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1 author:

Apip Amrullah
Universitas Lambung Mangkurat

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Apip Amrullah, Universitas Lambung Mangkurat, Banjarbaru, Indonesia

ABSTRACT

Currently the use of motor gasoline from year to year increase. In 2010 the number of vehicles in Indonesia about 26,706,705 vehicles, in 2011 amounted to 30,769,093 vehicles and 2012 amounted to 38,156,278 vehicles. This resulted in the consumption of petroleum fuels and exhaust emissions in motor vehicles is increasing. To overcome these problems, conducted research on synthetic fuel which is one of the alternative fuel sources. This research was conducted at gasoline engine. Variations in fuel mixture gasoline and synthetic fuel. This research will be able to generate and determine the effect of fuel mixture gasoline-synthetic fuel on levels of exhaust emissions, to determine the effect of fuel mixture gasoline-synthetic fuel for engine performance. Based on the analysis of performance and exhaust emissions test on a gasoline engine, for most engine performance is good and efficient set at first to mix synthetic fuel.

KEYWORDS

Efficient, Gas Emissions, Gasoline, Indonesia, Performance, Plastic Waste, Synthetic Fuel, Vehicles Engine

INTRODUCTION

The invention of plastics is a major milestone that led to improvement in the quality of the lives of human beings. Since its first synthesis in early 1900s, plastics have substituted many types of materials such as wood, metals and ceramics in production of consumer products, as they are light, durable, resistance to corrosion by most chemicals, diversity of applications, ease to processing and low cost. Other than the mentioned advantages of plastics, studies have shown that plastic-based products are responsible for reduction in cost of production in different fields of human endeavor (Sartorius I., 2010).

High Level Convention on Environment and Development in June 1992 in Rio de Janeiro, Brazil has discussed the issue of global warming and the Indonesian delegation also participated in the signing of active participation in various meetings to discuss its implementation. (Murdiyarso, 2003).

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The global environment has suffered from air pollution that has huge implications for global climate change since the industrial revolution because the industry is built with a source of energy derived from coal, oil and gas greenhouse dispose of waste, such as carbon dioxide, methane and nitrous oxide.

In the other hand, from manufacturing to disposal stage, plastic garbage emit greenhouse gases into the atmosphere by production activities require about 12 million barrels of oil and 14 million trees every year and at the stage of disposal in landfill, plastic waste also emit greenhouse gases and also can threaten human health. Plastic garbage only in the recycle or in fuel can increase the levels of toxic substances such as CCl up to 2-fold and will decompose into the air. Behind the negative side of the plastic waste, plus side to use as an alternative energy more beneficial to the environment and human welfare. Well as power plant litter mapun as an alternative fuel by way of gasification (D.M.Mudita, 2012).

The plastic waste can be utilized to make fuel for the engine. The process of making fuel from plastic is called pyrolysis. The assorted waste plastic is fed into a reactor along with 1% (by weight) catalyst and 10% (by weight) coal and maintained at a temperature of 300e400 C at atmospheric pressure for about 3e4 h. The pyrolysis process involves the breakdown of large molecules into smaller molecules produces hydrocarbons with small molecular mass (e.g. Ethane) that can be separated by fractional distillation and used as fuels and chemicals. (J. Devaraj, 2015).

Currently the use of motor gasoline from year to year increase. Indonesian police statistics in 2010 the number of vehicles in Indonesia about 26,706,705 vehicles, in 2011 amounted to 30,769,093 vehicles and 2012 amounted to 38,156,278 vehicles. This resulted in the consumption of petroleum fuels and exhaust emissions in motor vehicles is increasing. It is really very worrying, because of the increased use of fossil fuels will decrease while demand for oil is increasing.

Ministry of Energy and Mineral Resources (ESDM), as the fit tempo.com 4th edition April 2012, claims will continue to look for ways to adjust the volume of subsidized fuel consumption. With the search for alternative fuel sources of energy other, although only as a fuel mix that already exist.

Many studies related to engine performance, among others is Akbar A (2011), examined the effect of a mixture of bioethanol with premium fuel as fuel for performance and exhaust emissions in motor vehicles, with variation mixture 0%-v, 2.5%-v, 5%-v, 7.5% -v, and 10%-v. For testing exhaust emissions premium fuel mixture of 90% -10% bioethanol has the lowest CO value with the value of 0.023%, while the value of the lowest HC on premium fuel mixture of 97.5% - 2.5% bioethanol with a value of 32 ppm.

H.G Dwi & Arijanto (2006), examines the testing of premium fuel mixture-methanol at 4 stroke motorcycle engine the influence of the exhaust gas. To that end, research and testing this machine using premium fuel and premium-methanol mixtures of various compositions, ie M20, M40 and M60. The results of the best composition of premium-methanol mixtures tested, namely M60 (60% methanol and 40% Premium) seen from the levels of exhaust emissions produced by the test machine.

Agrariksa FA, (2013), examines the performance test of motor gasoline (on chassis) using a mixture of gasoline and ethanol. Tests using gasoline and bioethanol blending materials (0%, 5%, 15%, 25% ethanol). Exhaust emissions test results obtained by the value of the lowest CO exist in a mixture of 25% ethanol is 0.85% by volume of air; the highest CO2 value is in a mixture of 25% ethanol is 10.6% by volume of air.

However, of the few studies that have been carried out as above, still relying on the use of so in the market and not using waste materials that have been the problem in the community. Besides aims to reduce the waste problem, this study was aimed to giving out the sale value of the waste, so that it can improve the economy of the local community.

EXPERIMENTAL

There are several steps being taken in this study namely, the initial conditions of the fuel using a measuring cup as needed, to condition the engine in the standard state, mixing fuel with synthetic diesel fuel, and continue to test the performance of the engine. Tests using Infrared multigas analyzer.

Data collection was done by evaluating the fuel consumption per milliliter, time, average time and content levels of Carbon Oxides and Hydro Carbon on each fuel mixture.

In this study, there are some things that will be studied with a variety as inscribed in Table 1.

Table 1 shows some variation in the samples used in this study. Of some samples listed in Table 1, will be doing the testing of effective power (kw), fuel consumption (kg/h), specific fuel consumption (kg/ kWh), energy fuel (kw), thermal efficiency (%), and exhaust emissions in this case examination of the concentration of Hydro Carbon and Carbon Oxides.

Efective Power (KW)

Effective power is the power that actually measured on the wheel and the source of the engine load:

$$P_e = \frac{T.n}{9549.305} \tag{1}$$

where:

$Pe =$ Efective Power (KW)
$T =$ Torsi (N.M)
$n =$ Engine Rotation (rpm)

Fuel Consumption (Kg/h)

Fuel Consumption is the distance travelled per unit volume of fuel used; for example, kilometres per litre (km/L) or miles per gallon (MPG), where 1 MPG (imperial) ≈ 0.354006 km/L. In this case, the higher the value, the more economic a vehicle is (the more distance it can travel with a certain volume of fuel):

$$FC = \frac{V_{gu \cdot 10^{-3} \cdot \rho_f \cdot 3600}}{t} \tag{2}$$

Table 1. Sample of variation

Fuel Mixture		Fuel Consumption (ml)
Gasoline (%)	Fuel Synthetic (%)	
50	50	10
60	40	10
70	30	10
80	20	10
90	10	10

where:

$$FC = \text{Fuel Consumption } \left(\frac{Kg}{h}\right)$$
$$Vgu = \text{Measure glass volume } \left(ml\right)$$
$$\rho f = \text{Massa Fuel } \left(\frac{g}{cm^3}\right)$$
$$t = \text{Time } \left(s\right)$$

Specific Fuel Consumption (Kg/ Kwh)

Specific fuel consumption, SFC, is an engineering term that is used to describe the fuel efficiency of an engine design with respect to thrust output. TSFC may also be thought of as fuel consumption (grams/second) per unit of thrust (kilonewtons, or kN):

$$SFC = \frac{FC}{Pe} \tag{3}$$

where:

$$SFC = \text{Specefic Fuel Consumption } \left(\frac{Kg}{Kwh}\right)$$
$$FC = \text{Fuel Consumption } \left(\frac{Kg}{h}\right)$$
$$Pe = \text{Efective Power } \left(Kw\right)$$

Energy Fuel (Kw)

Fuel is any material that can be converted into energy. Usually fuel containing heat energy that can be released and manipulated. Most fuels used by humans through the combustion process (redox) where the fuel will release heat after reacted with oxygen in the air. Another process for the release of energy from the fuel is through exothermic reactions and nuclear reactions (such as nuclear fission or nuclear fusion). Hydrocarbons (including gasoline and diesel) is by far the type of fuel that is most often used by humans. Other fuels that can be used is a radioactive metal:

$$Q = \frac{LHV \cdot FC}{3600} \tag{4}$$

where:

$$Q = \text{Fuel Energy } \left(Kw\right)$$

$$LHV = 44.000 \left(\frac{Kj}{Kg}\right)$$

Thermal Efficiency (%)

In thermodynamics, the thermal efficiency $\left(\eta_{th}\right)$ is a dimensionless performance measure of a device that uses thermal energy, such as an internal combustion engine, a steam turbine or a steam engine, a boiler, a furnace, or a refrigerator for example:

$$\eta_{th} = \frac{Pe}{Q} x100\% \tag{5}$$

where:

η_{th} = Thermal Efficiency $\left(\%\right)$

Q = Fuel Energy $\left(Kw\right)$

Exhaust Emissions

Yardstick of decreasing levels of HC and CO, are produced complete combustion. To achieve this, should be improvements include:

1. Improve the ability of the carburetor and injection system so as to produce a mixture of air and fuel that is precise and constant;
2. Changing the shape of the combustion chamber so that the mixture of air and flammable fuel;
3. Enhanced ignition system.

RESULTS AND DISCUSSION

Engine performance testing is intended to provide supporting data in order to increase the utilization of waste plastics, so they can have more value, and the method used is the pilot data by varying the mix of standard fuel with fuel distillation of plastic waste. Test data are shown in Table 2.

Table 2 shows the overall test data from the testing, and is generally seen that the existence of a significant effect on the mix synthetic fuel with engine performance in the test. More details will be outlined in a chart shown in Figures 1-5.

Figure 1 show the effective power testing, engine rotation constant in 1700 rpm. Effective power relations, *Pe* (Kw) against n = 1700 (Rpm) with variations mixed gasoline-synthetic fuel. For fuel mixture gasoline-synthetic fuel (50% + 50%) effective power of 1,396 Kw and for gasoline fuel mixture of synthetic fuel (60% + 40%), (70% + 30%), (80% + 20%), (90% + 10%) also effective power of 1,396 Kw. Because n = 1700 (Rpm) fixed or constant so that the effective power of the five kinds of variations of the fuel mixture gasoline-synthetic fuels are also obtained the same result by 1,396 Kw.

Figure 2 and Figure 3 show the results is, the smaller the synthetic fuel mixture contained in gasoline the fuel consumption will be more frugal. In order to obtain the most fuel consumption or saving both contained in the fuel mixture variations gasoline-synthetic fuel (90% + 10%) is equal to 0.132 kg/h and 0,095 Kg/Kwh.

Whereas there Figure 4 shows that the relationship thermal efficiency, (%) against n = 1700 (Rpm) with variations mixed fuel (gasoline-synthetic fuel. For fuel mixture gasoline-synthetic fuel (50% + 50%) thermal efficiency of 59.18%. For fuel mixture gasoline-synthetic fuel (60% + 40%) thermal efficiency of 60.43%. For fuel mixture gasoline-synthetic fuel (70% + 30%) thermal efficiency of 64.15%. For fuel mixture gasoline-synthetic fuel (80% + 20%) thermal efficiency of 71.37%. For fuel mixture gasoline-synthetic fuel (90% + 10%) thermal efficiency of 86.55%. Thus, the smaller

Table 2. Research results gasoline mixture with synthetic fuel

Fuel Mixture		Fuel Consumption (ml)	Time (sekon)	Pe (Kw)	FC (Kg/h)	SFC (Kg / Kwh)	Eff. Thermal %	Exhaust Emission Levels	
Gasoline (%)	Synthetic fuel (%)							CO (%)	HC (ppm)
50	50	10	2.18	1.396	0.193	0.138	59.18	0.47	137
		10	2.15					0.39	143
		10	2.27					0.46	137
60	40	10	2.24	1.396	0.189	0.135	60.43	1.25	141
		10	2.26					1.19	138
		10	2.19					1.13	136
70	30	10	2.35	1.396	0.178	0.126	64.51	1.69	119
		10	2.30					1.85	121
		10	2.31					1.83	111
80	20	10	2.50	1.396	0.160	0.115	71.37	2.35	82
		10	2.53					2.52	75
		10	2.44					2.33	77
90	10	10	3.28	1.396	0.132	0.095	86.55	2.48	25
		10	3.21					2.54	19
		10	3.26					2.63	19

Figure 1. Relationship between effective power in rotation engine n = 1700 (RPM) with variation mixed fuel (gasoline-synthetic fuel)

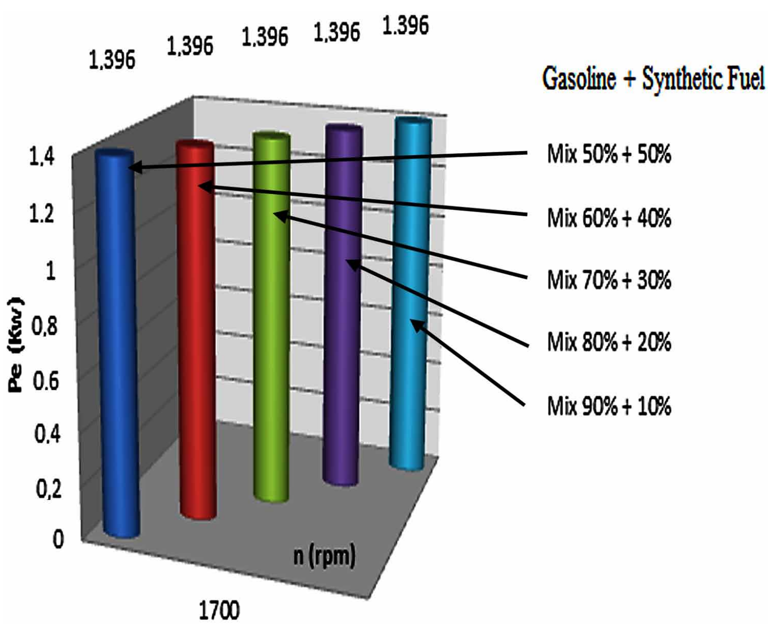


Figure 2. Relationship between fuel consumption, FC (Kg/h) in rotation engine n = 1700 (RPM) with variations mixed fuel (gasoline-synthetic fuel)

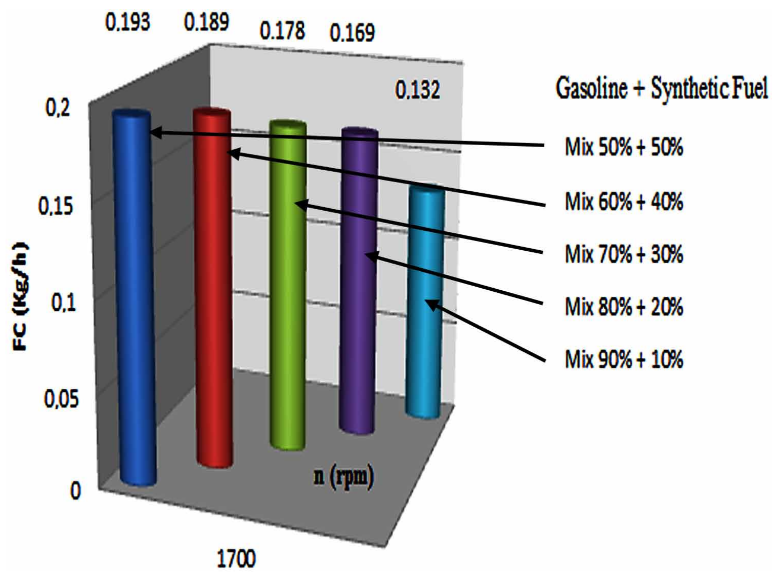


Figure 3. Relationship between specific fuel consumption, FC (Kg/h) in rotation engine n = 1700 (RPM) with variations mixed fuel (gasoline-synthetic fuel)

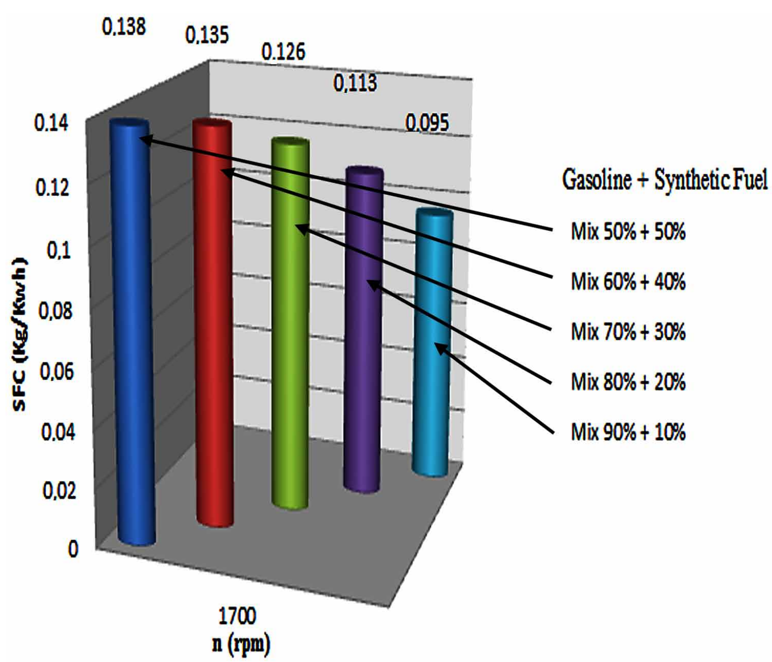


Figure 4. Relationship between thermal efficiency η_{th} (%) in rotation engine n = 1700 (RPM) with variations mixed fuel (gasoline-synthetic fuel)

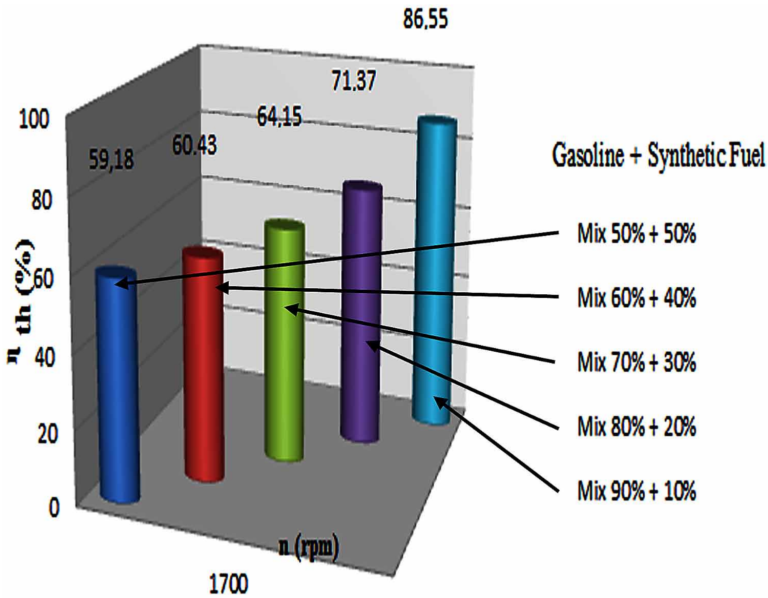
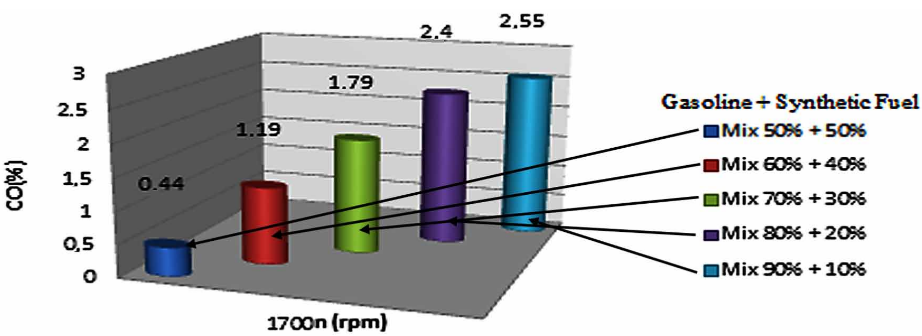
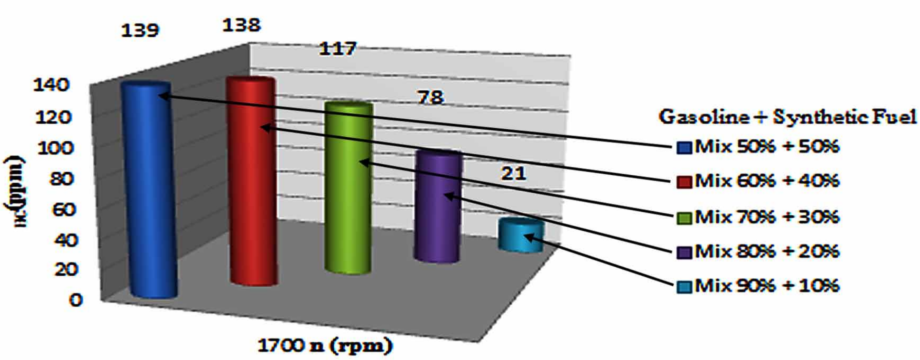


Figure 5 (a) Relationship between emissions level CO in rotation engine n = 1700 (RPM) with variations mixed fuel (gasoline-synthetic fuel); (b) relationship between emissions level HC in rotation engine n = 1700 (RPM) with variations mixed fuel (gasoline-synthetic fuel)





the synthetic fuel mixture contained in gasoline the thermal efficiency will be even greater. In order to obtain the most excellent thermal efficiency is contained in the fuel mixture variations gasoline-synthetic fuel oil (90% + 10%) in the amount of 86.55%.

Of some of the above data, as the support is more important in this case is the level of exhaust gas emissions. This can be in the show on the pictures of

Carbon dioxide levels 5a and Figure 5b shows the levels of Hidro Carbon.

In Figure 5a show the smaller the synthetic fuel mixture contained in gasoline the CO emission levels will be even greater. Emission levels in order to obtain the lowest CO contained in the fuel mixture variations gasoline-synthetic fuel (50% + 50%) is equal to 0.44%. Because the threshold levels of exhaust emissions standards set by the state environment minister no. 5 in 2006 to levels of CO emissions is equal to 5.5% of the vehicle under the year 2010. Thus 4 stroke for CO emission levels in five variations of the fuel mixture gasoline-synthetic fuel is safe for use.

In contrast in Figure 5b, the smaller the HC concentration of synthetic fuel mixture contained in gasoline the HC emission levels will be smaller. Thus obtained HC emission levels that are best found on the variation of the fuel mixture gasoline-synthetic fuel (90% + 10%) in the amount of 21 ppm. Because the threshold levels of exhaust emissions standards set by the state environment minister no. 5 in 2006 to levels of HC emissions is equal to 2400 ppm in the vehicle 4 stroke under 2010. So for HC emission levels in five variations of the fuel mixture pertamax-synthetic oils are safe to use.

CONCLUSION

From the analysis and discussion of research data obtained it can be concluded as follows.

Based on the test results of exhaust emissions engine performance, so for exhaust emissions is best to set the mixture gasoline-synthetic fuel (90% + 10%), because the value of HC = 21 ppm and CO value = 2.55%. Although its value CO highest of several variations of the fuel mixture gasoline-synthetic fuel but CO value is still below the safe standard of CO emission levels are at 5.5%.

In the other hand, based on the analysis of performance on the engine, so for most engine performance well and efficiently is set at gasoline mix-synthetic fuel (90% + 10%), because the value of the fuel consumption (FC = 0.132 Kg/h), the value of the specific fuel consumption (SFC=0.095 kg/ kWh) and the energy value of the fuel (Q = 1.613 Kw) while the lowest value of thermal efficiency (η_{th} = 86.55%) were the highest, with the effective power (Pe=1.963 Kw), Torque (T=7.84 Nm) and the engine rev (n =1700 rpm) constant against variations in the fuel mixture gasoline-synthetic fuel.

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Apip Amrullah received a Master of Engineering from Gadjah Mada University, Indonesia in 2010. He started his career in the field of education about 5 years ago. He worked as a lecturer at a Lambung Mangkurat University in South Kalimantan, and has a research interest in the field of energy conversion, renewable energy and solid waste.