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Optimization Study of the Ratio of Bioethanol Bioaceton Ron 90 on the Power and Emissions of a 110cc Gasoline Motor

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Abstract

Fossil fuels have become one of the main causes of increasing pollution in the world, especially in Indonesia. Comparisons between proposed bio-acetone fuel blends and other biofuels were introduced in a unique study. bio-acetone is a promising alternative and can improve performance and emissions over the others. The aim of the research was to determine the optimization of the ratio of bioethanol, bioacetone-Ron 90 to power and exhaust emissions (HC and CO). Fuel mixture ratio bioethanol, bioacetone - RON 90 ((3:7:10), (5:5:10), (7:3:10), (10:5:5), (7,5:7, 5:5), (5:10:5), (2,5:2,5:15), (3,5:1,5:15), (1,5:3,5:15)) and engine speed (2000, 3000, 4000, 5000, 6000) 110cc gasoline engine rpm. The data processing method uses the Response surface method. The results of research on power and emission tests that have been optimized, the optimum value for fuel ratio power at standard spark plugs, at a ratio of 1.5:3,5:15 and Rpm 4424.24 with a power of 8.02065 HP. The optimum value for HC emissions is at a ratio of 3:7:10 at Rpm 4222.22 and HC gas emissions are 43.9879 ppm. Optimum value for CO emissions at a ratio of 7.5:7.5:5 and 2000 rpm with a CO emission of 0.208712%.

Keywords: Optimization Bioethanol, Biocetone, Power and Emissions

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INTRODUCTION

The increasing use of motorcycles in Indonesia is also increasing the need for fuel. The material used in gasoline motor vehicles is fuel oil (BBM), namely RON 90 fuel or gasoline. In the presence of sufficient fuel oil or fossil fuels this results in dwindling supplies of petroleum.

Fossil fuels have become one of the main causes of increasing pollution in the world, especially in Indonesia or decay in the near future. Besides the possibility of depletion or decay in the near future this has led to the search for newer and less polluting alternative fuels [1-2]. Comparison between mixed bio-acetone and biofuel fuels. In this case led to the search for alternative fuels that are renewable and less polluting. Based on this view, research on mixtures of bioethanol, bioacetone and RON 90, with the main objective of improving engine performance and reducing emissions in vehicles, has been published in several papers [3-4].

Previous studies revealed significant improvements in engine performance and reduced pollutant emission blended biofuels compared to pure gasoline. However, previous researchers found butanol's chemical structure has a number of advantages over bioethanol and bio-methanol, in that it contains a minor vapor pressure, which reduces the possibility of vapor locking. Ability to blend with gasoline at high concentrations or without readjustment to the vehicle. Kemudain examined butanol fuel mixed with gasoline and the results obtained positive values or advantages of butanol fuel mixture compared to gasoline, especially in pollutant emissions [5-7].

Other researchers have moved on to examine the blends of biofuel themes in several publications. [8-9] investigated dual mixtures of methanol or hydrogen in spark engines using an injection strategy on methanol, and the results showed reduced emissions for the fuel mixture. Hydrogen can also speed up the combustion rate of the fuel mixture. The addition of hydrogen to methanol can expand the combustion limit of methanol fuel and produce a more stable flame.

Other researchers [10] investigated a mixture of bioethanol-bio-methanol-gasoline and the result was an increase in emissions and performance for the fuel mixture compared to pure gasoline. Applying n-butanol-bio-methanol-gasoline and the results show a decrease in engine performance in mixed fuels. [11] Examined the mixture of n-butanol-i-butanol-gasoline and the result was a decrease in engine performance for the fuel mixture. Examining the mixture of n-butanol-i-butanol-gasoline and the results recommend a mixture of biofuels rather than pure gasoline [12]. Investigating the fuel mixture of bioethanol-i-butanol-gasoline and the results showed an increase in engine pollutant emissions for this fuel mixture [13]. First applied to spark plug engines, the ternary mixture, i-butanol-bio-methanol-gasoline, showed better engine performance than the n-butanol-bioacetone-gasoline mixture [14-15]. Other researchers suggested alternative fuels by investigating bio- acetone in internal combustion engines, bioacetone was first examined in compression ignition engines in several publications. Bio acetone is mixed with diesel fuel at 1-3% by volume and the results show a promising fuel, which can increase combustion efficiency and emissions, compared to pure diesel engine fuel.

Bioacetone was tested in gasoline engines and the study concluded that bioacetone is a very promising alternative and can provide more performance and emissions than using pure gasoline; The fuel mixture increases emissions by almost 33% UHC, 43% CO33% UHC, 43% CO, and 32% CO2 [16]. Comparisons between bioacetone fuel mixtures and other biofuels have been introduced in a unique study [17]. Comparing bio-acetone with bio-ethanol, bio-methanol, i-butanol and n-butanol biofuels at various blend levels in gasoline engines. The study shows a promising alternative bioacetone that can improve performance and emissions compared to others [18-19]. The author strongly recommends that in the near future, especially bioacetone fuel shows new possibilities for production in large quantities. The whole process of fermentation of biomass from various types of biomass such as household waste, palm oil waste, household waste, wood residue and very abundant agricultural harvests. In addition, bio acetone is one of the main biofuels produced from the biomass conversion process. In addition, bioacetone shows superiority in its high octane number with an octane rating of 110 due to its aromatic content, which is suitable for combustion engines.

The above discussion makes it clear that bio-acetone is a highly propulsive fuel for internal combustion engines and because of that, researchers investigated bioacetone mixed with gasoline fuel. Bioacetone was also investigated in ternary basic mixtures in diesel engines. Examined on a bio-acetone-bioethanol diesel blend and the results were greater performance and lower emissions on the fuel mixture [20-21]. The fuel mixture of bioacetone and bioethanol has the advantage of being a by-product during the production of biobutanol, so the use of bioacetone and bioethanol as biofuels has economic value [22].

Literature Review

Comparison between mixed bio-acetone fuels and other biofuels. Comparing bio-acetone with bioethanol, bio-methanol, i-butanol and n-butanol biofuels in various blend levels with gasoline and engine operating conditions. The study shows that bio-acetone is a promising alternative and can improve performance and emissions over the others. The author strongly recommends bio-acetone as a gasoline supplement in transportation in the near future, especially bioacetone shows a new possibility to be produced in large quantities throughout the fermentation process of biomass from various types of biomass such as palm oil waste, household waste, wood residue, and abundant agricultural crops.

Bioethanol is an alternative fuel processed from plants, which has the advantage of being able to reduce CO2 emissions by up to 18%. There are 3 groups of plant sources of bioethanol: plants containing starch (such as cassava, oil palm, tengkawang, coconut, kapok, jatropha, rambutan, soursop, malapari, and nyamplung), sugary (such as molasses or molasses, palm sap, niratebu, and sweet surgum sap) and cellulose fibers (such as sorghum stalks, banana stalks, straw, wood, and bagasse). This material containing glucose, starch, and cellulose fiber can be used as fuel, with the chemical formula C_2H_6O[23].

Bio-acetone as a gasoline supplement in transportation in the near future, especially bioacetone shows a new possibility to be produced in large quantities. the whole process of biomass fermentation from various types of biomass such as palm oil waste, household waste, wood residue, and abundant agricultural crops. In addition, bio-acetone is one of the main biofuels produced from the biomass conversion process as well as along with the cracking development process. Bio-acetone also shows an advantage in its high octane number due to its aromatic content, which makes it suitable for combustion engines with the chemical formula $C._3H_6$The [24].

Therefore, the mixture of bioacetone – bioethanol – gasoline mixture that they have the advantage as a by-product during the production of biobutanol, so that the use of bioacetone and bioethanol as biofuels has economic benefits. Comparison of flame propagation of various bioefuel mixtures shows that bioacetone has a low flame speed while bioethanol has a high flame speed and gasoline is between the two fuels. The reason for the warning flame propagation (laminar burning rate) of different bioefuels is mainly due to the different molecular structures and combustion mechanisms in each biofuel, for example, the type and concentration of the intermediate produced during the combustion of the bioefuel. Bioacetone forms a high concentration of methyl radical (CH3), increasing the chain breaking reaction and resulting in reduced reactivity of bioacetone; bioacetone has a lower flame velocity as a consequence. On the other hand, the initial combustion of bioethanol containing hydroxyl groups occurs in three zones. In the first zone the C-C and C-OH bond dissociation occurs in the preheat zone due to the low bond energy. In the second zone, the C-H bonds dissociate in the partial preheating zone due to the high bond energy, and in the third zone the reaction of H with OH occurs to produce H2O and releases heat/energy. This makes the burning speed of bioethanol higher than bioacetone [25]. For this reason, the strength of bioethanol is greater than bioacetone.

The propagation of the flame is influenced by several factors in the same biofuel in particular, the propagation of the mixed fuel flame increases significantly with an increase in the volume fraction of the biofuel (bio-ethanol and bio-acetone) [26]. Flame propagation is also related to the compression ratio, for example the greater the compression ratio, the higher the flame propagation speed [27]. Thus the use of bioefuels makes it possible to increase the compression ratio in gasoline engines, without the problem of knocking and accelerating flame propagation, on the other hand flame propagation is not affected by the ignition method, which is a characteristic of biofuel-air mixtures [28]. Flame instability also plays a role in performance and emission results. Gasoline has the shortest markstein length and its flame front is the most unstable [29] and can cause a reduction in performance and emissions. However, bioethanol has the largest markstein length and its flame front is very very stable [30]. Bioefuels improve gasoline performance and emissions, spark timing can also affect bioefuel combustion, performance, and emissions. In addition, the spark time must match the ignition delay and the duration of the biofuel combustion. Advances spark timing, for example increasing engine UHC emissions and decreasing engine CO emissions [31].

METHOD

The variation of mixing bioethanol, bioacetone - Ron 90 ((3:7:10), (5:5:10), (7:3:10), (10:5:5), (7,5:7, 5:5), (5:10:5), (2,5:2,5:15), (3,5:1,5:15), (1,5:3,5:15)) and engine speed (2000, 3000, 4000, 5000, 6000) rpm for 110cc automatic motorbikes. To test the power using a dynotest with the specifications: Maximum speed of 330 km/h, Control using Remote Control, Sport Devices System, Maximum power of 250 Hp, while for emission tests using a gas analyzer with Measuring CO 0.00-9.99%, Range HC 0-9999 ppm and operating temperature0^{O}C – 40^{O}C.

RESULTS AND DISCUSSION

Power Test Results

Figure 1. The ratio of the mixture of bioethanol-bioaceton-Ron 90 to power

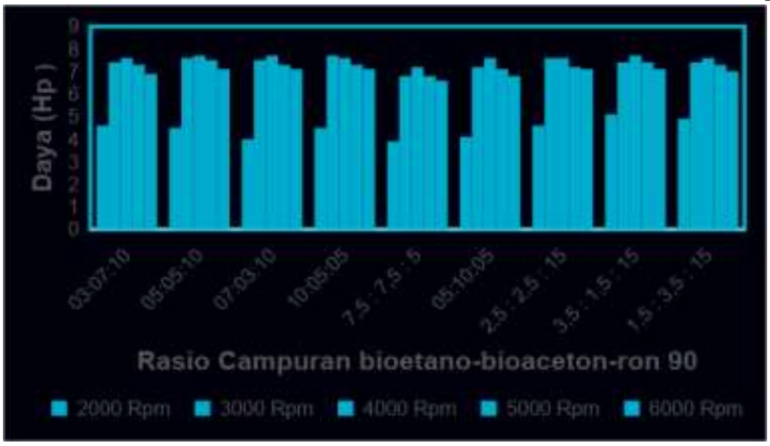

Figure 1 shows that the power generated by the vehicle power test changes linearly at each engine speed. In the power test, the highest power was obtained, namely the fuel mixture ratio of bioethanol + bioacetone + pertalite sample 7 at 4464 rpm with 7.9 HP. An increase in RPM (revolutions per minute / rotations per minute) on the engine will generally cause an increase in the power produced. This happens because RPM is a measure of the rotational speed of the engine in one minute. when the RPM goes up it means the engine is doing more revolutions in the same period of time. In some cases the increase in RPM is caused by an increase in the amount of fuel or air entering the engine.

HC Emission Test Results

Figure 2. Ratio of bioethanol-bioaceton-Ron 90 mixture to HC exhaust emissions

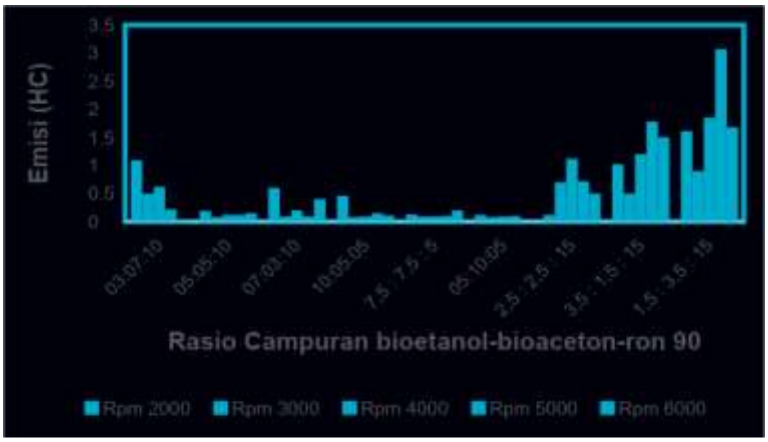

Figure 2 shows the lowest HC emission at the mixture ratio (5 : 5 : 10) at 3868 rpm 100 ppm. When the engine speed is high, the HC (hydrocarbon) content in the exhaust tends to decrease due to several factors. More efficient combustion, at high engine speed usually results in more efficient combustion. A good combustion process results in more complete combustion, where fuels such as gasoline burn more completely and produce unburned HC indicators. Air movement is faster at high rpm, the airflow entering the engine increases significantly, faster and larger airflow is able to help mix the fuel properly so as to increase combustion and reduce the amount of unburned HC CO Emission Test Results

Figure 3. The ratio of the mixture of bioethanol-bioaceton-Ron 90 to HC exhaust

Figure 3 shows the lowest CO emission at a mixture ratio (7.5 : 7.5 : 5) 0.20%. Shows CO at low engine speed to high engine speed shows the results of rising and falling CO emissions.

At low engine speed to high engine speed, the results show a steady increase and decrease in CO emissions, this is due to the presence of a mixture of fuel and air that can burn completely or close to stoichiometry. The lowest emission for the use of standard spark plugs and can also maintain stable CO emission results. If the fuel and air mixture is rich, the CO emission levels produced by the vehicle will be less. Meanwhile, if the fuel and air mixture is poor, the CO content produced will be more. In fulfilling the conditions of complete combustion it takes a lot of oxygen to decompose the CO that is burned.

CONCLUSION

Optimum value for fuel ratio power on standard spark plugs, at a ratio of 1.5:3,5:15 and Rpm 4424.24 with a power of 8.02065 HP. The optimum value for HC emissions is at a ratio of 3:7:10 at Rpm 4222.22 and HC gas emissions are 43.9879 ppm. The optimum value for CO emissions is at a ratio of 7.5:7.5:5 and Rpm 2000 with a CO emission of 0.208712%.

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