EMISSION CONTROL USING AQUA SILENCER

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ABSTRACT

An Aqua Silencer is used for control of emission and noise in automobile exhaust. By using activated charcoal, perforated tube and outer shell it is constructed. An aqua silencer is connected to the exhaust pipe of the engine. The activated charcoal filters the harmful sulphur oxides and nitrogen oxides content produced from the engine. Sound produced under lime water is less hearable than it produced in conventional silencer. This mainly because of small sprockets in water molecules, which lowers its amplitude thus, lowers the sound level. Because of this property lime water is used in this silencer and hence its name aqua silencer. It is tested in a single cylinder 4- stroke petrol engine the noise and smoke level is considerable less than the conventional silencer. The main pollutants contributed by automobiles are Carbon monoxide(CO), Unburnt Hydrocarbon(HC),Oxides of nitrogen (Nox) and Lead etc., other sources such as electric power generating stations, industrial and domestic fuel consumption, refuse burning, industrial processing.

Keywords:

Aqua Silencer, exhaust pipe ,Carbon monoxide(CO), Unburnt Hydrocarbon(HC),Oxides of nitrogen (Nox) and Lead

INTRODUCTION

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. Inspire, 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 the USA and EUROPE. While constant research is going on to reduce the toxic content of diesel exhaust, the diesel power packs find the ever increasing applications and demand. 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, chemical processing industries, open cast mines and other confined areas, which demands the need for diesel power packs. To achieve 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.

The principle involved is by bubbling the exhaust gas through the scrubber tank containing an alkaline solution, here the temperature of the gases is reduced, while most of the oxides of nitrogen in the exhaust are rendered non – toxic.

The highly dangerous carbon monoxide is not such a menace in diesel exhaust, as it does not exceed 0.2 percent by volume, whereas in petrol engines the CO content may be as high as 10 percent. A lime stone container in the scrubber tank reduces the considerable percentage of sulphur – di – oxide presents in the exhaust.

The provision of suitable baffles in the scrubber tank aids the turbulence so that thorough scrubbing takes place. The bell-mouth solution, while reducing the back pressure. For measuring the contents of the exhaust gas, provisions are made to take samples between engine outlet and scrubber inlet and after the scrubber outlet before the gases are let out to the atmosphere. These sampling points enable us to measure the exhaust gas content before and after scrubbing. The difference is evaluated and effective control is initiated.

The main pollutants contributed by automobiles are Carbon monoxide(CO), Unburnt Hydrocarbon(HC),Oxides of nitrogen(Nox) and Lead etc., other sources such as electric power

generating stations, industrial and domestic fuel consumption, refuse burning, industrial processing. An aqua silencer is used to control emission and noise.

It is tested in a single cylinder 4- stroke diesel engine the noise and smoke level is considerable less than the conventional silencer. 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's life the air pollution causes physical ill effects to the human beings and also the environment. The main contribution of air pollution is automobiles releasing gases like carbon dioxide, unburned hydrocarbons etc.
In order to avoid this type of gases by introducing this 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 it is highly porous and possesses extra free valences so it has high absorption capacity. So absorb the gases from the engine and release much less position to the environment.

PROBLEM IDENTIFICATION

EMISSION AND NOISE:

A lot of effort is being made to lessen the air pollutants from petrol and diesel engines and regulations for emission limits are also imposed. Moreover, trends in petrol and diesel engines, blended with upgrades in the vehicles, will make gasoline intake a discount of 40% or greater in the destiny automobiles. One such improvement is development of the silencer unit of an engine.
That is wherein an Aqua Silencer comes into play. An Aqua Silencer particularly offers manipulation of emission and noise in engine exhaust. It basically consists of a perforated tube that is established on the go out of the exhaust from the engine, which may additionally have holes of variable diameters. This is performed to divide the gas molecules of large proportions to shape gas molecules of smaller diameter. Theoretically, four or extra units of holes are made at the perforated tube using drilling. The alternative quit of the perforated tube is sealed using a plug.

In addition to heat and water vapour, the pollutants formed in engine exhaust are,

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

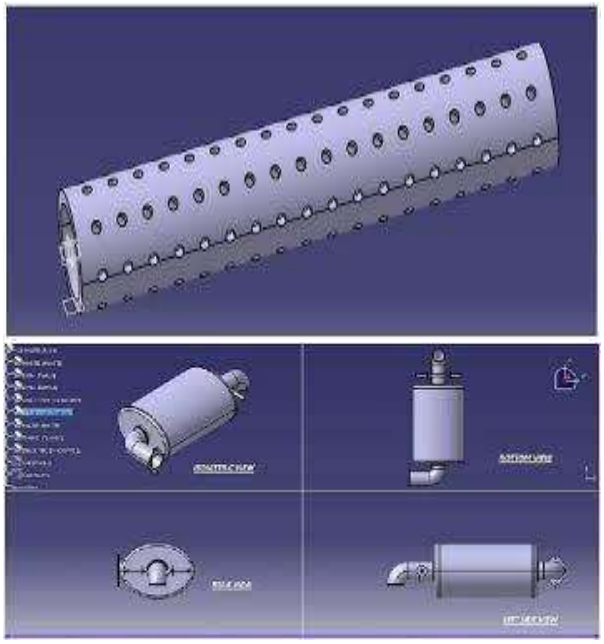
The above polluting contents in the engine exhaust are to be controlled by the Aqua Silencer.

OBJECTIVES

The immense study and research is going to reduce emission levels in auto-mobiles at various levels. Our main objective of work is to contribute our knowledge to control the emission level at lowest value as possible in an IC engine, reduce noise level and also reduce back pressure as much as possible. There has been an increasing issue in recent few years about transportation and discharge outlets of industrial waste into the environment. The engine emission contains smoke which creates air pollutants and other species.Hence, removal of these pollutants was a necessary concern over these years. There are many other expensive techniques which are developed in countries. In which adsorption technique is less expensive and economically feasible. It has been used for present study using some cheap cost chemicals as an effective adsorbent. Therefore the objective of the project work is to test the ability of an Aqua Silencer in minimizing air pollutants and reducing noise of emission from the engine.

DESIGN AND FABRICATION PROCESS

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 a 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 backflow of exhaust gas and lime water



Perforated tubes are made of aluminium, stainless steel, carbon steel and alloy sheet. According to the opening diameter, we design the width of plate and punch holes customized by you. Then these plates are rounded in a spiral or straight strip and welded by argon arc welding. The perforated filter tube surface is processed by electrolytic polishing, galvanization, sandblasting, pickling and passivation.

As the exhaust gases enter into the aqua silencer, the perforated tube converts high mass bubbles in low mass bubbles after that they pass through a charcoal layer which again purifies the gases. It is highly porous and possesses extra free valences so it has high absorption capacity. After passing over the charcoal layer some of the gases may dissolve into the water and finally the Exhaust gases escape through the opening into the atmosphere. Hence aqua silencer reduces noise and pollution.

Following chemical reactions take place in aqua silencer:

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.

$$NO2 + 2H2O \; 2\,HNO2 + 2HNO3 \text{ (Diluted)} \quad \text{……..I}$$

Chemical Reaction 2

If a small amount of lime water is added to the scrubber tank, further reaction takes place as below.

$$Ca\,(OH)\,2 + 2HNO2 \; Ca\,(NO2)2 + 2H2O$$

$$Ca\,(OH)\,2 + 2HNO3 \; Ca\,(No3)2 = 2H2O \quad \text{……..II}$$

Chemical Reaction 3

When the carbon-di-oxide present in the exhaust gas comes in contact with the limewater, calcium carbonate will precipitate. The calcium carbonate when further exposed to carbon-dioxide, calcium-bi-carbonate will be precipitated. The following is the chemical reaction,

$$Ca\,(OH) + CO2 \; CaCO3 = H2O$$

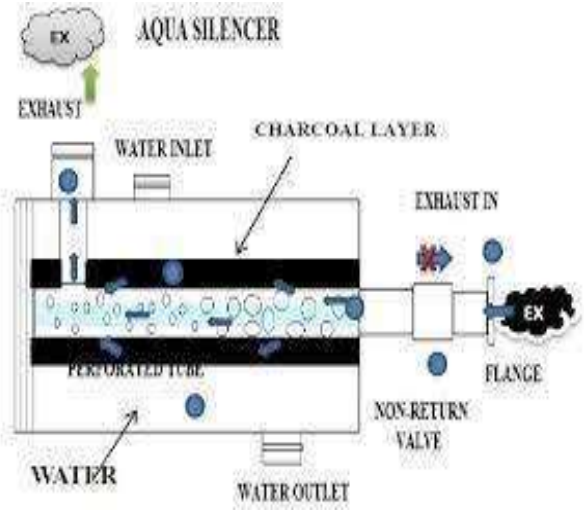
$$CaCO3 + H2O + CO2 \; Ca\,(HCO3)2 \quad \text{……..III}$$

Chemical Reaction 4

The sulphur-di-oxide present in the Diesel Exhaust also reacts with the limewater. But the small trace of sulphur-di-oxide makes it little difficult to measure the magnitude of the chemical reaction, accurately. The following equation gives the chemical reaction and calcium sulfate will precipitate.

$$Ca\,(OH)\,2 + SO2 \; CaSO3 + H2O \quad \text{……IV}$$

From calcium carbonate, calcium sulfate will precipitate and CO2 will be by-product. Because of the small percentage and SO2 presence, the liberation of Carbon dioxide is very less. But the liberated CO2 will again combine with CaCO3 to form calcium bicarbonate.



RESULT & DISCUSSION

Smoke Test

Smoke testing determines the level of air pollutants emitted from the exhaust of a motor vehicle. The first emissions testing were done in California in 1966. Since then, many states began requiring testing for all registered vehicles. If a vehicle fails the emissions test, repairs must be done and the vehicle retested.

Each state determines its own testing specifications. Depending on the testing apparatus, emissions testing can detect levels of hydrocarbons, nitrogen oxide, carbon monoxide, carbon dioxide, and emissions from evaporation. Emissions testing are separate from vehicle safety inspection in most states. Requirements and testing facilities may be independent for emissions and safety. Still, some testing locations might be qualified to perform both inspections. Many mechanical problems can cause a vehicle to emit excess pollutants. For example, a faulty fuel injection can lead to a rich fuel mixture (too much fuel, not enough air). Rich fuel mixtures tend to lead to high carbon dioxide levels.

The air injection system forces fresh air into the exhaust. If this system fails, emissions testing may detect high levels of hydrocarbons or carbon monoxide. Other problems that can lead to emissions testing failure are oxygen sensor malfunction, ignition system defects, and vehicle vacuum leaks.

As per the acceleration given and driven to the engine the emission varies such as therefore conversion is done due to the presence of, Activated charcoal is placed inside the Perforated Tube with the AQUA medium to dissolve the gas and to reduce the emission. The results which are obtained from the project analysis are given below in Table 1. Smoke analyzer tests were carried out for analyzing the performance of the Aqua silencer. The smoke emission of the Aqua silencer, from a single cylinder two stroke petrol engine is analyzed using a gas analyzer. During these tests, it is observed that the amount of hydrocarbons and CO are reduced. This is because of the lime water and activated carbon embedded has absorbed the gases. The reduction in the contents of the emission in this aqua silencer is due to the charcoal embedded and has absorbed 74% of the gases. **COMPARISON BETWEEN BEFORE AND AFTER INSTALLATION OF AQUA SILENCER**

PARAMETERS	BEFORE INSTALLATION OF AQUA SILENCER	AFTER INSTALLATION OF AQUA SILENCER
CARBON MONOXIDE (CO)	0.387%	0.084%
NON - METHANE HYDROCARBONS (HC)	524 PPM	239 PPM
VIBROMETER READING (AVG.)	113.66 db	99.33 db

COMPARISON BETWEEN CONVENTIONAL SILENCER AND AQUA SILENCER:

PARAMETER	CONVENT	AQUA

S	IONAL SILENCER	SILENCER
CO [%vol]	2.663	0.161
HC hexane [ppm vol]	1397.0	282.0
CO_2 [%vol]	3.52	4.64
O_2 [%vol]	12.85	14.04
LAMBDA [-]	7.959	6.773
LAMBDA CONSTANT Hev[-]	0.0000	0.0000
LAMBDA CONSTANT Hev[-]	0.0000	0.0000
NO [ppm vol]	119	55

CONCLUSION

The aqua silencer is more effective in the reduction of emission gases from the engine exhaust using perforated tubes and activated charcoal and lime water. By using a perforated tube the backpressure will remain constant and the sound level is reduced. By using a perforated tube the fuel consumption remains the same as the conventional system.

By using lime 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. It is smokeless and pollution free emission and also it is very cheap. This aqua silencer's performance is almost equivalent to the conventional silencer. It can be also used both for two wheelers and four wheelers and also can be used in

Industries which use IC engines. The only limitation in an aqua silencer is the evaporation of the lime water which needs to be periodically refilled or else it will cause overheating of silencer and toxic gases from silencer would be emitted to the atmosphere.

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