Measurement of the sound intensity level of motorized vehicles using the Sound Level Meter application

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Abstract

The use of motorized vehicles is currently increasing, especially in big cities in Indonesia. This condition can affect the environmental noise level. Therefore, in this study, a measurement of the sound intensity level of motorized vehicles on the ground was carried out in a certain time. The research method used was by directly measuring the sound source of 4 types of motorized vehicles, namely Trains, Motorbikes, Urban Transportation (Angkot) and Transjakarta in the Tanjung Priok-North Jakarta area using the Sound Level Meter application. Measurements were made at a distance of 50 cm from the source of the sound within 30 seconds. The measurement results show that the value fluctuates in the strong noise level category range (60 dB to 80 dB), with the Train producing the highest sound intensity level (67.03 ± 5.65 dB) and the lowest Angkot (62.70 ± 4.03 dB). The conclusion is that the sound intensity level of the four types of vehicles is still below the threshold value of 80 dB, so it is rationally safe for the sense of hearing even though they do not use hearing protection devices.

Keywords: Noise level; sound source; motorized vehicles; sound level meter

1. Introduction

Sound is a vibration that propagates from the sound source (Song, et al., 2020). Sound waves are longitudinal waves that can propagate through solid, gas and liquid objects (Kustaman, 2017). Sound waves cannot propagate in a vacuum (Kalempa, et al., 2019). Sound waves are limited by the frequencies that can stimulate the human ear and brain. This frequency range is in the 20 Hz to 20 KHz area. There is a sound that is not desired to be heard because it disturbs the sense of hearing which is called noise (Jairwala, et al., 2017; Singh, et al., 2018). The source of the noise can come from activities or efforts in a certain level and time, it can cause human health problems and environmental comfort (Alimohammadi, et al., 2018; Khan, et al., 2018). Noise can cause various disturbances

to normal humans, such as physiological disorders, psychological disorders, communication disorders and deafness (Yaroshovych, et al., 2019; Nasution, 2019; Asmarani, 2017).

In carrying out our daily activities and learning physics, we are never separated from the source of the sound (Putra, et al., 2018; Fatihah, et al., 2020). One of them is from moving sound sources such as motorized vehicles. Especially if we live in a big city like Jakarta, on our way to reach a destination using Urban Transportation (Angkot), we can use more than one type of vehicle, for example using a public car, Urban Transportation (Angkot), then continue by using a train or bus, even for transportation. reach narrow alleyways that can be reached by motorbike. During the trip, it is certain that there will be sounds produced from each of these vehicles. We must ensure that the sound coming out of this vehicle does not exceed the sound threshold and does not interfere with the sense of hearing.

Several previous studies have conducted measurements related to sound intensity. However, the measured sound source comes from a sound source that is quite extreme, such as measuring the intensity of the sound coming from an aircraft engine (Erbe, et al., 2018), measuring the sound source from a bomb explosion (Xiong, et al., 2021), and measuring the sound source from a bomb explosion (Xiong, et al., 2021). source of the sound of volcanic explosions (Johnson, 2003). The various sound sources whose intensity was measured by the previous researchers were situational and conditional, besides that they were not necessarily found in all regions. Therefore, the measurement of sound sources that are always around us, namely sound sources originating from motorized vehicles, is the novelty of this study. In addition, the Android-based sound source measurement tool makes this sound source measurement easier for anyone to do because it is easier and more practical.

Therefore, in this study, the measurement of the sound intensity level of 4 types of land vehicles in a certain time using the Sound Level Meter application. The purpose of this research is expected to be able to take early action against noise pollution from moving source noise disturbances, namely from motorized vehicles which are currently increasing. Early action that can be taken if we know that the surrounding environment is indicated to have sound pollution, namely with a sound intensity level above the threshold value, then we can protect our ears by using hearing protection devices from noise sources that are commonly found in the market at relatively affordable prices.

2. Materials and Methods

2.1. Materials and Tools

The materials and tools used in this study consisted of a stopwatch, a Sound Level Meter application, a sound source from 4 types of land vehicles, namely the KRL Commuter Line Train for the Jabodetabek route, the sound of a Yamaha Vixion 150 cc motorbike exhaust, a car Urban Transportation (Angkot) types Suzuki APV and Transjakarta types Articulated Bus Scania. Measurements were made when all types of vehicles are driving.

2.2. Location and Time of Measurement

The locations and measurement times of the four noise sources are presented in Table 1.

Table 1. Location and time of noise measurement

Source / Condition	Train	Motorbikes	Urban Transportation (*Angkot*)	Transjakarta
Location / address	Kp Muara Bahari Street A9 Tanjung Priok, North Jakarta	Kp Muara Bahari Street No.255 Tanjung Priok, North Jakarta	Tanjung Priok Bus Station, North Jakarta	Enggano Bus Stop, Tanjung Priok, North Jakarta
Date and time	Sunday, December 20, 2020	Sunday, December 20, 2020	Sunday, December 20, 2020	Sunday, December 20, 2020
Time	08:13:10 s.d 08:13:40	20:08:15 s.d 20:08:45	11:48:15 s.d 11:48:45	12:00:31 s.d 12:01:02
Weather	Bright	Bright	Bright	Bright

2.3. Sound Level Meter Application

The Sound Level Meter application used was downloaded for free from the Play Store. The Sound Level Meter application was released by Abc Apps with version 3.5.8, then installed on the Vivo Y12 android smartphone.

2.4. Data Analysis and Statistical Analysis

Measurements of the noise source were each carried out at a distance of 50 cm from the sound source and the measurement time was 30 seconds. Measurement data in the form of sound intensity were recorded every 5 seconds, starting from the first 5 seconds to the 30th second. Statistical analysis was performed using independent t test to compare the measurement results of the four types of vehicles using Microsoft Excel 10. P value <0.05 deemed to indicate a real/significant difference.

3. Results and Discussion

The results of sound intensity measurements for the four types of land vehicles are presented in Figure 1. Based on Figure 1, it appears that the sound intensity measurement for 30 seconds shows a fluctuating value. This shows that the sound that comes out of each type of vehicle is not constant. Some of the factors that cause this include road conditions that are not empty, so that the speed of the vehicle also changes. In addition, the driver's factor in driving his vehicle to go faster or more slowly can also

affect the sound intensity value. It has been stated in previous studies, that the speed of the vehicle can affect the level of the sound produced (Gilsa, 2017; Indrawati, 2017).

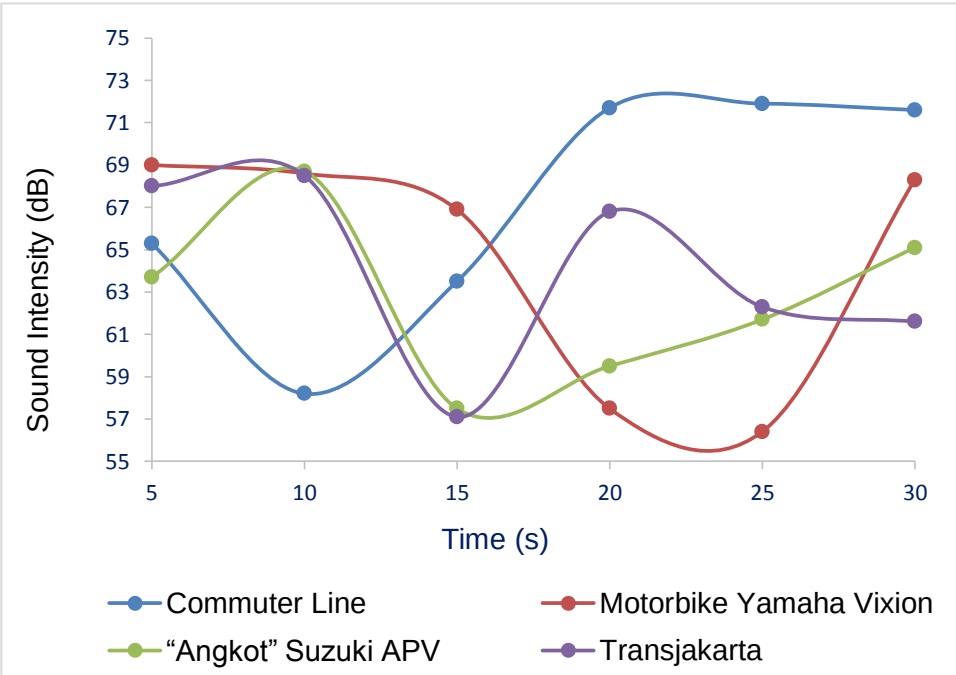

Fig. 1. Relationship between the sound intensity of the four types of land vehicles with time

Referring to the circular minister of labor and transkop No. SE 01 / MEN / 1978, regarding the noise threshold value (SE MEN, 1978), as shown in Table 2, the overall average sound intensity value of the four types of vehicles has a noise level with a strong category, which is in the 60 dB value range. up to 80 dB. However, this value is still relatively secure against normal human hearing, because in accordance with Law No. 22 of 2009 on traffic and road transport, for vehicles above 150 cc generated sound intensity level up to 80 dB (UU No. 22, 2009). The average value of the sound intensity measurement results is still below 80 dB with less the average value of the most high-intensity sound generated by the Railways and the lowest average value generated by Car Urban Transportation (Angkot). This value is safe to sound 8 hours/day or 40 hours/week.

Based on the color code stated by Syarifuddin and Munzir (2015), the sound intensity level between 100 to 120 dB is given a black color code which is deafening, 80 to 100 dB is colored red which is very chaotic, 60 to 80 dB is colored yellow which is strong, 40 to 60 dB is given a medium green color, 20 to 40 dB is given an orange color which is calm and 0 to 20 dB is given a blue color which is very calm. The average measured sound intensity value of the four types of vehicles as shown in Table 2, all of them are in the yellow area.

Table 2. Average value of sound intensity

Transportation type	Average Sound intensity (dB)
Commuter Line	67.03 ± 5.65[a]
Motorbike	64.45 ± 5.86[a]
Urban Transportation (*Angkot*)	62.70 ± 4.03[a]
Transjakarta	64.05 ± 4.48[a]

Note: The same lowercase letter in the same column shows no insignificant difference at P <0.05.

Based on the threshold value, the yellow area is an area that is still safe at noise. In this area the noise level will decrease if it is far from the source so that in this area it is not too noisy. However, in the yellow area, it is still recommended to use ear protection in the form of ear plugs or ear-muffs so that the ears can be protected. In addition, the measured value from the Sound Level Meter application is not a standard value for obtaining a vehicle noise test certificate.

Statistically, the average value of the sound intensity of the four types of vehicles measured did not show a significant difference. This means that people are free to choose the type of Urban Transportation (Angkot) they will use without having to worry about noise disturbances from the sound source produced by the vehicle. However, we are required to remain vigilant and strive to control noise pollution, because the source of environmental noise pollutants does not only come from motorized vehicles but can come from other human activities such as sounding trumpets, lighting firecrackers, lighting loud music, industrial activities or other sources.

In previous studies, it has been stated that the use of measurement applications on the Play Store is quite accurate compared to actual measuring instruments, such as that of Kasim (2020) who obtained a confidence level above 97% (Kasim, 2020). However, to get more accurate measurement results, in future studies it is recommended to take measurements with actual measuring instruments and compare the results with the results obtained from application-based measurements. In addition, measurements should not be taken in bad weather. The ambient temperature should be 0^{o}C to 40^{o}C, he values for wind speed and direction, relative humidity and atmospheric pressure should be recorded.

4. Conclusion

Based long sentence on the results of the study, it can be concluded that the sound intensity level of the four types of vehicles in the form of Electric Rail Train (KRL) or what is often known as the Commuter Line for the Jabodetabek route, the sound of the Yamaha Vixion 150 cc motorbike exhaust, the Suzuki APV and Transjakarta the type of Scania Articulated Bus, measured using the Sound Level Meter application in the Tanjung Priok-North Jakarta area, shows a value that is still below the threshold value of 80 dB, so it is relatively safe in the sense of hearing even though it does not use hearing protection devices.

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