

# Hydro aquatic Silencer for Noise and Pollution Reduction

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**ABSTRACT:-** Air pollution is most important from the public health point of view, because every individual person breathes approximately 22000 times a day, inhaling about 15 to 22 Kg of dry air daily. Polluted air causes physical ill effect decides undesirable aesthetic and physiological effects. The main pollutants contribute by automobiles are carbon monoxide (CO), unburned hydrocarbon (UBHC), oxides of nitrogen (NOx) and Lead. Automobiles are not the only source of air pollution, other sources such as electric power generating stations, industrial and domestic fuel consumption, refuse burning, industrial processing etc.

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. Sound produced under water is less hearable than it is produced in atmosphere. The structure of the silencer is so developed such that it reduces the Noise due to water and porous walls and Pollutants by using Lime water and activated charcoal. Thus the proposed project can help to bring down the pollution and noise levels of conventional silencers.

**KEYWORDS:** Aqua, Noise, Porous, Charcoal, Lime water, pollution, sound etc.

## I. INTRODUCTION:-

Drive time, peak hour, freeway, take-away delivery, drive through the introduction of the automobile has had a huge impact on our lifestyle and environment. Yes, that's right. In major cities and large towns throughout the world, motor vehicles cause a wide range of air pollution problems. Under Victorian guidelines, a car is only considered smoky if it emits visible smoke from its exhaust pipe for a continuous period of more than 10 seconds. Your car is not classified as smoky if

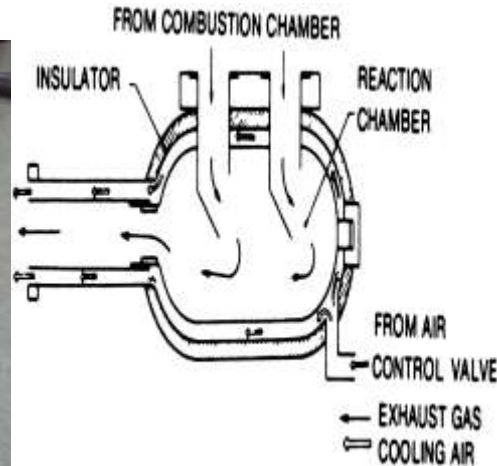
the exhaust emissions are caused by heat or the condensation of water vapour, which can occur when the car has just been started, particularly on cold days. Smoky cars contribute far more to air pollution than well maintained cars. Anyone who has driven behind or walked near a smoky car will know, smoky car exhausts are very offensive as well as posing a risk to public health. In certain circumstances, even well maintained vehicles can sometimes produce smoke from their exhaust. This can occur during heavy acceleration climbing steep hills and as engine turbo and supercharges are building sufficient speed to provide enough air to burn fuel properly.

It has been long observed that diesel engines play a crucial role in the transport industry, 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 of everything, we cannot ignore the harmful effects of the large mass of the burnt gases, which erodes the purity of our environment every day. An aqua silencer is used to control the noise and emission in IC engines. The reason why we opt for an aqua silencer is that, air pollution and noise pollution causes physical ill effects to human beings and also the environment. The main contributor of air pollution is automobiles releasing gases like carbon dioxide, unburned hydrocarbons, etc. In order to cut down on emission of these gases, we can use an aqua silencer. It is fitted to the exhaust pipe of the engine. Sound produced under water is less audible than in atmosphere. This is mainly due to presence of small sprockets in water molecules, which lowers its amplitude and 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 possess extra free valences so it has high absorption capacity and lime water chemically reacts with the exhaust gases from the engine and release much less polluted gases to

the environment. The noise and smoke level is considerably less than the conventional silencer; there's no need of a catalytic converter and it is easy to install.

**PRESENT TECHNOLOGIES IN TREATMENT OF EXHAUST GASES**



**1. After burner Technology:**

After burner is a device used to burn the unburned components of exhaust gas by supplying secondary air. The device is fitted with ignition source. CO and HC are the direct result of incomplete combustion of mixture inside the engine cylinder due to non availability of sufficient amount of oxygen and time of combustion, these un-burnt components (i.e. HC and CO) are once again burnt in after burner with an ignition source by supplying secondary air.

CO and HC undergo oxidation to CO<sub>2</sub> and H<sub>2</sub>O. The oxidation of HC in after burner is mainly depends on the temperature of the exhaust gases. Hence, in order to avoid the loss of heat.

**2. Exhaust Manifold Reactor:**

It is the modification of after burner. It is also known as the Thermal Reactor. Oxidation of CO and HC mainly depends upon the temperature and the retention time. Oxidation of CO and HC increases with temperature and retention time. Temperature required for the effective oxidation of CO and He is about 600° to 700°C. Thermal reactor does the function of oxidation of CO and HC in pressure of High temperature. A thermal reactor is an enlarged manifold that is mounted on Cylinder head. The main objective of the system is to provide a rapid mixing of exhaust gases with the secondary air injected into the exhaust port in order to get uniform temperatures and uniform mixture composition. It has a provision to retain the gases at

high temperatures for longer time in order to get higher conversion efficiency 30mm.

**DESIGN CALCULATIONS:**

There are two components in this project which require a design attention. They are the Silencer pipe and design of non return valve. Till now the design calculations of non return valve are finalized.

**Design of non return Valve:**

The material used for non return valve to be used in the project is SAE 1095 annealed. Considering the properties of the above selected material, we have

Yield Stress  $\sigma_y = 380 \text{ N/mm}^2$

Youngs Modulus  $E = 200 \text{ GPa}$

Poissons Ratio  $\nu = 0.3$

Factor of safety = 2

$$\text{Allowable Sheer Stress } \tau = \frac{\sigma_y}{\text{FOS}}$$

$$= 380/2 = 190 \frac{\text{N}}{\text{mm}^2}$$

Considering the Standard Non Return Valve:

Diameter of spring wire  $d = 0.65 \text{ mm}$

Outer Diameter of the Spring  $D = 13 \text{ mm}$

Free length of the spring  $L_0 = 18.6 \text{ mm}$

Active number of coils:  $i = 9$

$$\text{Pitch } P = \frac{L_0}{i}$$

$$= 18.6/9$$

$$= 2.06 \text{ mm}$$

Solid Length of the spring is given by  $L = (i + 1)d$   
 $= 6.5 \text{ mm}$

Modulus of Rigidity:  $G = \frac{E}{2(1+\nu)}$   
 $= 76923.08 \text{ N/mm}^2$

Stiffness  $K = Gd^4 / (8D^3i)$   
 $= \frac{101N}{m}$

Maximum Force  $F_{\max} = K(L_0 - L)$   
 $= 0.101(18.6 - 6.5)$   
 $= 1.22 \text{ N}$

Maximum Shear Stress  $\tau_{\max} = \left[ \frac{8WD}{\pi d^3} \right] F_{\max}$

Wahls Stress Correction Factor  $W = \left[ \frac{4C-1}{4C-4} \right] + \left( \frac{615}{C} \right)$

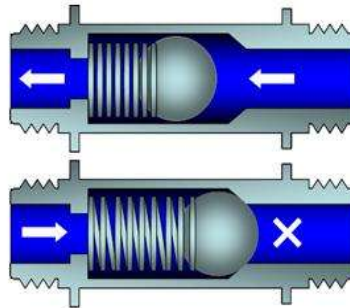
Spring Index  $C = D/d$   
 $= 20$

Substituting above values to get  $W=1.07$   
 Therefore

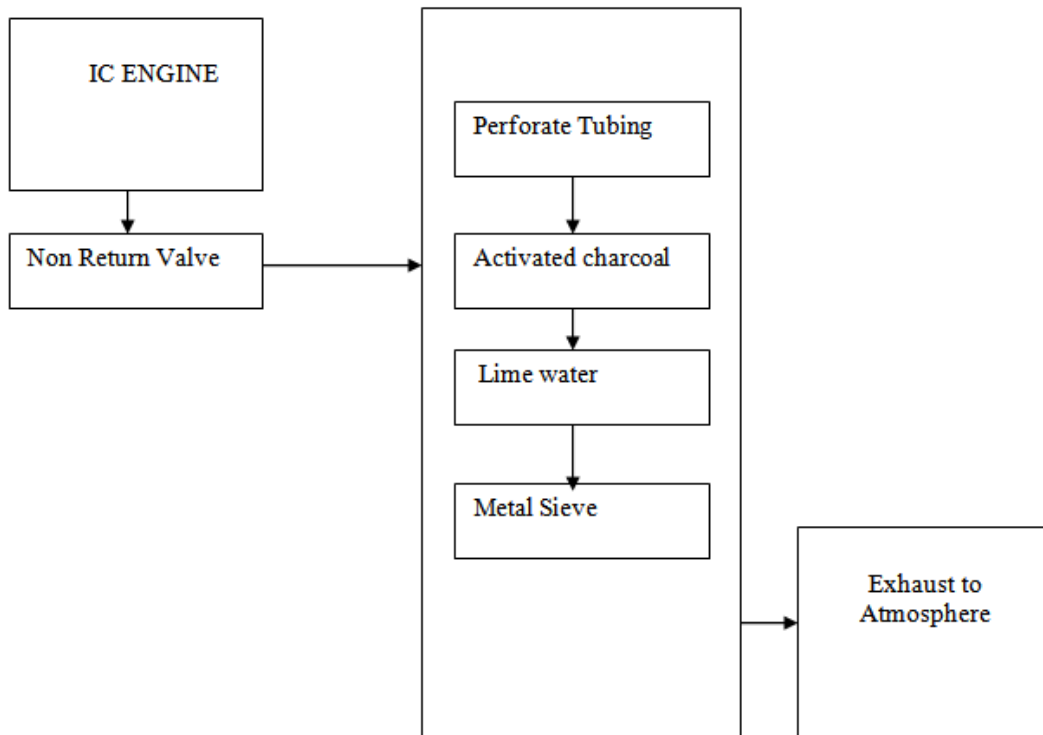
$\tau_{\max} = 157.3 \frac{\text{N}}{\text{mm}^2}$

Since  $\tau_{\max} < \tau$  the design is safe.

**NON-RETURN VALVE:-**



**BLOCK DIAGRAM**



## OBJECTIVES:

There has been an increasing concern in recent years over the increasing of transportation and discharge of industrial waste waters into environment. The engine emission contains air pollutants and other species. Almost all pollutants are toxic in nature. Some of the examples are CO, CO<sub>2</sub>, NO<sub>x</sub>, and Hydrocarbon. The main objectives of the project are:

1. To design and fabricate, Hydro Silencer.
2. To reduce emission of air pollutants like NO<sub>x</sub>, SO<sub>x</sub>, CO, UBHC to the atmosphere.
3. To reduce noise of the engine.
4. To conduct an emission test to compare the results of conventional silencer with that of Aqua Silencer.

## METHODOLOGY:

The entire approach to the project is carried out in phases to eliminate the errors which may occur at the end. The entire project is carried out in phases to ensure proper methodology to the project. The following phases are involved in the project.

- **Phase 1: Literature review:**

In this phase the literature work is studied in details which is carried out by number of research scholars. The number of research papers are referred to arrive at the problems definitions. Similar project approaches are studied in detail in this phase.

fabricated components to form a full hydroaquatic silencer.

- **Phase 7:**

Testing: The silencer is finally tested for noise and emission to arrive at the conclusion.

## Proposed Construction And Working Principle:

This project involves design and fabrication of hydro aquatic silencer for noise and emission reductions. The illustration below shows the line diagram of the proposed concept.

As shown in the figure, the fabricated silencer has an inlet for exhaust from engine. The exhaust from the engine passes through this inlet into the silencer via a non return valve. The exhaust gases are directed to the perforated tube where in the noise is reduced to some extent. Then the exhaust is passed through the charcoal as shown in the figure. The charcoal absorbs the gases and then the exhaust is directed to the water bath where the noise is further reduced. Finally it is released to atmosphere.

As the exhaust gases enter into the hydro silencer, the perforated tube converts high mass

- **Phase 2: Material survey:**

The material survey is carried out to find out the most appropriate materials for the project in this phase. The most optimum materials for the project are chosen in this phase.

- **Phase 3: The silencer pipe:**

It is a steel tube which is bent. It conveys exhaust gases into the water tank. The bent is provided in order to increase the velocity of gas also it allows the gases to expand before going into the tank. . The steel pipe is fabricated in this phase

- **Phase 4: Fabrication of tank:**

In this phase the tank is fabricated to hold water. The tank is made of sheet metal, which is elliptical in shape. It is a water reservoir. It contains a perforated tube and baffle plate. It also contains activated charcoal suspended into the water.

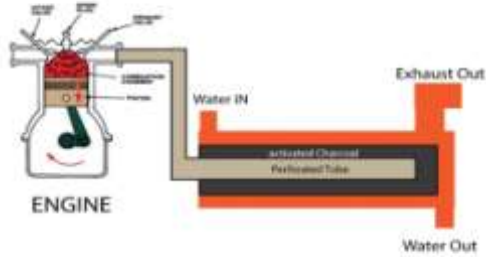
- **Phase 5: The Non return valve:**

The non return valve is incorporated in this phase which blocks the return of exhaust.

- **Phase 6: Assembly:**

Once all the components are fabricated the final stage is assembly which consists of assembling all the

bubbles into low mass bubbles after that they pass through charcoal layer which again purify 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 in to the water and finally the exhaust gases escape through the opening into the atmosphere. Hence Hydro silencer reduces noise and pollution. 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 other end of the perforated tube is closed by plug. 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 water container. A small opening 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 back flow of gases and water as well.



### STANDARD COMPONENTS AND STRUCTURAL DETAILS:

- **SILENCER PIPE**

It is a steel tube which is bent. It conveys exhaust gases into the water tank. The bent is provided in order to increase the velocity of gas also it allows the gases to expand before going into the tank.. The silencer pipe is made in steel as this is locally available and cheap compared to other materials.

- **TANK**

The tank is made of sheet metal, which is circular or elliptical in shape. It is a water reservoir. It contains a perforated tube and baffle plate. It also contains activated charcoal suspended into the water.

- **ACTIVATED CARBON:**

Activated carbon, also called activated charcoal, activated coal or carbo activatus, is a form of carbon that has been processed to make it extremely porous and thus to have a very large surface area available for adsorption or chemical reactions. The word activated in the name is sometimes replaced with active. Due to its high degree of micro porosity, just 1 gram of activated carbon has a surface area in excess of 500 m<sup>2</sup> (about one tenth the size of a football field), as determined typically by nitrogen gas absorption. Sufficient activation for useful applications may come solely from the high surface area, though further chemical treatment often enhances the adsorbing properties of the material. Activated carbon is usually derived from charcoal.

Activated carbon is carbon produced from carbonaceous source materials like nutshells, peat, wood, coir, lignite, coal and petroleum pitch. It can be produced by one of the following processes:

1. Physical reactivation: The precursor is developed into activated carbons using gases. This is generally done by using one or a combination of the following processes: Carbonization: Material with carbon content is pyrolyzed at temperatures in the range 600-900 °C, in absence of oxygen (usually in inert atmosphere with gases like argon or nitrogen)
2. Chemical activation: Prior to carbonization, the raw material is impregnated with certain chemicals. The chemical is typically an acid, strong base, or a salt (phosphoric acid, potassium hydroxide, sodium hydroxide, chloride, and zinc chloride 25%). Then, the raw material is carbonized at lower temperatures (45~900 °C). It is believed that the carbonization/ activation step proceeds simultaneously with the chemical activation. Chemical activation is preferred over physical activation owing to the lower temperatures and shorter time needed for activating material.

A gram of activated carbon can have a surface area in excess of 500 m<sup>2</sup>, with 1500 m<sup>2</sup> being readily achievable. Carbon aerogels, while more expensive, have even higher surface areas, and are used in special applications.

Carbon adsorption has numerous applications in removing pollutants from air or water streams both in the field and in industrial processes such as:

- Spill cleanup
- Groundwater remediation
- Drinking water filtration
- Air purification
- Volatile organic compounds capture from painting, dry cleaning, gasoline dispensing operations, and other processes.

Activated carbon is also used for the measurement of radon concentration in air.

### ADVANTAGES AND APPLICATIONS:

- By using perforated tube the backpressure will remain constant and the sound level is reduced.
- By using water 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 hydro silencer.
- It is smokeless and pollution free emission and also it is very cheap. This hydro 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.

- Can be used in industries as well as commercial establishments
- Can be used for diesel generators

## II. FUTURE SCOPE:

- With some modifications Hydro Silencer technology can be applied in industries and power plants
- Using carbon fiber material for tank and pipe overall weight of the unit can be reduced.
- Instead of water other fluids which have higher boiling point and which absorbs all the gases can be used.

If this technology is used in four wheelers, the water in the silencer tank can be recirculated and cooled by radiator.

## III. CONCLUSION:

The project deals with the development of hydro aquatic silencer for noise and pollution reduction. From the project it can be concluded that the proposed project prototype can be used in the place of conventional silencers as it not only reduces noise but also reduces pollution. The project also serves an economical design as it is built using simple materials and can be easily manufactured on mass scale. The proposed project uses charcoal and lime water bath to absorb pollutants from the exhaust before they are released to atmosphere thus reducing noise as well as pollution.

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