# Comparison Analysis of Quality of Ax-7 Advance Shelling Lubricants and Pertamina Enduro Racing Lubricants on Kawasaki Ninja 250cc Injeksi Motor

**Theo Agytha Putra Susila, Fajar Anggara**

Program Studi Teknik Mesin, Fakultas Teknik, Universitas Mercu Buana

E-mail: theoagytha37@gmail.com

***Abstract--****An analysis of the degradation of the quality of lubricating oil in motorized vehicles has been carried out. In this study 4tak motorcycles were used, namely the 2016 Kawasaki Ninja 250cc Injection motorbike with two different lubricants and lubricants used, namely the Ax 7 and Enduro racing Shell Advance with SAE 10W40. Parameters that will be analyzed are viscosity, Water content, Wear metal and a reduction in TBN value with the lab testing method in addition to lubricant testing and also testing the performance of the engine using both of these oils using a dyno test and for fuel consumption testing using a road test. Testing the value of viscosity, water content, wear metal and decreasing the value of TBN. Lab tests were conducted to determine the value of viscosity, contamination of water, wear on the vehicle engine and a decrease in the value of TBN by taking samples of oil that has been used for about 2000 km, this lab test aims to predict the cleanliness of the combustion chamber, contamination of water and view equipmen which wear occurs so that it can prevent more fatal damage. From the three tests, it was found that using Shell Advance Ax 7 oil was better than using Enduro Racing oil.*

***Keywords****: Lubricants, Shell, Enduro, Kawasaki, Injection*

## 1. INTRODUCTION

Motorcycle is a product of automotive technology that is most widely used by Indonesian people. However, most of the users are still unfamiliar with motorcycle engines, so if they experience problems or disturbances, the thing they do is to bring the motorcycle to the garage. Efficiency and effectiveness of motor vehicle engine performance is strongly influenced by the condition of the lubricating oil used (Suyanto, 1989). Lubricating oil (oil) is the main support of the work of a machine Wayan Diatniti et al: Analysis of the Decrease in the Quality of Lubricating Oil in Motorized Vehicles Based on Viscosity Value, Water content, wear metal and a decrease in TBN value (Yubaidah, 2008). Not only that, even oil also determines the performance and durability of the engine. The better the quality of the oil used, the better the performance and durability of the engine. Things that can accelerate the wear rate of components, that is if the filter does not function properly (clogged filter). A filter is a filter to separate solid particles from a liquid or gas. In addition, things that can accelerate the wear rate of components are found in lubricants. Oils that have been used at certain times (based on distance or working time) must also be replaced because oil viscosity has generally changed (added dilute) (Hidayat, 2012) and along with the time of oil use, the oil color will change. Not only causes metal wear on the engine, but also causes sediment or crust due to too much impurities in the lubricating oil. Based on several things described from the above discour

se, the author took the initiative to analyze the characterization of the quality degradation of lubricating oil in motor vehicles using oil

## 2. RESEARCH METHODS

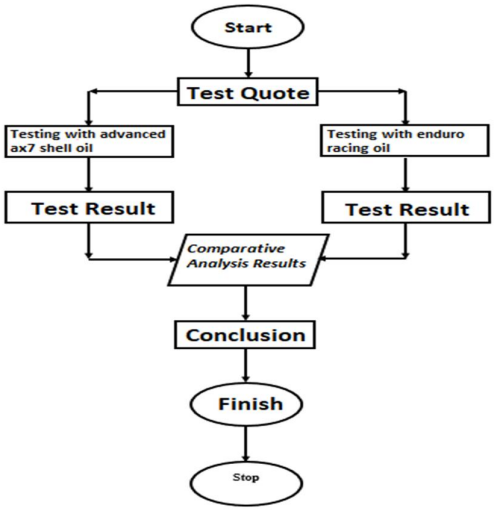


**Figure 1.** Research Flow Chart

Testing the value of viscosity, water content, wear metal and decreasing the value of TBN. Lab tests were conducted to determine the value of viscosity, contamination of water, wear on the vehicle engine and a decrease in the value of TBN by taking samples of oil that has been used for about 2000 km, this lab test aims to predict the cleanliness of the combustion chamber, contamination of water and view equipmen which wear occurs so that it can prevent more fatal damage.

### 2.1 Machine Performance Testing

Dyno test (Dynometer) is a device used to measure the power or power released or generated from a motorized vehicle. This dyno test is done with two different oils, the Dyno Test (Dynamotester) components as follows:

### 2.2 Fuel Consumption Test Results Using 4T Racing Enduro Oil

**Table 1.** Fuel Consumption Test Results Using 4T Racing Enduro Oil

| No | RPM | Fuel (cc) | Testing (s) | | |
|---|---|---|---|---|---|
| | | | I | II | III |
| 1 | 2000 | 100 | 902.05 | 853.58 | 850.63 |
| 2 | 3000 | 100 | 733.19 | 726.22 | 719.5 |
| 3 | 4000 | 100 | 553.09 | 532.87 | 538.81 |
| 4 | 5000 | 100 | 421.78 | 401.58 | 352.29 |
| 5 | 6000 | 100 | 326.25 | 311.71 | 258.48 |

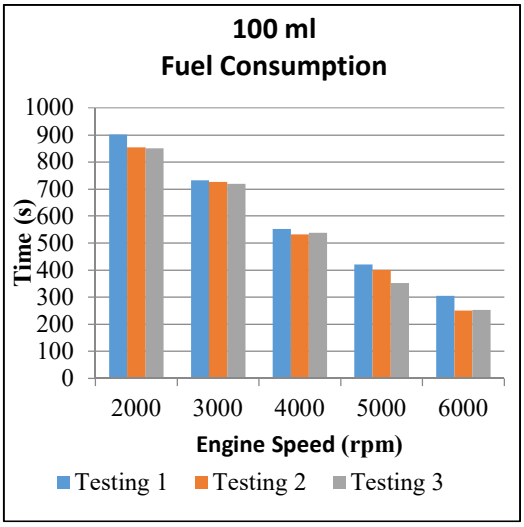


**Figure 2.** Pareto diagram

From the results of observations in the graph above using Enduro 4T Racing oil, it can be concluded that, at 2000 rpm the average time generated from the 100 ml fuel volume is 868.75 seconds (s). Then at 3000 rpm the average time generated from the 100 ml fuel volume is 726.30 seconds (s). While at 4000 rpm the average time generated from 100 ml fuel volume is 541.59 seconds (s). Then at 5000 rpm the average time generated from the 100 ml fuel volume is 391.88 seconds (s). The last one is at 6000 rpm the average time generated from the 100 ml fuel volume is 270.48 seconds (s).

The formula calculates torque and power
Power is torque multiplied by rotation (angular velocity):

$$P = \tau \times \omega$$

In International System (SI):
Power unit P is watt
Unit of torque τ is Nm (newton meter)
Unit of angular velocity ω is radians a second

Formulas for other units are:

$$P = \tau \times \omega \times 2p / 60.000$$

Where the units used are:

P power in kilowatts (kW)
Torque τ in newton meter (Nm)
Angle speed ω in Revolution Per Minutes (RPM)

Example calculation:
Torque, τ = 145 Nm
Angle speed, ω = 4800 RPM
Then power, P = 145 x 4800 x 2 x 22/7 / 60,000
= 72.91 kW

In the internal combustion engine, maximum torque is not obtained at the exact same rotation where maximum power is obtained. In vehicles used to pull heavy loads such as trucks, the maximum power produced by the engine is at a low RPM so that the maximum torque is also at low RPM.

In vehicles used for high speed with light loads such as sedans and motorbikes, the maximum power produced by the engine is at a high RPM, so that the maximum torque is also at high RPM.

Following are examples of power and torque graphs, it can be seen that the maximum torque obtained at engine speed is around 3900 RPM and maximum (horse power) power is obtained at engine speed of around 5800 RPM, this example is from a V8 engine.

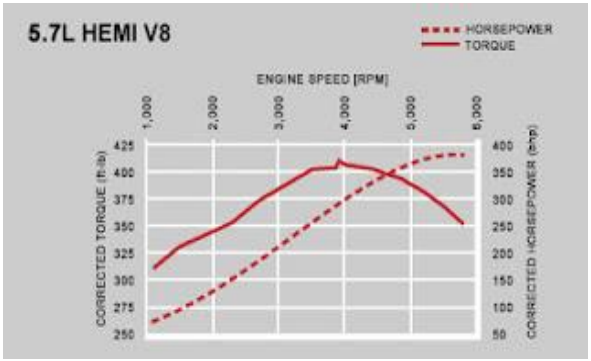


**Figure 3.** V8 engine

For Americans because the units are different, the following formula is used:

$$P = \tau \times \omega \times 2p / 33.000$$

Where the units used are:
P power in horsepower (hp)
Torque τ in pound feet (lbf.ft)
Angle speed ω in Revolution a Minutes (RPM)

### 2.3 Torque with Dynotest Using 4T Racing Enduro Oil

The results and data obtained from torque testing using Enduro Racing oil can be seen as follows:

**Table 2.** Comparison of Tors with Dynotest Using Ax 7 Shell Advance Oil and Enduro Racing

| No | Rpm | Torque with Shell Advance Ax7 1 | Torque with Enduro Racing |
|---|---|---|---|
| 1 | 4000 | 17.20 | 17.89 |
| 2 | 5000 | 17.85 | 18.62 |
| 3 | 6000 | 19.87 | 18.86 |
| 4 | 7000 | 19.17 | 18.36 |
| 5 | 8000 | 19.11 | 19.20 |
| 6 | 9000 | 18.09 | 18.46 |
| 7 | 10000 | 19.18 | 18.89 |
| 8 | 11000 | 19.79 | 17.68 |
| 9 | 12000 | 18.13 | 16.22 |

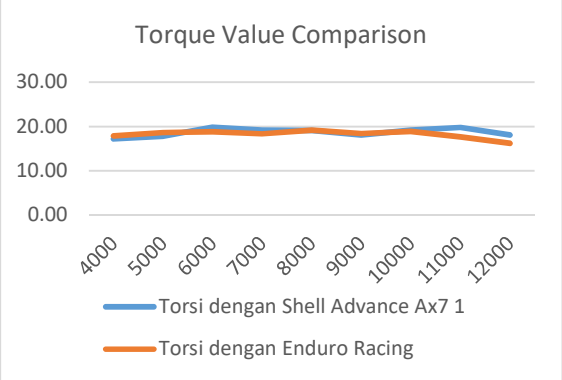


**Figure 4.** Torque Testing Using Enduro Racing Oil and Shell Advance Ax 7

From the graph above, it can be seen that Rp. 4000 in the test results is 17.89 Nm and 17.20 Nm, at Rp. 5000, the results are, 18.63 Nm and 17.85 Nm, at Rp. 6000, the results are 18.86 Nm and 19.87 Nm, at Rp. 7,000 obtained results of 18.36 Nm and 19.17 Nm, at Rp. 8000, the results of the test were 19.2 Nm and 19.11 Nm, at Rp. 9000, the test results were 18.46 Nm and 18.09 Nm, the test results obtained were Rp. 10000. that is 18.89 Nm and 19.18 Nm, at Rp. 11000 the results of the test were 17.68 Nm and 19.79 Nm, at Rp. 12000 the results of the test were 16.22 Nm 18.13 Nm.

### 2.4 Power dengan *Dynotest* Menggunakan Oli Shell Advance Ax 7 dan Enduro Racing

**Table 3.** Power Testing Results Using Ax 7 Shell Advance Oil and Enduro Racing

| No | Rpm | Power with Shell Advance Ax 7 1 | Power with Enduro Racing |
|---|---|---|---|
| 1 | 4000 | 10,3 | 12,0 |
| 2 | 5000 | 12,6 | 14,5 |
| 3 | 6000 | 16,1 | 17,3 |
| 4 | 7000 | 18,9 | 19,4 |
| 5 | 8000 | 21,6 | 22,6 |
| 6 | 9000 | 23 | 24,7 |
| 7 | 10000 | 27 | 27,9 |
| 8 | 11000 | 31,2 | 28,7 |
| 9 | 12000 | 30,6 | 28,3 |

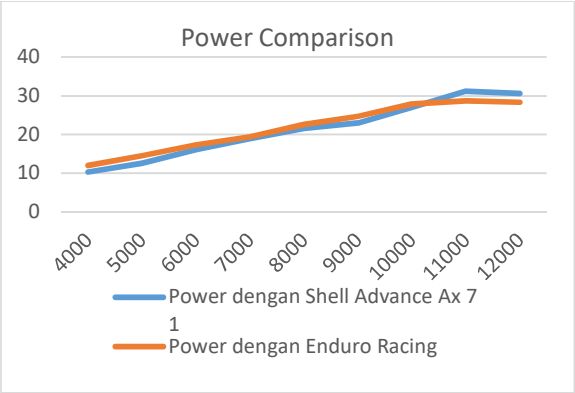


**Figure 5.** Calculation of power using Enduro Racing oil

On the calculation of power using Enduro Racing oil and Shell Advance Ax 7 at Rpm 4000, the results obtained were 12 hp and 10.3 hp at Rpm 5000, the results were 14.5 hp and 12.6 hp, at Rp. 6000, the results were 17.3 hp and 16.1 Hp, at Rp. 7,000, the results were 19.4 Hp and 18.9 Hp. At Rp. 8,000, the results were 22.6 Hp and 21.6 Hp. At Rp. 9,000, there were 24.7 Hp and 23 Hp. namely 27.9 Hp and 27 Hp, at Rp. 11,000 the results obtained were 28.7 Hp and 31.2 Hp, at Rp. 12,000 the results obtained were 28.3 Hp and 30.6 Hp.

### 2.5 Fuel Consumption Test Results with Shell Advance Ax 7

**a. First Test**

The first test is at 2000 rpm with a fuel volume of 100 ml.

**Table 4.** Fuel Consumption at 2000 rpm

| With Shell Ax 7 oil | RPM | Fuel Volume (ml) | Time (s) |
|---|---|---|---|
| Testing 1 | 2000 | 100 | 1146,06 |
| Testing 2 | 2000 | 100 | 1107,92 |
| Testing 3 | 2000 | 100 | 1009,78 |

**b. Second Test**

In the second test at 3000 rpm with a fuel volume of 100 ml.

**Table 5.** Fuel Consumption at 3000 rpm

| With Shell Ax 7 Oil | RPM | Fuel Volume (ml) | Time (s) |
|---|---|---|---|
| Testing 1 | 3000 | 100 | 923,19 |
| Testing 2 | 3000 | 100 | 902,22 |
| Testing 3 | 3000 | 100 | 853,59 |

**c. Third Test**

Pada pengujian ketiga yaitu pada 4000 rpm dengan volume bahan bakar 100 ml.

**Table 6.** Fuel Consumption at 4000 rpm

| With Shell Ax 7 Oil | RPM | Fuel Volume (ml) | Time (s) |
|---|---|---|---|
| Testing 1 | 4000 | 100 | 816,45 |
| Testing 2 | 4000 | 100 | 754,33 |
| Testing 3 | 4000 | 100 | 725,25 |

**d. Fourth Test**

In the fourth test at 5000 rpm with a fuel volume of 100 ml.

**Table 7.** Fuel Consumption at 5000 rpm

| With Shell Ax 7 Oil | RPM | Fuel Volume (ml) | Time (s) |
|---|---|---|---|
| Testing 1 | 5000 | 100 | 625,28 |
| Testing 2 | 5000 | 100 | 601,26 |
| Testing 3 | 5000 | 100 | 548,23 |

**e. Fifth Test**

In the fifth test at 6000 rpm with a fuel volume of 100 ml.

**Table 8.** Fuel Consumption at 6000 rpm

| With Shell Ax 7 Oil | RPM | Fuel Volume (ml) | Time(s) |
|---|---|---|---|
| Testing 1 | 6000 | 100 | 457,07 |
| Testing 2 | 6000 | 100 | 423,17 |
| Testing 3 | 6000 | 100 | 427,11 |

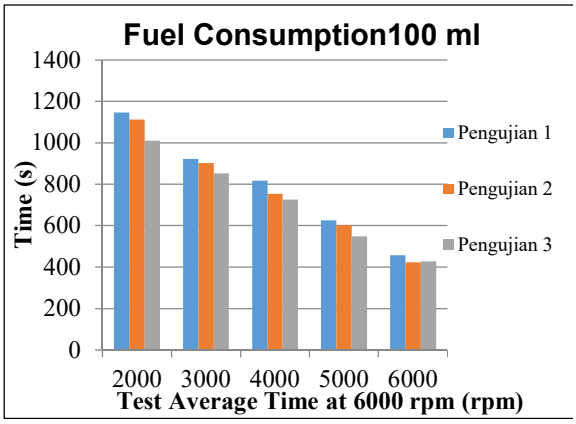


**Figure 6.** Fuel Consumption Using Shell Advance Ax 7 Oil

From the results of observations in the graph above after using Shell Advance Ax 7, it can be concluded that, at 2000 rpm the average time generated at 100 ml fuel volume is 1088.92 seconds (s). Then at 3000 rpm the average time generated at 100 ml fuel volume is 893 seconds (s). While at 4000 rpm the average time generated at 100 ml fuel volume is 765.34 seconds (s). Then at 5000 rpm the average time generated at 100 ml fuel volume is 591.59 seconds (s). The last one is at 6000 rpm the average time generated at 100 ml fuel volume is 435.78 seconds (s).

**2.6 War Metal Testing Results**

Work procedures are explained using the following parameters

$$\text{m sample (g)} = \frac{10}{\text{expected BN (mg/g)}}$$

weighed with the following precision

**Table 9.** Sample Weight and Precision Weight

| Sample Weight (g) | Precision Weight (g) |
|---|---|
| 5 – 10 | 0.02 |
| 1 – 5 | 0.005 |
| 0.25 – 1.0 | 0.001 |
| 0.1 – 0.25 | 0.0005 |

• Burette volume = 10 mL

**Comparison of Wear Metal**

Table 11 Wear Metal Test Results

| No | Wear Metal | Unit | Method | Shell oil test results | Enduro 4T Racing oil test results | Attention | Urgent |
|---|---|---|---|---|---|---|---|
| 1 | Iron (Fe) | Ppm | ASTM D 5185-13e1 | 12 | 32 | 50 | 80 |
| 2 | Cupper (Cu) | Ppm | ASTM D 5185-13e1 | 1 | 1 | 20 | 30 |
| 3 | Alumunium (Al) | Ppm | ASTM D 5185-13e1 | 3 | 4 | 18 | 25 |
| 4 | Chromium (Cr) | Ppm | ASTM D 5185-13e1 | <1 | 1 | 10 | 15 |
| 5 | Nickel (Ni) | Ppm | ASTM D 5185-13e1 | <1 | <1 | 5 | 10 |
| 6 | Tin (Sn) | Ppm | ASTM D 5185-13e1 | <1 | 1 | 10 | 20 |
| 7 | Lead (Pb) | Ppm | ASTM D 5185-13e1 | <1 | <1 | 15 | 25 |
| 8 | TBN | mg KOH/g | ASTM D2896-11 | 6.24 | 3.44 | 5.05 | 3.4 |

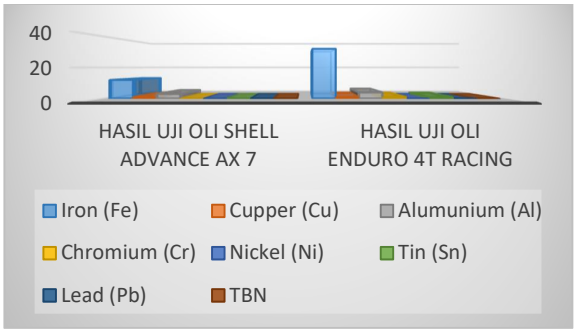


**Figure 7.** Comparison of Wear Metal

In the wear metal test using a lab, for Shell Advance Ax 7 the iron (Fe) value was obtained 12 ppm while for Enduro 4T Racing the iron (Fe) value was 32 ppm, for Shell Advance Ax 7 Copper

(Cu) was obtained 1 ppm while for Enduro 4T Racing oil the value of Copper (Cu) is 1 ppm, for Shell Advance Ax 7 values of Aluminum (Al) the results are 3 ppm while for Enduro 4T Racing the value of Aluminum (Al) is 4 ppm, for Shell Advance Ax 7 value of Chromium (Cr) obtained the results <1 ppm while for Enduro 4T Racing oil the value of Chromium (Cr) obtained 1 ppm, for Shell Advance Ax 7 Nickel (Ni) values obtained <1 ppm while for Enduro 4T Racing grades Nickel (Ni) yields <1 ppm, for Shell Advance Ax 7 the Tin (Sn) value is <1 ppm while for Enduro 4T Racing oil the value of Tin (Sn) is 1 ppm, for Shell Advance Ax 7 is Lead (Pb ) <1 ppm is obtained while for Enduro 4T Rac oil ing the value of Lead (Pb) obtained yield <1 ppm, For Shell Advance Ax 7 TBN value obtained 6.24 mg KOH / g, while for Enduro 4T Racing oil obtained 3.44 mg KOH / g. where the allowable TBN reduction value is 50% of the value of TBN New oil.

## 3. DATA ANALYSIS

### 3.1 Analysis of Fuel Consumption Data

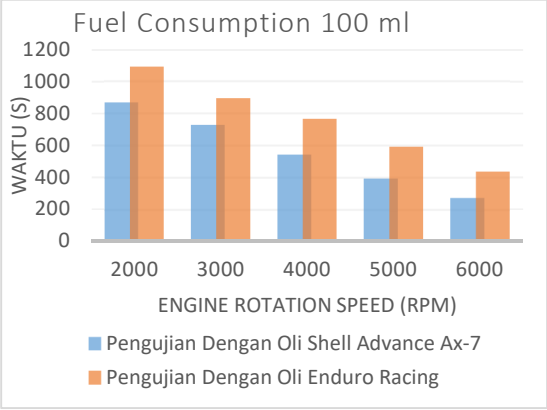


**Figure 8.** Comparison of Fuel Consumption Using 4T Racing Enduro Oil and Shell Advance Ax 7 Oil

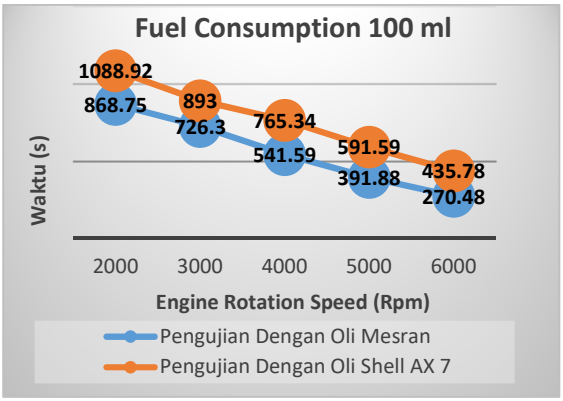


**Figure 9.** Comparison of Fuel Consumption

From the analysis results in the diagram and graph above, it can be concluded as follows:

- At 2000 rpm using Enduro 4T Racing oil, the average time obtained with 100 ml fuel volume is 868.75 seconds (s). While at 2000 rpm using Shell Advance Ax 7, the average time obtained with 100 ml fuel volume is 1088.92 seconds (s).
- At 3000 rpm using Enduro 4T Racing oil, the average time obtained with a 100 ml fuel volume is 726.30 seconds (s). While at 3000 rpm using Shell Advance Ax 7, the average time obtained with 100 ml fuel volume is 893 seconds (s).
- At 4000 rpm using Enduro 4T Racing oil, the average time obtained with a 100 ml fuel volume is 541.59 seconds (s). While at 4000 rpm using Shell Advance Ax 7, the average time obtained with 100 ml fuel volume is 765.34 seconds (s).
- At 5000 rpm using Enduro 4T Racing oil, the average time obtained with a 100 ml fuel volume is 391.88 seconds (s). While at 5000 rpm using Shell Advance Ax 7, the average time obtained with 100 ml fuel volume is 591.59 seconds (s).
- At 6000 rpm using Enduro 4T Racing oil, the average time obtained with a 100 ml fuel volume is 270.48 seconds (s). While at 6000 rpm using Shell Advance Ax 7, the average time obtained with 100 ml fuel volume is 435.78 seconds (s).

Fuel consumption using Ax 7 Shell Advance Oil has been proven to have been reduced, this is due to the ability of lubricants in making film coatings to reduce friction between metal to metal, in addition to cleaning up the remaining dirt (crust) in the combustion chamber, with some aspects owned by Shell Advance Ax 7, the fuel removal process can run optimally.

## 4. CONCLUSION

Berdasarkan hasil pengujian yang telah dilakukan pada motor Kawasaki Ninja 250 cc Injeksi, maka dapat diambil kesimpulan sebagai berikut:

Based on the results of testing that has been carried out on the Kawasaki Ninja 250 cc Injection motorbike, the following conclusions can be drawn:

1. The use of the Shell Advance Ax 7 lubricant on the Kawasaki Ninja 250 cc injection proved to have experienced a reduction in fuel consumption.
2. For the value of Power Value increased from 21501.02 W to 22072.72 W by using Shell Advance Ax 7 5% catalyst at Rpm 11000 and power using Shell Advance Ax 7 10% catalyst obtained the highest yield 2218.42 W at Rp. 11000.
3. For Torque Increased from the Highest Results 19.04 Nm at Rpm 8000, to 19.41 Nm using Shell Advance Ax 7 5% catalyst at Rp.

11000 and using Shell advanvance Ax 7 lubricant 10% catalyst obtained the highest value 19.54 Nm at Rp. 11000 .

4. Based on the lab results that have been done shows that there are indications of increased wear using Enduro 4T Racing when compared to the shell.

The TBN value (Total Base Number) shows that the most decrease occurred in Enduro 4T Racing oil with a decrease of about 57%.

## REFERENCES

[1]. Ardiyanto Oki, (2013) The Importance of Lubrication in the Machine. Yogyakarta. Adicita Karya Nusa.
[2]. Darmansyah Kiki, (2011) Impact of Wear on Machines. Bandung. Brillian Media Utama.
[3]. Darmanto, (2011) Machine Elements That Require Lubrication. Surabaya: Ten November Institute of Technology.
[4]. Doloksaribu Gimbal, (2014) Fuels and Lubricants. Yogyakarta. Andi publisher.
[5]. Haidar Farras. (2012). Engine Lubricants For Vehicle Fuel Savers. Solo. Intermedia Era.
[6]. Hidayat, Wahyu. 2012. Modern Gasoline Motors. Rineka Cipta. Jakarta. Limantoro, Setiawan and Felisia, Puspitaningsih. 2012. Determination of Relative Viscosity (Stormer method). Journal of Viscosity.
[7]. Krisna Eri, (2011) Various types of lubricants. Padang. Anggrek Media.
[8]. Rahardiyan Mohammad Tri, (2013) Lubrication Systems on Machines. Surabaya. Angkasa Multi Karya.
[9]. Utomo Jati, (2013) Machine Performance Testing on Motor Vehicles. Semarang. Aridas Karya Satria.
[10]. Yulianda, Ari, Hasan Maksum, Donny Fernandez, (2015) Influence the Use of Various Lubricant Brands on Four Step Motorcycle Engines. Padang. Padang State University.
[11]. Yuwono, Triwibowo. 1991. Macromolecules and molecular interactions. Erlangga. Jakarta.