# Single Cylinder SI Engine Fuelled with Petrol and Diesel

**Mohammed Anwar**
*Assistant Professor*
*Department of Mechanical Engineering*
*LORDS Institute of Engineering & Technology, Hyderabad, India*

**Mohd Shahrukh**
*B. Tech. Student*
*Department of Mechanical Engineering*
*LORDS Institute of Engineering & Technology, Hyderabad, India*

**Saif Bin Abdullah**
*B. Tech. Student*
*Department of Mechanical Engineering*
*LORDS Institute of Engineering & Technology, Hyderabad, India*

**Mohd Ali Junaid**
*B. Tech. Student*
*Department of Mechanical Engineering*
*LORDS Institute of Engineering & Technology, Hyderabad, India*

**Moinuddin**
*B. Tech. Student*
*Department of Mechanical Engineering*
*LORDS Institute of Engineering & Technology, Hyderabad, India*

## Abstract

The Industrial Revolution and increased population in the last two centuries have resulted in depletion of fossil fuels and environmental degradation. It is obvious that novel solutions must be found to meet the fuel demand and environmental requirements. Particularly, the alternative fuels could be proposed as a solution for the future in the field of SI engine. Promising alternative fuels for SI engines Dual fuel concept has been adopted to reduce the costing in the market. Dual fuel Spark ignition engine has been proposed as one approach to reduce Petrol engine which is highly expensive. In the present context, the world is facing difficulties with the crisis of fossil fuel depletion and environmental degradation. The depletion and the greenhouse gases generating can be neglected by installing the carbon filters before the petrol carburettor. Diesel fuels have a high self-ignition temperature; and hence are excellent spark ignition engine fuels. And among these wide area of research, use of Diesel as Spark ignition source in engine could be most appropriate field to research as alternative source of fuel and can be used for transportation. It is appropriate because it is in expensive than petrol.

**Keywords: Dual Fuel, Diesel Carburettor, Compressive Gun, Pressurized Nozzle, SI Engine**

## I. INTRODUCTION

The world is running out of oil and the laws of supply and demand are set to make petrol prohibitively expensive in very near future. Here is the research has a new combustion technique that offers significantly better fuel consumption. Spark ignition engines have become an integral part of our life without which the world would stop moving and will not meet its daily necessities. These engines act like the hearts of majority of the prime movers. The fuel used by these engines is generally non-renewable. This calls for the search for a diesel fuel, which promises to be harmonious in correlation with sustainable development, conservation, management efficiency and environmental preservation. It has become a prime subject of study in the transportation, agriculture, industrial, submarines, and many more applications. Maximum energy used by the world is supplied by the fossil fuels.

As it is observed that there are several disadvantages in using fossil fuels such as generating waste materials, emitting pollutants and is limited to usage. Today, the development of a country is measured on the basis of the number of automotive vehicles used by the public of the country. To enhance the above issues raised in the real world a new technique is adopted by the utilization of other fossil fuel named diesel which is much good and more in expensive than the petrol fuel.

## II. EXPERIMENTATION

A 4 stroke SI engine is operated on both the fuels for ex: Diesel and petrol use to run the engine and to reduce the emission through filter with charge production of petrol from the mineral source. We utilized a different innovative technique to run the engine on diesel and not on petrol continues by external diesel pressurizer connected to the compressive gun can be shown further below. The gun is connected directly to the diesel tank where the diesel is heated by an external heating device apparatus with immersed thermometer displaying flash and fire point of diesel. The flash point for the diesel ranges from 52-54 degrees

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and the fire point ranges from 54-56 degrees. Now these pre heated diesel is pressurise from the silencer exhaust passing through the nozzle of the gun entering into the petrol carburettor. This diesel on pre heating changes its properties nearly similar to equalize with the petrol properties. The altering of diesel makes the fuel combust in the engine cylinder with help of the spark ignition.

Spark ignition engines operating on petrol fuel have been known for a long time. Many large stationary engines (Generators) use two fuels. Normally of these dual fuels, one is Petrol and the other a diesel fuel. These two fuels can be taken in widely varying proportion to run an engine; such as engine is usually called a dual fuel engine. The shortage of liquid fuel and the realization that Diesel fuel are far cheaper than Petrol fuel have led to increased attention on the dual-fuel engine. An experimental investigation was carried out on a single cylinder, air cooled engine designed to develop power in kW at some rpm calculated below. Diesel was injected into the intake valve as a secondary fuel and Petrol was injected directly into the cylinder. Below is the graphical abstract for the SI engine that consist of carburettor through which first petrol is injected. There is an external installation where diesel is to be injected from the air inlet which the diesel fuel is pre heated and brought to the flash point.

The experimental setup of dual fuel SI engine consists of separate diesel tank and a different diesel sprinkler called as compressive gun and the connecting pipes between the apparatus. The diesel in the tank is preheated up to its flash point with a range of 52-54 degrees and later to the fire point up to the range of 54-57 degrees measured using the external thermometer. Now the preheated diesel fuel is supplied to the air inlet of the petrol carburettor. The engine is initially started with petrol and then the petrol is made to cut off while the diesel is introduced in to the carburettor through the compressive gun. The above process is done in such a way that it is made an external connection from the silencer of the engine which is connected to the compressor gun which also consist of a nozzle that pressurizes the fuel to overtake in to the combustion chamber through petrol carburettor. A passage from the silencer called as connection taken to pressurise the pre heated diesel in the diesel tank with certain angle operated by a ball valve. The engine that first started on a petrol gives nearly 60% of the exhaust gases through the silencer, where in between by operating the ball valve these gas is again utilized by a hose pipe connecting directly to the compressive gun to pressurise diesel through the nozzle. The diesel tank is arranged with an external heating system.

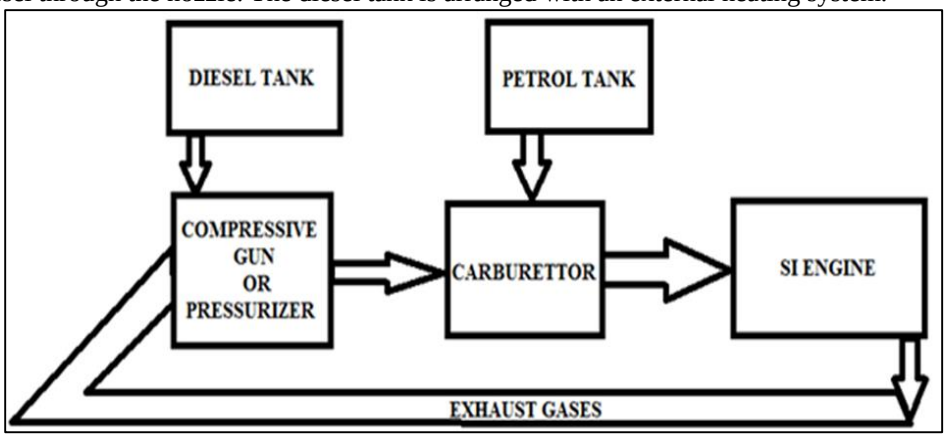


Fig. 1: Block Diagram

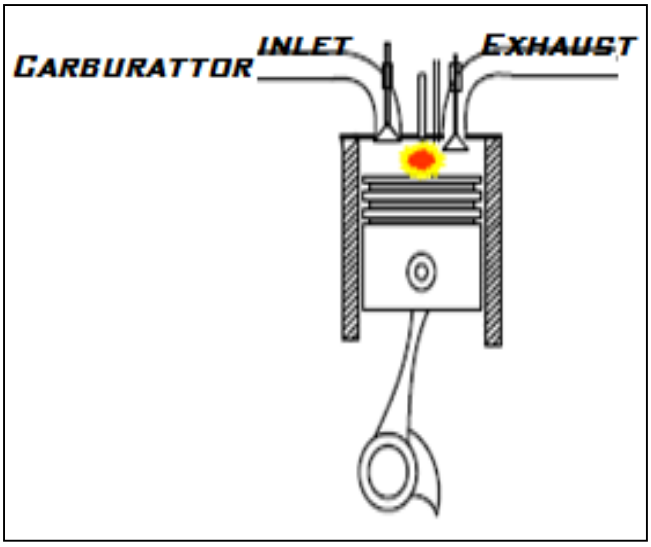


Fig. 2: Combustion in Si Engine

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## III. EQUIPMENT'S USED AND FUNCTIONING

### *A. Compressive Gun or Pressurizer*

The compressive Gun or the pressurizer is the device that is used to insert the preheated diesel into the petrol carburettor from which it inserts in the SI engine. It is the gun that compress the diesel from the exhaust gases coming from the engine exhaust towards the petrol carburettor and then to the SI engine.

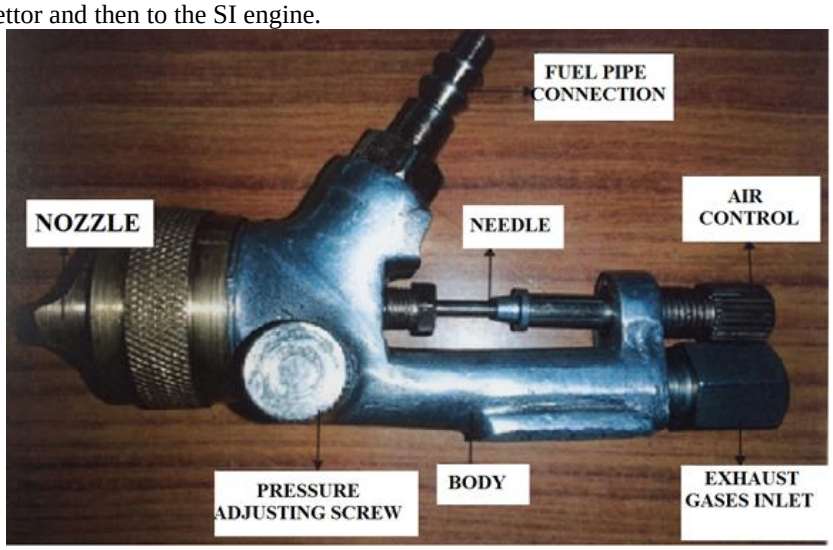


Fig. 3: Compressive Gun or Pressurizer

### *B. Hose Connection*

It is the pipe connection which allows the exhaust gases to flow from it to the pressurizer gun to compress the preheated diesel. The diesel coming from the diesel tank is pressurized through the hose pipe connected to the compressive gun.

### *C. Diesel Tank*

It is the external tank or the storage area of diesel fuel carried to pass the diesel in to the preheating device similarly to the petrol tank passing the petrol to the carburettor.

### *D. Preheating Device*

The device that heats the diesel before entering in to the air inlet of the carburettor, alternating the diesel properties similar to the petrol properties.

### *E. Thermometer*

Thermometer is used to check the flash point and fire point up to a range of 52 to 57 degrees.

## IV. ENGINE SPECIFICATIONS

Table – 1
Engine Specification

| *Engine specification* | *Data* |
|---|---|
| *Type* | *Horizontal, 4 stroke, single acting, totally enclosed, air cooled* |
| *Type of ignition* | *Spark ignition* |
| *Bore (mm)* | *50* |
| *Stroke (mm)* | *55.6* |
| *Crank radius (mm)* | *35* |
| *Connecting rod length (mm)* | *190.5* |
| *Compression Ratio* | *Petrol: 8:10 both fuels are combusted at* |
| | *Diesel: 15:20 same compression ratios.* |
| *Displacement* | *97cc* |
| *Maximum power* | *7.5 bhp @ 8000 rpm* |
| *Maximum torque* | *0.73 Nm @ 5000 rpm* |
| *Piston bowl* | *Hemi spherical* |
| *Fuel injection* | *Innovative external engine* |
| *Starting* | *Kick start, auto start.* |

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## V. SAMPLE CALCULATION

1) The brake power is the power output delivered by the engine shaft. It is less than the indicated power since heat is lost to overcome the total friction generated in the engine which is summed as friction power.
   Break power = $2\pi$NT/60000 KW
2) Mass of diesel= 1.02 x 3600/time taken x 60 kg/hr
3) Energy of diesel= mass of diesel x calorific value of diesel kg/hr
4) Engine thermal efficiency= η= P/Mf x Qh

η= thermal efficiency
P= output power produced/ cycle (kw)
Mf= mass flow rate of fuel/ cycle (kg/sec)
QHv= lower calorific value of fuel (mj/kg)

The brake mean effective pressure is a useful measure of the relative performance of an engine. It refers to the mean pressure to be maintained in the pistons of the cylinder to produce a power output during a power stroke. The brake mean effective pressure can be calculated from the torque and is defined as:

a) Break mean effective pressure

Bmep= Bp x 60 /$\pi$/4 x D^2 x L x N/n x no. of cylinder x100

Bp = brake power output (kw)
L= length of the stroke (m)
N= engine speed in rpm
n = stroke 2 or 4

5) Brake Specific fuel consumption is the measure of fuel flow rate per unit brake power and relates to the fuel efficiency of an engine. It is inversely proportional to the efficiency of the engine a slower values of brake specific fuel consumption are favourable for higher performance. Brake Specific fuel consumption is defined as:

Basic specific fuel consumption

- BSFC = Mf/ Bp x 3.6 x10^6
- BSFC=Brake specific fuel consumption,
- Mf = Mass flow rate of fuel (Kg/sec),
- Bp = Brake power output (kw).

## VI. FUEL PROPERTIES

Table – 2
Fuel Properties

| *Properties* | *Petrol* | *Diesel* |
|---|---|---|
| *Formula* | *C5-C8* | *C8–C20* |
| *Density at 1.01325 bar and 293 K (kg/m3)* | *737.22* | *840* |
| *Ignition temperature (K)* | *519.15* | *527* |
| *Flammability limits (% vol.)* | *-* | *0.6-5.5* |
| *Flame speed (m/s)* | *16.5* | *0.3* |
| *Adiabatic flame temperature (K)* | *2500* | *2200* |
| *Lower calorific value (kJ/kg)* | *-* | *42,500* |

## VII. RESULT

The combustion in the dual fuel engines is basically controlled by the Petrol - Diesel air mixing process which is influenced by the spray characteristics, air motion and the lpm substitutions of petrol and diesel. Combustion and engine performance characteristics the combustion studies with diesel only are shown as the effects of both fuels are more significant than in the rest of the ratios. At low load the diesel addition retarded the start of engine at such temperature and the fuel is combusted on altering the fuel property.

With a high load on the cylinder the temperature conditions changes and the fuel is atomized, creating good combustion and fuel oxidization. In addition, the fuel addition reduced the ignition delay, promoted faster combustion of the mixture and increased the in-cylinder pressure. Combustion duration results were obtained from 10% to 80% mass fraction burnt and is depicted.

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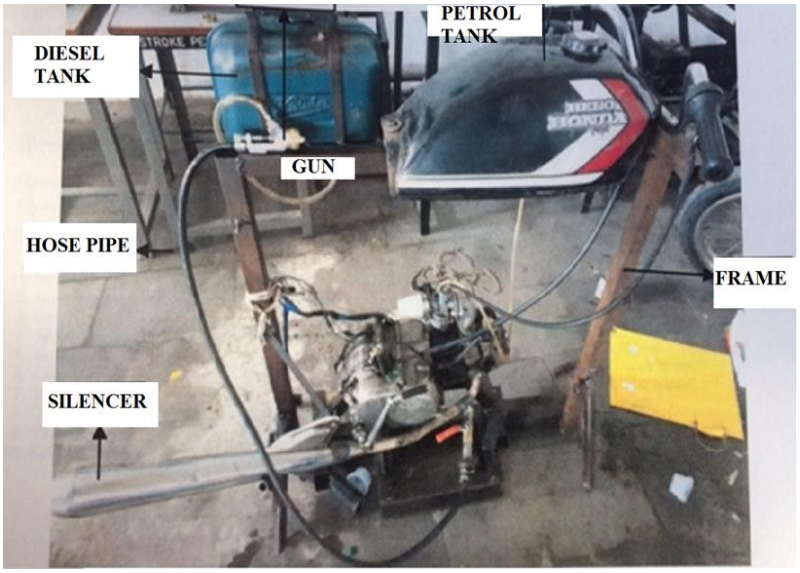

Fig. 4: Experiment Done

From the above Experiment diagram it is observed that petrol is inserted first in to the combustion chamber where the ignition takes place and the exhaust burnt gases is taken out through the silencer. A ball valve is placed with different way connection made on the silencer, to some extent of angle these ball valve is opened and the burnt gases is allowed to pass in to the compressive gun. These burnt gases pressurize the preheated diesel present in the gun towards the petrol carburettor passing from the air intake. The petrol flow is turn to cut off and diesel is allowed to pass for the combustion in the engine cylinder where it gets ignited using spark.

High flame speed of fuel contributed to faster combustion leading to more gaseous fuels–air mixture ignited spontaneously. The lower liquid fuel replacement obtained in the case of diesel additions than in the case of petrol was due to the low Carbon variation and volume energy densities. The brake thermal efficiency of dual fuel combustion was improved for the two different engine loads with utilizing the dual fuels. These improvements of the combustion reaction intensity mainly in the expansion stroke, allowed more of the chemical energy of the combustible mixture to be converted to useful work. From the above made study it is proved that the improvement in the efficiency can be made using the diesel than the diesel. Generally a new diesel engine can be introduced by installing the filters before the petrol carburettor for diesel to be atomised in the combustion chamber.

## VIII. CONCLUSIONS

This project briefly explains the working of diesel carburettor in SI engine and the necessity of dual fuel engine in modern world. This project also explains the procedure for implementing an additional carburettor for diesel fuel in SI engines. The engine works on petrol as well as diesel known as dual fuel engine. By observing the functionality of SI engine on both fuels we came on to the conclusion that spark ignition engines can be run on diesel when the diesel fuel is slightly warmed up and highly pressurised.

Diesel makes better homogenous mixture with air therefore better mixing of fuel which leads to better combustion. The efficiency of the engine is increased by using two fuel combustion process. Hence the usage of diesel can be utilised by installing filters for emission produced and back knocking.

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