Relationship Analysis of Road Facilities to Motorbike Emissions for CO and CO_2 Parameters in Arterial Road Section in Makassar City

Ria Rezki Ramadhani Bahar, Sumarni Hamid Aly, Arwin Amiruddin

Abstract: ***Makassar is the capital of South Sulawesi province which serves as a center of trade, services, transportation and industry activities, making the city of Makassar a city with a large density that causes air pollution. This study aims to describe the characteristics of emission quantity to the distance traveled in the arterial road of Makassar City. This research was conducted in 4 arterial road segments in Makassar city with road type 2/1 UD, 4/1 UD, 4/2 D, and 6/2 UD at peak time period. The required data are the characteristics of motorcycle emissions, mileage and travel time, as well as road facilities. Measurement of light vehicle emissions using Gas Analyzer Portable Measurement System connected to vehicle exhaust tool in mobile condition Measurement data analysis using Microsoft Office Excel. The analysis is done by interpolating the data of motorcycle emission distribution to cumulative data of vehicle emission frequency, so it can be seen in the speed change segmentation which is done by visually observing the formed graph. The result of the research shows that there is a change visually to the relationship between mileage, travel time and emission quantity as well as the difference of variance level of distribution of motorcycle emission and emission average value every time interval of the test between track, time period and road type.***

Keywords: Air pollution, Air quality, Gas analyzer, Vehicle emissions.

I. INTRODUCTION

Air is a component of life that is very important for the survival of humans and other living things such as plants and animals [1]. However, due to recent developments, the quality of the air that has changed its composition from its natural air into polluted air [2].

The air has never been clean without pollutants. Some gases such as Sulfur Dioxide (SO_2), Hydrogen Sulfide (H_2S), and Carbon Monoxide (CO) are always released into the air as a by-product of natural processes such as volcanic activity, decomposition of plant waste, forest fires, and so on [3-8]. In addition small solid or liquid particles can be dispersed in the air by wind, volcanic eruptions, or other natural disturbances [9]. Besides these natural pollutants, air pollution can also be caused by human activities [10,11].

Air is a mixture of several types of gases where the ratio is not fixed, depending on the state of air temperature, pressure, and the surrounding environment. In the air there is oxygen (O_2) which is utilized for breathing , carbon dioxide for photosynthesis process by chlorophyll in plants and ozone (O_3) to resist ultraviolet light [5,6].

Transportation is a very valuable and is needed as a part in supporting the development of the progress of big cities in the world, but on the other hand this increase will also bring undesirable negative effects. One example of transportation that is often used by people in Indonesia is motorized vehicles [12].

Motor vehicles contribute almost 71-89% of hydrocarbons, 34-73% of nitrogen oxides (NOx), and almost all carbon monoxide (CO) is airborne [7,8]. While transportation is the transfer of objects from one place to another while its role is to support the dynamics of development, facilitate the mobility of people, goods and services and support increased relations nationally and internationally.

In Indonesia, motorized vehicles have long been a source of pollutants in many major cities in the world [12]. Exhaust emissions of CO and CO_2 are dangerous compounds derived from two-wheeled vehicles. With millions of vehicles fueled by gasoline making it the largest source of air pollutants in several cities over industries and households [6,8]

Makassar is the capital of South Sulawesi Province which functions as a center for trade, service, education, tourism, transportation and industrial activities. Thus, the usage of the roads in Makassar is very frequent to meet the demands of the trade business. Hence, the roads along Makassar are heavily utilized by motorcycles which cause pollution.

Therefore, in this work, Analysis of the Relationship of Road Facilities to Motorized Moving Emissions for CO and CO_2 Parameters in Arterial Roads in Makassar City was done. This work has focused to describe the characteristics of the amount of emissions based on segmentation of changes in speed with the condition of road facilities on the

Revised Manuscript Received on February 05, 2019.

Ria Rezki Ramadhani Bahar, Department of Environmental Engineering, Faculty of Engineering, University of Hasanuddin, Jl. Perintis Kemerdekaan Km. 10, Tamalanrea, Makassar, 90245, Indonesia.

Sumarni Hamid Aly, Department of Environmental Engineering, Faculty of Engineering, University of Hasanuddin, Jl. Perintis Kemerdekaan Km. 10, Tamalanrea, Makassar, 90245, Indonesia,

Arwin Amiruddin, Department of Environmental Engineering, Faculty of Engineering, University of Hasanuddin, Jl. Perintis Kemerdekaan Km. 10, Tamalanrea, Makassar, 90245, Indonesia.

Makassar City arterial road segment. In addition, the differences and similarities in the amount of emissions to the distance of each track, period and type of road were done.

II. METHODOLOGY

Research Design

Quantitative analysis was done in this work. Measurement of motorcycle emission surveys was carried out at locations that had been determined by using a Portable Measurement System

Research Location and Time

The research location comprised of several arterial roads in the city of Makassar. The roads involved were. The roads involved were a) Type of Road 2/1 UD: Jalan Sulawesi .In this type of road there are 2 lanes and one direction without median.(b) Type of Road 4/1 UD: Ahmad Yani Road. In this type of road there are 4 lanes and one direction without median. (c) Type of Road 4/2 D: Student Army Road. In this type of road there are 4 columns, 2 directions and the distance.(d) Type of Road 6/2 UD: Jalan Jend. Sudirman. In this type of road there are 6 lanes, 2 directions and no median.

The research was conducted for 3 days and data processing was carried out for approximately 8 weeks starting from April 2017 to June 2017. Data collection was carried out at peak hours in each time phase, namely morning at 07.00 am-09.00 am, noon 12.00 pm-14.00 pm, and afternoon at 15.00 pm-18.00 pm

Material and Tools

Motorbike moving emission test activities include sampling at the Makassar City Arterial Road. The tools and materials used are as follows.1. Garmin 64 S GPS serves to measure the driving cycle of a test vehicle with specifications measuring motorbike's moving speed per second.2. Emission test equipment (Gas Analyzer Portable Measurement System)Gas Analyzer Portable Measurement System is a two-wheeled motor vehicle emission measuring instrument capable of measuring motor vehicle emissions in a moving state. This tool is able to measure 5 types of emissions by connecting to a laptop with the help of the Parallax program to read the emissions including CO (carbon monocide), CO_2 (carbon dioxide), SO_2(Sulfur dioxide), NO_2 (Nitrogen dioxide) and CH_4 (Methane).

Data Collection

Data collection comprised of primary data and secondary data. Primary data was collected by interviewing the motorcycle owner and seeing the vehicle registration certificate. The collection of motorbike characteristics is carried out in several Pertamina gas stations in the city of Makassar (Perintis Kemerdekaan gas station, Alauddin gas station, Dr. Sam Ratulangi gas station). Data on operational characteristics of motorbikes recorded are Brand, type, year of manufacture, distance traveled, type of engine, type of disposal. The method of retrieving data on operational characteristics is by interviewing the motorcycle owner and seeing the vehicle registration certificate. Next a preliminary survey at Jalan Sultan Alauddin, Jalan Perintis Kemerdekaan, Jalan Ratulangi gas station which is used as a place to retrieve data on motorcycle use, registration of motorcycles in the form of engine type, odometer, brand, type of disposal, year of manufacture, type of motorbike, preliminary survey data After obtaining the motorbike characteristics data in Makassar City, checking was done according to the standard in IVEM (International Vehicle Emission Model), so that the test vehicle was obtained, namely the type of Honda Scoopy motorbike with a length of 10,000-20,000 km / hour. This motorcycle is used as a sample of test vehicles to measure emissions on arterial roads in Makassar City. This test vehicle is considered to represent a motorcycle that is widely used by people in Makassar City. As for secondary data, it was in terms of maps and street names in the city of Makassar obtained from literature studies and survey.

Data Analysis Method

To analyze motorbike emission levels in moving conditions, data obtained from primary data surveys in the form of exhaust gas concentration data obtained from emission test equipment and speed and distance data obtained from GPS are tabulated and timed first. After that, a graph of emissions per second is made. The graph will later explain the amount of exhaust gas emission concentration released in the air per second which is combined with a graph of distance relation. From the graph, the distance relationship with the time will be analyzed visually the changes in the graph and segmentation per change to obtain the average speed. Then to tabulate motorcycle emission levels in moving conditions, the results of the analysis of motorcycle emission levels in moving conditions that have been obtained in the analysis process above tested the homogeneity of Emission Intensity per speed using statistical tests namely F test and T test using Microsoft Excel Program.

III. RESULT AND DISCUSSION

The intensity of emissions between road types involves data from 4 research locations through the F test and T test to see the variance and mean of processing data between these types of roads. For CO parameter In Table 1 shows that for Test F between types of roads that have the same variance value only found on road types 6/2 UD and 4/2 D. Whereas for other types of roads show differences in variance because the results of data processing F table values are smaller than F count value.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

Table. 1 Test Result F between Type of Road for CO

Type	4/1UD	2/1UD	4/2D	6/2D	
4/1UD		49.94	3.03	3.28	F-Value
2/1UD	1.36		16.46	15.22	
4/2D	1.36	1.29		1.08	
6/2D	1.35	1.28	1.28		
F-Table Value					

In Table 2 shows that for the T test between types of roads that have the same average values are found on road types 6/2 UD and 4/2 D, as well as on road types 2/1 UD and 4/2 D. While for other types of roads has a variance difference, because the T table value is smaller than the calculated T.

Table. 2 Test Result T between Type of Road for CO

Type	4/1UD	2/1UD	4/2D	6/2D	
4/1UD		2.44	3.76	2.60	T-Value
2/1UD	1.97		-1.20	2.44	
4/2D	1.97	1.97		-1.12	
6/2D	1.96	1.97	1.96		
T-Table Value					

For Parameter CO_2 results is shown in Table 3. In Table 3 shows that for F Test between types of roads no one has the same variance value this is evidenced by the results of data processing F table value is smaller than the calculated F value.

Table. 3 F Test Results between Road Types for CO_2

Type	4/1UD	2/1UD	4/2D	6/2D	
4/1UD		1.37	10.04	7.50	F-Value
2/1UD	1.36		13.68	7.50	
4/2D	1.36	1.29		1.82	
6/2D	1.35	1.28	1.28		
F-Table Value					

In Table 4, shows that for the T test between types of roads that have the same average value for all types of roads, because the T table value is greater than the calculated T.

Table. 4 T Test Results between Road Types

Type	4/1UD	2/1UD	4/2D	6/2D	
4/1UD		0.20	-0.35	0.22	T-Value
2/1UD	1.97		-0.09	0.63	
4/2D	1.98	1.97		1.73	
6/2D	1.98	1.97	1.96		
T-Table Value					

IV. CONCLUSION

Based on the results of direct surveys in the field, it can be obtained some conclusions, as follows:
1. The intensity of the amount of emissions to the speed and facilities of the segment road shows that changes in speed are not affected by road facilities. 2. The results of the analysis of the homogeneity of the amount of emissions to the distance traveled by using the F and T tests for each track, it appears as a whole that shows no difference. For the F and T test results for each time period, there are differences in variance in Test F, while the T Test generally shows no mean difference, for testing using the F test and T Test for the road type shows that the
erage similarity and variance are in type 4 / 2 D and 6/2 UD.

ACKNOWLEDGEMENT

The author would like to acknowledge and thanks to all respondents and Department of Environmental Engineering, University of Hasanuddin for unconditional support.

REFERENCES

1. Costanza, R., Fisher, B., Ali, S., Beer, C., Bond, L., Boumans, R., ... & Gayer, D. E. (2007). Quality of life: An approach integrating opportunities, human needs, and subjective well-being. *Ecological economics*, *61*(2-3), 267-276.

2. Monks, P. S., Granier, C., Fuzzi, S., Stohl, A., Williams, M. L., Akimoto, H., ... & Blake, N. (2009). Atmospheric composition change–global and regional air quality. *Atmospheric environment*, *43*(33), 5268-5350.
3. Greyson, J. C. (1990). *Carbon, nitrogen, and sulfur pollutants and their determination in air and water*. CRC Press.
4. Baukal Jr, C. E. (Ed.). (2003). *Industrial combustion pollution and control*. CRC Press
5. Mishra, Pramod Chandra. *Fundamentals of air and water pollution*. APH Publishing, 2008.
6. Koren, H., & Bisesi, M. S. (2016). *Handbook of Environmental Health, Volume II: Pollutant Interactions in Air, Water, and Soil*. CRC Press.
7. Chandrappa, R., & Kulshrestha, U. C. (2015). *Sustainable air pollution management: theory and practice*. Springer.
8. Sharma, B. K. (2014). *Environmental chemistry*. Krishna Prakashan Media.
9. Pye, K. (2015). Aeolian dust and dust deposits. Elsevier.
10. Goudie, A. S. (2018). *Human impact on the natural environment*. John Wiley & Sons.
11. Hinds, J., & Sparks, P. (2011). The affective quality of human-natural environment relationships. *Evolutionary Psychology*, *9*(3), 147470491100900314.
12. Joewono, T. B., & Kubota, H. (2007). User satisfaction with paratransit in competition with motorization in indonesia: anticipation of future implications. *Transportation*, *34*(3), 337-354.