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Pertamax Quality Improvement with Ethanol on Octane Number, Density and Water Content

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Abstract: Fuel oil is very important to be used as a source of power for the engine. Fuel in circulation today is still in the spotlight regarding high exhaust emissions. Currently the world has emphasized the use of energy sources that are environmentally friendly and do not cause excessive emissions. The purpose of this research is to create an environmentally friendly fuel oil to minimize emissions caused by engine combustion. The solution used is to mix 92 gasoline with bioethanol. Based on the Decree of the Director General of Oil and Gas on the specification of 95 gasoline, it stated that the octane number is 95, the specific gravity (at 15^{o}C) is 715-770 kg/m^{3} and the water content in 95 gasoline is maximum of 0.15% m/m. American Society for Testing and Materials (ASTM) is used to measure, test, and classify various products and materials to ensure that the research conducted meets the necessary quality, safety, and performance requirements. In conducting the study, there were several concentration variables including 92 gasoline blended with 5% bioethanol. One of things we discuss in this blending process is the octane number using the Octane Number Analyzer tool by comparing the octane of 92 gasoline and the octane of 92 gasoline that has been blended. The results of commercial 92 gasoline which is in accordance with the standard, obtained an octane number of 92 while the optimal results obtained from a mixture of 92 gasoline with 5% bioethanol obtained an octane number of 94.8. In mixing process, results obtained for the specific gravity of commercial 92 gasoline with 5% bioethanol is 0.73757 g/cm^{3}. From the research results that has been done, it is concluded that the process of mixing bioethanol with 92 gasoline can increase the octane number so as to reduce emissions caused by vehicles.

Keywords: density, ethanol, octane number, pertamax, water content.

Introduction

The population in Indonesia is increasing continuously every year, which has an impact on the use of energy that is large enough to meet the needs of each community. Global warming is a problem that arises from the high use of fuel oil due to the CO^{2} content produced from vehicle exhaust emissions. Therefore, it is necessary to develop technology that is able to meet energy needs and can reduce emissions produced by motorized vehicles. One of the efforts in overcoming these problems is to develop renewable energy sources that are environmentally friendly (Ibrahim et al., 2019).

In the process of dealing with increasingly high levels of pollution, Pertamina continuously makes innovations to succeed the energy transition towards a pollution-free Indonesia. Pollution resulting from motor vehicle emissions can be reduced by using environmentally friendly products such as Pertamax Green. However, the limited types of environmentally friendly fuels in Indonesia lead to relatively high prices and little demand for environmentally friendly fuels. Pertamax Green is a new Pertamina product that can be an alternative fuel to reduce pollution which has superior specifications compared to pure Pertamax.

There are many ways to improve vehicle engine performance, one of which is by using additives in the form of bioethanol which has a positive impact both in terms of increased engine performance and

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low CO^2 exhaust emissions. Bioethanol is a type of alcohol derived from plants such as corn, wheat, potatoes and sugar cane (Yudistirani et al., 2019). One of the functions of bioethanol is as an octane booster, which means that bioethanol can raise the octane number to make combustion more efficient and save the engine. Bioethanol also contains oxygen, which enhances the fuel combustion process and minimizes air pollution. Another function of bioethanol is as a fuel extender or fossil fuel saver (Ubaidillah et al., 2021).

Pertamax Green made by Pertamina is the result of a mixture between Pertamax 92 and bioethanol which produces Pertamax with an octane number of 95 or can be called Pertamax Green. The octane number is a number that expresses the volume of isoctane in percent, which explains the quality of a fuel, the higher the octane number, the better the fuel is to use and the less emissions produced. In addition, the addition of bioethanol can improve engine performance, so it is necessary to test the water content and specific gravity of Pertamax 95. Water content is one of the fuel oil testing parameters to determine the water content in a fuel oil. Density is the ratio of the weight of fuel oil at a certain temperature to water at the same volume and temperature. The two test parameters explain that if a fuel oil, especially Pertamax green, has a high number and exceeds the maximum limit of the predetermined standard, the quality of the fuel is not suitable for sale to consumers according to the specifications issued by the Director General of Oil and Gas on July 13, 2023.

Based on the background and literature review described above, this study aims to determine the effect of the addition of 5% bioethanol (E5) in Pertamax 92 which is tested through several tools and is expected to be a new innovation to overcome the problem of high pollution in Indonesia.

Materials and Methods

Study Area

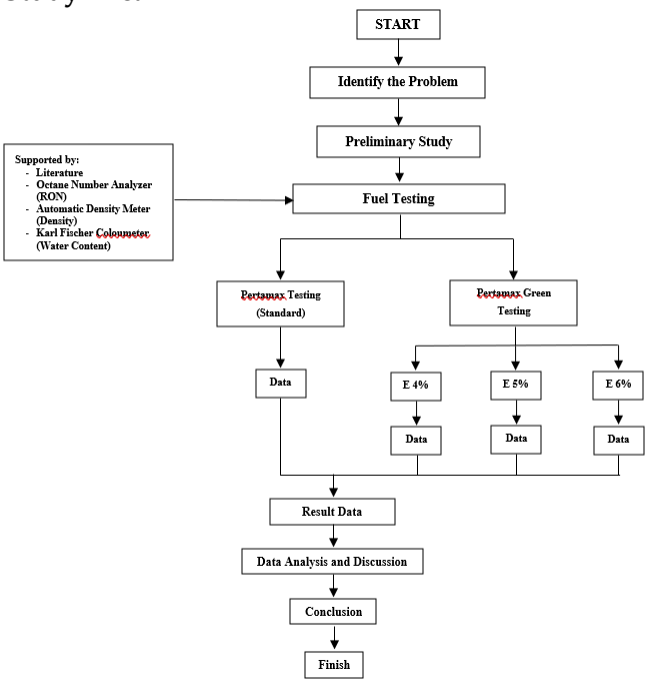


Figure 1. research design.

The material used in this research is Pertamax 92 produced by Pertamina which is mixed with 96% ethanol as a mixer. Testing with the aim of determining the quality of the firstx 92 product with the scheme as shown in Figure 1. The parameters measured in this test are octane number, density, and water content at various percentage mixtures. These parameters were also determined with tools namely Octane Number Analizer to determine the octane number of the experimental product, Autometic Density Meter to determine the density and Karafischer Coloumeter to determine the water content in this experimental product.

Procedures

Several procedures are carried out to produce firstx with octane number 95, namely by conducting the first test procedure by testing the firstx 92 fuel produced by Pertamina as the basic material for testing. The data obtained will be the basic data of pure firstx. The next procedure pure firstx 92 fuel is tested with a mixture of 96% ethanol with a percentage of 4% (E 4), 5% (E 5), 6% (E 6) which is done in several ways, namely:

1. Take 96 ml of Pertamax 92 liquid using a measuring pipette (10 ml) and pour the product in a beaker glass.
2. Next, take 4 ml of ethanol liquid using a measuring pipette (10 ml) and pour the ethanol liquid into the beaker glass containing the firstx liquid product in step 1.
3. Perform procedures 1 and 2 to determine 5% and 6% liquids with different amounts of content. That is, if to determine 5%, it takes 95 ml of firstx 92 with a mixture of ethanol as much as 5 ml. if to determine 6%, it takes 96% ml of firstx 92 with a mixture of ethanol as much as 4 ml.
4. There are 3 beakers that have different liquid compositions and are marked differently with the names E4%, E5%, E6%, so the next procedure is carried out.
5. Each beaker glass will be carried out mixing the liquid, which uses a tool that is a hot plate stearer for 5 minutes of mixing.
6. When the mixing procedure is complete, the sample is tested on an octane number analyzer, automatic density meter, karafischer coloumeter.

The following is the procedure for using an octane number analyzer to test the octane number on samples of firstx 92, E4%, E5%, E6%.

1. Switch power to ON. The display will show the version number followed by a 15-second countdown, after which "Clear Chamber and Press Measure" will appear.
2. Make sure there is no sample holder in the sample chamber. Cover the chamber with the light shield.
3. Press the MEASURE key to standardize the instrument. Put in sample" will appear on the display. This indicates the instrument has been standardized: it is now ready to measure the sample. (The K88600XL must be standardized prior to making any measurement.)
4. Remove the light shield from the sample chamber.
5. Place the sample holder containing gasoline in the sample chamber, being careful to align the alignment stripe on the jar with the left alignment stripe on the instrument.
6. Carefully replace the light shield over the jar. This shield must always be used when measuring a gasoline sample or a standard; otherwise, the results will be incorrect.
7. Press MEASURE. "Remove & Replace" will be displayed.
8. Remove the jar and rotate it to align the stripe on the jar with the right alignment stripe on the instrument.
9. Carefully replace the light shield over the jar.
10. Press MEASURE. "Remove & Press M" will be displayed.
11. Remove the jar and cover empty chamber with light shield. Press MEASURE. The results will appear in the display while they are printed."
12. After the measurement is complete, repeat steps 3-8 to measure another sample.

The following is the procedure for using an automatic density meter to test the specific gravity of the firstx 92, E4%, E5%, E6% samples.

1. Press the power on button on the device
2. Select in the density menu 15
3. Enter the conventional firstx sample using a 5 ml syringe tool
4. Inject the product using the syringe into the hose connected to the tool until the product runs out.
5. Then click start, and wait for the tool to finish reading the product.
6. If it has been read, rinse using the product that will be injected next
7. Repeat the above steps using samples of 4%, 5%, 6%

The following is the procedure for using a karafischer coloumeter to test the water content in samples of Pertamax 92, E4%, 5%, 6%.

1. Turn on the water content device by pressing the power button.
2. First press the mode button, then select the mode by pressing the buttons right and left.
3. Select KFC mode then press enter then press start.
4. Wait for the wait text to change to ready.

5. While waiting for it to be ready, prepare the Pertamax test sample.
6. Insert the Test Sample into the injection tool and ensure that no air enters the injection tool
7. Weigh the injector containing the Test Sample and zero the number on the weighing instrument.
8. If the tool is ready, press start then inject the Pertamax Test Sample.
9. After that, weigh the injection tool again, and enter the number listed on the weighing by typing it into the water content tool then pressing enter.
10. Then print the results by pressing the print button, then clicking the right and left buttons until the results appear and then enter.
11. Perform the same procedure on the 4%, 5%, and 6% samples

The test procedure above is a pure firstx 92 test that will determine the octane number, density, and water content contained in the product with the tools and schemes in Figure 1 as initial data. Mixing of firstx 92 fuel products with 96% ethanol as much as 4% (E 4%) or mixing 96 ml of firstx 92 mixed with 4 ml of ethanol with 96% content, this mixing is done with the tool used, namely Hot Plate Stirer as a mixing tool. Likewise with the percentage (E 5%), namely 95 ml of firstx 92 volume and 5 ml of ethanol volume and (E 6%) 94 ml of firstx 92 with 6 ml of ethanol with the same procedure. The data obtained is then processed and analyzed to get a conclusion.

Result and Discussion

Result-1

Table 1. Pertamax Green specification.

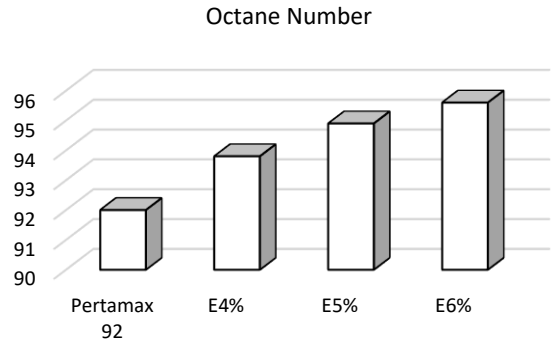
Pertamax Green	Spesification
Octane Number	95.0
Density	715 – 770 kg/m^3
Water Content	1.500 ppm (Max)

Result-2

Table 2. octan number of four samples.

Product	Octane Number
Pertamax Konvensional	92
E4%	93,8
E5%	94,9
E6%	95,6

Figure-2

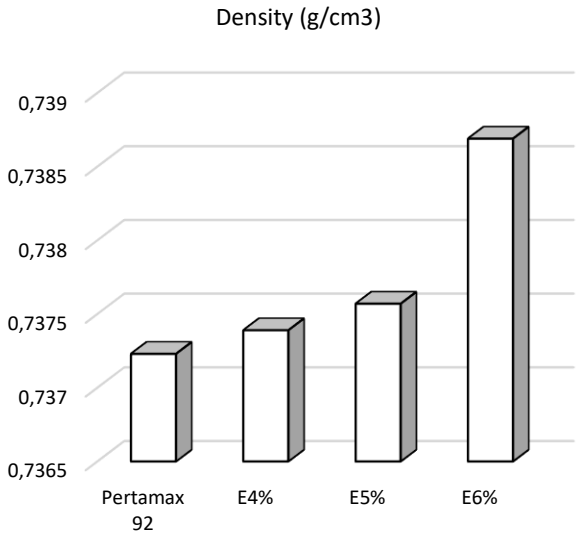


Result-3

Table 3. density of four samples.

Product	Density (g/cm^3)
Pertamax Konvensional	0,73723
E4%	0,73739
E5%	0,73757
E6%	0,73869

Figure-3

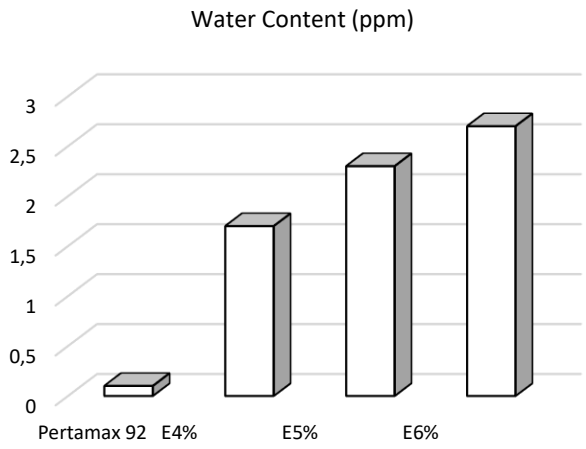


Result-4

Table 4. water content of four samples.

Product	Water Content (ppm)
Pertamax Konvensional (0,2467 g)	0,1
E4% (0,2642 g)	1,7
E5% (0,2576 g)	2,3
E6% (0,2683 g)	2,7

Figure-4



Discussion

The existence of Pertamax Green 95 as one of the environmentally friendly fuel products produced by Pertamina makes consumers interested and has a high level of trust in buying environmentally friendly products that will have an impact on reducing pollution in Indonesia. For this reason, Pertamina and other oil and gas companies should be more aggressive in conducting marketing promotions involving the younger generation such as students.

Based on research that has been conducted on testing fuel oil specifications using three predetermined variables. The three variables are testing the octane number, density and water content contained in the determined sample. These variables are used to detect the content contained in fuel oil and are also the main parameters in determining fuel that is very good for consumption by the community. Improving the quality of fuel oil, especially Pertamax, is strongly supported by the government by making new environmentally friendly products as an effort to tackle the very high air pollution in Indonesia.

Based on table 3.1 and graph 3.1, the test carried out was the octane number test on the sample using a tool called Octane Number Analyzer. The samples used included Pertamax 92 and the three samples blended from Pertamax 92 with bioethanol which had concentrations of 4%, 5% and 6%. This test was carried out by taking a 100 ml sample which is put into the Octane Number Analyzer using a vessel. The tests carried out obtained results on the Pertamax 92 test that the octane number on the product was 92.0, the experiment on the E4% test product obtained results with an octane number of 93.8, the E5% test product obtained results with an octane number of 94.9, and the last product test it was E6% which obtained an octane number of 95.6.

Based on table 3.2 and graph 3.2, the test carried out was a test of the density contained in the sample using a tool called an Automatic Density Meter. This test is carried out by taking 5 ml of sample which is inserted into the Automatic Density Meter using a syringe. The samples used included Pertamax 92 and the three samples blended from Pertamax 92 with bioethanol which had concentrations of 4%, 5% and 6%. The tests carried out obtained results in the Pertamax 92 test that density in this product is 0.73723 g/cm^3, the experiment on the E4% test product obtained results density of 0.73739 g/cm^3, E5% test product results were obtained density of 0.73757 g/cm^3, and in the last product test it was E6%, the results were obtained density of 0.73869 g/cm^3.

Based on table 3.3 and graph 3.3, the test carried out was a test for the water content of the sample using a tool called Karl Fischer. The samples used included Pertamax 92 and the three samples blended from Pertamax 92 with bioethanol which had concentrations of 4%, 5% and 6%. This test is carried out by taking 25 drops of sample which are inserted into the test Karl Fischer uses a syringe and weighing the difference in the numbers obtained in grams. After testing, the Pertamax 92 product obtained a water content of 0.1 ppm, the E4% product obtained a water content of 1.7 ppm, the E5% product obtained a water content of 2.3 ppm, and finally the E6% test product obtained was a water content of 2.7 ppm.

The overall test showed an increase but not significant in each variable due to the addition of bioethanol. This is due to the addition of concentrations that have a small range of bioethanol content. The higher the level of bioethanol added to the sample, the higher the octane number, density, and water content that will affect the quality of the fuel. According to the Director General of Oil and Gas Decree, the provisions for the octane number obtained for Pertamax 92 are 92 while for Pertamax Green it is 95, the provisions for product density in gasoline have a range of 0.715 – 0.770 g/cm^3, and the water content provisions in gasoline have a maximum limit of 1,500 ppm. From the research results it can be concluded that the samples tested complies with the specifications set by the Decree of the Director General of Oil and Gas and the sample results that are closest to Pertamax Green 95 are the E5% blending samples.

Pertamax Green 95 must not be inferior to the attributes of other non-green products to attract consumers who have an awareness of environmental sustainability. Consumers must know information regarding the specifications of Pertamax Green 95 related to octane number, density and water content. These three specifications are the most important things and are easily understood by ordinary people in petroleum. The environmentally friendly Pertamax Green has a high octane number but low lead which can improve the combustion system in vehicles and result in effective and efficient use of fuel, time and costs. The high level of fuel consumption due to the use of quite a lot of vehicles in Indonesia strongly supports the use of Pertamax Green 95 because this fuel is more economical compared to other non-green products. So, Pertamax Green is a solution to overcome several problems that occur in Indonesia.

Conclusions

Based on the results of the research that has been carried out, it can be concluded that the tests and analyzes that have been carried out on Pertamax 92 and three samples resulting from the blending of Pertamax 92 with bioethanol which have levels of 4% (E4), 5% (E5) and 6% (E6) there is an increase in specifications compared to Pertamax 92 which is supported by research data by testing the octane number, density, and water content in the samples. Pertamax green produced by pertamina has relatively the same specification ratio as the E5 sample that has been tested so that this product has a very positive impact on the environment with large-scale use which can reduce excess emissions. However, not only does it have a positive impact on the environment but Pertamax green has the benefit of improving engine performance and is much more economical than other products so it is very good for use by the Indonesian people.

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