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Polypropylene Fuel Utilization with Varying Additives for Motor Fuels

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Abstract. This research aims to develop polypropylene fuel as an alternative fuel. With the abundance of plastic waste around us, this waste can be used as raw material for alternative fuels by the pyrolysis process. This is done by using the hydrocarbon compounds in the plastic-forming polypropylene. In fact, without further processing, the fuel has not been able to provide optimal results when used. A simple attempt to increase polypropylene fuel capability by adding additives. In this polypropylene fuel tester, a gasoline-engined motorcycle is used which is tested for performance on a dynotest. The treatment in this test is in the form of mixing polypropylene fuel with general fuels and adding selected additives, including the R30 type and octane amplifier. In the fuel testing process, a single cylinder two-stroke gasoline engine is used. The two-stroke engine has a two stroke piston combustion system duty cycle. It can be said to have a four-stroke double cycle combustion system with the same operating time. With engine repair, it can improve performance. In research, polypropylene fuel is mixed with general fuels and added with a certain volume of additives. The additive fuel is used for the consumption of a motorbike engine that is tested for performance at the dynotest. By comparing the treatment with the addition of additives to the fuel, the results of this ability are not known.

Keywords: polypropylene fuel, two stroke gasoline engine, additives, dynotest.

1. Introduction

The performance of the motor fuel in the form of torque and power can be influenced by several factors, including the fuel used. The use of fuel is directly related to the combustion process in the engine cylinder. The use of fuel can also be varied by the addition of additives in order to increase the performance ability of the engine. Polyprophylene fuel has been studied by several researchers. One of the studies has been carried out by processing polypropylene (pp) plastic waste into fuel with the catalytic cracking method using synthetic catalysts [1]. Polypropylene or polypropene (PP) is a thermo-plastic polymer made by the chemical industry and used in a variety of applications [2]. It has been studied about the effect of a mixture of premium fuel and pyropylene plastic polypropylene (PP) on the calorific value of fuel [3]. Other studies suggest that plastics can be made from cheap and readily available hydrocarbons and reduce the amount of waste by examining the production of engine fuel from pyrolysis plastic waste and evaluating the performance of diesel engines [4]. Furthermore , polyprophylene fuel can be investigated its use as an alternative fuel in gasoline motors. In order to optimize engine performance, a better combustion process is needed. The combustion process can be improved by using fuel added with additives. The addition of additives is carried out with the intention

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of being an activator to increase reactive properties so that it is flameable. In general, additives can be divided into two, namely synthetic or artificial additives and natural additives. Additives are usually obtained from the metabolism of microorganisms as described in a study on bio-fuels made from microorganisms as anti-knock additives [5]. Additives are materials added to motor vehicle fuels, both gasoline and diesel engines [6] . One study on the use of additives has investigated the impact of several additives on gasoline motor performance [7]. The additives used in this study are divided into three, namely gasoline additive, gasoline booster and octane booster.

From the previous description, researchers are interested in focusing on knowing the performance of a motorcycle engine, namely power and torque using polypropylene fuel by being given several variations of a mixture of additives.

2. Research Methods

2.1. Types of Research
This research is included in experimental research, by making direct observations on the results of material testing. Research was carried out by comparing the results of performance of the engine based on the fuel consumption of a mixture of polypropylene with additives are varied (variation of volume and types of substances adatif).

2.2. Equipment
The machines and equipment used for research are as follows.

a. Honda Brand KW6 Type Two Stroke Engine
   1) Diameter x measures : 59 mm x 54.5 mm
   2) Cooling system : Liquid cooling (radiator)
   3) Electrical system : DC 12 V, 6.5 A
   4) Carburetor : Keihin SPJ 39 mm (pilot jet 55, main jet 160)

b. The dynamometer with the following specifications:
   1) Measurement item : Speed, RPM, Acceleration, Torque, Power
   2) Data transfer : RS232 - USB
   3) Maximum torque : 50 Nm
   4) Maximum RPM : 20,000 rpm
   5) Maximum power : 50 HP
   6) Maximum speed : 350 km / hour
   7) Roller diameter : 25 cm
   8) Roller weight : 154 kg
   9) Inertia roller : 1.2 Kg.m2
   10) Width : 97 cm
   11) Length : 195 Cm
   12) Applications to be used : Hofmann Werkstatt- Technik

c. Additives
   1) R-30 Rotary
   2) Octane Up (Octane Booster)
   3) Aceton 75%

d. Synthetic two stroke engine oil (lubrication oil)

e. The fuel used by VP Power and Polypropylene

f. Measuring cup

2.3. Research Procedure
All data retrieval is carried out on the *dynotest* equipment which is first positioned on the motorbike with the rear wheel directly above the roller and the body on the motorbike is secured by the fastening belt on the dynamometer.

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2.4. Research Preparation Stage

After the process of preparing the equipment and test the motor is mounted properly on dynamometer, carried out the process of checking on the condition of the motor mounting against the gauge and tachometer located on a dynamometer.

2.5. Research Stage

a. The process steps torsion test and power on the two stroke gasoline engine type 147cc clicking KW6 use the cylinder block model two holes exhaust fuel mixture VP- Power and polypropylene and lubrication oil :
   1) Using a two- hole exhaust cylinder block model on the engine.
   2) Using a mixture of VP-Power (2000ml), polypropylene (2000ml) and lubrication oil (40ml).
   3) Start the engine.
   4) Initiate the test or process of taking data for torque and power by the dynamometer.
   5) After knowing the torque and power, stop the data retrieval process on the dynamometer engine.
   6) Save the data obtained.
   7) Repeating steps 2 - 6 in succession for five data stores.

b. The process steps torsion test and power on the two stroke gasoline engine type 147cc , KW6 use the cylinder block model two holes exhaust fuel mixture VP- Power and polypropylene and additives (R30 Rotary):
   1) Using a two- hole exhaust cylinder block model on the engine.
   2) Using a fuel mixture of VP-Power (2000ml), polypropylene (2000ml) and additives (20ml).
   3) Start the engine.
   4) Initiate the test or process of taking data for torque and power by the dynamometer.
   5) After knowing the torque and power, stop the data retrieval process on the dynamometer engine.
   6) Save the data obtained.
   7) Repeating steps 2 - 6 in succession for five data stores.

c. The process steps torsion test and power on the two stroke gasoline engine type 147cc , KW6 use the cylinder block model two holes exhaust fuel mixture VP- Power and polypropylene and octanebooster (OctaneUp):
   1) Using a two- hole exhaust cylinder block model on the engine.
   2) Using a fuel mixture of VP-Power (2000ml), polypropylene (2000ml) and octanebooster (25ml).
   3) Start the engine.
   4) Initiate the test or process of taking data for torque and power by the dynamometer.
   5) After knowing the torque and power, stop the data retrieval process on the dynamometer engine.
   6) Save the data obtained.
   7) Repeating steps 2 - 6 in succession for five data stores.

d. The process steps torsion test and power on the two stroke gasoline engine type 147cc KW6 use the cylinder block model two holes exhaust fuel mixture VP- Power and polypropylene and acethon:
   1) Using a two- hole exhaust cylinder block model on the engine.
   2) Using a fuel mixture of VP-Power (2000ml), polypropylene (2000ml) and acethon (25ml) .
   3) Start the engine.
   4) Initiate the test or process of taking data for torque and power by the dynamometer.
   5) After knowing the torque and power, stop the data retrieval process on the dynamometer engine.
   6) Save the data obtained.
   7) Repeating steps 2 - 6 in succession for five data stores.

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e. The process steps torsion test and power on the two stroke gasoline engine type 147cc KW6 use the cylinder block model two holes exhaust fuel mixture VP- Power and polypropylene and mixtures of additives and acethon:
   1) Using a two- hole exhaust cylinder block model on the engine.
   2) Using a fuel mixture of VP-Power (2000ml), polypropylene (2000ml) and an additive mixture (20ml) and acethon (25ml).
   3) Start the engine.
   4) Initiate the test or process of taking data for torque and power by the dynamometer.
   5) After knowing the torque and power, stop the data retrieval process on the dynamometer engine.
   6) Save the data obtained.
   7) Repeating steps 2 - 6 in succession for five data stores.
f. The process steps torsion test and power on the two stroke gasoline engine type 147cc KW6 use the cylinder block model two holes exhaust fuel mixture VP- Power and polypropylene and mixtures of additives and octanebooster:
   1) Using a two- hole exhaust cylinder block model on the engine.
   2) Using a fuel mixture of VP-Power (2000 ml), polypropylene (2000ml) and an additive mixture (20 ml) and octanebooster (25 ml).
   3) Start the engine.
   4) Initiate the test or process of taking data for torque and power by the dynamometer.
   5) After knowing the torque and power, stop the data retrieval process on the dynamometer engine.
   6) Save the data obtained.
   7) Repeating steps 2 - 6 in succession for five data stores.
g. The process steps torsion test and power on the two stroke gasoline engine type 147cc KW6 use the cylinder block model two holes exhaust fuel mixture VP- Power and polypropylene and mixtures acethon and octanebooster:
   1) Using a two- hole exhaust cylinder block model on the engine.
   2) Using a fuel mixture of VP-Power (2000ml), polypropylene (2000ml) and the mixture acethon (20ml) and octanebooster (25ml) .
   3) Start the engine.
   4) Initiate the test or process of taking data for torque and power by the dynamometer.
   5) After knowing the torque and power, stop the data retrieval process on the dynamometer engine.
   6) Save the data obtained.
   7) Repeating steps 2 - 6 in succession for five data stores.

2.6. Research Data Collection
Data taken the form of input engine rpm, torque and power respectively by impulse is entered by each sensor which subsequently recorded in the internal memory to a dynamometer. The discussion is carried out by analyzing and comparing the data recorded on the dynamometer.

3. Results and Discussion

3.1. Research Result
This study aims to obtain a mixture of *polypropylene* fuel with various additives that improve engine performance. The data obtained are as follows:

3.1.1. VP-Power and Polypropylene Test Results Data and Side Oil
Standard test result data can be seen in Table 1. following:

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Table 1. Standard Test Results

Testing	Measurement Results				
	Engine power (corrected) (hp)	Engine power (measured) (hp)	Wheel power (measured) (hp)	Power losses (measured) (hp)	Torque (corrected) (kgm)(wheel)
Standart (1)	26,4	25,5	21,7	3,8 @ 92 (km/h) / 4113 (1/min)	39 @ 72 km/h / 3251 (1/min)
Standart (2)	28,7	27,5	18,9	8,6 @ 130 (km/h) / 5819 (1/min)	34 @ 89 km/h / 4005 (1/min)
Standart (3)	34,7	33,3	20,7	12,6 @ 128 (km/h) / 5730 (1/min)	41 @ 74 (km/h) / 3341 (1/min)
Standart (4)	28,2	27,0	17,6	9,4 @ 129 (km/h) / 5810 (1/min)	33 @ 71 (km/h) / 3206 (1/min)
Standart (5)	27,8	26,6	22,4	4,2 @ 95 (km/h) / 4248 (1/min)	38 @ 74 (km/h) / 3305 (1/min)

3.1.2. Data on VP-Power and Polypropylene Testing Results and Additive

Standard test data can be seen in Table 2. following:

Table 2. VP-Power and Polypropylene Test Results and Additives

Testing	Measurement Results				
	Engine power (corrected) (hp)	Engine power (measured) (hp)	Wheel power (measured) (hp)	Power losses (measured) (hp)	Torque (corrected) (kgm)(wheel)
Additive(1)	26,4	25,2	20,7	4,6 @ 87 (km/h) / 3907 (1/min)	43 @ 53 km/h / 2371 (1/min)
Additive(2)	30,1	28,7	22,5	6,2 @ 80 (km/h) / 3996 (1/min)	40 @ 89 km/h / 3987 (1/min)
Additive(3)	27,4	26,1	20,8	5,4 @ 96 (km/h) / 4320 (1/min)	43 @ 53 (km/h) / 2398 (1/min)
Additive(4)	27,3	26,0	20,4	5,6 @ 90 (km/h) / 4032 (1/min)	44 @ 55 (km/h) / 2470 (1/min)
Additive(5)	24,8	23,6	18,1	5,5 @ 116 (km/h) / 5191 (1/min)	32 @ 52 (km/h) / 2344 (1/min)

3.1.3. VP-Power and Polypropylene and Octanebooster Testing Results Data

Test result data can be seen in Table 3. following:

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Table 3. Results Testing VP-Power and Polypropylene and Octanebooster

Testing	Measurement Results				
	Engine power (corrected) (hp)	Engine power (measured) (hp)	Wheel power (measured) (hp)	Power losses (measured) (hp)	Torque (corrected) (kgm)(wheel)
Octane booster (1)	25,8	24,8	20,2	4,6 @ 106 (km/h) / 4712 (1/min)	34 @ 20 km/h / 907 (1/min)
Octane booster (2)	24,7	23,6	18,2	5,4 @ 101 (km/h) / 4544 (1/min)	58 @ 21 km/h / 952 (1/min)
Octane booster (3)	26,0	24,8	19,3	5,5 @ 89 (km/h) / 4014 (1/min)	46 @ 26 (km/h) / 1176 (1/min)
Octane booster (4)	27,2	26,0	20,4	5,6 @ 107 (km/h) / 4748 (1/min)	60 @ 20 (km/h) / 907 (1/min)
Octane booster (5)	26,7	25,5	21,1	4,4 @ 96 (km/h) / 4311 (1/min)	41 @ 75 (km/h) / 3377 (1/min)

3.1.4. VP-Power and Polypropylene and Acethon Testing Results Data

Test result data can be seen in Table 4. following:

Table 4. Results Testing VP-Power and Polypropylene and Acethon

Testing	Measurement Results				
	Engine power (corrected) (hp)	Engine power (measured) (hp)	Wheel power (measured) (hp)	Power losses (measured) (hp)	Torque (corrected) (kgm)(wheel)
Acethon (1)	22,5	21,5	15,8	5,6 @ 102 (km/h) / 4598 (1/min)	44 @ 26 km/h / 1176 (1/min)
Acethon (2)	24,2	23,1	17,3	5,8 @ 115 (km/h) / 5146 (1/min)	45 @ 26 km/h / 907 (1/min)
Acethon (3)	24,3	23,2	16,5	6,7 @ 129 (km/h) / 5784 (1/min)	35 @ 52 (km/h) / 2317 (1/min)
Acethon (4)	26,0	24,8	18,5	6,3 @ 112 (km/h) / 5011 (1/min)	34 @ 53 (km/h) / 2380 (1/min)
Acethon (5)	24,3	23,2	17,6	5,6 @ 114 (km/h) / 5101 (1/min)	35 @ 76 (km/h) / 3404 (1/min)

3.1.5. Data on VP-Power and Polypropylene Test Results and Additives plus Octanebooster

Test result data can be seen in Table 5. following:

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Table 5. Results Testing VP-Power and Polypropylene and Additives plus Octanebooster (Ad + Ob)

Testing	Measurement Results				
	Engine power (corrected) (hp)	Engine power (measured) (hp)	Wheel power (measured) (hp)	Power losses (measured) (hp)	Torque (corrected) (kgm)(wheel)
(Ad+Ob) (1)	28,4	27,1	18,4	8,7 @ 125 (km/h) / 5631 (1/min)	41 @ 31 km/h / 1410 (1/min)
(Ad+Ob) (2)	25,0	23,9	19,0	4,8 @ 94 (km/h) / 4212 (1/min)	45 @ 20 km/h / 916 (1/min)
(Ad+Ob) (3)	25,9	24,7	19,6	5,1 @ 92 (km/h) / 4122 (1/min)	46 @ 20 (km/h) / 907 (1/min)
(Ad+Ob) (4)	25,6	24,4	19,3	5,1 @ 108 (km/h) / 4850 (1/min)	39 @ 32 (km/h) / 1419 (1/min)
(Ad+Ob) (5)	25,7	24,5	20,0	4,5 @ 87 (km/h) / 3898 (1/min)	40 @ 56 (km/h) / 2515 (1/min)

3.1.6. VP-Power and Polypropylene Test Results Data and Additives plus Acethon

Test result data can be seen in Table 6. following:

Table 6. Results Testing VP-Power and Polypropylene and Additives plus Acethon (Ad + Ac)

Testing	Measurement Results				
	Engine power (corrected) (hp)	Engine power (measured) (hp)	Wheel power (measured) (hp)	Power losses (measured) (hp)	Torque (corrected) (kgm)(wheel)
(Ad+Ac) (1)	23,8	22,7	16,8	5,9 @ 89 (km/h) / 4014 (1/min)	37 @ 52 km/h / 2317 (1/min)
(Ad+Ac) (2)	22,4	21,3	18,6	2,7 @ 115 (km/h) / 5164 (1/min)	31 @ 34 km/h / 1518 (1/min)
(Ad+Ac) (3)	22,4	21,3	18,6	2,7 @ 115 (km/h) / 5164 (1/min)	31 @ 34 km/h / 1518 (1/min)
(Ad+Ac) (4)	21,9	20,9	14,2	6,7 @ 88 (km/h) / 3934 (1/min)	34 @ 29 (km/h) / 1302 (1/min)
(Ad+Ac) (5)	24,8	23,7	18,4	5,4 @ 106 (km/h) / 4778 (1/min)	34 @ 70 (km/h) / 3152 (1/min)

3.1.7. Data on VP-Power and Polypropylene Testing Results and Octanebooster plus Acethon

Test result data can be seen in Table 7. following:

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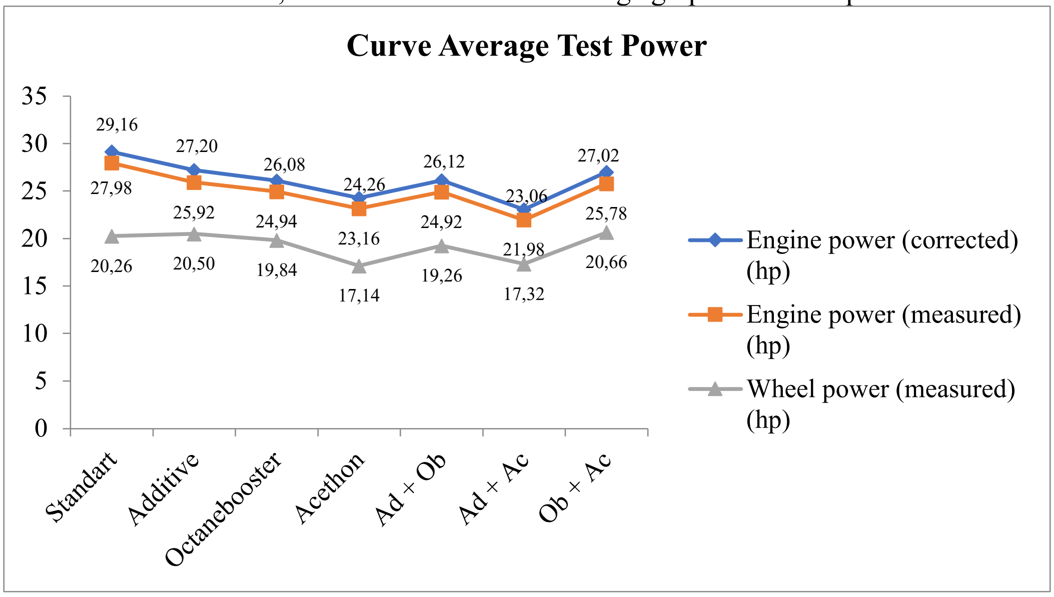
Table 7. Results Uji VP-Power and Polypropylene and Octanebooster plus Acethon (Ob+ Ac)

Testing	Measurement Results				
	Engine power (corrected) (hp)	Engine power (measured) (hp)	Wheel power (measured) (hp)	Power losses (measured) (hp)	Torque (corrected) (kgm)(wheel)
(Ob+Ac) (1)	27,5	26,3	21,5	4,8 @ 98 (km/h) / 4383 (1/min)	41 @ 52 km/h / 2326 (1/min)
(Ob+Ac) (2)	28,0	26,7	21,1	5,6 @ 89 (km/h) / 4014 (1/min)	56 @ 22 km/h / 970 (1/min)
(Ob+Ac) (3)	26,6	25,3	21,3	4,0 @ 90 (km/h) / 4041 (1/min)	38 @ 76 km/h / 3422 (1/min)
(Ob+Ac) (4)	27,6	26,3	20,5	5,8 @ 91 (km/h) / 4095 (1/min)	46 @ 54 (km/h) / 2425 (1/min)
(Ob+Ac) (5)	25,4	24,3	18,9	5,4 @ 77 (km/h) / 3467 (1/min)	39 @ 76 (km/h) / 3422 (1/min)

3.2. Discussion

The research was conducted to see the performance test results of a mixed fuel gasoline engine (standard fuel with plastic/ polypropylene waste). In addition, additional variations are used in the mixture used, in the form of additives, octanebooster, and acethon to find out how engine performance is. The weaknesses that were found in the implementation of this research were the lack of conditioning of the cooling system and the installation of a funnel in the exhaust that affected the resulting combustion gases.

Based on the test results, it can be seen that the average graph of each experiment is as follows.



Based on the graph the average power produced by each treatment, gained an average of the highest power in the treatment with the mixture of fuel VP-Power and polypropylene (PP) as well as side

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synthetic oil, with a mean value of 29.16 Hp. While the lowest average power occurs in the treatment with a mixture of VP-Power and polypropylene as well as additives plus acethon, with a mean value of 23.06Hp.

In the treatment of VP-Power + PP + synthetic oil obtained by the average power of 29. 16Hp with a peak power generated in the third data retrieval by 34.7Hp. The lowest power in this treatment was obtained at 26.4Hp in the first data collection.

In the VP + PP + Ad treatment, the greatest power was obtained worth 30.1Hp in the second repetition. While the lowest power is worth 24.6Hp in the fifth repetition. While on treatment of VP + PP + Ob largest power obtained 27.2 at the fourth repetition. The lowest value is 24.7Hp on the second repetition. In the treatment VP + PP + Ac obtained the greatest power amounting to 26.0Hp on repetition fourth. The lowest power value is 22.5Hp on the first repetition. In the treatment VP + PP + Ad + Ob obtained the highest power worth 28.4Hp, a repetition of the first. While lowest power obtained by power worth 25.0Hp, the second repetition.

In the treatment with a combination of VP + PP + Ad + Ac, the highest power was obtained at 24.8Hp in the fifth repetition. S edangkan lowest power amounted to 21.9Hp on repetition fourth. In combination VP + PP + Ob + Ac obtained the greatest power amounting to 28.0Hp on repetition second, lowest power obtained worth 25.4Hp on repetition fifth.

The test results with a mixture of VP-Power fuel with polypropylene and synthetic oil gave the greatest power, namely 34.7 Hp. This shows that with the addition of synthetic oil, polypropylene is able to provide good benefits for increasing engine performance. This is in line with the results of research which have concluded that a lubricating oil with a small kinematic viscosity and a large viscosity index will produce high power and torque (good engine performance) [8].

4. Conclution

Based on the results and discussion, it was concluded that the greatest power is obtained on testing the fuel mixture VP-Power with polypropylene and synthetic oil in the amount of 34.7Hp.

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