parameter	Unit	Test result		Quality standards	Reference Method
			Period I	Period II		
Chemistry						
1	Nitrogen Dioxide (NO_2)	µg/Nm ^{3}	7,15	6,73	400	SNI 19-7119.2-2005
2	Sulfur Dioxide (SO_2)	µg/Nm ^{3}	4.56	4,24	900	SNI 19-7119.7-2005
3	Oxidants (O_3)	µg/Nm ^{3}	3,18	3.64	235	SNI 19-7119.8-2005
Physics						
1	Dust (TSP)	µg/Nm ^{3}	105	108	230	*Direct Reading*
Odor						
1	Hydrogen Sulfide (H_2S)	Ppm	3.1×10^{-6}	2.5×10^{-6}	0.02	JIS K-108
2	Ammonia (NH_3)	Ppm	0.15	0.11	2	SNI 19-7119.2-2005
Noise						
1	Noise	dB	**72.0 ^**	**76.2 ^**	70	Kep-48/MENLH/11/1996

Table 10. Air Pollution Laboratory Test Results on Jl. Ir. H. Juanda (I)

No.	Parameter	Unit	Test result		Quality standards	Reference Method
			Period I	Period II		
Chemistry						
1	Nitrogen Dioxide (NO_2)	µg/Nm ^{3}	7.51	8.49	400	SNI 19-7119.2-2005

2	Sulfur Dioxide (SO_2)	µg/Nm ^{3}	2.93	2.25	900	SNI 19-7119.7-2005
3	Oxidants (O_3)	µg/Nm ^{3}	8.75	8,15	235	SNI 19-7119.8-2005
Physics						
1	Dust (TSP)	µg/Nm ^{3}	78	85	230	*Direct Reading*
Odor						
1	Hydrogen Sulfide (H_2S)	Ppm	3.2 x 10 $^{-6}$	2.8 x 10 $^{-6}$	0.02	JIS K-108
2	Ammonia (NH_3)	Ppm	0.06	0.06	2	SNI 19-7119.2-2005
Noise						
1	Noise	dB	**74.1 ^**	**77.8 ^**	70	Kep-48/MENLH/11/1996

Table 11. Air Pollution Laboratory Test Results on Jl. Dr. Sukardjo (J)

No.	Parameter	Unit	Test result		Quality standards	Reference Method
			Period I	Period II		
Chemistry						
1	Nitrogen Dioxide (NO_2)	µg/Nm ^{3}	4,12	4,22	400	SNI 19-7119.2-2005
2	Sulfur Dioxide (SO_2)	µg/Nm ^{3}	4,11	3.63	900	SNI 19-7119.7-2005
3	Oxidants (O_3)	µg/Nm ^{3}	6,45	6,37	235	SNI 19-7119.8-2005
Physics						
1	Dust (TSP)	µg/Nm ^{3}	81	66	230	*Direct Reading*
Odor						
1	Hydrogen Sulfide (H_2S)	Ppm	2.1 x 10 $^{-6}$	2.65 x 10 $^{-6}$	0.02	JIS K-108
2	Ammonia (NH_3)	Ppm	2.6 x 10 $^{-3}$	2.6 x 10 $^{-3}$	2	SNI 19-7119.2-2005
Noise						
1	Noise	dB	**71.8 ^**	**72.4 ^**	70	Kep-48/MENLH/11/1996

From the test results it can be seen that the parameters Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Oxidants (O_3), Dust (*TSP*), Ammonia (NH_3) and Hydrogen Sulfide (H_2S) at 10 test locations still meet the required quality standards (Republic of Indonesia Government, 1999). The results of measuring dust parameters from the 10 measurement locations ranged from 56µg/Nm 3 ^{to} 110µg/Nm ^{3} . The smallest concentration of dust was found at the test location (10), namely Jl. Dr. Sukardjo (07°19'12.9"S 108°13'12.6"E) of 56 µg/Nm ^{3} , while the highest dust concentration was found at location 3, namely on Jl. Hospital (07°19'56.3"S 108°13'25.0"E) of 70.2 µg/Nm ^{3} . When compared with the quality standards based on Government Regulation of the Republic of Indonesia No. 41 of 1999, the dust content at all sampling locations is still below the quality standard set at 230 µg/m ^{3} .

The results of noise level measurements at 3 (three) activity locations ranged from 69 - 78 dBA so that they exceeded the 60 dBA quality standard (Ministry of Environment of the Republic of Indonesia, 1996). This is because the activity location is on a road that is quite busy with motorized vehicles. When compared with Kep-48/MENLH/11/1996 concerning Noise Level Standards (Allocation of Government Areas and Public Facilities), the noise parameters at all air sampling points are above the required quality standard.

Conclusions

The results of monitoring the quality of emissions from immovable sources in Tasikmalaya City are still below the predetermined quality standards. This condition needs to be maintained so that emissions released from businesses/activities do not pollute the air.

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