FUEL TIME EFFECT AND COMBUSTION LOSS IN DIESEL ENGINE BASED ON SPRAY EFFECT

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Abstract.

Injection pump with automatic timer and based on wear and tear of walls due to spring action are the causes for fuel spray timing effect. Hence combustion loss and fuel unburnt may happen. As a result of the wear of the automatic timer spring, the fuel spraying time is delayed especially when operating with heavy loads, the motor can not reach normal power even sometimes the motor dies suddenly. The purpose to be achieved in this paper is to find out how much heat loss from combustion due to the delay in spraying fuel. The method used in this writing is based on secondary dataon fuel consumption in normal conditions and fuel consumption when there is a delay in spraying fuel. The result analysis indicates that the heat production in the engine has got effect due to spraying time whether slow or advance.

1.Introduction

Combustion is a chemically fast compounding process between oxygen and fuel. The combustion process that occurs in the combustion chamber with a system of spraying certain fuels with fuel is atomized in the combustion chamber by the atomizer through the nozzle hole and distributed evenly on the piston cross section. The fuel injection timing tuning coupler installed on the injection pump and connected to the injection pump drive shaft serves to continue the rotation of the gears to the fuel injection pump.

The clutch is added to the vacuum speed regulator called Automatic timer, useful to speed up when the fuel injection is in accordance with the motor rotation. With an automatic spring or spring the wear and tear is reduced. As a result of the wear of the automatic timer spring, the fuel spraying time is delayed especially when operating with heavy loads, the motor cannot reach normal power even sometimes the motor dies suddenly. This study aims to determine how much heat loss from combustion due to the delay in spraying fuel.

2. Methodology

The technical life of a machine will last long if the machine gets good and regular maintenance. The combustion that occurs in the cylinder will cause heat and if the heat exceeds the motor working temperature limit it will also affect the performance of the engine. Therefore the motor cooling system needs to get serious attention so that the engine can operate properly and there is no excessive heat.

Excessive motor temperature rises can be caused by damage to the components of the motor cooling system such as the thermostat, water pump, water hose radiator and so on that will result in parts of the motor that are directly related to the cooling median or require cooling or deformation and also the viscosity of the lubricating oil will rapidly decrease so that the components in the motor will experience rapid wear. In addition, the increase in motor temperature will affect the parameters for motor work, such as pressure (Pc) and compression temperature (Tc), indicator pressure (Pi) and effective motor pressure (Pe), effective use of motor (Fe) efficiency materials, pressure (Pz), and maximum combustion temperature (Tz), efficiency of motor gear (ηth), motor power and motor balance.

2.1. Thermodynamic Cycle

The Diesel cycle is the ideal cycle of a Diesel motor known as compression ignition. In terms of the thermodynamic view, the Diesel cycle is different from the Otto cycle, only in the process of heat input. In the Otto cycle, heat input occurs at a constant volume (isochoric) whereas in the Diesel cycle, heat input occurs at constant pressure (isobaric).

a) Process 1 - 2: Isentropic compression

b) Process 2 - 3: Enter heat at constant pressure (isobaric), qm

c) Process 3 - 4: Isentropic expansion

d) Process 4 - 1: Release of heat at a constant volume (isochoric).

2.2. Fuel combustion

What is meant by the combustion process on a Diesel motor is chemically fast compounding between acid (oxygen, O_2) and fuel. The combustion process takes place in the combustion chamber with a system of spraying certain fuels, with the fuel atomized into the combustion chamber by the atomizer through the hole of the nozzle and distributed evenly on the surface of the piston crossing. The fog fuel is in the form of very fine grains. Because the air inside the cylinder has very high temperatures and pressures, the last time the compression process of the fuel fog grains will then mix with the compressed air until it gradually catches fire and an explosion can cause a working process in the form of a straight motion rod which is then converted into rotational motion by the crankshaft.

A motor with fuel is burned in the cylinder to convert from heat energy into heat energy. But not all of the heat energy produced is converted into energy. Only about 25% of energy is utilized effectively. About 45% is lost when exhaust or friction gas and 30% is absorbed by the engine itself. The heat absorbed by the engine must be discharged into the air immediately, otherwise, will overheat and can speed up wear. Then the cooling system is equipped inside the engine for cooling and preventing excessive heat. Generally the engine is cooled by an air conditioning system or water cooling system (New Step 1 Training Manual, p.3-29).

The maximum power obtained from an operation should the combustion gas composition of the cylinder (the composition of the combustion gases) be made as ideal as possible, so that the gas pressure from combustion can be maximally pressed against the piston and reduce the occurrence of detonation. The composition of fuel and air in the cylinder will determine the quality of combustion and will affect engine performance.

The process or level of combustion in a machine is divided into four separate levels or periods. These periods are:

a) Delay period

The first period starts from point 1, which starts spraying the fuel until it enters the cylinder, and ends at point 2. This trip is in accordance with the crank travel angle a. During this period there is no increase in pressure over compressed air produced by the piston. And the fuel enters continuously through the nozzle.

b) Fast burning

At point 2 there are a number of fuels in the combustion chamber, which are finely broken and some evaporate and then ready to be burned. When the fuel is turned on which is at point 2, it will ignite quickly which results in a sudden increase in pressure until point 3 is reached. This period corresponds to the crank angle trip b. which forms the second level.

c) Controlled combustion

After point 3, the unburned fuel and the fuel are still being sprayed (injected) at a speed that depends on the injection speed, and the amount of oxygen distribution that is still present in the charging air. This period is called the controlled period or also called burning bit by bit which will end at point 4 with the cessation of injection. This period is in accordance with the crank travel angle c, with the angle c depending on the load carried by the engine load, so that the greater the load c.

d) Post combustion

The remaining fuel in the cylinder when injection stops and finally burns. Post combustion is not seen in the diagram, because piston retreating results in a decrease in pressure even though heat is generated by burning the end of the fuel. In ordinary hydrocarbon combustion there will be no symptoms if possible for the hydrolysis process. This will only happen if the initial mixing between fuel and air has sufficient time to allow the entry of oxygen into the hydrocarbon molecule.

3. Results and discussion

Calculation of Diesel Motor Thermodynamics

Diesel motor cycle which consists of steps to fill the air in the cylinder, compression steps, effort steps / expansion and exhaust steps. The cycle can be calculated using thermodynamic calculations to determine the performance of the motor.

a) Charging Step

To = Outside air temperature, 301 0K

□Tw = Increase in air temperature due to heat contact with the large cylinder wall between (10 0C – 20 0C) taken 10 0C

□r = residual gas coefficient (0, 03 – 0, 04) taken 0,035

Tr = Residual gas temperature = 800 0K

Therefore: Ta has limits (320 – 330 0K), Ta = 327, 87 0K

Filling recovery (□ch) obtained; Where:

Pa = Initial compression pressure = 0, 85 atm

To = Outside air temperature = 301 0K

□tw = 12 0C

□r = 0,035

Tr = 720 0K

The pressure and end temperature of the compression step can be calculated based on equation 2.3 that is the curved line of compression politropy:

Pc = Pa. n1 ; atm

Pa = 1, 1875 atm

A = 4, 62

B = 0, 00053

A and B are the coefficient obtained from the experiment.

4. Conclusion

1. As a result of weak spring automatic timing clutch, there is a delay in spraying fuel from the injection pump to the nozzle injector especially when it occurs at high speed with heavy motor workload. The amount of fuel consumption under normal conditions is 3.33 kg / hour or equivalent to 4.1625 liters / hour, after a delay in spraying, the amount of fuel consumption is 2.667 kg / hour or equivalent to 3.33375 liters / hour.

2. As a result of the late spraying it will affect the amount of heat generated from burning fuel. In normal circumstances the amount of heat produced is 33633 Kcal / hour, while the amount of fuel combustion heat due to late spraying is 26936.7 Kcal / hour, which means that there is an energy loss of 6696.3 Kcal / kg or a loss of energy around 10.44 HP.

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