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THE IMPACT OF MOTORIZED VEHICLE ACTIVITY ON THE LEVEL OF AIR POLLUTION IN BALI ISLAND

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Abstract

Number of vehicles moving in the city of Denpasar is quite dense and has the potential to produce high carbon monoxide (CO) and hydrocarbon (HC) exhaust gases which can be fatal to human health. The research objective is to analyze the level of air pollution in the city of Denpasar and analyze the factors that cause pollution from motorized vehicles. To calculate the volume of traffic using the application traffic counter on an android phone. The research method uses trend analysis and multiple linear regression analysis. The growth of CO pollutants in the city of Denpasar increased with a growth value of 0.88 to 3.25 per year so that in 2021 the level of CO is predicted to be between 32.41% to 81.52%. Likewise, HC levels increase with a growth value of 0.85 - 1.59 per year so that in 2021 HC levels are predicted between 2,670 ppm to 24,383 ppm. The vehicles age and engine combustion system have a strong correlation in producing CO and HC values; while brand, engine capacity and mileage correlate very weak. The conclusion is that newer vehicles and the latest combustion systems produce lower CO and HC levels.

Keywords: Vehicles; Pollutants; CO; HC; Combustion Systems.

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1. Introduction

Various potential sectors in air pollution, one of the related sectors. Fuel for vehicles can remove pollutants such as CO, NOx, SOx, dust, HC, and lead. In big cities, the contribution of motor vehicle exhaust gas as a source of air pollution reaches 60-70%. While the contribution of exhaust gases from the chimney industry that only takes 10-15%, is received from other sources of combustion, for example from households, burning waste, forest fires, and others (Ratnani, 2008). Mobile vehicles that become transportation means, in the context of air pollution are classified as moving sources. With these characteristics, the spread of pollutants emitted from vehicle sources

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will have a broad spatial distribution pattern. The Denpasar city has the highest number of vehicles. The type of vehicle that increases the number of bicycles (Bali Provincial Statistics, 2009)

Previous research stated the volume of vehicles affects the level of air pollution (Jeremy, 2002). In countries that have strict vehicle exhaust emissions standards, there are 5 exhaust gases that will be used are HC, CO, CO2, O2 and NOx compounds. While in countries where the emission standards are not too strict, only measure four not in the flue gas namely HC, CO, CO2 and O2, including Indonesia. (Gunadi, 2010). In this study an analysis of vehicle exhaust emissions containing carbon monoxide (CO) and hydrocarbons (HC) is the impact of vehicle activity in the city of Denpasar. Related to the relationship between traffic vehicles that are known to have a close relationship, but a detailed assessment of the level of budget obtained involves vehicles that have not been reviewed. The city of Denpasar on the island of Bali with traffic transition and pollution measures during rush hour, from 07.00 to 17.00.

2. Materials and Methods

location of the study relies on four road segments representing each area of Denpasar City, namely location one on the Jalan Mulawarman, the location of two Jalan raya Sesetan, the location of three Jalan raya Puputan Renon and the location of four Jalan Teuku Umar Barat. The study population is the number of vehicles that pass through the four sections of the study site. How to determine a sample of traffic volume research with the amount of traffic that crosses four research points. To calculate the volume of traffic using the application traffic counter on an android phone. Large samples in this study were vehicles sponsored by BLH Denpasar and pick tests at 4 research locations as well as the number of vehicles using these roads. Emission levels that analyze carbon monoxide (CO) and hydrocarbons (HC), using a gas analyzer equipment and smoke test. The time of the study was conducted in December 2016 during office hours from 07.00 - 17.00 PM.

Data analysis of the results of research using the time series method (Hanke & Wichern, 2005) to determine the growth graph of CO and HC pollutants in Denpasar every year. Exhaust emission data from 2013 to 2016 obtained from the BLH Denpasar office and a survey of researchers in December 2016, were analyzed into numerical data so that CO and HC pollutant growth can be calculated until 2021. Volume Analysis was then carried out using a Fight vehicle conducted at the point and predictions that will be converted in units of vehicle types in 1 (one) full day during business hours.

3. Results and Discussion

The volume in the time frame of 07.00 am - 17.00 pm with the division of three categories of motorcycles, passenger cars, freight cars using the application is traffic counter presented in Figure 1. Research data on the location of Jalan Mulawarman, Lumintang passed by 15,618 motorized vehicles, Jalan Raya Sesetan 20,111 vehicles are passed, Renon is 18,986 vehicles and Teuku Umar Barat are 22,213 vehicles.

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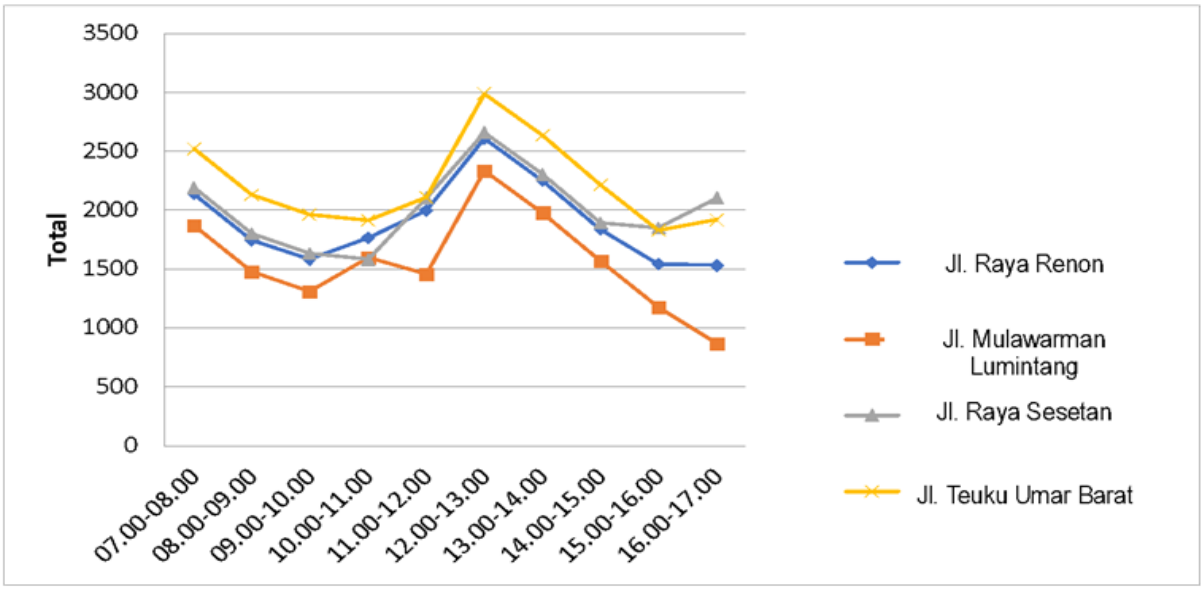

Figure 1: Denpasar City vehicle fluctuation volume from 07.00 am to 19.00 pm

Figure 2. shows the average number of CO pollutants in four locations in Denpasar City over a four-year period. To be able to know the rate of growth carried out by CO and HC, carried out by the method trend combined factor, where the value of i is the percentage of growth in 2016. Location CO rate 1, i = 0.88; location 2, i = 1.10; location 3, i = 3.25; location 4, i = 1.27.

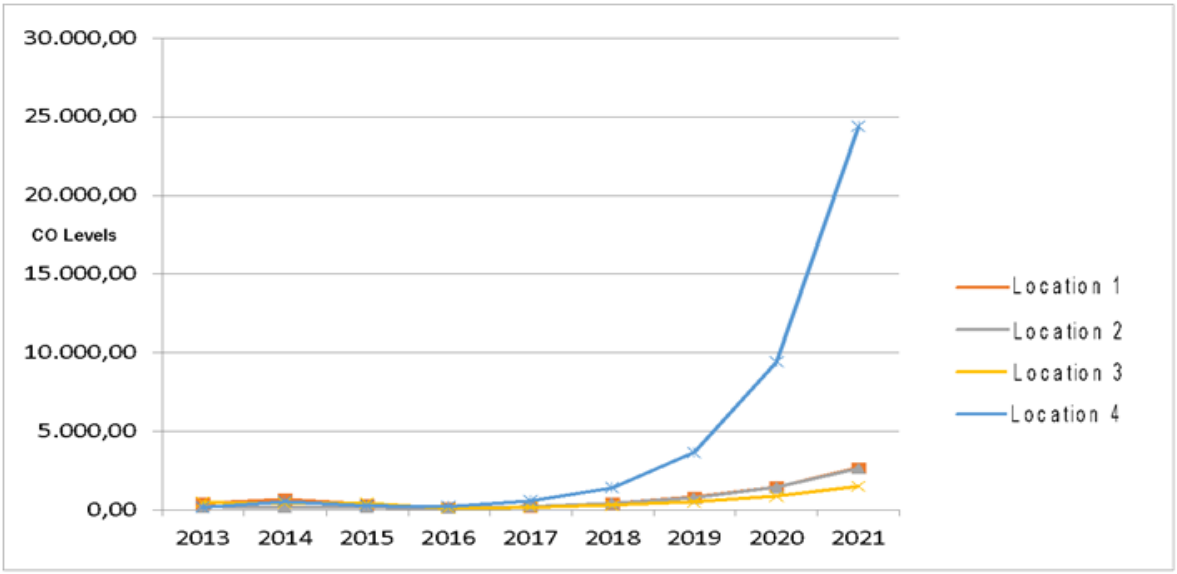

Figure 2: Predicted graph of CO level increase

Figure 2. shows the highest growth rate of CO pollutants at location four (Teuku Umar Barat Street) can affect when testing exhaust emissions of many vehicles produced in a long time and the combustion system is still using carburetors. For HC growth in location 1, i = 0.85; location 2, i = 0.85; location 3, i = 0.73; location 4, i = 1.59.

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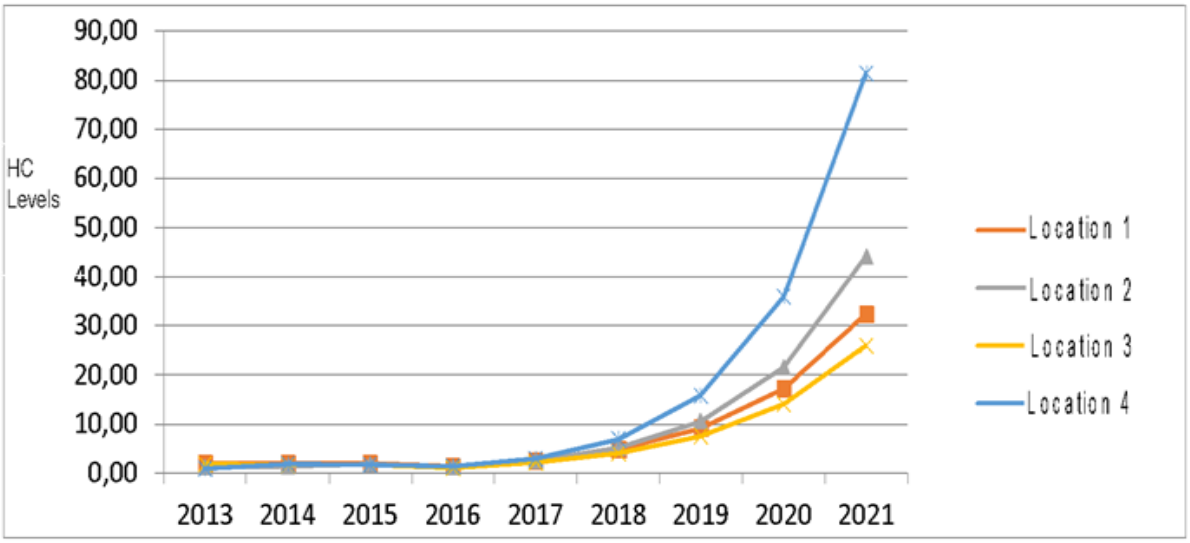

Figure 3: Predicted increase in HC level

Similar to CO pollutants, the HC growth rate at location 4 is expected to increase the highest compared to other locations. Overall by using the formula, the combined factors can predict CO and HC levels in five years which will increase, if the conditions are still the same as now. The number of vehicles that are upgraded in Denpasar City each year that increases the data that has been processed using trends with the data available in 2016 obtained CO and HC results increase every year from 2017 on the Jalan Mulawarman CO by 2.58% up to 2021 by 32.41%, so that for HC of 227 ppm in 2017 to 2.670 ppm in 2021. On the jalan Sesetan CO 2.63% until 2021 to 51.56%, while for HC of 222 ppm until 2021 to 2.627 ppm. For Jalan Raya Puputan Renon, the amount CO is 5.02% up to 2021 to 1638.29%, while for HC, it is 168 ppm until 2021 to 1.502 ppm. On the Jalan Teuku Umar Barat CO by 3.08% until 2021 to 81.52%, while for HC it was 544 ppm until 2021 to 24.383 ppm. The city of Denpasar to be able to increase the budget for CO and HC gas emissions, and greening needs to be done so that people are not involved in health licensing involving inhaled CO and HC content. The increasing level of CO and HC is in line with the increasing number of vehicles in the city of Denpasar increasing air quality which decreases air quality so that it can improve human health and improve other quality of life. This is related to research on the effect of traffic density in the city of Surabaya in addition to causing air pollution and also causing noise pollution (moved) by the immediate disposal (emission) of transportation vehicles which are chemical elements in free air that are diverted loss of free air quality. Encouraging, the emergence of health problems become eye irritation, respiratory / lung disorders, encouraging, nausea, weakness, etc. and have a major impact on life that occurs in the vicinity (Widyawati, 2011).

Button (1993), states that CO poisoning gas arises due to carboxyhemoglobin (COHb) in the blood. CO levels are greater than oxygen (O2) against Hb which causes the Hb function for oxygen that carries the entire body to be disrupted. Reduced oxygen supply to the whole body will make breathing difficult and can cause death, no need to get fresh air again. In addition, Button also stated that carbon dioxide (CO2) is a problem because it causes climate. CO emissions are the result of burning fossil fuels. Malkhamah (2004) writes about the effects of pollution on health, namely respiratory and cardiovascular diseases, reducing the capacity of the lungs and damaging

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the lungs, damaging respiratory cells and causing cancer. Tugaswati (2008), states that pollutants involved in the systemic, such as hydrocarbon monoxide and lead / lead are suspected of causing cancer.

The results of trials between vehicle brands, production years, systems fuel ignition, and mileage to exhaust gas levels are presented in Table 1. Data in Table 1 shows the results of the comparison with low / weak increase rates shown in the relationship between vehicle brands, capacity engine, and mileage with CO and HC levels. A high level of consideration occurs in the relationship between the year of production of the vehicle and the system combustion with CO and HC levels.

Table 1: Comparative test results of various vehicle parameters to CO and HC levels.

No	Test Parameters Correlation	Value Correlation	Level Correlation
1	Vehicle brand with CO levels	0.162	Low
2	Years of production with CO levels	-0.510	High
3	Engine capacity with CO levels	-0.158	Low
4	Mileage with CO levels	0.239	Low
5	Combustion system with CO levels	0.512	High
6	Branded vehicles with HC levels	0.250	Low
7	Years of production with HC levels	-0.561	High
8	Engine capacity with HC levels	-0.143	Low
9	Mileage with HC levels	0.187	Low
10	Combustion system with HC levels	-0.616	High

Correlation test results show a strong and significant correlation between CO with the year of manufacture with a return value of -0,510 means an inverse linear relationship between CO and the year of production, in other words the younger the year of manufacture the less CO. Correlation of CO with an combustion system of -0,512 shows that CO with the latest fuel system is getting less. Likewise the relationship between HC and vehicle production year has a correlation value of -0.561 meaning there is an inverse linear relationship between HC and the year of manufacture, in other words the younger the year of manufacture the less HC levels. The correlation value of HC with the combustion system is -0.492, it shows there is an inverse linear relationship between the HC level with the engine combustion system. Vehicles with the latest combustion system are getting less HC. The probability value of CO or HC between the year of manufacture and the combustion system is 0 <0.05, meaning that there is a significant correlation. Can be seen that there is a significant relationship between the year of manufacture and the combustion system on the results of CO and HC exhaust emissions. Regression values for CO are $Y = 195.38-1.882 X_1-0.95X_2$ and for HC that is $Y = 17661,578-81,493X_1-8,662X_2$, where X_1 is the combustion system and X_2 is the year of manufacture. These results are consistent with the statement of Firdaus, et al. (2013) that vehicles with routine maintenance and using injection machines produce low HC emissions, in addition Winarno (2010), states that vehicle exhaust emissions decrease as the vehicle ages. There is a correlation between the year of manufacture and the emissions produced and strategies are needed to control the amount of air pollution so that it can support sustainable development and transportation (Wibisono, 2002).

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4. Conclusion

Growth of CO and HC pollutant levels in the city of Denpasar is increasing from year to year with an increase in CO value of 0.88 - 3.25 per year, so that in 2021 CO levels are predicted to be 32.41% to 81.52%. HC levels increase with values of 0.85 - 1.59 per year, so that in 2021 HC levels are predicted to be 2,670 ppm up to 24,383 ppm. The year of manufacture and engine combustion system has a strong correlation in producing CO and HC levels; while for brands, engine capacity and mileage correlate very weak. Years of making younger vehicles and the latest combustion system results in lower CO and HC levels.

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