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Performance and Analysis of Engine Using Aqua Silencer

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ABSTRACT

This study has been undertaken to investigate the An Aqua Silencer is mainly dealing with control of emission and noise in automobile exhaust. By using activated charcoal, perforated tube and outer shell it is constructed. An aqua silencer is fitted to the exhaust pipe of engine. The activated charcoal filters the harmful sulphur and nitrous content produced from the engine. Sound produced under water is less hearable than it produced in atmosphere. This mainly because of small sprockets in water molecules, which lowers its amplitude thus, lowers the sound level. Because of this property water is used in this silencer and hence its name aqua silencer. It is tested in single cylinder 4- stroke diesel engine the noise and smoke level is considerable less than the conventional silencer. The main pollutants contribute by automobiles are CO, HC, Nox etc. The Aqua Silencer will reduces the hazardous content in the exhaust silencer.

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I. INTRODUCTION

The Nowadays Air pollution is major problem. The main pollutants contribute by automobiles are (CO), UBHC, (Nox) and Lead etc. Other sources such as electric power generating stations, industrial and domestic fuel consumption refuse burning, industrial processing. So it is imperative that serious attempts should be made to conserve earth's environment from degradation. An aqua silencer is an attempt in this direction, it is mainly dealing with control of emission and noise. An aqua silencer is fitted to the exhaust pipe of engine.

Diesel engines are playing a vital role in Road and sea transport, Agriculture, mining and many other industries. Considering the available fuel resources and the present technological development, Diesel fuel is evidently indispensable. In general, the consumption of fuel is an index for finding out the economic strength of any country. In spite, we cannot ignore the harmful effects of the large mass of the burnt gases, which erodes the purity of our environment every day.

This project is an attempt to reduce the toxic content of diesel exhaust, before it is emitted to the atmosphere. This system can be safely used for diesel power packs which could be used in inflammable atmospheres, such as refineries, chemicals processing industries, open cost mines and other confined areas, which demands the need for diesel power packs.

An aqua silencer is used to control the noise and emission in IC engines. The reason why we go for aqua silencer is, in today life the air pollution causes physical ill effects to the human beings and also the environment. The main contribution of the air pollution is automobiles releasing the gases like carbon dioxide, unburned hydrocarbons etc. In order to avoid this type of gases we can use aqua silencer. It is fitted to the exhaust pipe of the engine; Sound produced under water is less hearable than it produced in atmosphere.

This mainly because of small sprockets in water molecules, which lowers its amplitude thus, lowers the sound level. The emission can be controlled by using the activated charcoal layer and Lime water. Activated charcoal layer is highly porous and posse's extra free valences so it has high absorption capacity along with this lime water chemically reacts with the exhaust gases from the engine and release much less. pollution to the environment. The noise and smoke level is considerable less than the conventional silencer, no need of catalytic converter and

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easy to install. The aqua silencer is more effective in the reduction of emission gases from the engine exhaust gas using perforated tube. By using perforated tube the back Pressure. Will remain constant and the sound level is reduced. Using the perforated tube the fuel consumption remains same as conventional system.

By using water as a medium the sound can be lowered and also by using activated charcoal in water. We can control the exhaust emission to a greater level. The water contamination is found to be negligible in aqua silencer, because the amount of acidity level in aqua silencer is expected to be below the dangerous acidity. It is smokeless and pollution free emission and also very cheap.

1.1. PROBLEM STATEMENT

The problems that arise from the automobile exhaust in the environment may be listed as follows:

- Gases and particulate in engine emission
- Heat and Humidity
- Risk of explosion and fires
- Transportation and storage of fuel
- High speed in long hauls
- The Risk of trackless vehicles entering inadequately ventilated areas
- Noise

Hence we the group of engineer has decided to make our project based on emission control which will reduce the above stated problems.

1.2. OBJECTIVES

- To reduce NOx
- To reduce COx
- To reduce noise

II. PART IMPLEMENTATION

2.1. Construction:

Basically an aqua silencer consists of a perforated tube which is installed at the end of the exhaust pipe.

The perforated tube may have holes of different diameters. The very purpose of providing different diameter hole is to break up gas mass to form smaller gas bubbles the perforated tube of different diameters. Generally 4 sets of holes are drilled on the perforated tube. The other end of the perforated tube is closed by plug. Perforated tube contains lime water inside it which chemically reacts with exhaust gas from the engine.

Around the circumference of the perforated tube a layer of activated charcoal is provided and further a metallic mesh covers it. The whole unit is then placed in a water container. A small opening is provided at the Top of the container to remove the exhaust gases. A U bend is provided at the end of perforated tube which functions as a non return valve which prevents the back flow of exhaust gas and lime water back to the engine.

The outlet pipe from the engine was connected to the scrubber tank. The nominal bore of the pipe is 50mm, which is also the inlet diameter of the scrubber tank. The shape and length of the pipe are decided according to the space available to keep the flow resistance to a minimum. The scrubber tank is fabricated in three stages and it contains the following sub-assemblies.

- Tank
- Perforated tube
- Lime stone container

2.1.1. Inner Tank and Perforated Tube:

Fig.2.1.1: Inner Tank and Perforated Tube

The perforated tube consists of number of holes of different diameters. It is used to convert high mass bubbles to low mass bubbles. The charcoal layer is pasted over the perforated tube.

Inner Tank- Perforated Tube-

- Material-M.S.sheetMaterial-M.S.sheet
- Thikness-1.5mm Thikness-1.5mm
- Dimension-150*150*150mm Outer Dia-70 and Inner Dia-40mm
- Quantity-1 Quantity-1

2.1.2. Charcoal Layer:

The charcoal layer has more absorbing capacity because it has more surface area. This charcoal is called as activated charcoal. It is produced by heating the charcoal above 1500 ‘c for several hours in a burner. Its surface area gets increased.

2.1.3. Outer Shell:

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Fig.2.1.3: Outer Shell

The whole setup was kept inside the outer shell. It is made up of iron or steel. The water inlet, outlet and exhaust tube was provided in the shell itself.

- Material-M.S.sheet
- Thikness-1.5mm
- Dimension-300*300*300mm
- Quantity-2

2.1.4. Flange and NRV

A flange joint is a connection of pipes, where the connecting pieces have flanges by which the parts are bolted together. Here flange is used to connect the silencer to the engine.

Fig.2.1.5: Flange and NRV

NRV-

- Size-15mm
- Pressure Range-2-3000Psi

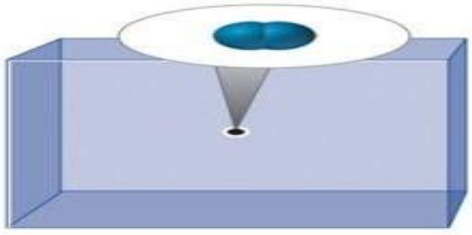
2.1.5. Frame

- Material-M.S.Square pipe
- Size-25*25mm (side)
- Thikness-1.5mm
- Dimension-1000*300*100mm (L*W*H)

2.2. Design Calculations

Design of tank:

Take Standard volume From the backpressure of engine, From Gas Low, $V \propto 1/P$



$V = 15.625$ Lit
$P = 1$ atm
$T = 0°C$

Volume=L*B*H (L=B=H) 15.625*10^6 = 3L
L=250 mm B=250mm

III. METHODOLOGY

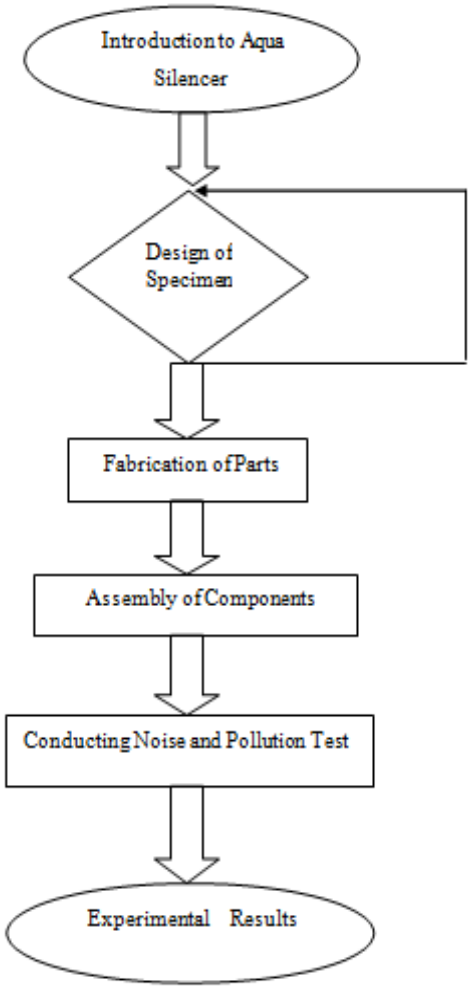


Fig.3. Flow chart of process

IV. WORKING

Fig.4.1: Setup of the system

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As the exhaust gases enter in to the aqua silencer, the perforated tube converts high mass bubbles in to low mass bubbles after that they come in to contact with lime water they chemically react with it and pass through the pass through charcoal layer which again purify the gases. It is highly porous and posses extra free valences so it has high absorption capacity.

Since the charcoal layer is covered with outer shell which is filled with water. Sound produced under water is less hearable than it produced in atmosphere. This is mainly because of small sprockets in water molecules, which lowers its amplitude thus, lowers the sound level hence aqua silencer reduces noise and pollution.

The lime water is a good absorbing medium. In aqua silencer the gases are made to be dissolved in lime water. When these gases dissolved in water they form acids, carbonates, bicarbonates etc.

When SOx is mixed in water, it form SO2, SO3, SO4, H2SO4 i.e. sulfur Acid (H2SO3), it forms Hydrogen Sulphide which causes fol rotten egg smell, acidify and corrosion of metals. The dissolved carbon dioxide forms bicarbonate at lower PH and Carbonates at higher PH. This levels 40-400 mg/liter. The carbon dioxide mixes with water to form Carbonic acid. It is corrosive to metals and causes green house effect. The NOx in exhaust gas under goes Oxidation to form ammonia, Nitrate, Nitrite, Nitric acid. This synthesis of protein and amino acids is affected by Nitrogen. Nitrate usually occurs in trace quantities in exhaust gas.

Activated charcoal is available in granular or powdered form. As it is highly porous and Possess free valences. So it possesses high absorption capacity. Activated carbon is more widely used for the removal of taste and odorous from the public water supplies because it has excellent properties of attracting gases, finely divided solid particles and phenol type impurities, The activated carbon, usually in the powdered form is added to the water either before or after the coagulation with sedimentation. But it is always added before filtration. Feeding devices are similar to those used in feeding the coagulants.

The problems that arise from the Diesel utilization in inflammable environment may be listed as follows:

- Gases and particulate in engine emission
- Heat and Humidity
- Risk of explosion and fires
- Transportation and storage of fuel
- High speed in long hauls
- The Risk of trackless vehicles entering inadequately ventilated areas
- Noise

This section examines the first two of these problems and suggests means by which they may be reduced or overcome. In addition to heat and water vapor, the pollutants in diesel exhaust are:

- Carbon monoxide (CO)
- Carbon dioxide (CO2)
- Oxides of Nitrogen (NOx)
- Sulphur dioxide (SO2)
- Hydrocarbons (HC)

The high temperature high pollutant exhaust gas is allowed to pass through the belt mouth assembly of the scrubber in the first phase. The bell mouth of the inlet/outlet is approximately 2 ½ times more in an area is that of the inlet. This allows the exhaust gas to expand considerably. This expansion allows the gas to cool, because the temperature is a function of pressure. This considerable reduction of backpressure allows for the additional involved due to the introduction of water and lime stone container. The venture effect of the bell – mouth is minimized because the exhaust gas escapes out of the bell – mouth randomly along the periphery. Fig 2 shows the aqua silencer.

After expansion, the emission comes in contact with oil where the obnoxious products of combustion are scrubbed when bubbled through it. The bell mouth also allows for more contact area with water, so that effectively cooling takes place within the short span of time available for the gas to pass through the oil. The length of bubbling can be increased by the oil level in the scrubber tank. But this will be increased result in an abnormal backpressure, which inadvertently affect the performance of the engine.

And for this reason the bell – mouth is a multipurpose component, to allow for reduction in back pressure, and provides for an increased contact area with the scrubbing agent. After bubbling through the oil, it comes in contact with bubbles, which encourage turbulence of the exhaust gas within and below the oil surface without unduly increasing the back pressure of the exhaust. This allows for the thorough scrubbing of the emission, so that more obnoxious product is absorbed in the allowed time.

He baffles are of invaluable help to reduce the carry-over of oil particles which are converted into steam, which otherwise will escape out of the system. A lime stone container, which is provided above the baffles, allows the exhaust emission to pass through limestone radially. In the scrubber tank water is used as an alkaline solution mainly to dissolve the Unburned Hydro Carbons (UBHC). By this method, the UBHC, even if it is in glowing conditions, it is dissolved in water; thereby it is suppressing a spark which could escape from the engine to the inflammable environment.

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V. RESULT AND CALCULATION

5.1 Emission results:

Without using Aqua at 0 load

Result report

Continuous measurment gas

27/04/2019 13:30

Phone:

Fax:

Licence number:	Manufacturer:
Mileage:	Vehicle type :
VIN:	Engine code :
Registration date:	Engine type :

Fual type	Petrol

Measured Values

Parameter		Actual value
CO2	[%vol]	1.72
O2	[%vol]	18.46
HC	[ppm]	17
CO	[%vol]	0.04
NO2	[ppm]	66

With using Aqua at 0 load

Result report

Continuous measurment gas

27/04/2019 12:30

Phone:

Fax:

Licence number:	Manufacturer:
Mileage:	Vehicle type :
VIN:	Engine code :
Registration date:	Engine type :

Fual type	Petrol

Measured Values

Parameter		Actual value
CO2	[%vol]	0.60
O2	[%vol]	20.14
HC	[ppm]	4
CO	[%vol]	0.02
NO2	[%vol]	17

Without using Aqua at 3 load

Result report

Continuous measurment gas

27/04/2019 13:15

Phone:

Fax:

Licence number:	Manufacturer:
Mileage:	Vehicle type :
VIN:	Engine code :
Registration date:	Engine type :

Fual type	Petrol

Measured Values

Parameter		Actual value
CO2	[%vol]	2.43
O2	[%vol]	17.52
HC	[ppm]	14
CO	[%vol]	0.04
NO2	[%vol]	125

With using Aqua at 3 load

Result report

Continuous measurment gas

27/04/2019 14:07

Phone:

Fax:

Licence number:	Manufacturer:
Mileage:	Vehicle type :
VIN:	Engine code :
Registration date:	Engine type :

Fual type	Petrol

Measured Values

Parameter		Actual value
CO2	[%vol]	1.17
O2	[%vol]	19.29
HC	[ppm]	6
CO	[%vol]	0.04
NO2	[%vol]	54

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Without using Aqua at 6 load

Result report

Continuous measurment gas

27/04/2019 14:30

Phone:

Fax:

Licence number:	Manufacturer:
Mileage:	Vehicle type :
VIN:	Engine code :
Registration date:	Engine type :

Fual type	Petrol

Measured Values

Parameter		Actual value
CO2	[%vol]	2.22
O2	[%vol]	17.65
HC	[ppm]	19
CO	[%vol]	0.04
NO2	[%vol]	158

With using Aqua at 6 load

Result report

Continuous measurment gas

27/04/2019 14:50

Phone:

Fax:

Licence number:	Manufacturer:
Mileage:	Vehicle type :
VIN:	Engine code :
Registration date:	Engine type :

Fual type	Petrol

Measured Values

Parameter		Actual value
CO2	[%vol]	3.11
O2	[%vol]	16.6
HC	[ppm]	10
CO	[%vol]	0.07

Without using Aqua at 9 load

Result report

Continuous measurment gas

27/04/2019 15:01

Phone:

Fax:

Licence number:	Manufacturer:
Mileage:	Vehicle type :
VIN:	Engine code :
Registration date:	Engine type :

Fual type	Petrol

Measured Values

Parameter		Actual value
CO2	[%vol]	1.57
O2	[%vol]	18.70
HC	[ppm]	18
CO	[%vol]	0.02
NO2	[%vol]	126

HC	[ppm]	10
CO	[%vol]	0.07

With using Aqua at 9 load

Result report

Continuous measurment gas

27/04/2019 15:01

Phone:

Fax:

Licence number:	Manufacturer:
Mileage:	Vehicle type :
VIN:	Engine code :
Registration date:	Engine type :

Fual type	Petrol

Measured Values

Parameter		Actual value
CO2	[%vol]	1.72
O2	[%vol]	18.55
HC	[ppm]	8
CO	[%vol]	0.04
NO2	[%vol]	139

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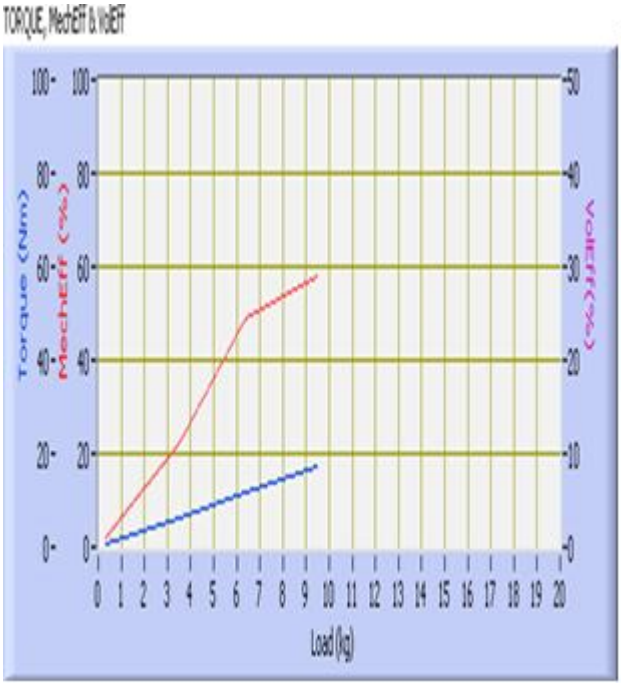
5.2: Performance Analysis test:

Without using Aqua



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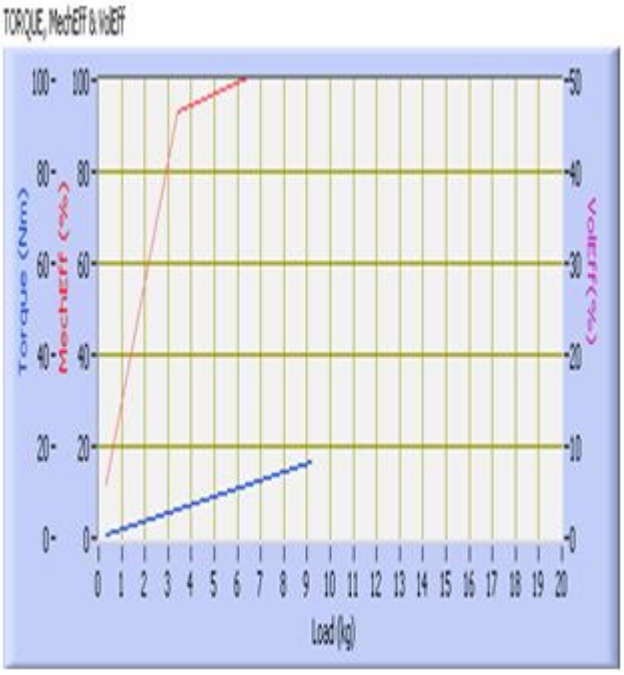

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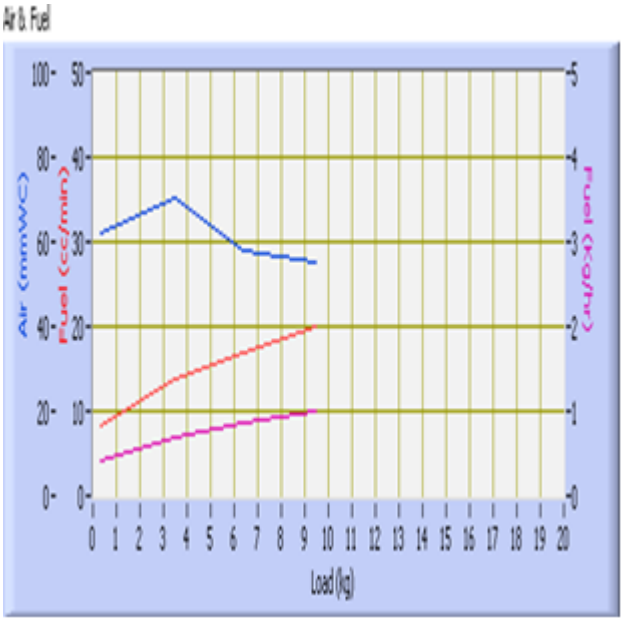
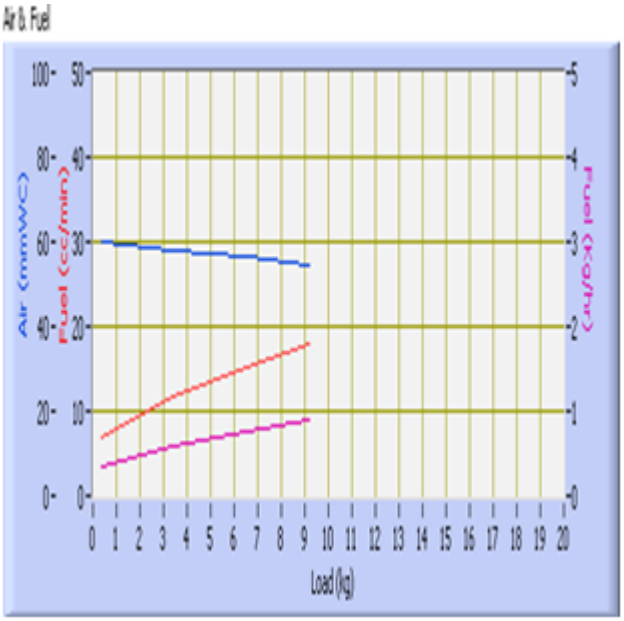


With using Aqua



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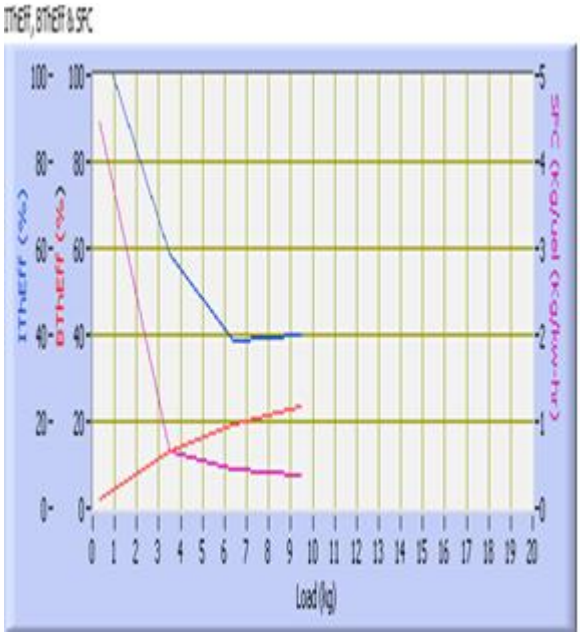
Without using Aqua



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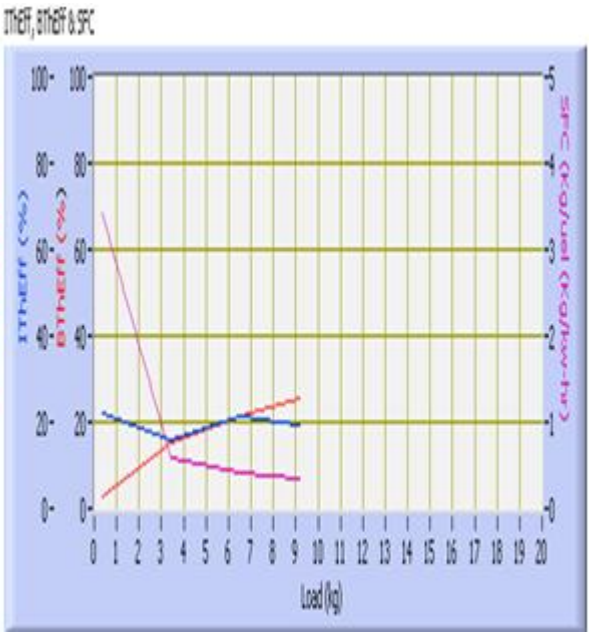

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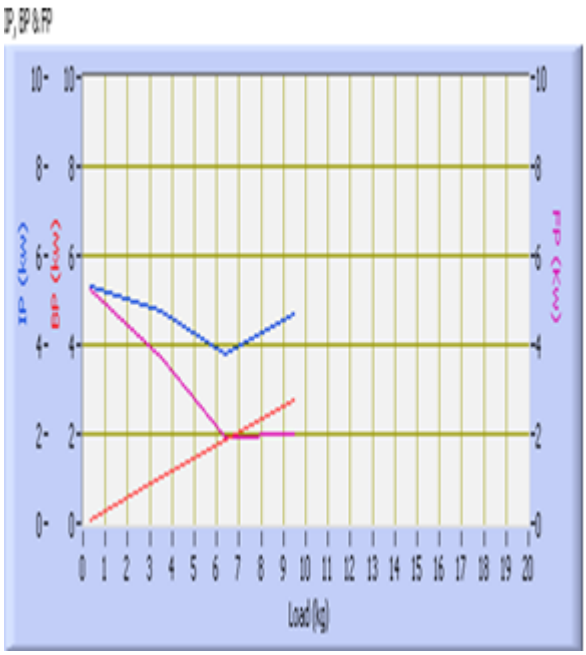
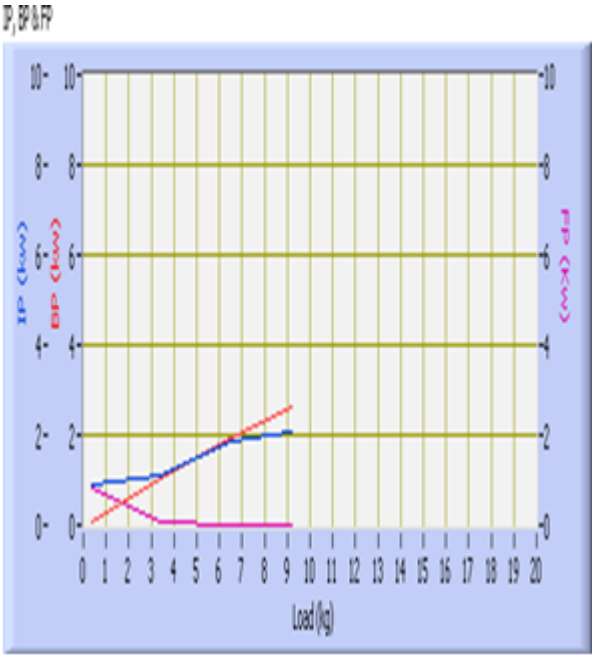


With using Aqua



VI. ADVANTAGES, LIMITATION AND APPLICATION

6.1 Advantages

- Diesel engines are playing a vital role in Road and sea transport, Agriculture, mining and many other industries.
- Considering the available fuel resources and the present technological development, Diesel fuel is evidently indispensable.
- In general, the consumption of fuel is an index for finding out the length of any country.

6.2 Limitations

- Need to alter the silencer which may increase the total weight of the vehicle.
- As we increase the load the % of may be equal to or some amount greater than actual.

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6.3 Applications

- For achieving this toxic gases are to be reduced to acceptable limits before they are emitted out of this atmosphere, which otherwise will be hazardous and prone to accidents.

VII.FUTURE SCOPE

The aqua silencer is more effective in the reduction of emission gases from the engine exhaust gas using perforated tube. By using perforated tube the back Pressure will remain constant and the sound level is reduced. Using the perforated tube the fuel consumption remains same as conventional system.
By using water as a medium the sound can be lowered and also by using activated charcoal in water. We can control the exhaust emission to a greater level. The water contamination is found to be negligible in aqua silencer, because the amount of acidity level in aqua silencer is expected to be below the dangerous acidity. It is smokeless and pollution free emission and also very cheap. The aqua silencer's performance is almost equivalent to the conventional silencer.

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