REDUCTION OF CARBON PARTICLES FROM EXHAUST GAS

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ABSTRACT

Purity of air is heart of the living being. Now a days, air pollution is the major problem occurs in the modern era. The main pollutants which were come from the exhaust gases are carbon monoxide and oxide of nitrogen (NOx) etc. So it is necessary to reduce the pollution which is caused by the engine exhaust gas. As considering the effects, our project is made to reduce the carbon monoxide and nitrogen oxides. This project will help to reduce the emission which were comes out from petrol engine exhaust. Petrol has less density when compared to diesel engine and lime water can easily react rapidly with petrol thus why we choose the petrol engine. Perforated square tube, lime water and charcoal layer are used in this technology. Lime water is placed inside the perforated tube. Due to this lime water, noise gets reduced to some level. The whole assembly of the silencer unit is fitted to the exhaust manifold of the engine. It does not give rise to any complications in assembling it. This system is very cost effective and more economical. This silencer will help to reduce the emission which were comes out from petrol engine exhaust. Petrol has less density when compared to diesel engine and lime water can easily react rapidly with petrol thus why we choose the petrol engine.

Key words: *Emission, Pollutants, Perforated square tube, Lime water and Charcoal solution*

INTRODUCTION

Petrol 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, Petrol 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. It is especially so, in most developed countries like USA and EUOPE. While, constant research is going on to reduce the toxic content of petrol exhaust, the petrol power packs find the ever increasing applications and demand.

This project is an attempt to reduce the toxic content of petrol exhaust, before it is emitted to the atmosphere. This system can be safely used for petrol 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 petrol power packs. 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.

LITERATURE SURVEY

A great deal of exertion is being made to lessen the air contamination from petrol and diesel engines and guidelines for emanation limits are likewise forced. Moreover, advancements in petrol and diesel engines, joined with upgrades in the vehicles, will make fuel utilization decrease of 40% or more lately on vehicles. One such advancement is improvement of the silencer unit of an engine. This is the place a new silencer unit becomes an integral factor. The new silencer unit predominantly manages control of discharge and commotion in engine fumes.

It essentially comprises of a box type unit which is introduced at the exit of the fumes from the engine, which may have openings of variable measurements. This is done to isolate the gas atoms of huge extents to frame gas particles of littler distance across. Hypothetically, at least four arrangements of openings are made on the model utilizing penetrating. A little covering of initiated charcoal is given all around the model utilizing an inward box which holds the charcoal set up and isolates the charcoal and lime water from the water in the silencer. This unit is then put in a holder in which water is filled to a specific dimension. A little opening is given on the top of the internal box which conveys the fumes from it to the outside utilizing a little distance across pipe. Subsequent to disregarding the charcoal layer, a segment of the gases break up into the water lastly the fumes gases escape through the opening in to the environment. "Emission" is a term that is utilized to depict the totality of undesired gases and particulates which are discharged into the air or produced by various sources. Its sum and type change with changes in the modern action, innovation, and various different components, for example, air contamination guidelines and outflows controls. Notwithstanding warmth and water vapor, the contaminations shaped in motor fumes are,

- Carbon monoxide (CO)
- Carbon dioxide (CO2)
- Oxides of Nitrogen (NOx)
- Sulfur dioxide (SO2)
- Particulate and Unburned Hydrocarbons (UBHC)
- Respirable ignitable Dust (RCD)

The above dirtying substance in the engine fumes are to be constrained by the new silencer.

CAUSES OF SMOKE

The main cause of smoke is incomplete combustion of fuel inside the combustion chamber. Two main reasons for incomplete combustion are incorrect air - fuel ratio and improper mixing.

These might result due to engine design factors, such as injection system characteristics, the induction system, governor control, the fuel used, and the engine rating.

- Injection system
- Rating
- Fuel
- Load
- Engine type and Speed
- Fuel - Air ratio

We know that in addition to harmful emission, engines also produce a very high amount of noise. Industrialization, together with the needs of our modern society for various machines for Human comfort, fast travel and appliances for routine jobs in homes and offices, has led to increase in the levels of noise pollution almost everywhere. The harmful effects of noise are well known. Exposure to noise causes detrimental effects on neuro-endocrine, cardiovascular, respiratory and digestive systems. Chronic exposure to noise causes fatigue and interferes with concentration, thus reducing work efficiency. The basic principle of using water in reducing noise is that sound produced under water is less audible than in atmosphere. This is mainly because of small sprockets in water molecules, which lowers its amplitude thus, lowers the sound level.

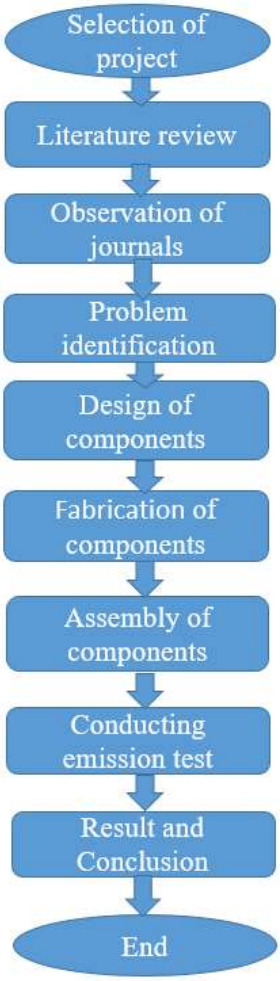
OBJECTIVE

There has been an expanding worry as of late over the expanding of transportation and release of modern waste waters into condition. The engine discharge contains air poisons and different species. Practically all toxins are poisonous in nature. A portion of the precedents are CO, CO2, NOX, and Hydrocarbon. Consequently, evacuation of these poisons was chosen as the essential concern. There are a few costly methods accessible in created nations. In spite of the fact that in creating nations (for example, India), adsorption procedure which is more affordable and financially plausible is utilized. It has been chosen for the present examination utilizing some modest cost synthetic compounds as a viable adsorbent. In this manner the goal of the present work is to test the newly designed silencer in evacuating air toxins and lessen clamor of emanation from engine.

SCOPE

A silencer system is designed in such a way as to substitute for conventional single unit engine silencers installed on industrial engines and heavy vehicles. Its construction is simple and it has a slender design; in addition to having a minimal 'footprint', it also optimizes the engine exhaust system for reducing backpressure and decreasing noise levels. It is used to control the noise and emission in IC engines. The reason why we opt for new silencer is that, in our world, air pollution causes physically and mentally harmful effects to human beings and also to the environment. The main contribution of air pollution comes from automobiles and industrial engines releasing gases like carbon dioxide and unburnt Hydrocarbons. By using water as a medium, the sound produced can be lowered. With further development, it can also be used in automobiles.

METHODOLOGY OF THE PROJECT



System is an essential component to be considered to ensure the familiar working of the undertaking and to get anticipated outcomes. As it were, technique can be portrayed as a system which contains the components of the work dependent on the targets and extent of the task. A decent structure can exhibit the general perspective on the task and be utilized to mastermind or concentrate the information effectively. This incorporates the different advances included, for example, writing study and structure of example, manufacture of parts, get together, testing stage, and so forth.

DESIGN AND CONSTRUCTION OF PROJECT

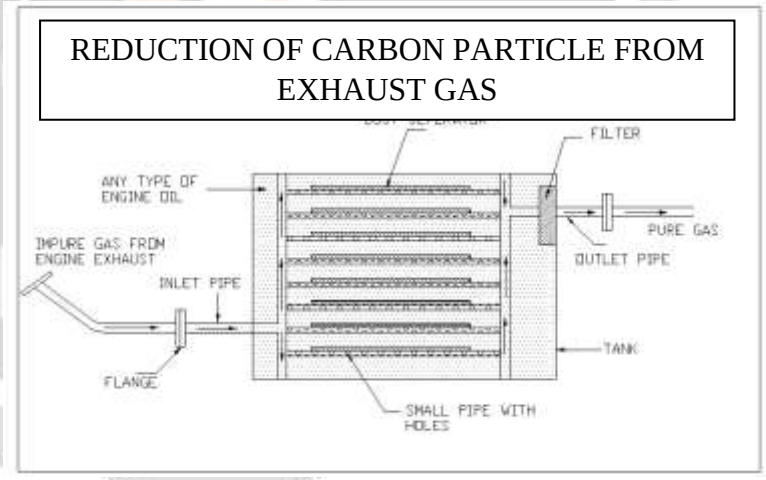


Fig.1: Design of the new silencer

CONSTRUCTION

The silencer unit is connected to the exhaust manifold of the engine. This unit basically consists of a perforated square tube which is installed inside the silencer unit, which is having holes of variable diameters. This is done to divide the gas molecules of large proportions to form gas molecules of smaller diameter. Lime water is stored inside the perforated tube, which chemically reacts with the exhaust coming from the engine. A small coating of activated

charcoal is provided all around the perforated tube using an inner box which holds the charcoal in place and separates the charcoal and lime water from the water in the silencer unit. A U bend pipe is connected at the inlet of perforated tube which works as a non-return valve which prevents the back flow of engine exhaust or lime water back into the engine. A filter is provided at the outlet of perforated tube to filter the soot particles.

Fig.2: Silencer unit

Fig.3: Interior of the silencer unit

Fig.4: Silencer unit connected to the Engine unit

WORKING

When the exhaust gas from the engine enters the silencer unit, gas molecules of large proportions are converted into gas molecules of smaller diameter using the perforated square tube and then they chemically react with the lime water solution and ultimately passes through the charcoal layer, which again purifies the exhaust gases. The activated charcoal is highly porous and has a quite high absorption capacity due to possession of extra free valences in it. Since the silencer unit containing the charcoal and water solution, noise produced is damped and reduced to a low level. Hence, this unit reduces noise and air pollution to an acceptable level.

CHEMICAL REACTIONS

Chemical reaction 1:

The obnoxious product of combustion is NOx- the oxides of Nitrogen. Water will absorb the oxides of Nitrogen to a larger extent. The following chemical reaction will enhance the proof for the above statement.

$NO_2 + 2H_2O \longrightarrow 2\,HNO_2 + 2HNO_3$ (Diluted) ……. I

Chemical reaction 2:

If a small amount of limewater is reacted to the exhaust gases the reaction will take place as

$Ca(OH)_2 + 2HNO_3 \longrightarrow Ca(No_3)_2 + 2H_2O$

$Ca(OH)_2 + 2HNO_2 \longrightarrow Ca(NO_{2)2} + 2H_2O$ …….. II

Chemical reaction 3:

When the carbon dioxide present in the exhaust gas comes in contact with the limewater, calcium carbonate will precipitate. The calcium carbonate when further exposed to carbon dioxide, carbon bicarbonate will be precipitated. The following reactions

$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$

$CaCO_3 + H_2O + CO_2 \longrightarrow Ca(HCO_3)_2$ …… III

Chemical reaction 4:

The sulphur dioxide present in the exhaust gas also reacts with the limewater. But the small trace of sulphur dioxide makes it little difficult to measure the magnitude of the chemical reaction and calcium sulphate will precipitate.

$Ca(OH)_2 + SO_2 \longrightarrow CaSO_3 + H_2O$ …… IV

Chemical reaction 5:

From calcium carbonate, calcium sulphite will precipitate and CO2 will be by-products. Because of the small percentage and SO2 presence, the liberation of carbon dioxide is very less. But the liberated CO2 will again combine with calcium carbonate to form calcium bicarbonate.

$CaCO_3 + SO_2 + H_2O \longrightarrow CaSO_3 + CO_2 + H_2O$ ……..…… V

TESTING OF PROJECT AND RESULT ANALYSIS

The results which are obtained from the project analysis are given in the below table. Emission test was conducted on this project. During test, it is observed that the amount of hydrocarbons and CO are reduced.

Engine Details

Engine	- CD 100
Type	-Horizontal 4 stroke
Fuel	-Petrol
No. of cylinder	- One
Bore Dia.	- 114.3mm
Stroke	-134.7mm
Speed	-650rpm
Power	-4.40kw
Cooling system	- air cooling

Emission Comparison

Pollution gases	Silencer without solution
CO	0.187 %
HC	684 ppm
CO2	3.70 %
O2	15.13 %
NOx	69 ppm

Pollution gases	Silencer with limestone and water solution
CO	0.157 %
HC	924 ppm
CO2	3.00 %
O2	16.23 %
NOx	54 ppm

Pollution gases	Silencer with charcoal and water solution
CO	0.157 %
HC	394 ppm
CO2	3.70 %
O2	14.42 %
NOx	52 ppm

Fig.2: Silencer without solution reading

Fig.3: Silencer with limestone and water solution

Fig.4: Silencer with charcoal and water solution

The above comparison is experimentally tested and analysis the emission of gases in our silencer unit, it made a good output that it could control the emission. This type of silencer is also used for diesel engine

because the diesel engine having high emission gases and it will control the emission and reduce the pollutants gases.

ADVANTAGES AND DISADVANTAGES

Advantages

- Control emission in greater level
- Reduce noise pollution
- No vibration when the engine is running
- Chemical reaction will be fast
- Carbon is precipitated
- It is light in weight
- Outer shell will not rust because of lime water
- No need of catalytic convertor
- Low cost
- Easy in construction
- Easy starting

Disadvantages

- Lime water should be refilled once in a year
- Need a separate space to setup

FUTURE ENHANCEMENT

There has naturally been an expanding worry as of late over the expanding rate of transportation and release of modern waste waters into condition just as the arrival of dangerous outflow into the climate from vehicle and mechanical motors. Mechanical achievements like the new silencer can be the response to the decrease of lethal outflows into nature from engines. Presently, the new silencer is appropriate for use in mechanical motors and overwhelming weight vehicles. In any case, R&D offices have thought about the subject and are going into creating and updating the silencer to make it conceivable to be fitted in to vehicles keeping its streamlined properties stable and supporting or expanding its proficiency.

CONLUSION

It has been experimentally observed that the new silencer is successfully effective in reducing emission of gases from the engine exhaust. By using water as a medium, the sound levels have been reduced and by using activated charcoal in water, it produces almost pollution-free and smokeless emission and is also cheap considering long term use. The new silencer's performance is almost equivalent to the conventional silencer. It can be widely used in industrial engines and with a little improvisation, in heavy weight vehicles. This project analyzed the smoke content of the exhaust gas before and after treatment and it was found that there is a considerable reduction in the emission as pointed out by the test results.

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