ISSN 2087-3336 (Print) | 2721-4729 (Online)
TEKNOSAINS: Jurnal Sains, Teknologi dan Informatika
Vol. 11, No. 1, January 2024, page. 154-159
http://jurnal.sttmcileungsi.ac.id/index.php/tekno
DOI: 10.37373

Exhaust gas emissions in daihatsu granmax vehicles based on the year of manufacture

Fikri Setiawan, Ali Akbar*, Mulyadi

* Mechanical Engineering, Muhammadiyah University of Sidoarjo, East Java, Indonesia, Jl. Raya Gelam no. 250 Sidoarjo Temple, East Java, Indonesia

*✉ aliakbar@umsida.ac.id

Submitted : 12/12/2023 Reviseded : 05/01/2024 Accepted: 12/01/2024

ABSTRACT

Air pollution is a condition caused by exhaust gas from motorized vehicles operating on the highway. To minimize greater air pollution, the government is making preventive efforts by carrying out periodic vehicle emission tests which are currently being carried out. carry out transport targeting vehicles. The research aims to determine the year of the vehicle that produces the dominant CO (carbon monoxide) and HC (hydrocarbon) exhaust emissions which were tested based on vehicle year from 2017 to 2022, with the type of gasoline-fueled vehicle, in this case the Daihatsu granmax. The method used is experimental using Manova analysis of 30 samples used with variations in data taken from testing CO and HC exhaust emissions on 30 samples with 5 vehicles each in each year of production. The results of the research that has been carried out show that the emission test results on sample data show the highest CO exhaust emissions in vehicles in 2017 and the lowest in vehicles in 2021, while the HC test results in vehicles in 2017 are the highest and continue to decline to the lowest point in vehicles in 2022, this provides a conclusion: Vehicles produced longer have the potential to produce high exhaust emissions, while vehicles produced younger do not cause exhaust emissions

Keywords: Gas emissions; manova; CO; HC.

1. INTRODUCTION

The number of motorized vehicles in Indonesia is increasing day by day [1]. Air pollution is a problem that has been faced for a long time and is difficult to solve. Motorized vehicles are indeed very beneficial for human life, but motorized vehicles also have negative impacts [2]. The development of vehicles is very fast, so the problems that arise must be immediately sought and addressed because this can have an impact on traffic accidents and air pollution produced by motor vehicle exhaust emissions [3].

The increase in the population of motorized vehicles in the world is very rapid, with this we get both positive and negative sides. From the positive side, with the rapid development of motorized vehicles, people and goods can move places easily using motorized vehicles, but from the negative side, motorized vehicles produce exhaust emissions which are the largest contributor to air pollution compared to pollution resulting from other factors [4]. The contribution of air pollution from the transportation sector reaches 60% from the industrial sector 25%, pollution from households 10%, and pollution from waste 5% [5]. Dangerous substances contained in air pollution such as lead/lead, nitrogen oxides (NOx), hydrocarbons (HC), carbon monoxide (CO) [6].

This pollution condition is worrying because every second the pollution resulting from vehicle exhaust emissions continues to increase along with increasing vehicle activity. Exhaust gas emissions can also have an impact on the human body, such as experiencing respiratory problems, internal organ disorders and other organ disorders [7].

Vehicles function as a means of transportation for transporting people and goods, but transportation also has a negative impact on the environment caused by exhaust emissions produced by motorized vehicles. The two negative impacts of this vehicle are usually caused by the performance of the engine used. Emission pollution can also result from the combustion process and the type of engine used by the vehicle [8].

The CC power of the engine and the year of manufacture have an influence on the exhaust emissions produced. If the greater the strength of the CC and the further the year of manufacture, it is likely to influence the concentration of exhaust emissions produced, the smaller the strength of the CC and the younger the year of manufacture of the vehicle also influences the concentration of exhaust emissions [9]. The engine components involved in combustion greatly influence the emissions produced and the greater the CC, the more complex the components. The type of vehicle also has an effect on the emissions produced.

Exhaust gas emissions produced by motorized vehicles are very worrying for human health. And actually all types of vehicles certainly emit exhaust emissions which cause air pollution on this earth [10]. However, the emissions produced by each vehicle also have different emission compositions due to differences in engine component systems between one vehicle and another [11]. Nowadays there are many types of vehicle fuel, increasingly advanced technology in the world is encouraging people to think about creating better fuel than before [12]. Fuel also influences the emissions produced, good combustion will produce good emissions if the vehicle fuel supports it, but if the fuel supports it but the combustion is not good it will also produce bad emissions [13].

Referring to research that has been carried out regarding exhaust gas emission tests, especially CO and HC content emitted by gasoline-fueled motor vehicles, it is clear that CO levels are mostly produced by vehicles produced under 2007 [13]. Furthermore Determining the threshold limit in testing exhaust gas emissions greatly influences the year the vehicle was assembled [2] , and other research requires the addition of E10 ethanol as an effort to produce better exhaust emissions [3] . High levels of CO and HC content occurred in vehicles in 2016 [15].

Daihatsu Granmax brand gasoline vehicles. This research aims to determine the effect of vehicle production year on CO and HC exhaust emissions.

2. METHOD

The testing process was carried out on gasoline-powered Daihatsu Granmax vehicles produced from 2017 to 2022. The inspection mechanism begins with idling the engine for a few seconds, then continues with full acceleration of the gas pedal for 10 seconds to remove any remaining soot or carbon residue in the exhaust pipe. Then the testing process is carried out by applying several acceleration variants, in each variation or testing stage at a certain acceleration the smoke thickness testing process is carried out three times to find out the most accurate results possible then the average results of each testing process are recorded in a table for later analysis. thoroughly using Manova Analysis using SPSS version 27 as a data processing tool

3. RESULTS AND DISCUSSION

3.1 RESULTS

a) Statistical description

The following descriptive statistics explain the average and standard deviation of the test results for vehicle exhaust emissions, namely CO and HC. The following are detailed Descriptive Statistics on the results of testing for CO and HC exhaust emissions in vehicles, based on year of production, as in Table 1.

Table 1. Descriptive statistics

	Vehicle Year	Mean	Std. Deviation	N
CO Test Results	2017	1,0000	.18708	5
	2018	.8000	.10000	5
	2019	,5000	.15811	5
	2020	,2500	.02236	5
	2021	1.2300	.65536	5
	2022	1,0000	.10000	5
	Total	.7967	.42858	30

	Vehicle Year	Mean	Std. Deviation	N
HC Test Results	2017	100,0000	8.09321	5
	2018	75,0000	1.58114	5
	2019	50,0000	1.58114	5
	2020	35,0000	2.23607	5
	2021	10,0000	1.58114	5
	2022	2,0000	1.00000	5
	Total	45.3333	35.20025	30

Table 1. Descriptive Statistics, explains that the CO test results have a high average value in 2021 of 1.2300 with a standard deviation value of 0.65536, while the HC test results have the highest average value in 2017 of 100,0000 with a standard value deviation of 8.09321

b) Output box's M test

The box's M test is used to test MANOVA assumptions which include homogeneity of variance and covariance matrices. The test conditions with the H0 criterion are accepted if the covariance variance matrix is between homogeneous groups with significant results >0.05. Following are the results of the Box's M test, as explained in Table 2.

Table 2. Box's M test results

Box's M	59,076
F	3,836
df1	12
df2	2964.706
Sig.	,000

Table 2 the test results show that the Box's M value is 59.076 with a significance of 0.000. Because the significance value is 0.000 < 0.05, H0 is rejected which states that the variance covariance matrix is homogeneous.

c) Multivariate test output

The following test is a simultaneous test, namely to determine the average comparison of CO and HC exhaust emission test results between vehicle years based on the eigenvalue, a statistical test which includes 4 tests, namely Pillai's trace, Wilk's lambda, Hotelling trace, Roy's largest root. Detailed multivariate tests results are in Table 3.

Table 3. Multivariate tests

Effect	Value	F	Hypothesis df	df error	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	,995	2256.856 [b]	2,000	23,000	,995
	Wilks' Lambda	,005	2256.856 [b]	2,000	23,000	,995
	Hotelling's Trace	196,248	2256.856 [b]	2,000	23,000	,995
	Roy's Largest Root	196,248	2256.856 [b]	2,000	23,000	,995
Vehicle_Year	Pillai's Trace	1,603	19,411	10,000	48,000	,802
	Wilks' Lambda	,003	75,157 [b]	10,000	46,000	,942
	Hotelling's Trace	117.205	257,850	10,000	44,000	,983
	Roy's Largest Root	115,627	555,009 [c]	5,000	24,000	,991

Table 3 shows that the Pillai's trace value shows a positive value of 1.603 with a significance of 0.802. Increasing this value provides a meaningful value to the model or a significant mean difference between data groups. Wilk's lambda value is 0.003 with a significance of 0.942, which means there is an average difference between data groups. Likewise for Hotelling trace and Rpy's largest root each obtained a value of 117.205 and a significance of 0.983. From the four tests, a significance value > 0.05 was obtained.

d) Output levene's test

Levene's test is a test used to determine the results of univariate homogeneity of variance testing. H0 is declared accepted if the test results have a significant value greater than 0.05, which means that

the variance in the test is homogeneous and vice versa, if the significant value is <0.05, it means that the variance in the test value is heterogeneous. Detailed test results are in Table 4.

Table 4. Levene's test of equality of error variances [a]

		Levene Statistics	df1	df2	Sig.
CO Test Results	Based on Mean	3,287	5	24	.021
	Based on Median	2,771	5	24	.041
	Based on Median and with adjusted df	2,771	5	5.136	.141
	Based on trimmed mean	3,088	5	24	,027
HC Test Results	Based on Mean	4,761	5	24	,004
	Based on Median	4,761	5	24	,004
	Based on Median and with adjusted df	4,761	5	5,696	,046
	Based on trimmed mean	4,815	5	24	,003

Table 4. Represents the results of univariate homogeneity testing. This can be seen from the base on mean results of the CO and HC test results with a significant value below 0.05, which means the resulting variant value is heterogeneous.

e) Tests of between subject effects

The test of between subject provides an overview of univariate model testing. The test results can be seen in table 5.

Table 5. Tests of between-subject effects

Source	Dependent Variable	Sig.	Partial Eta Squared
Corrected Model	CO Test Results	,000	,617
	HC Test Results	,000	,991
Intercept	CO Test Results	,000	,903
	HC Test Results	,000	,995
Vehicle Year	CO Test Results	,000	,617
	HC Test Results	,000	,991
Error	CO Test Results		
	HC Test Results		
Total	CO Test Results		
	HC Test Results		
Corrected Total	CO Test Results		
	HC Test Results		

Table 5. Represents the results of the test between subjects, where the test results show a significant value for the corrected model test of 0.000, which means it is below the significance of 0.05, which means there is a difference in the average value of the results of the CO test and HC test.

3.2 DISCUSSION

a. CO Test Results

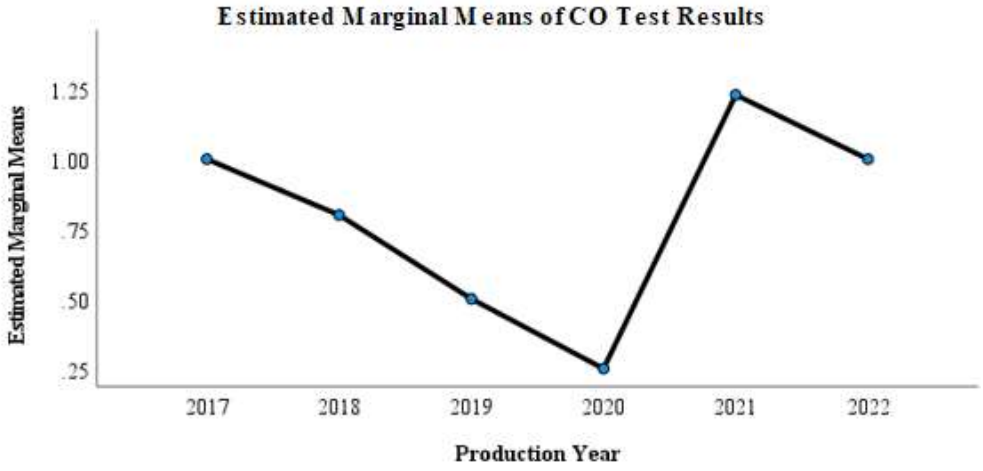

Figure 1. CO test results

Based on Figure 1, the test results for CO exhaust emissions by vehicle year show that vehicle production in 2017, which was initially 1,000, decreased to 0.2500 in testing for Daihatsu GrandMax vehicles produced in 2021. However, it then increased again to 1,255 in 2021. however, it has decreased again until vehicles in 2022. Increases and decreases in emissions testing results for gasoline vehicles, in this case Daihatsu Grandmax vehicles.

The increase or decrease that occurs in the results of HC exhaust emissions testing, influences the increase in pollution carried out by the Daihatsu Granmax which is based on the existing production year. So that the decrease or increase must be an effort made by the owner, especially in carrying out engine maintenance on vehicles that experience exhaust gas emission problems.

b. HC Test Results

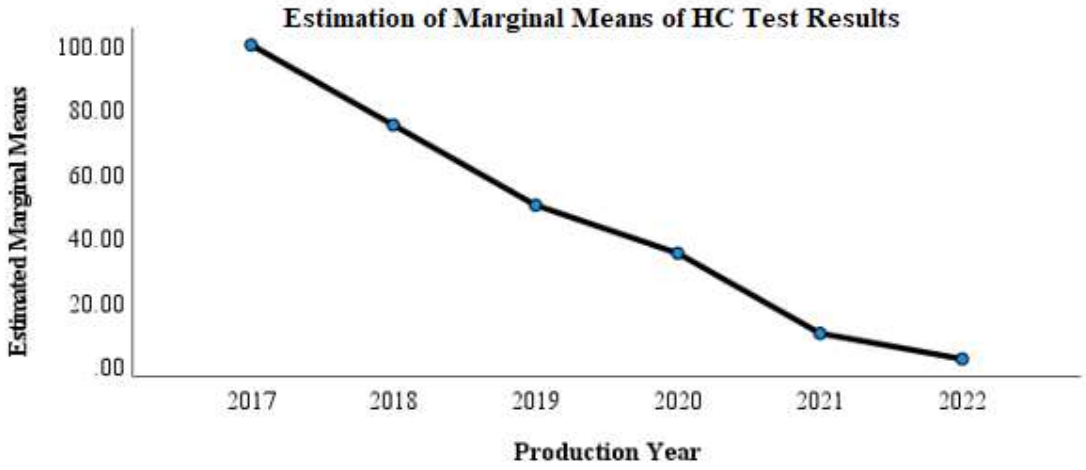

Figure 2. HC test results

Based on Figure 2, the test results for HC exhaust emissions for 2017 vehicles were 100.00 and decreased to 1.00 in testing for Daihatsu GrandMax vehicles produced in 2022. Based on the analysis results in Figure 2, it can provide an illustration that HC exhaust emissions have an influence on the year of the vehicle, the older the vehicle, the greater the HC exhaust emissions produced, thus having a high pollution impact, and conversely, the younger the vehicle, the lower the HC exhaust emissions produced by the Daihatsu GrandMax vehicle.

4. CONCLUSION.

Based on the test results, it was found that non-woven geotextile rice husk ash had better water vapor absorption capabilities than silica gel with original packaging and silica gel with non-woven geotextile packaging. Especially with a weight of 15 grams. These results show that non-woven geotextile rice husk ash has better water vapor absorption capacity compared to silica gel. The difference in the range of absorption values also reflects the absorption characteristics of each absorbent material. Thus, non-woven geotextile rice husk ash can replace silica.

REFERENCE

[1] L. Sun and K. Gong, “Silicon-based materials from rice husks and their applications,” *Industrial and Engineering Chemistry Research*, vol. 40, no. 25. American Chemical Society, pp. 5861–5877, Dec. 12, 2001. doi: 10.1021/ie010284b.

[2] A. K. Singh and V. Sudhakar, “Highly efficient method of utilizing waste silica hazards,” *Process Safety and Environmental Protection*, vol. 153, pp. 239–248, Sep. 2021, doi: 10.1016/j.psep.2021.07.007.

[3] A. A. Chirsty and P. Sivarukshy, “Comparison of adsorption properties of commercial silica and rice husk ash (RHA) silica: A study by NIR spectroscopy,” *Open Chem*, vol. 19, no. 1, pp. 426–431, Jan. 2021, doi: 10.1515/chem-2021-0044.

[4] J. P. Nayak and J. Bera, "Preparation of an efficient humidity indicating silica gel from rice husk ash," 2011.

[5] V. P. Della, I. Kühn, and D. Hotza, "Rice husk ash as an alternate source for active silica production." [Online]. Available: www.elsevier.com/locate/matlet

[6] P. A. Handayani, E. Nurjanah, and W. D. P. Rengga, "PEMANFAATAN LIMBAH SEKAM PADI MENJADI SILIKA GEL," *Jurnal Bahan Alam Terbarukan*, vol. 3, no. 2, Dec. 2014, doi: 10.15294/jbat.v3i2.3698.

[7] hendriwan fahmi, "Analisa Daya Serap Silika Gel Berbahan Dasar Abu SekamPadi," *Jurnal Iptek Terapan*, vol. 10, no. 3, pp. 176–182, 2016, doi: 10.22216/jit.2016.v10i3.425.

[8] Y. Zou and T. Yang, "Rice husk, rice husk ash and their applications," in *Rice Bran and Rice Bran Oil: Chemistry, Processing and Utilization*, Elsevier, 2019, pp. 207–246. doi: 10.1016/B978-0-12-812828-2.00009-3.

[9] S. K. S. Hossain, L. Mathur, and P. K. Roy, "Rice husk/rice husk ash as an alternative source of silica in ceramics: A review," *Journal of Asian Ceramic Societies*, vol. 6, no. 4. Taylor and Francis Ltd., pp. 299–313, Oct. 02, 2018. doi: 10.1080/21870764.2018.1539210.

[10] F. Azharul, Rahmawati, Choiruddin, and Wilarso, "RANCANG BANGUN ALAT KALIBRASI PENGUKUR SUHU BERBASIS DIGITAL TEMPERATUR CONTROLLER," *TEKNOSAINS : Jurnal Sains, Teknologi dan Informatika*, vol. 8, no. 2, pp. 109–116, Jul. 2021, doi: 10.37373/tekno.v8i2.103.

[11] D. Mugisidi, A. Ranaldo, J. W. Soedarsono, and M. Hikam, "Modification of activated carbon using sodium acetate and its regeneration using sodium hydroxide for the adsorption of copper from aqueous solution," *Carbon N Y*, vol. 45, no. 5, 2007, doi: 10.1016/j.carbon.2006.12.009.

[12] E. C. N. Lopes, F. S. C. Dos Anjos, E. F. S. Vieira, and A. R. Cestari, "An alternative Avrami equation to evaluate kinetic parameters of the interaction of Hg(II) with thin chitosan membranes," *J Colloid Interface Sci*, vol. 263, no. 2, pp. 542–547, 2003, doi: 10.1016/S0021-9797(03)00326-6.

[13] D. Mugisidi, "Penggunaan Persamaan Avrami Untuk Menentukan Koefisien Konveksi Solar Still," vol. 6, 2021.

[14] Alessandro Di Bucchianico, "Coefficient of Determination (R2)," in *Encyclopedia of Statistics in Quality and Reliability*, Wiley Online Library, 2008. doi: https://doi.org/10.1002/9780470061572.eqr173.

[15] J. P. Barrett, "The coefficient of determination-some limitations," *American Statistician*, vol. 28, no. 1, pp. 19–20, 1974, doi: 10.1080/00031305.1974.10479056.

[16] N. J. D. Nagelkerke, "A Note on a General Definition of the Coefficient of Determination," 1991.