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Aqua Silencer

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Abstract: ***Air pollution is a large problem from the public health of view, because of every individual person breaths approximately 22000 times a day, inhaling about 15 to 22 kg of air daily. Polluted air causes physical ill effects decide undesirable aesthetic and physiological effects. Air pollution can be defined as an addition to our atmosphere of any material, which will have a dexterous effect on life. The main pollutant contributes by automobile are carbon monoxide (CO), unburned hydrocarbon (UBHC), oxides of nitrogen (NO_x) and Lead. These toxic gases are harmful not only to the atmosphere, but also to the human and animal race. The Pollution Control Aqua Silencer is used in the exhaust to direct the gas from the engine after going through the process of reducing the toxic gases and also water is used to reduce the exhaust noise. The objective of this project is to design and fabricate a simple system, where the toxin levels are controlled through chemical reaction to the more agreeable level. The whole assembly is fitted in the exhaust pipe; it does not give rise to any complications in assembling it. This system is very cost-effective and more economical.***

Keywords: Aqua Silencer, Scrubber Tank, Perforated Tube, Exhaust Gas Manifold, Charcoal.

INTRODUCTION

The purpose of this project is to overcome pollutions in an efficient way rather than using a conventional silencer. The conventional silencer is source route for air and noise pollutions [3]. Hence, to reduce this Pollution Control Aqua Silencer is used which is the latest invention in the trend to reduce these two pollutions. In order to avoid this type of gases, Pollution Control Aqua Silencer is introduced. It is fitted to the exhaust pipe of the engine; sound produced under water is less hearable than it produced in the 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 layers and it is highly porous and posse's extra free valences so it has high absorption capacity. So absorb the gases from the engine and release much less position to the environment. The noise and smoke level are considerably less than the conventional silencer, no need of catalytic converter and easy to install. In this silencer, the charcoal, and water so it is called hybrid aqua silencer, and it is useful in automobile, industry, DG sets and DG machines, Marine and Boats also.

Fig.: Pollution Control Aqua Silencer

CONSTRUCTION

Basically, an Pollution Control Aqua Silencer consists of a perforated tube which is installed at the end of the exhaust pipe. The perforated tube – different diameters. The purpose of providing different diameter hole is to break up gas mass to form smaller gas bubbles. Generally, four sets of holes are drilled on the perforated tube [4]. The other end of the perforated tube a layer of activated charcoal is provided and further a metallic mesh cover it. The whole unit is then placed in a water container. A small opening is at the top of the container to remove the exhaust gases and a drain plug is provided at the bottom of the container for periodically cleaning of the container. Also, a filler plug is mounted at the top of the container. At the inlet of the exhaust pipe, a non-return valve is provided which prevents the backflow of gases and water as well.

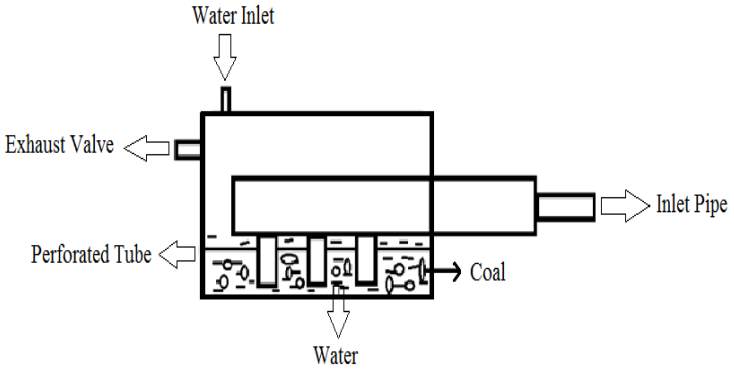


Fig.: Line Diagram of Pollution Control Aqua Silencer

WORKING

In this Pollution Control Aqua Silencer when the exhaust gases enter into the Pollution Control Aqua Silencer, the perforated tube converts high mass bubbles after that they pass through a charcoal layer which again purifies the gases. It is highly porous and possess extra free valences so it has high absorption capacity [6]. After passing through 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, Pollution Control Aqua Silencer reduces noise and pollution. In these chemical reaction involved is as follows [2]:

Reaction: 1

The obnoxious product of combustion is NO_x – 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.

$$NO_2 + 2H_2O \rightarrow 2HNO_2 + 2HNO_3 \text{ (Diluted)} \ldots\ldots\ldots\ldots\ldots I$$

Reaction: 2

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

$$Ca(OH)_2 + 2HNO_3 \rightarrow Ca(NO_3)_2 = 2H_2O$$

$$Ca(OH)_2 + 2HNO_3 \rightarrow Ca(NO_2)_2 + 2H_2O \ldots\ldots\ldots\ldots\ldots II$$

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, calcium-bi-carbonate will be precipitated. The following is the chemical reaction [1].

$$Ca(OH) + CO_2 \rightarrow CaCO_3 = H_2O$$

$$CaCO_3 + H_2O + CO_2 \rightarrow Ca(HCO_3)_2 \ldots\ldots\ldots\ldots\ldots III$$

Reaction: 4

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

$$Ca(OH)_2 + SO_2 \rightarrow CaSO_3 + H_2O \ldots\ldots\ldots\ldots\ldots IV$$

Reaction: 5

$$CaCO_3 + SO_2 + H_2O \rightarrow CaSO_3 + CO_2 + H_2O \ldots\ldots\ldots\ldots\ldots V$$

From calcium carbonate, calcium sulphate will precipitate and CO_2 will be a by-product. Because of the small percentage and SO_2 presence, the liberation of Carbon dioxide is very less. But the liberated CO_2 will again combine with $CaCO_3$ to form calcium bicarbonate as mentioned in equation 5.

SPECIFICATION

Scrubber Tank

- Alkaline solution – Lime Water ($Ca(OH)_2$)
- Water level from bottom – 120 mm
- Chemical – Lime stone ($CaCO_3$)

Bell mouth bottom portion

Submerged in the alkaline solution – 25 mm

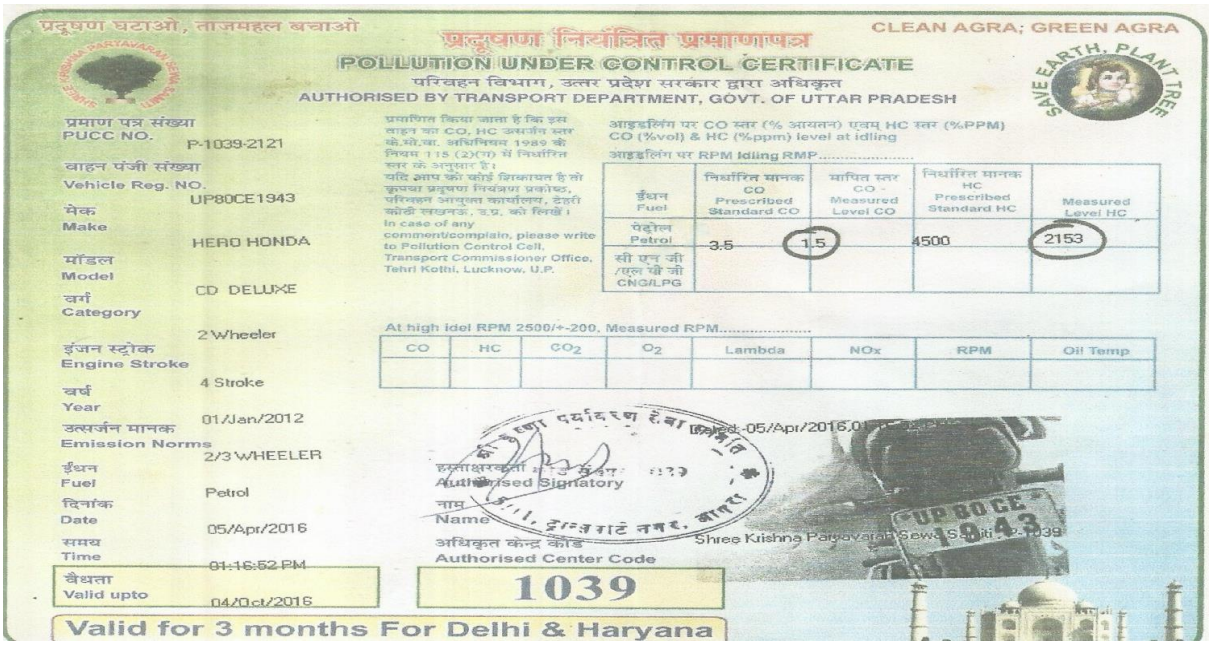
Water

- Thermal properties of water
- Maximum density – 1000 kg/m^3
- Specific weight – 9.807 KN/m^3
- Freezing point – 0^o C
- Boiling point – 100^o C
- Latent heat of melting – 334 KJ/Kg
- Latent heat of evaporation – 2270 KJ/Kg
- Specific heat – 4.187 KJ/Kg K
- Thermal expansion – 4^o C to 100^o C

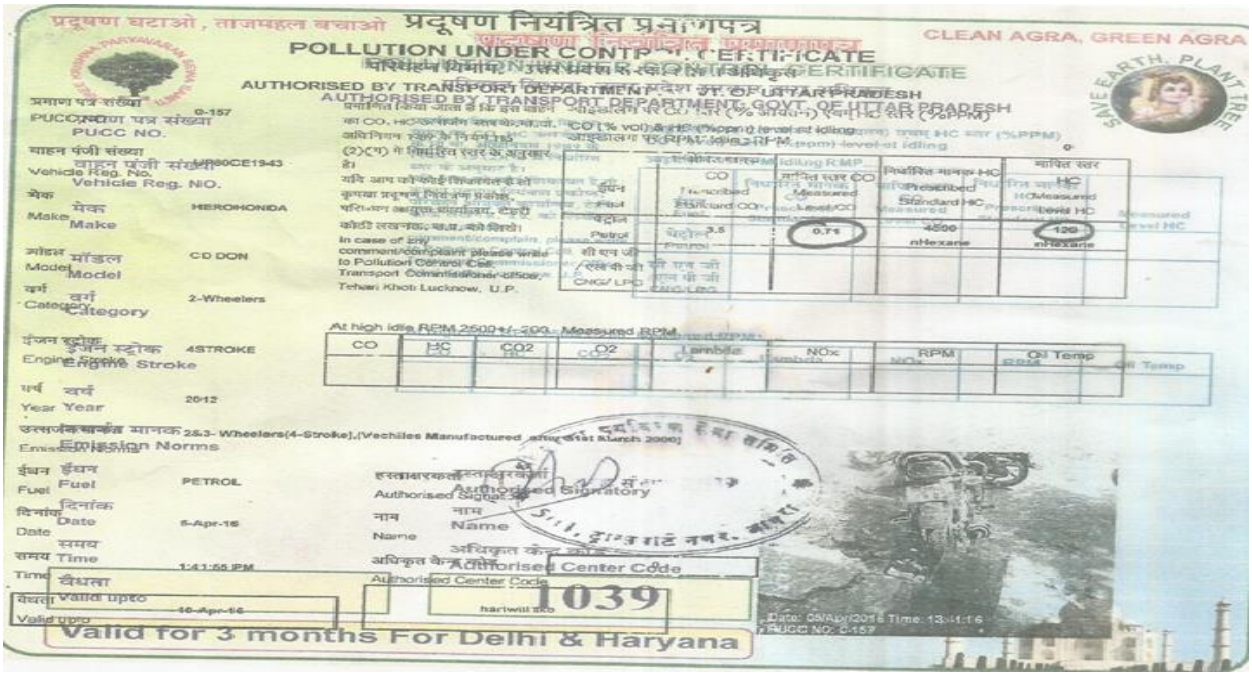
RESULT AND DISCUSSION

The experimental data of Pollution Control Aqua Silencer is shown below in PUC Certificate without Pollution Control Aqua Silencer and with Pollution Control Aqua silencer.

PUC Certificate without Pollution Control Aqua Silencer



PUC Certificate with Pollution Control Aqua Silencer



From PUC testing of two stroke petrol engine the following result about Carbon dioxide and Hydrocarbon is found.

	Prescribed Standard CO	Measured Level CO	Prescribed Standard HC	Measured Level HC
Ordinary Silencer	3.5	1.5	4500	2153
Aqua Silencer	3.5	.71	4500	120

CO and HC level at idling (% volume) (ppm)

Sound Characteristics

	Sound Level without Aqua silencer	Sound Level with Aqua Silencer
Without any Load	104.5 db	75 db
50 % Load	106.5 db	76.5 db
100 % Load	107 db	78 db

APPLICATION AND ADVANTAGES

The Pollution Control Aqua Silencer is useful in automobile, industry, DG sets, DG machines, Marine, and Boats also. The advantages of Pollution Control Aqua Silencer is that in this sound is reduced [5], CO is reduced 60 to 70 % compared to the ordinary silencer and low cost.

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