THE EFFECT OF NOSSEL PRESSURE IN THE USE OF FUEL OF INDIRECT INJECTION DIESEL MOTOR

U. Petrus Palinggi & Zulhaji
Makassar State University

Abstract :
This study aimed to determine the effect of pressure on the fuel nozzle. For that reason, the research was conducted in laboratory experiments quasy Automotive Engineering. The object of this study is the Indirect Injection diesel motor with no load and without using a timing change with variations in pressure nozzle (110, 115, 120, 125, and 130) kg / cm^2. The analysis of the data used in this research was descriptive analysis and inferential analysis In several rounds (1000, 1500, and 2000 rpm), we obtained an average consumption of diesel, the nozzle at a pressure of 110 kg / cm^2 = 35.33 cc / minute, the nozzle at a pressure of 115 kg / cm^2 = 35 , 33 cc / minute, the nozzle at a pressure of 120 kg / cm^2 = 35.05 cc / minute, the nozzle at a pressure of 125 kg / cm^2 = 33.67 cc / minute, the nozzle at a pressure of 130 kg / cm^2 = 33.67 cc / minute. Based on the results by using Univariate Analysis of Variance with the help of SPSS 12 For Windows sofware, we obtained Fmeasure = 1132.806, and the significance value was 0.00 or smaller than the value of 0.05 or (0.00 <0.05). It means that Ho is rejected and Ha is accepted. This suggested that there was influence of nozzle pressure on diesel fuel use in diesel motor Indirect Injection type L 300.

Keywords: *Pressure nozzle, fuel consumption, Motor Indirect Injection.*

Introduction

In recent situation, we can see that the main energy resources is fuel which is getting limited in its availability.This makes the availability of fuel is getting lesser and lesser and it is predicted that in the near decade will be finished.

Based on this fact, nowadays, there are some efforts have been done to develop and converse enery as alternatives to replace fuel. We also see many efforts to use less energy by utilize energy as efficient as possible. In addition, automotive world as one of the biggest energy user also need fuel in large amount especially diesel. Therefore, it needs more ways to efficiently use diesel but still maintain the optimal condition of the motor. Diesel motor is one of motors which is used by community in many sectors in everyday life especially those that comes in big power such as in busses, trucks, tractors, ships, trains, manufacture machines, industrial machines and as drivens in electrical generators. The use of diesel is a unit that measure how much diesel has been used in one motor. To show the use of efficient diesel can be done in many ways such in ignition system, fuel system in the motors. Special for diesel motor, it can be changed in diesel flowing system component such as in the change of nossel pressure. Nossel is one of diesel flowing system components in motor which pressure can be changed by controlling the spring pressure, either by using shim (ring) or using tuning bolt. For diesel motor with indirect injection type L 300 has standard pressure 110 – 130 kg/cm^2. The change can be done by adding or lessening shim/ring. This nossel pressure change can also be done if the nossel is separated from the machine (cylinder head). One of diesel motor types which are available in community and gets less attention from researcher are diesel motor indirect injection, because the use of fuel in the motor is very much compared to those in diesel motor direct injection Karyanto (2002). This consideration becomes the main factors that many people in society complaining as the price of fuels is getting higher and higher.

Diesel Motor

Diesel engine is one of the combustion engine (internal combustion engines) that do not require spark plugs to ignite the fuel (Hary, 1997). Motor is planned to use a high compression ratio of 15-22, while also not using a mixture of air and gasoline, but only the air that is sucked into the combustion chamber on the suction step. In general, the compression ratio in diesel motors between 15-22, meaning that businesses step (cylinder volume) compared with the combustion chamber volume 15:1 - 22:1, Karyanto (2002), and for the type L 300 diesel motors that use indirect injection type of comparison compression is 21: 1, Anonymous (no year 1), clean air is compressed to achieve pressure (26-40) kg/cm2 and the combustion temperature range (1200-1600) ^{o}c.

The working principle of diesel engine 4 (four) steps

1) The first step (step suction)

At this step, the suction valve is open and pure air into the combustion chamber, the piston moves from the (TMA) to (TMB) while the output valves is closed until the piston in TMA position.

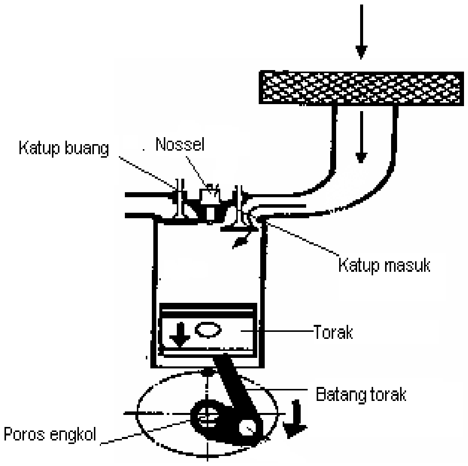


Figure 1. The Working Principle of Diesel Motor 4 Steps in Suction Step
Source: Bagyo (1997).

2) The second step (compression stroke).

Piston moves from (TMB) to (TMA), suction valves and exhaust valves is closed, the piston compresses pure air up to 40 kg/cm2 pressure and temperature around 700 ° C. Approximately 5° C, before the TMA in the form of mist sprayed diesel fuel, so the solar begin to burn.

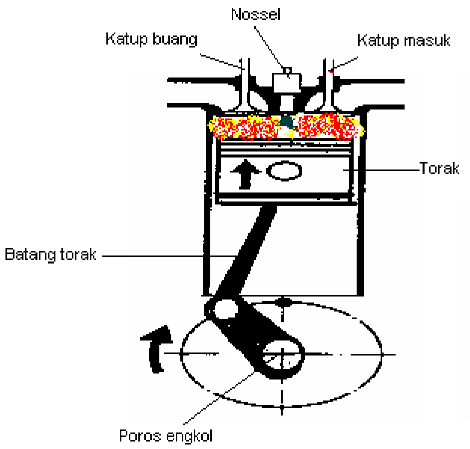


Figure 2. The Working Principle of Diesel Motor 4 Steps in Compression Step
Source: Bagyo (1997)

3) The third step (acting step)

With high temperature and pressure, the combustion products in the second step, the piston moves from top dead point (TDC) to bottom dead point (TMB) and this step is called the effort a step that produces mechani

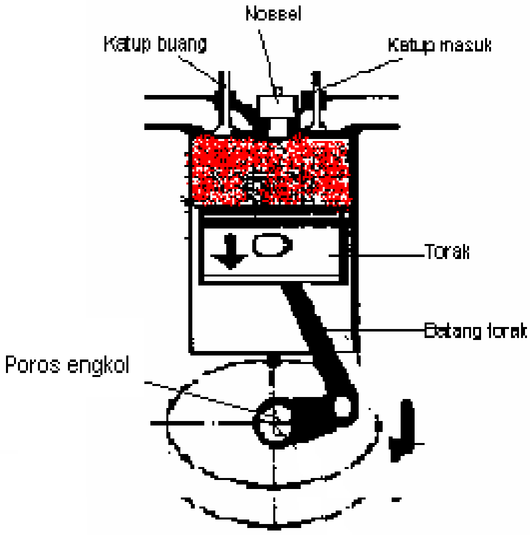


Figure 3. The Working Principle of Diesel Motor 4 Steps in Acting Step
Source: Bagyo (1997)

4) The fourth step (step disposal).

TMB to the piston moves from TDC, the rest of the combustion gases exit through the exhaust valve which has been opened .. After all the gas used up, the movement of the piston reaches TDC after returning to the TMB, and the suction valve begins to open. (Suction step)

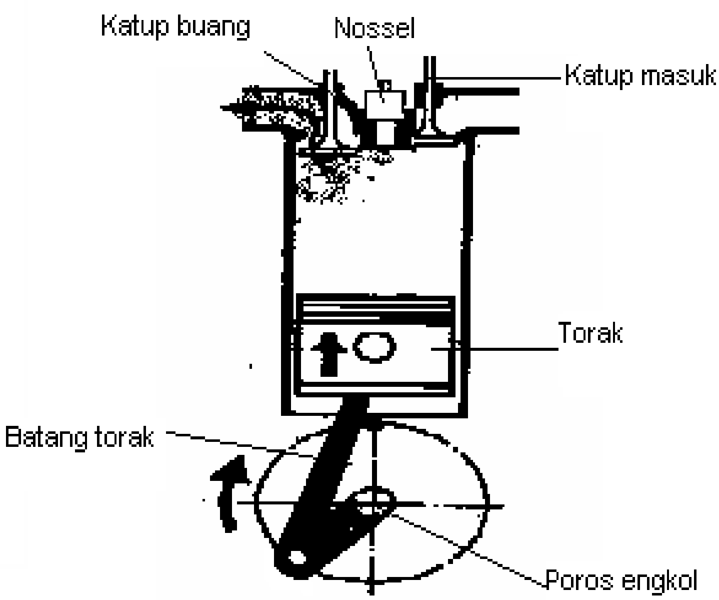


Figure 4. The Working Principle of Diesel Motor 4 Steps in disposal step
Source: Bagyo (1997)

Nossel

Nozzle is one of the components of diesel engine fuel system functioning solar spray mist which is distributed in the form of an injection pump, high pressure and the pressure deployment. By Maleev. V. L. (1995), the nozzle can be divided into two types:

a). Many nozzle holes and single holes

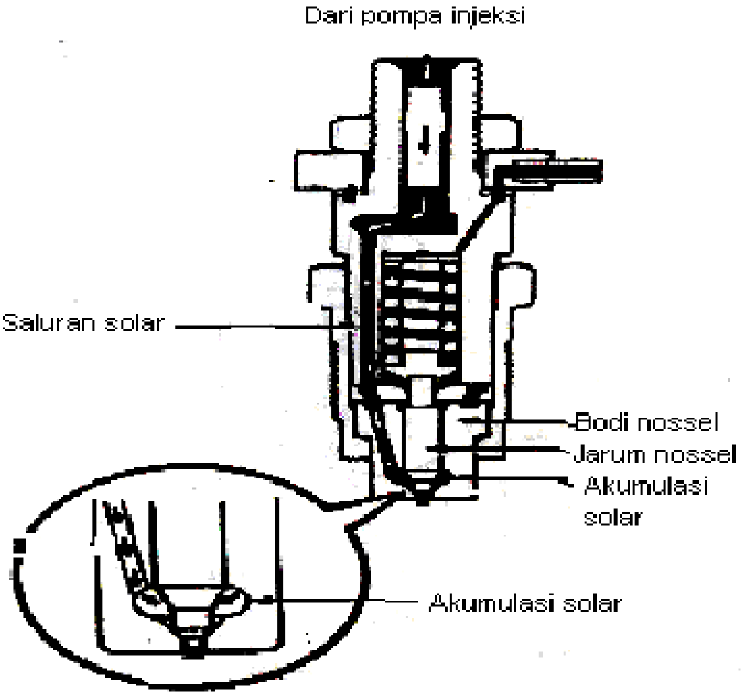
b). throttle model and pintle model.

Nebulization nozzle holes provide a good fog, but it requires high pressure to achieve good sprayig carburetion. To determine the type of nozzle used in diesel motors can be determined by the combustion process and combustion chamber shape. Nozzle pin models used for diesel motors with front room and bedroom systems navel, as in diesel motors L 300 is pressurized (110-130) kg/cm2.

Nossel *indirect injection*

By Anonymous (1995), the workings of the nozzle can be described as follows:

a. Before the injection of diesel fuel
   Solar high-pressure flow of diesel fuel injection pump through the channels on the handle of the nozzle (nozzle holder) leading to accumulation of diesel fuel (oil pool) at the bottom of the nozzle body (nozzle body).



b. Injection of diesel fuel
   When the solar pressure on the accumulation of diesel fuel (oil pool) up, it will hit the surface of the tip of the needle (needle). When this pressure exceeds the strength of the spring, the needle nozzle (nozzle needle) will be pushed upwards by solar pressure and the nozzle needle regardless of body position on the nozzle (nozzle body), these events cause the nozzle to spray into the engine cylinder diesel motor.

c. The final injection of diesel fuel

When the flow of diesel fuel injection pump stops, solar pressure and pressure drop springs (spring pressure) returns the nozzle needle (nozzle needle) to its original position. At this time the nozzle needle (needle) strongly depressed the nozzle body and the seat cover solar channels. Most of the remaining diesel fuel between the nozzle needle and the nozzle body (nozzle body), the pen pressure (pressure pin) and the handle of the nozzle (nozzle holder) and others, lubricate all components and the flow of diesel fuel leaked out through the vent pipes.

4. Fuels of Diesel Motor

In the first stage of the development of diesel engine used coal dust as fuel (Arismunandar and Tsuda , 1975). However, because it did not work well and are not practical then the coal is no longer used, instead of diesel oil which is till date is one type of fuel that is widely used in middle round or high round motor and employed in a long time.

Solar has a specific gravity of 0.83 to 0.85, the boiling temperature between (175-370) °C (Hardjono, 2000). Flash point (65-70) °C, has a degree of viscosity or viscosity of 1.5 to 3.5, the combustion of 9983 cal / kg.

Conditions that must be met by solar, namely:

1) Must be able to light up in time
2) Must have the ability to lubricate the valves and pump diesel components rubbing against the injection pump
3) Must have a low viscosity and free of solid material to easily flow through narrow channels and easily atomized
4) Does not contain sewage or harmful elements

Firing Point

Firing Point is the lowest temperature at which the oil vapor contained in the liquid can form mixtures with air, and will light up if the temperature rises. Flash point is too low complicated storage and transport. Flash point for diesel is 65.5 °C. For high-speed motors, this value could be taken higher at around 68.3 °C (Daryanto, 2004) Spraying is completed, the needle nozzle must close tightly so that diesel fuel does not come out or drip under pressure from the pump before the next injection.

Research Method

The research was conducted at the Laboratory / Workshop Automotive Engineering Department Faculty of Engineering, State University of Makassar.

Variables divided into two groups: the independent variable is the pressure of the nozzle while the dependent variable is the amount of fuel used in the measuring tube.

Data Collection Techniques

Close the tube and the valve is opened up and the return hose was transferred to the reserve tube solar at the same time. Observing last position on the scale of the measuring cup and record the number of cubic centimeters (cc) diesel fuel consumption by as much as three times the treatment of each round back and change the nozzle motor. Opening pressure by using a nozzle tester in accordance with the procedures adjustment. After testing and data collection, the results obtained in each test is checked, then do the comparison of the use of diesel fuel each nozzle pressure in units of cubic centimeters (cc). Data has been collected put into format study.

Data Analysis Technique

The data obtained were processed using descriptive statistical analysis and inferential statistics. Testing criteria as follows:

a. H0: The average before and after treatment are the same.
b. Ha: The average before and after treatment are not the same.
c. 0.05, H0 is accepted or rejected Ha≥If a significant value
d. If a significant value <0.05, H0 is rejected or accepted Ha

Result And Discussion

Research Results

Descriptive Data aims to get the value of the average, minimum and maximum values which give a general idea of the influence of pressure on the use of diesel nozzle diesel 4 stroke motors. The test data on the use of diesel fuel each nozzle pressure obtained from the study are as follows:

a. Motor rotation 1000 rpm

Table 1. The use of solar (cc) at 1000 rpm with a motor rotation number spraying nozzle 500 stroke

Rotation	Test	Nossel pressures (kg/cm^2) / The use of solar (cc)/minutes				
		110	115	120	125	130
1000 rpm	1	20	20	20	20	20
	2	20	20	20	20	20
	3	20	20	20	20	20
Sub Total		60	60	60	60	60
average (x)		20	20	20	20	20

Based on Table 1, it can be explained that the use of solar is no difference in pressure at each nozzle, diesel fuel consumption average of 20 cc.

To see the use of solar (cc) and its relationship to the pressure on the test are presented in the following chart:

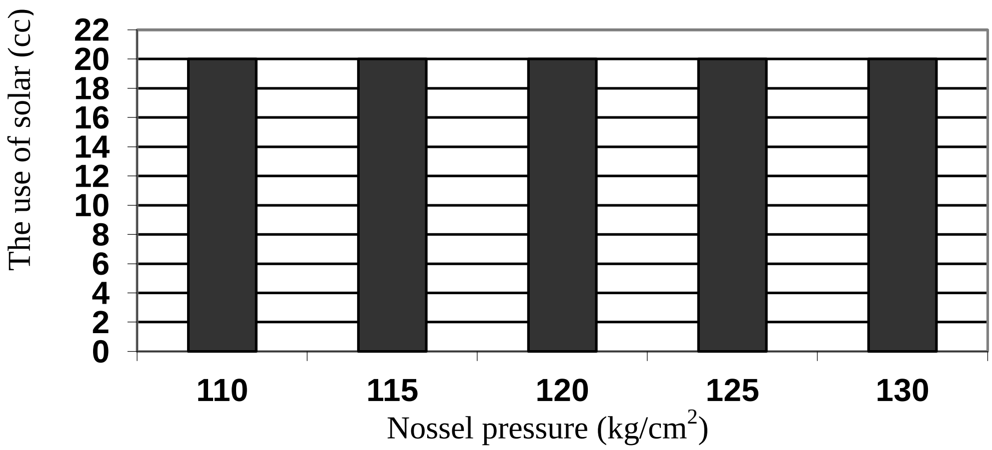


Figure 6. Use of solar chart (cc) at 1000 rpm motor rotation the amount of spraying nozzle 500 stroke

a. Motor rotation 1500 rpm

Table 2. The use of Solar (cc) in 1500 rpm rotation with the amount of nossel spray 750 stroke

Rotation	test	nossel pressure(kg/cm^2) / The use of solar (cc)/minutes				
		110	115	120	125	130
1500 rpm	1	36	36	35,5	35	35
	2	36	36	36	35	35
	3	36	36	36	35	35
Sub Total		108	108	107,5	105	105
average (x)		36	36	35,833	35	35

Based on Table 2 can be explained that the use of diesel fuel contained in the lowest pressure (125 and 130) kg/cm2 with an average of 35 cc. While the average The highest use of diesel fuel contained in the pressure (110 and 115) kg/cm2 which is 36 cc. To see the use of solar variations (cc) and its relationship to the nozzle by pressure testing are presented in the following chart:

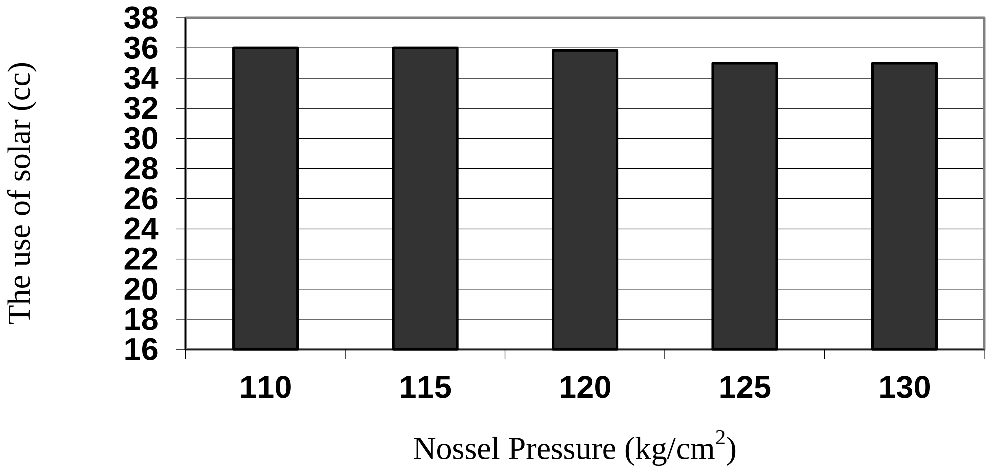


Figure 7. Use of solar chart (cc) at 1500 rpm motor rotation the amount of spraying nozzle 750 stroke

b. Motor rotation 2000 rpm

Table 3. The use of solar (cc) in the amount of rotation 2000 rpm spraying nozzle 1000 stroke

Rotation	test	Nossel pressure (kg/cm^2) / The use of solar (cc)/minutes				
		110	115	120	125	130
2000 rpm	1	50	50	49	46	46
	2	50	50	50	46	46
	3	50	50	49	46	46
Sub Total		150	150	148	138	138
Average (x)		50	50	49,333	46	46

Based on table 3 can be explained that the use of diesel fuel at a pressure nozzle are the lowest (125 and 130) kg/cm2 with an average of 46 cc. While the average of the highest use of diesel fuel contained in the nozzle pressure (110 and 115) kg/cm2 is 50 cc.
To see the use of solar variations (cc) and its relationship to the pressure on the test are presented in the following chart:

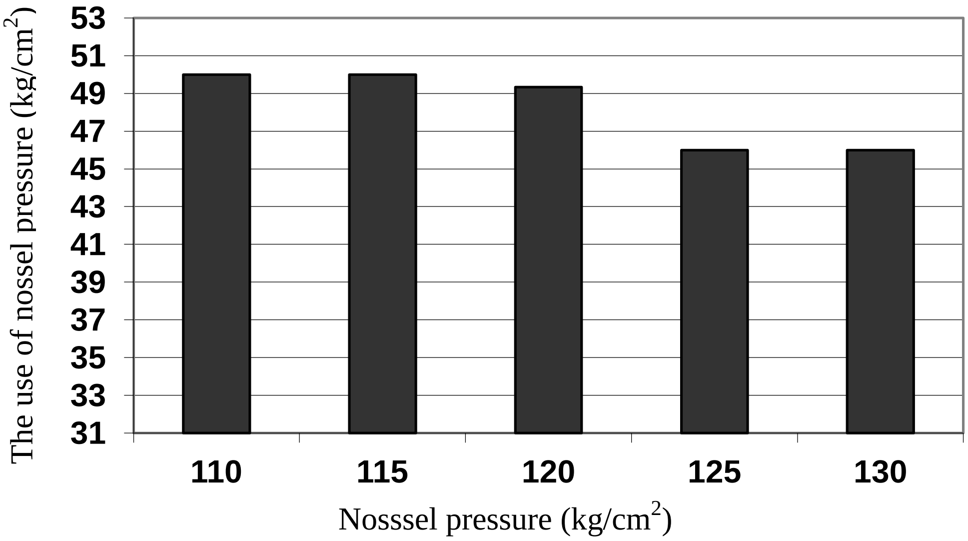


Figure 8. Use of solar chart (cc) the motor rotation 2000 rpm spraying nozzle 1000 by the number of stroke

c. Overall motor rotation.

Table 4. The use of Solar (cc) in total.

Rotation	Test	The use of solar (cc) / Nossel pressure (kg/cm^2)				
		110 kg/cm^2	115 kg/cm^2	120 kg/cm^2	125 kg/cm^2	130 kg/cm^2
1000 rpm	I	20	20	20	20	20
	II	20	20	20	20	20
	III	20	20	20	20	20
Total		**60**	**60**	**60**	**60**	**60**
Average $(\bar{x})$		**20**	**20**	**20**	**20**	**20**
1500 rpm	I	36	36	35,5	35	35
	II	36	36	36	35	35
	III	36	36	36	35	35
Total		**108**	**108**	**107,5**	**105**	**105**
Average $(\bar{x})$		**36**	**36**	**35,833**	**35**	**35**
2000 rpm	I	50	50	49	46	46
	II	50	50	50	46	46
	III	50	50	49	46	46
Total		**150**	**150**	**148**	**138**	**138**
Average $(\bar{x})$		**50**	**50**	**49,333**	**46**	**46**

Total	**318**	**318**	**315,5**	**303**	**303**
Average $(\bar{x})$	**35,33**	**35,33**	**35,05**	**33,67**	**33,67**

Based on table 4 can be explained that the use of diesel fuel contained in the lowest standard nozzle pressures (120 and 130) kg/cm2 with an average of 33.67 cc. While the average of the highest use of diesel fuel contained in the nozzle pressure (110 and 115) kg/cm2 is 35.33 cc. To see the use of solar variations (cc) and its relationship to the nozzle by pressure testing are presented in the following chart:

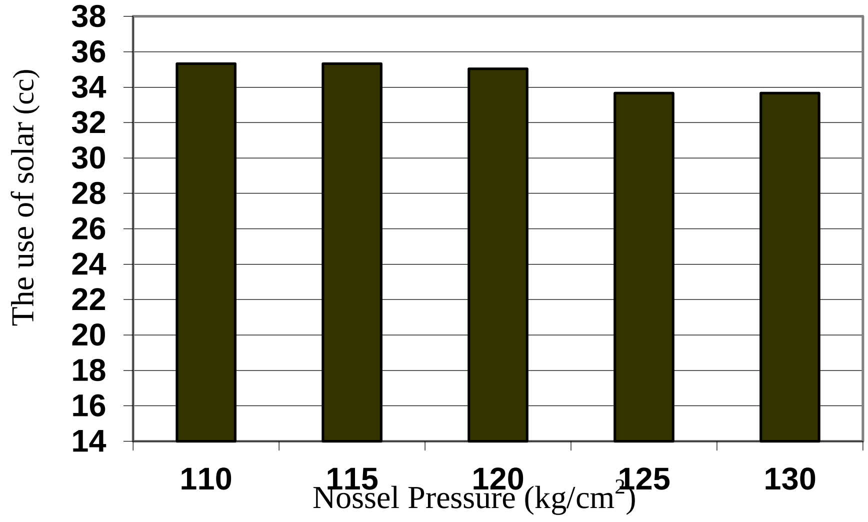


Figure 9. Chart average diesel consumption (cc) at each nozzle pressure and the motor

Hypothesis Testing

Hypothesis testing was conducted to determine the presence or absence of pressure effect on the use of diesel fuel nozzle at 300 L diesel engine by using statistical software SPSS 12 For Windows. Based on the results of univariate data analysis Analysis of Variance with the help of SPSS 12 For Windows software, acquired Fcount = 1132.806 and the values of significance is 0.00 or the values of significance is less than α = 0,05 (0,00 < 0,05) means H_0 rejected and H_a can be accepted. So it can be concluded that the influence of diesel nozzle pressure 4 is not the type L 300, there is an average difference before and after treatment are not the same. Based on the results of descriptive analysis, it is stated that the average difference in the use of diesel fuel at 1000 rpm spin motor with pressure (110, 115, 120, 125, 130) kg/cm2 = 20 cc / min. For motor rotation 1500 rpm with pressure (110 and 115) kg/cm2 = 36 cc / min, pressure nozzle 120 = 35.833 cc / min, and nozzle pressure (125 and 130) kg/cm2 = 35 cc / min. To the motor 2000 rpm with pressure (110 and 115) kg/cm2 = 50 cc / min, pressure nozzle 120 = 49.333 cc / min, and nozzle pressure (125 and 130) kg/cm2 = 46 cc / min

Discussion

In this study, taken three levels of motor rotation, the rotation 1000 rpm, 1500 rpm spin and spin up to 2000 rpm, above this maximum spin, the measurements is not carried out due to a very dangerous condition of the motor. Based on the output of the software SPSS 12 For Windows, it is obtained the following results: Based on table 1 and the figure 6, the rotation of the motor 1000, it can be explained that the use of solar there is no difference at all pressure nozzle with an average of 20 cc for 1 minutes.

Based on table 2 and the figure 7, the rotation of the motor 1500, it can be explained that the use of diesel fuel at a pressure nozzle are the lowest (125 and 130) kg/cm2 with an average of 35 cc for 1 minute, while the average usage of the highest solar contained at a pressure nozzle (110 and 115) which is 36 cc kg/cm2 for 1 minute.

Based on table 3 and the figure 8, the rotation of the motor 2000, it can be explained that the use of diesel fuel at a pressure nozzle are the lowest (125 and 130) kg/cm2 with an average of 46 cc for 1 minute, whereas the highest use of diesel fuel contained in the nozzle pressure (110 and 115) kg/cm2 with an average of 50 cc for 1 minute. Grounding the theory that the higher the pressure nozzle, the more efficient usage of solar, it is described the motor to own certain restrictions which may affect the nozzle pressure thrifty diesel usage, the lower the spin rate given on the motor (1000 rpm max spin limit) under the rotation 1000 rpm the motor nozzle pressure (110-130) did not affect the use of solar kg/cm2 but at a high motor rotation to be more frugal use of diesel fuel (maximum motor rotation 2000 rpm).

Based on table 4and figure 9, with an average total usage of diesel fuel, the use of diesel fuel at low pressure nozzle (125 and 130) kg/cm2 with an average of 33.67 cc, while the average of the highest use of diesel fuel contained in the nozzle pressure (110 and 115) kg/cm2 with an average of 35.33 cc. So it can be concluded that the lower the higher the pressure nozzle and the higher use of diesel fuel nozzle pressure the lower the use of diesel in diesel motors 4 stroke with langsumg combustion (indirect injection) type L 300.

Of rounds (1000, 1500, and 2000) obtained an average rpm diesel fuel usage, the nozzle pressure of 110 kg/cm2 = 35.33 cc / min, the nozzle pressure of 115 kg/cm2 = 35.33 cc / min, at pressures nozzle 120 kg/cm2 = 35.05 cc / min, at a pressure nozzle 125 kg/cm2 = 33.67 cc / min, the nozzle pressure of 130 kg/cm2 = 33.67 cc / min.

Conclusions And Recommendations

Based on the results of research and discussion it can be concluded that: There are significant differences in the use of diesel fuel in diesel motors L 300 before changing the nozzle pressure and nozzle pressure after the change. There are differences in the use of diesel fuel diesel motor seen from the difference in treatment before and after the change of nozzle pressure nozzle pressure changes. To all users of diesel motors L 300 must know the appropriate pressure in the engine nozzle. To prospective researchers who are interested in this field, in order to examine further the impact that may result to changes in pressure at the nozzle that uses a diesel engine with indirect injection using direct injection. The Faculty of Engineering, State University of Makassar, especially the managers of the Laboratory of Automotive Engineering Department in order to better motivate students researching on the development of appropriate technology Automotive Department. Inform the public about the benefits of the nozzle pressure changes that can save the use of solar.

References

Anonim. No years. 1. *Workshop Manual Engine dan Chasis*. PT. Krama Yudha Tiga Berlian Motor.

Anonim. 1995. *New Step 1*. Jakarta: PT. Toyota Astra Motor.

Anonim. Tanpa tahun 2. *New Step 2*. Jakarta: PT. Toyota Astra Motor

Arnicum, Aziz. 1993. *GBHN LIMA*. Jakarta: Sinar Grafika

Arismunandar, Wiranto. Tanpa tahun. *Motor Bakar Torak*. Bandung: ITB.

Arismunandar, Wiranto dan Tsuda, Koichi. 1975. *Motor Diesel Putaran Tinggi*. Bandung: ITB

Bagyo, Sucahyo. 1997. *Otomotif Mesin Tenaga*. Solo: PT. Tiga Serangkai.

Daryanto. 1987. *Dasar-dasar Teknik Mobil*. Jakarta: PT. Bina Aksara.

Daryanto. 2004. *Motor Diesel Pada Mobil*. Bandung: CV. Yrama Widya.

Hardjono. 2000. *Teknologi Minyak Bumi*. Yogyakarta: Universitas Gadja Mada.

Haryono. G. 1997. *Uraian Praktis Mengenal Motor Bakar*. Semarang: CV. Aneka Ilmu.

Karyanto, E. 2002. *Panduan Reparasi Mesin Diesel*. Jakarta: PT. Pedoman Ilmu Jaya.

Maalev, VL. 1995. *Operasi dan Pemeliharaan Mesin Diesel*. Jakarta: Erlangga

Permana, Danu, 2004. *Mobil Diesel*. Jakarta: Puspa Swara.

Soenarto, Nakoela dan Furuhama, Shoichi. 1985. *Motor Serba Guna*. Jakarta: PT. Pradnya Paramita.

Sudarto. Tanpa tahun. *Pengetahuan Praktis Teknik Mobil*. Semarang: CV. Ilmu Jaya.

Sudjana. 1992. *Metode Statistika*. Bandung: Tarsito..