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## **ANALYSIS OF NOISE AND AIR POLLUTION ON SULTAN HASANUDDIN INTERNATIONAL AIRPORT (ECO-AIRPORT)**

**NATSIR ABDUH, GUFRAN DARMA DIRAWAN AND AHMAD RIFQI ATSRIB**

Post Graduate Program, Makassar State University, Makassar, South Sulawesi, Indonesia

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**Key words:** Noise, Air Pollution, Eco-Airport

### **ABSTRACT**

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The objective of this study was to analyze the level of noise and air pollution in a designated eco-airport. The parameter of measured : Noise level measurement using a sound level meter, carried out in the span of one hour at 5 points, namely on the apron, waiting room-2 departure gate, gate departure lounge-5, arrivals lounge area and basement area. Moreover the indicators of air pollution instrument was measuring the level of air pollution conducted in the laboratory by Sulfur Dioxide (SO<sub>2</sub>), Nitrogen Dioxide (NO<sub>2</sub>) and Carbon Monoxide (CO). Measurements were done in a span of one hour at 7 points, namely on the apron, the departure gate lounge area 2, the area of the departure lounge gate 5, the arrival of the southern area, the northern part of the arrival area, basement, ground parking lot area. Results of the analysis of the average measurements showed that the noise level was 72.53 dBA, while for the analysis of air pollution level measurement parameters, i.e sulfur dioxide (SO<sub>2</sub>) is 13.748 µg/Nm<sup>3</sup>, Nitrogen Dioxide (NO<sub>2</sub>) is 18.650 µg/Nm<sup>3</sup> and Carbon Monoxide (CO) is 25.942 µg/Nm<sup>3</sup>. Based on these results the Sultan Hasanuddin eco-airport due to the Measured values does not pass the quality standard threshold levels of noise and air pollution levels. However, little improvement in air and noise quality can make it eg-airport.

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### **INTRODUCTION**

The concept of eco-airport in terms of planned, developed, and operated is creating infrastructure and facilities that are environmentally friendly for airport as a transportation infrastructure. Application of this concept of environmentally sound aerodrome in airport is a ratio of environmental pollution around airports, and capacity of aerodrome to improve their facility and how the airport can perform preventive

and prevent pollution, such as noise, and air (atmosphere). However some legal products in the management of the airport environment that can be used is the ICAO (International Civil Aviation Organization) and the FAA (Federal Aviation Administration). Both of these regulations provide technical design, planning and implementation of the airport's physical and also environmentally sound structure (Heru Basuki, 1986).

The concept of environmentally friendly airport

(Eco-airport) is based on the goal, to reduce the impact of noise, reduce water pollution, and reduce air pollution emissions. It also aims to reduce the greenhouse effect, by promoting renewable energy and promoting water conservation and recycling of waste water. The concept of eco-airport also supports the government's program to prevent global warming, so that the construction materials used to build the airport consists of materials that are licensed eco-green.

*"The airport operation is not only focused on the movement of passengers and goods, but also the environmental quality control system should be given high priority. During the airport operational it can cause impact on the environment such that the existence of airport should be environmentally friendly. The airport it self could become environmentally friendly if the airport operator could reduce the environmental impacts caused by airport activities" (Adisasmita and Hadipramana, 2011).*

Eco-airport is also a concept which aims to reduce or minimize the impact caused by human activities at the airport. Aspects of eco-airport must be fulfilled in quality standards, such as; the impact of noise, air pollution, surface water quality, waste management, waste management and the use of excessive energy such as electricity and water consumption.

Quality standard noise level for comfort and health for people was standarise by Decree of the Minister of Environment No. KEP-48/MNLH/11/1996 dated 25 November 1996, and standar for the level of air pollution was regulated by Government Regulation No. 41 of 1999 date. May 26, 1999 on air pollution control. Pollution occurs in the air with the fall in air quality, including noise pollution in the form of noise. Noise can be defined as an unwanted noise that loud noises are not pleasant. The source is human activities are carried out at home or outside the home, indoors and in open areas, including at the airport. Therefore, the noise which has a negative effect on human health, namely; physiology disorders include increased blood pressure, psychological disorders affect the heart, balance disorders cause dizziness and effects on the auditory cause deafness can be reduce by improving the infrastructure system (Ambar Widya, 1999).

In connection with the concept of Eco-Airport and the level of noise which accous as noise pollution, air pollution levels are also not a major study point in this research. Generally pollutants that contaminate the air in the form of gas and smoke as a result of oxidation of the various constituent elements of the

fuel, such as: Sulfur Dioxide (SO<sub>2</sub>), Nitrogen Dioxide (NO<sub>2</sub>) and Carbon Monoxide (CO). The level of SO<sub>2</sub> in the air from the burning of fuel is influenced by the content of SO<sub>2</sub> on the type of fuel used. While CO, is the result of fuel combustion process that occurs when incomplete combustion, produced by factory machinery, power plants, motor vehicles and aircraft. The amount of NO<sub>2</sub> is a concentrated amount of NO<sub>2</sub> contained in the air.

## RESEARCH METHODS

The method used is survey by using quantitative approach. The study was conducted at the Sultan Hasanuddin International Airport (BSHas) from January 5 to May 22, 2015.

Focussig on the activity of Sultan Hasanuddin International airport has an impact on the environment around airports. The impact that occurs as; noise, and declining air quality is the concentration of substances such as; Sulfur Dioxide (SO<sub>2</sub>), Nitrogen Dioxide (NO<sub>2</sub>), Carbon Monoxide (CO). The purpose of this study was to analyze the level of noise and air pollution levels caused by the activities of the aerodrome at Sultan Hasanuddin International Airport Makassar.

### 1. Noise level

To measure the noise level is done in several steps, namely:

- a) Determine five sampling points. This 5 point is determined by human activities at this location that generates noise.
- b) Measure the noise level at any point by using a tool called a Sound Level Meter sample value in the span of one hour.
- c) Calculate the value or the noise equivalent (L-eq) from the results of the sample by using the formula:

$$L\text{-eq (dBA)} = 10 \log \frac{1}{N} \left( \sum_{i=1}^N 10^{\frac{L_i}{10}} \right)$$

Specification:

- L-eq = noise equivalent (dBA)
- N = Total sample
- ni = the range of values
- Li = the average value of the sample

- d) Analyze the results obtained and compare the quality standard of airport noise levels, maximum at 75 dBA (decision of the Minister of Environment No. KEP-48/MNLH/11/1996 of 25 November 1996 on

**Table 1.** Sampling point to calculate noise levels

Sample	Location	Specifications
Point1	Apron	S: 05 04' 35,96" E: 119 32' 51,77"
Point 2	departure lounge gate 2	S: 05 04' 34,37" E: 119 32' 51,44"
Point 3	departure lounge gate 5	S: 05 04' 38,28" E: 119 32' 49,24"
Point 4	waiting room arrival	S: 05 04' 38,46" E: 119 32' 47,44"
Point 5	basement area	S: 05 04' 35,30" E: 119 32' 35,30"

**Table 2.** Sample Ambient Air Measurement Methods and Specifications.

No.	Sample Ambient Air	Specifications/ Measurement Method
1.	Sulfur Dioxide (SO <sub>2</sub> )	SNI 19-7119.7-2005
2.	Nitrogen Dioxide (NO <sub>2</sub> )	SNI 19-7119.7-2005
3.	Carbon monoxide (CO)	Spektrofotometric.

the quality standard of the noise) in relation to the airport-based eco-airport.

## 2. Pollution levels

Measurements were carried out on the ambient air for 3 parameters, namely, Sulfur Dioxide (SO<sub>2</sub>), Nitrogen Dioxide (NO<sub>2</sub>) and Carbon Monoxide (CO) at 7 sampling points. This sample points are determined by human activities at this location which produces air pollution so. Sampling points, namely; The apron, gate departure lounge area 2, the area of the departure lounge gate 5, the arrival area of the southern part, the arrival area of the northern part, basement, ground parking lot area.

Secondary data sourced from Angkasa Pura I Branch Makassar, the data in the form of noise and air pollution data that is used to back up the results of primary data.

## RESEARCH RESULT

### 1. Noise level

Regulation of the Minister of Health No.718/Menkes/Per/XI/1987, about Noise is the unwanted noise that may disturb or endanger health. Noise is a collection of tunes with an assortment of unwanted intensity that disturb the tranquility of people, especially hearing.

Noise measurements was carried out by using the Sound Level Meter at five points. Comparison of the results of measurement refers to the Decree of the Minister of Environment No. KEP-48/MNLH/11/1996 dated November 25, 1996 and refers to Environmen-

**Table 3.** Standard of Noise Level For Comfort and Health

Appropriation Region / Environmental Activities	Noise level (dBA)
4. Appropriation Region	
1. Housing and Settlement	55
2. Trade and Services	70
3. Offices and Trade	65
4. Green Open Space	50
5. Industry	70
6. Government and Public Facilities	60
7. Recreation	
8. Special	
- Airport*	75
- Seaports	70
- Cultural Heritage	60
b. Environmental Activities	
1. Hospitals	55
2. Schools	55
3. Places of Worship	55

Source:

- Decree of the Minister of Environment No. KEP-48/MNLH/11/1996 dated 25 November 1996
- UPTD (Environmental Laboratory) Parameters Environment Agency Pare-Pare

tal Laboratory Environment Agency Pare-Pare, the quality standards of airport noise level 75 dBA.

Table 4 show the noise level that has been measure in several sampling point.

Based on the analysis of measurement in Table 4 are obtained lowest noise level at the point of sample 3 (departure lounge Gate 5) with a noise level of 64.22 dBA noise level is highest at the point of sample 1 (Apron) with a noise level of 82.5 dBA. While the results of the sample analysis at point 2 (Departure lounge gate -2 was 73.03 dBA) and sample point 5 (basement area is 74.00 dBA) obtained nearly approaches the quality standard noise level of 75 dBA. The average results of the analysis of measurements at five sample points was 72.53 dBA.

### 2. Air Pollution

Ambient air sampling was conducted in the span of

**Table 4.** Results of Analysis of Noise Level Measurement (dBA)

Sample Location	Result (dBA)			Quality Standars (dBA)	Note
	L-min	L-max	L-eq		
Point 1	72,1	89,2	82,5	75	Above the quality standard Below the quality standard
Point 2	59,1	82,0	73,03		
Point 3	56,8	72,0	64,22		
Point 4	63,2	79,6	68,9		
Point 5	64,1	85,9	74,00		
Average	72,53				

Specifications:

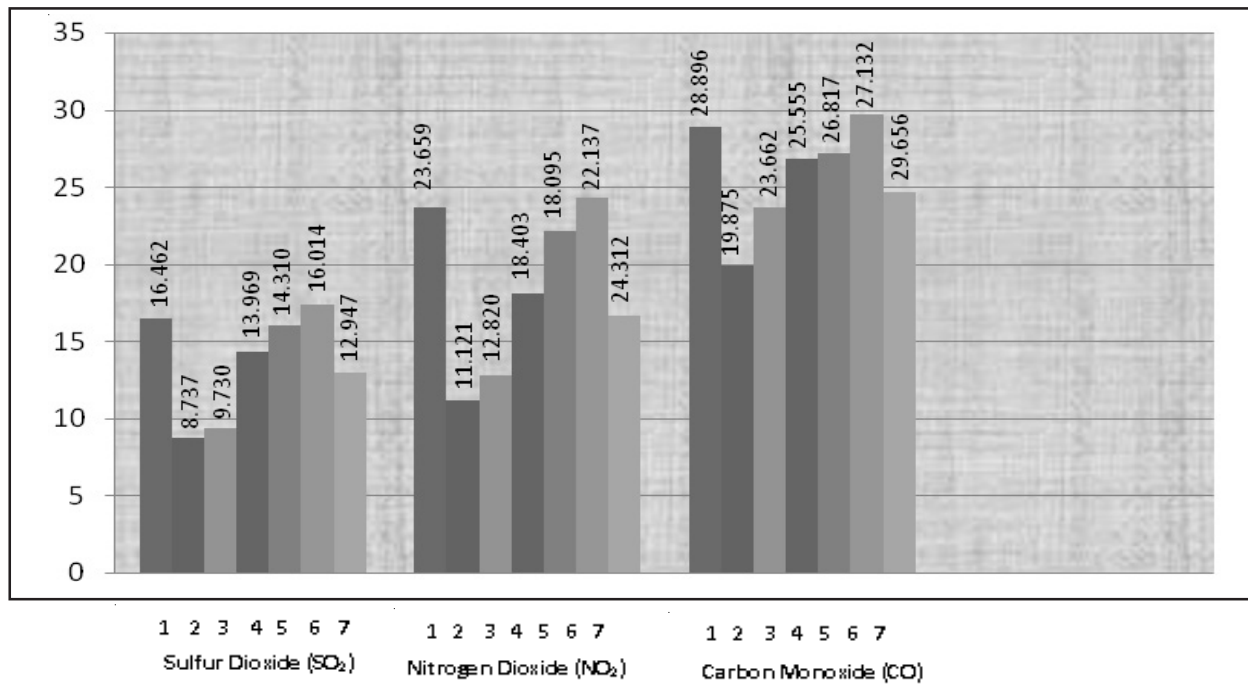
Point 1 : Apron, azimuth S: 050 04' 35,96" E: 1190 32' 51,77"

Point 2 : departure lounge gate 2, azimuth S= 050 04' 34,37" E: 1190 32' 51,44"

Point 3 : departure lounge gate 5, azimuth S: 050 04' 38,28" E: 1190 32' 49,24"

Point 4 : waiting room arrival, azimuth 050 04' 38,46" E: 1190 32' 47,44"

Point 5 : basemant area, azimuth: S: 050 04' 35,30" E: 1190 32' 35,30"



**Fig. 1** Results of Measurement Analysis ambient air samples

one hour. Results of measurement and analysis of ambient air samples at Sultan Hasanuddin Airport is illustrated in the Figure 1.

1. Sulfur Dioxide (SO<sub>2</sub>) are the lowest in point 3 (departure lounge Gate 5) of 8.737 µg/Nm<sup>3</sup> and most are on point 7 (parking area land vehicles) amounted to 17.377 µg/Nm<sup>3</sup>.
2. Nitrogen Dioxide (NO<sub>2</sub>) are at their lowest 3 (departure lounge Gate 5) amounted to 11.121 µg/Nm<sup>3</sup>

and the largest in point 7 (a parking area land vehicles) amounted to 24.312 µg/Nm<sup>3</sup>.

3. Carbon Monoxide (CO) lowest in point 3 (departure lounge Gate 5) amounted to 19.875 µg/Nm<sup>3</sup> and the largest in point 7 (a parking area land vehicles) amounted to 29.656 µg/Nm<sup>3</sup>.

Measurement analysis results obtained were then compared with the standard quality levels of air pollution declared by the Indonesian Government Regulation Number 40 of 2012 on the Development

**Table 5.** Results of Measurement of Ambient Air Samples

Sample	Parameter ( $\mu\text{g}/\text{Nm}^3$ )		
	SO <sub>2</sub>	NO <sub>2</sub>	CO
Point 1	16.462	23.659	28.896
Point 2	8.737	11.121	19.875
Point 3	9.730	12.820	23.662
Point 4	13.969	18.403	25.555
Point 5	14.310	18.095	26.817
Point 6	16.014	22.137	27.132
Point 7	12.947	24.312	29.656
Average	13.748	18,650	25,942

and Environmental Protection Airport. The rule clearly states that business entity airports or airport organizer unit shall maintain the threshold of noise and environmental pollution at the airport and its surroundings in accordance with thresholds and quality standards set by the government. Furthermore, in article 38 it is said that environmental pollution can be caused by: (a) Exhaust emissions and noise of aircraft operations; (b) exhaust emissions and noise of the equipment and/or motor vehicles;

## DISCUSSION

### 1. Noise Level

Based on the average results of the analysis of measurements of noise levels at Sultan Hasanuddin Airport conducted at five sample points obtained for 72.52 dBA which is then compared with the value of quality standard noise level (75 dBA).

Based on a survey conducted by PT. Angkasa Pura I (2014), which was carried out on three sample points,

an average of 78.13 dBA measurement results were obtained. The results showed that the Sultan Hasanuddin Airport is not Eco-Airport. It can be seen from the third point of the sample, as follows:

a) Apron, azimuth S: 05 04 '35.10 "E: 119 32' 40.9" is 88.6 dBA;

b) Runway 03, azimuth S: 05 86' 02,0" E: 119 32' 21,7" is 80,1 dBA;

c) passenger terminal parking, azimuth S: 05 04' 34,1" E: 119 32' 43,9" is 65,7 dBA

In the area of the airport is known that the cause of the noise generated by aircraft derived from the operation of aircraft is on the runway when the aircraft take off and on the apron when the aircraft is stopped. Besides the noise is also caused by human activities such as in the basement area and the sound of the speakers in the departure lounge gate 2 and gate 5.

Frequency of activity at Sultan Hasanuddin International Airport is quite high primarily at rush hour, as the number of passengers go up every year. Since Sultan Hasanuddin Airport is an International Airport, the capacity of the terminal building is designed to accommodate 7.5 million passengers annually. However, in 2013 the passenger has reached 9.645.38 person (Tommy Soetomo, 2014). This clearly confirms that besides derived from the operation of aircraft, the noise is also caused by the increasing activity of passengers each year.

### 2. Air Pollution

Based on the average results of the analysis of the air pollution level measurements at Sultan Hasanuddin Airport conducted at seven sampling points obtained parameters sulfur dioxide (SO<sub>2</sub>) is 13.748  $\mu\text{g}/\text{Nm}^3$ ;

**Table 6.** Quality Standards Air Pollution Levels

No.	Parameter	Time	Quality Standards	Analysis Method	Tools
1.	SO <sub>2</sub>	1 hour	900 $\mu\text{g}/\text{Nm}^3$	Pararosanilin	Spectrophotometer
	Sulfur	24 hour	365 $\mu\text{g}/\text{Nm}^3$		
	Dioksida	1 year	60 $\mu\text{g}/\text{Nm}^3$		
2.	NO <sub>2</sub>	1 hour	400 $\mu\text{g}/\text{Nm}^3$	Saltzman	Spectrophotometer
	Nitrogen	24 hour	150 $\mu\text{g}/\text{Nm}^3$		
	Dioksida	1 year	100 $\mu\text{g}/\text{Nm}^3$		
3.	CO	1 hour	30.000 $\mu\text{g}/\text{Nm}^3$	NDIR	NDIR Analyzer
		24 hour	10.000 $\mu\text{g}/\text{Nm}^3$		
4.	O <sub>3</sub>	1 hour	235 $\mu\text{g}/\text{Nm}^3$	Chemiluminescent	Spectrophotometer
	Ozone	1 year	50 $\mu\text{g}/\text{Nm}^3$		
5.	HC Hidro Carbon	3 hour	160 $\mu\text{g}/\text{Nm}^3$	Flame Ionization	Gas Chromatografi

Source: Regulation No.41 of 1999 on air pollution control date. May 26, 1999

parameter Nitrogen Dioxide ( $\text{NO}_2$ ) is  $18.650 \mu\text{g}/\text{Nm}^3$ ; parameters of Carbon Monoxide (CO) is  $25.942 \mu\text{g}/\text{Nm}^3$ , while the value of quality standard  $\text{SO}_2$  levels of air pollution is  $900 \mu\text{g}/\text{Nm}^3$ ;  $\text{NO}_2$  is  $400 \mu\text{g}/\text{Nm}^3$ ; and CO  $30.000 \mu\text{g}/\text{Nm}^3$ . Referring to the value of the quality standard of air pollution levels, the results of measurements of air pollution is still in the normal range. Seven-point air sampling sites had still not passed the quality standard threshold of air pollution. Based on these results it can be stated that the Sultan Hasanuddin Airport in general is Eco-Airport if judged by the level of air pollution.

Air pollution level measurement results obtained decreased significantly when compared with the results of a survey conducted by PT. Angkasa Pura I Makassar in 2014. The results showed that the parameters of sulfur dioxide ( $\text{SO}_2$ )  $17.614 \mu\text{g}/\text{Nm}^3$ ; Nitrogen Dioxide ( $\text{NO}_2$ )  $21.963 \mu\text{g}/\text{Nm}^3$ ; and Carbon Monoxide (CO)  $29.554 \mu\text{g}/\text{Nm}^3$ . The results of these measurements performed on passenger parking C.5 Sultan Hasanuddin Airport.

Subsequent surveys carried out in the area Apron by PT. Angkasa Pura I Makassar at the same time (2014) also found higher values. The results obtained are sulfur dioxide ( $\text{SO}_2$ ) is  $21.413 \mu\text{g}/\text{Nm}^3$ ; parameter Nitrogen Dioxide ( $\text{NO}_2$ ) is  $31.055 \mu\text{g}/\text{Nm}^3$ ; parameters of Carbon Monoxide (CO) is  $39.938 \mu\text{g}/\text{Nm}^3$ .

## CONCLUSION

Based on the objectives and results of measurements obtained it was concluded that in general the Sultan Hasanuddin Airport is Eco-Airport. Although for the Apron area can be expressed less as Eco-Airport. Pengukuran noise level measurement results showed that crossed the threshold value quality standard noise level. Reduction in the noise level at the apron area can be done by planting tree species that can

reduce noise in the area of open space (open space). In addition, the area of the departure lounge and basement space required proper design and utilization of material that can absorb the noise. Specifically in the departure lounge, it takes speaker (loudspeaker) that sound soft or better when using the system information via running text monitor.

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