DESIGN AND CONSTRUCTION OF AN AQUA SILENCER

A report submitted to the Department of Mechanical, Sonargaon University of Bangladesh in partial fulfillment of the requirements for the Award of Degree of Bachelor of Science in Mechanical Engineering.

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September 2022

LETTER OF TRANSMITTAL

September 2022

To

Niloy Sarkar

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Department of Mechanical Engineering.

Sonargaon University of Bangladesh

Subject: Submission of Project Report.

Dear Sir,

We are pleased to submit the project report on "**DESIGN AND CONSTRUCTION OF AN AQUA SILENCER**". It was a great pleasure to work on such an important topic. This project has been done as per the instruction of our supervision and according to the requirement of Sonargaon University.

We expect that the project will be accepted by the concerned authority we will remain happy to further explanations that you may feel necessary in this regard.

Thank You

Sincerely yours,

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DECLARATION

We do hereby solemnly declare that the work presented here in this project report has been carried out by us and has not been previously submitted to any University/ Organization for the award of any degree or certificate

We hereby ensure that the works that have been prevented here don't breach any existing copyright.

We further undertake to indemnify the university against any loss or damage arising from a breach of the foregoing obligation.

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We would like to bring up the name of **Prof. Md. Mostofa Hossain**, respected Head of the Department, and **Md. Ahatashamul Haque Khan Shuvo**, Coordinator of the Department of Mechanical Engineering for excellent guidance throughout the last four years.

We offer our sincerest gratitude to our Course Supervisor **Niloy Sarkar**, who has supported us throughout our report with his patience and knowledge whilst allowing us the room to work in our own way.

At last, we want to thank all of our faculty members and friends for their inspiration and cooperation throughout our whole academic life at **SONARGAON UNIVERSITY (SU).**

[Authors]

ABSTRACT

Trees naturally convert carbon dioxide into oxygen. But today because of Greed Selfish Humans are cutting down trees and forests in that place we humans are building white cement forests Thus; we humans are not getting pure air. The population is increasing and the number of trees is decreasing, just like mad society people are cutting trees after trees, even they are cutting hills to build a building to earn money. CO2 is not good for humans but Trees convert CO2 into oxygen which we humans need to survive. This will lead to Global warming problems, Acid Rain, respiratory diseases many more. But do not worry now **AQUA SILENCER** will do this Job in the future.

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CHAPTER 1
INTRODUCTION

1.1 Introduction:

The silencer has also termed a muffler. It is used for reducing the noise emitted by exhaust of an internal combustion engine, which is a major source of noise pollution. It becomes a more vital concern when used in residential areas or areas where noise creates hazard. Generally, noise level of more than 80-90 dB is injurious for human being. The main source of noise in an engine are divided in two parts, first is the exhaust noise and second is the noise produced due to friction of various parts of the engine. The engine exhaust noise is the most dominant. To reduce this noise, the most effective way of using a muffler in the engines. The level of noise reduction depends upon the design, construction and the working procedure of mufflers. If a car running without a muffler, then the noise level is unbearable. The most of the advances in the acoustic filters and exhaust mufflers came out in last four decades. Hence good design of the muffler should give the best noise reduction and offer optimum backpressure for the engine. Backpressure is the extra static pressure exerted by muffler on the engine through the restriction in the flow of exhaust gases. The insertion loss is defined as the difference in the acoustic power radiated without and with the muffler fitted.

The aqua silencer system is design for replace commonly used single unit silencers in engine with its slender structure and less weight. It plays an important role in control the noise and emission of gases from engines. Air pollution causes dangerous physical effect on the human body, animal and environment. The main reason to use aqua silencer is because now a days air pollution is increasing rapidly. This system reduces the dangerous exhaust gases from the auto. This emission controlled by the activated charcoal layer around perforated tube and lime water. The charcoal layer having high capacity to absorb emission gases from engine. These type charcoal layer with lime water reacts chemically with emission gases and change the chemical structure of emission gases. The smoke or emission gases and noise level in aqua silencer is very less than the commonly used silencers

Figure 1.1 Aqua Silencer

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. It is especially so, in most developed countries like 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, chemicals processing industries, open cost mines and other confined are as, which demands then effort diesel power packs. We all know that the automobile industry plays a major role in causing air pollution, so for reducing air as well as noise pollution we are using Aqua Silencer. The exhaust gases released from engine are carbon monoxide (CO), carbon dioxide (CO2), Nitrous Oxide (NOx), Sulphur Dioxide (SO2), Unburnt Hydrocarbons (UBHC). These toxic gases are very harmful for environment, human health. Aqua Silencer is used to reduce emissions and noise and also reduces its harmful effects with the help of activated charcoal, lime water. 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 are considerably less than the conventional silencer; there's no need of a catalytic converter and it is easy to install.

1.2 Objective:

We have some specific objectives for this project and they are pointed below:

- To test the ability of aqua silencer to remove air pollutants from the exhaust of IC engine.
- To test the ability of aqua silencer in reducing the noise lever of the engine exhaust.
- To check the performance of aqua silencer over the conventional silencer.

1.3 Structure of the Project

This project book consists of ten chapter. The first chapter contains the statement of the introduction, our background study for the project, objectives of the study in the project and the project organization. Chapter two contains literature review, history. Chapter three describes details of exhaust silencer and classification of silencer. Chapter four need to project. Chapter five block and concept diagram. Chapter Six to Eight discuses about material selection, cost estimation, working procedure and manufacturing process. Chapter nine result, comparison of result, discussion shows the complete photo of the project that we have built. In the final chapter, we discuss about future scope and conclusion of our project.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction:

In this section topics related to **DESIGN AND CONSTRUCTION OF AN AQUA SILENCER** System are included. These provide a sampling of problems appropriate for application of vehicles exhaust gas emission system of Aqua Silencer. The references are summarized below.

2.2 Literature of Review:

In previous decades, several numbers of work or project was done on aqua silencer for different purpose. Some are described below:

This literature review reveals the detailed work that has been carried out till date on the topic of aqua silencer Allen. M. A [1] A lot of effort is being made to reduce the air pollution from petrol and diesel engines and regulations for emission limits are also imposed. Furthermore, developments in petrol and diesel engines, combined with improvements in the vehicles, will make fuel consumption reduction of 40% or more in the future cars. One such development is improvement of the silencer unit of an engine. This is where an Aqua Silencer comes into play. An Aqua Silencer mainly deals with control of emission and noise in engine exhaust. It basically consists of a perforated tube which is installed at the exit of the exhaust from the engine, which may have holes of variable diameters. This is done to divide the gas molecules of large proportions to form gas molecules of smaller diameter. Theoretically, four or more sets of holes are made on the perforated tube using drilling. The other end of the perforated tube is sealed using a plug. A small coating of activated charcoal is provided all around the perforated tube using an inner cylinder which holds the charcoal in place and separates the charcoal and lime water from the water in the Aqua Silencer. This unit is then placed in a container in which water is filled to a certain level. A small opening is provided on the lid of the inner box which carries the exhaust from it to the outside using a small diameter pipe. A U-bend of pipe is constructed at the end of perforated tube which doubles as a nonreturn valve which prevents the back flow of engine exhaust or lime water back into the engine. After passing over the charcoal layer, a portion of the gases dissolve

into the water and finally the exhaust gases escape through the opening in to the atmosphere. “Emission” is a term that is used to describe the totality of undesired gases and particulates which are released into the air or emitted by numerous sources some of the examples are CO, CO2, NOX, and Hydrocarbon and the main contribution of air pollution comes from automobiles and industrial engines releasing gases like carbon dioxide and not burnt. Hydrocarbons. In addition to heat and water vapor, 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.

Maruthi Prasad Yadav et. al. [2] carried out research for the four stroke multi cylinder diesel engine with an aqua silencer. In most of application the final selection of an aqua silencer is based on an arrangement between the predicted acoustical, aerodynamic, mechanical and structural performance in conjunction with the cost of the resulting system then have performance and work in the model and get result. They conclude that load increases the contaminations gradually by using conventional silencer but by fitting with aqua silencer, the contaminations decrease. They found comparison of different silencer for sound characteristic of engine. In conventional silencer is sound level is 83db but in an aqua silencer is 75 db. without any load. Around 50% load in conventional silencer it gives 84.5db and in an aqua silencer give 76.5 db. load. In the fully loading condition the conventional silencer give 86 db. and in an aqua silencer is 78 db.

Keval Patel et. al. [3] designs the dimensions of aqua silencer for two stroke petrol engines. The exhaust pipe connects with shell and inner side of it perforated tube is arranged. The charcoal layer is pasted over the perforated tube. Bead Activated carbon is used as a charcoal layer. It is a process by which the carbonized product develops porous structure of molecular dimensions and extended surface area on heat treatment in the temperature range of 800 – 1000 C in presence of suitable oxidizing gases such as steam and carbon dioxide (CO2). Bead activated carbon is made from petroleum pitch and supplied in diameters from approximately 0.35 to 0.80 mm. It is also noted for its low pressure drop, high mechanical strength and low dust content, but with a smaller grain size. Its spherical shape makes it preferred for fluidized applications. According to operational parameter they conclude that CO is reduced 60-70% compared to ordinary silencer. But it is big in size and more space is required. It is used in both two-wheeler and four-wheeler. P. Balasingham et. al. [4] carried out the analysis in which

the lime stones are originally intended to reduce the toxic ingredients of the exhaust, gas through chemical reaction. It is evidently affected the flow of resistance and hence the combustion characteristics of the engine will finally contribute the increased toxic ingredients of the exhaust gas. Because of the introduction of the scrubber, the net length of the exhaust gas flow path is also increased which is again, against the original intention according to his study they conclude that water in scrubber tank can itself play an important role in absorbing the obnoxious products of combustion like the oxides of nitrogen. NO is converted into NO2 after emission which highly toxic is mainly absorbed in the water scrubber.

2.3 Summary

We try to do this project by reading the above literature, and we have been able to make our project successful by reducing the mistakes of last year's project.

CHAPTER NO 3

EXHAUST SILENCERS

3.1 Exhaust Silencers

Engine exhaust noise is controlled through the use of silencers and mufflers. Generally speaking, there is no technical distinction between a silencer and muffler and the terms are frequently used interchangeably. A silencer has been the traditional name for noise attenuation devices, while a muffler is smaller, mass-produced device designed to reduce engine exhaust noise.

3.2 Silencer Selection Factors

The use of an exhaust silencer is prompted by the need to reduce the engine exhaust noise. In most applications the final selection of an exhaust silencer is based on a compromise between the predicted acoustical, aerodynamic, mechanical and structural performance in conjunction with the cost of the resulting system.

3.2.1 Acoustical performance. The acoustical performance criterion specifies the minimum insertion loss (IL) of the silencer, and is usually presented in IL values for each octave band as well as an overall expected noise reduction value. Octave bands and sound attenuation are discussed in further detail in Chapter 25. The insertion loss is determined from the free-field sound pressure levels measured at the same relative locations with respect to the outlet of the unsilenced and silenced systems. The IL of a silencer is essentially determined by measuring the noise levels of a piping systems before and after the insertion of a silencer in the exhaust stream.

IL data presented by most manufacturers will typically be based upon insertion of the silencer into a standard piping system consisting of specified straight runs of piping before and after the silencer. Exhaust system configurations as well as mechanical design can have a substantial impact on the performance of and exhaust silencer and should be considered at the time of specification. Raw exhaust noise levels should be obtained from the engine manufacturer to determine the necessary noise reduction requirements of the proposed silencer. Specific installation conditions and exhaust noise levels will aid the manufacturer in determining the correct silencer to meet the required noise reduction.

If a silencer is located outside of the room or housing in which the engine is installed, one must be cognoscente of the effects of 'break-out' noise from either the silencer body or associated piping system. Breakout noise can dominate the stack radiated noise, particularly for high performance silencers that greatly reduce the noise transmitted downstream. A high-performance exhaust silencer may have extremely good IL performance, but utilization of a thin-walled piping system may allow substantial noise to be radiated from the piping system before entering the silencer body. The effects of sound transmission through a mass layer are discussed in Chapter 25. One solution avoids potential breakout from dominating the overall noise levels is to ensure a balance between the exhaust silencer shell thickness and corresponding piping. Manufacturers will often incorporate a multiple-layer shell on higher-grade silencers to increase transverse transmission loss of the silencer.

3.2.2 Aerodynamic performance. The Aerodynamic performance criterion specifies the maximum acceptable pressure drop through the silencer (backpressure of the silencer). The exhaust flow rate and temperature from the engine manufacturer are required to accurately predict the backpressure of a silencer and piping system. Selection of an exhaust silencer based solely on the diameter of the connecting piping can often lead to improperly selected products that may present installation issues. Traditional head loss calculations utilizing standardized coefficients for sudden contraction and expansion of fluids can be used to approximate the pressure drop through a silencer and combined with the values obtained for the remainder of the piping system. More complex silencer internal structures should be analyzed using Computational Fluid Dynamics (CFD) where traditional empirical calculations or assumptions may lead to inaccurate results. The pressure drop through silencers should be obtained from the manufacturer of the product upon submission of the required flow information.

3.2.3 Mechanical performance. The Mechanical performance criterion specifies the material properties of the exhaust system to ensure that it is durable and requires little maintenance when incorporated into service. Material selection is especially important in cases involving high temperature or corrosive gases. Traditional carbon steels will typically be sufficient for the majority of applications using Diesel fueled generators. Natural Gas engines will traditionally run at an elevated temperature above their Diesel counterpart, and may require a graded carbon or stainless steel that can maintain an element of structural performance at elevated temperatures.

Aluminized steel is available from many silencer manufacturers and is often preferred for general applications. Aluminized steel is slightly more heat resistant than carbon steel and offers an increased resiliency to corrosion and is often selected as an economical alternative to specifying a stainless-steel system. Regular periodic testing of a standby generator will subject the exhaust system to thermal cycles that can contribute to the premature corrosion of carbon steel.

3.2.4 Structural performance. The Structural performance criterion can specify the geometric restrictions and/or maximum allowable volume/weight of the silencer that can substantially influence the silencer design process. Secondary loading outside of the weight of the silencer can also affect the design and cost of the exhaust system. A standard engine silencer is not traditionally designed to absorb substantial loads due seismic activity, wind or thermal growth of adjacent piping. Silencers that are specifically incorporated as an element of an exhaust "stack" should be designed to accommodate the loads that will be absorbed due to potentially high wind loads as well as seismic activity. A commodity purchased silencer should be isolated from substantial piping runs through the use of flexible expansion joints to reduce or eliminate the transfer of loads and engine vibration. Customized silencers can easily be designed when the force and moment values that can be placed on a connection are indicated at the time of quotation.

3.3 Silencer Types

Despite the terms and myriad of configurations, the silencer can be broken into three fundamental types: reactive (reflective), absorptive (dissipative), and combination reactive/absorptive. In addition to the three main silencer types, other functionality such as spark arresting, emission control, heat recovery, etc., may also be incorporated into the silencer design. Each type of silencer has specific performance attributes that can be used independently or in combination to produce the required IL for a specific application. A number of additional silencer styles and options are also reviewed in the following sections.

3.3.1 Reactive silencer. Reactive silencers generally consist of several pipe segments that interconnect with a number of larger chambers. The noise reduction mechanism of reactive silencer is that the area discontinuity provides an impedance mismatch for the sound wave traveling along the pipe. This impedance mismatch results in a reflection of part of the sound wave back toward the source or back and forth among the chambers. The reflective effect of the silencer chambers and piping (typically referred to

as resonators) essentially prevents some sound wave elements from being transmitted past the silencer. The reactive silencers are more effective at lower frequencies than at high frequencies, and are most widely used to attenuate the exhaust noise of internal combustion engines. A generic reactive engine silencer comprised of two proportionally sized chambers with a pair of interconnecting tubes is shown below.

3.3.2 Absorptive silencer. Absorptive silencers contain fibrous or porous sound-absorbing materials and attenuate noise by converting the sound energy propagating in the passages into heat caused by friction in the voids between the oscillating gas particles and the fibrous or porous sound-absorbing material. The absorptive characteristics of materials are discussed in further detail in Chapter 25. Absorptive silencers usually have relatively wideband noise reduction characteristics at middle and higher frequencies. Absorptive silencers are often used to attenuate the engine intake noise or supplement the performance of reactive silencers for the engine exhaust noise control. The sound absorbing materials are generally held in position by the use of a perforated metal liner. Knowledge of the structural content of an exhaust system is important when considering the inclusion of a catalytic element or Selective Catalytic Reduction (SCR) system in conjunction with the silencer. Particulate migration of the insulation into the exhaust stream over a period of time can cause the catalytic element to become fouled and substantially impact or impede its performance.

3.3.3 Combination silencer. Some silencers combine both reactive and absorptive elements to extend the noise attenuation performance over a broader noise spectrum. Combination silencers are also widely used to reduce engine exhaust noise. Figure 19-1 shows typical noise attenuation curves of reactive, absorptive, and combination silencers.

Noise Attenuation (dB)

Reactive
Absorptive
Combination

3.3.4 Spark arresting silencer. Federal, state, local and municipal bylaws often dictating exhaust installations have provisions for arresting sparks from internal combustion engines. If an engine is to be used in an area where there is potentially dry vegetation of other combustible materials that are likely to be ignited by any hot carbon passing through the exhaust, one must incorporate spark-arresting capabilities

into the silencer. Most approved spark arresting systems will employ diffusers or modified interconnecting tubes that create a centrifugal flow action in the exhaust to direct carbon particulate into a collection chamber. The particulate trap should be periodically inspected and cleaned to ensure proper functionality of the spark arresting capabilities of the silencer.

3.3.5 Catalytic silencer. To enhance exhaust gas emission control, one may incorporate a catalytic converter element into a silencer to reduce the Oxides of Nitrogen (NOx), Carbon Monoxide (CO), and Non-Methane Hydrocarbons (NMHC) discharged in the exhaust stream. A catalytic converter is comprised of a NOx catalyst and an oxidation catalyst. The NOx beds reduce the NOx into benign N2 and H2O, while the oxidation catalyst reacts with CO and HC to form water vapor and carbon dioxide. Inclusion of the catalytic element into the body of an exhaust silencer can reduce the cost of a combination system by eliminating the need for a separate acoustic silencer as well as a specialized catalyst housing and tracking system.

3.3.6 Heat recovery silencer. Most of the energy available in the fuel used in reciprocating and gas turbine engines is rejected in the form of heat. A reciprocating engine running at full load converts about one-third of the available energy into useful work, while the remaining two thirds of the available energy is lost in the form of heat rejection. In a prime power installation where the rejected heat can be used to provide energy to auxiliary applications a heat recovery silencer can yield attractive savings. Typical applications of heat recovery silencers for internal combustion engines include hot water heating, steam generation, heat transfer fluid heating, etc.

3.3.7 Tuned silencer. When the low frequency noise within a narrow band is extremely high, a tuned silencer can be designed to combat the specific offending frequencies. Tuned silencers consist of pipe segments and cavities that are used to produce a low frequency resonance at a required frequency. The accurate prediction of the tuned (resonance) frequency is extremely important to facilitate a match of the peak frequency for reducing the narrow band noise to a desirable level. A small deviation of the silencer resonance frequency from the peak frequency of the noise will greatly degrade the silencing ability.

3.3.8 Active silencer. Active silencing, or sound cancellation systems, employ detectors used in sensing the noise in an exhaust pipe and a loudspeaker that is used to reintroduce an inverted signal have been developed to reduce low frequency noise. The theoretical effect of reintroducing an inverted signal will

result in complete elimination of sound from the exhaust silencer. Although the idea of sound cancellation is very simple and attractive, there are a variety of complications and problems arising from erratic fluctuations in the sound source. Active silencing is relatively expensive at the present time, and its acoustic attenuation performance at high frequencies is also limited. Widespread use will be dependent upon continued development of lower cost systems with improved performance realized through the use of better analytical algorithms, transducers and processors.

3.3.9 System arrangement. A generic exhaust system collects hot exhaust gases from the engine and discharges them to the environment as quietly and efficiently as possible. An exhaust arrangement with minimized backpressure and satisfactory noise attenuation characteristics will usually be the result of a well-specified system. The exhaust termination points should not be in close proximity to the air intake system for the engine or the ventilation system of adjacent structures and should comply with all federal, state, and local regulations. Physical characteristics of the equipment room can also determine the specific configuration of an exhaust system layout and should be considered at the conceptual layout phase of the design.

3.3.10 Exhaust silencer. The most widely used structural shapes of silencers are the cylindrical configurations with end-inlet/end-outlet, side-inlet/end-outlet, and side-inlet/side-outlet. When a silencer is installed on top or inside of enclosure, the side-inlet/end-outlet configuration is most popular. This enables a minimum of piping. Hockey puck and rectangular shape silencers are used sometimes due to space limit. Silencers require traps to drain moisture. Traps installed at the lowest point of the silencer prevent rainwater from reaching the engine.

3.3.11 Exhaust Accessories. Most exhaust systems will be comprised of flexible connectors, connecting piping, an exhaust silencer, stack and rain caps. All exhaust systems must be isolated from the engine with flexible connections to reduce or eliminate the possibility of structural damage caused by cyclic vibration. A flexible connection is also used to isolate the weight of the exhaust system from the engine to allow relative shifting of exhaust components due to thermal growth. Thermal growth of exhaust piping must be anticipated and supporting members as well as fixed points should be placed to avoid excessive load on supporting structures and minimize transverse loading on the flex connector. The exhaust system shown in Figure 19-2 is referred to as a dual system that uses separate silencers and flow paths for each engine outlet. A flexible Y Connector may also be used to merge the exhaust gases from a dual outlet

engine into a single inlet silencer where space permits. Mounting bands and supports should be designed to withstand all seismic, thermal and dead loads at the elevated temperatures that will be encountered during service. A wall or roof insulating thimble is generally required when the exhaust system passes through a combustible wall or roof and should be compliant with all applicable federal, state, and local fire codes. Rain caps are traditionally used to prevent precipitation from entering the exhaust system when the generator is idle.

3.3.12 Thermal insulation. Thermal insulation blankets may be needed to wrap the exhaust system to prevent excessive heat radiation into the generator room or to protect service personnel from exposure to extremely hot piping components. Flexible pipe connections, when insulated, must expand and contract freely within the insulation. The majority of insulation products traditionally used in engine exhaust systems consist of either an aluminum wrapped or a material
clad insulation layer. Determination of the maximum exterior temperature of an insulated exhaust component will depend on many factors, and is often difficult to predict without specific knowledge of the exact service environment. Factors such as the ambient temperature and air flow across the piping elements can greatly affect the heat flux from the system and have a direct impact on the expected surface temperature of the system.

3.4 System Evaluation

3.4.1 System noise. It is extremely important to evaluate the total system when specifying an exhaust silencer for a specific installation. As we have discussed several factors such as breakout, raw source levels and spatial constraints can play significant roles in silencer selection and design. For example, a silencer might theoretically reduce the exhaust noise of an engine to 60 dBA at 10 feet without effectively silencing or isolating the engine intake, mechanical casing noise, etc. Many silencers have been incorrectly specified and installed in environments where the measured noise level in the area is considerably higher than the level produced by the silenced engine. A general knowledge of acoustics and sound will help in identifying potential factors that could impact the overall noise levels of an installation but a silencer manufacturer or acoustic consultant should be engaged when an unknown or difficult situation arises. As a final evaluation of an installed system the radiated sound pressure level at a given distance from the source should be measured and compared against the acoustical specification.

3.4.2 System backpressure. It is essential to the performance of a generator set that the installed exhaust system does not exceed the engine manufacturer's maximum exhaust backpressure limit. Pressure drop of exhaust system includes losses due to piping, silencer, and Termination. High backpressure can cause a decrease in engine efficiency or increase in fuel consumption, overheating, and may result in a complete shutdown of the generating system potentially causing significant damage. Pressure drop is measured in a straight length of pipe 3 to 5 diameters from the last transition change after the turbocharger outlet.

CHAPTER NO 4

NEED OF PROJECT

4.1 Need of Project

- It satisfies today's most pressing environmental, social, cultural and aesthetic demands. The ability to combine innovative design with advanced technology, along with an acute sensitivity to environmental concerns makes the ideal vehicle for the development of this project.

- With the earth's population ever growing, air pollution and air quality is a major issue for many countries around the world. Air pollutants can lead to respiratory related illnesses in humans and animals, create acid rain, and deplete the ozone layer. Actions such as carpooling, reducing the use of fossil fuels, and simply turning off a light when leaving a room are all ways that reduce harmful CO2 levels in our atmosphere. There is also a natural source that eats away at harmful CO2 gases and that source is trees.

CHAPTER NO 5

DESIGN AND CONCEPT DIAGRAM

5.1 Design and Block Diagram:

Our project is an essential part of the whole setup, according to which this whole setup is designed. The dimensions of Aqua silencer. This component alone consists of several different components i.e.perforated tube, activated charcoal layer (mesh).

The exhaust tones are calculated using the following Formulae:

CFR = Engine Speed in RPM/60 . . . . For a two-stroke engine

CFR= Engine Speed in RPM/120 . . .For a four-stroke engine

EFR = N * (CFR)

CFR= 2200/120 . . . For a four-stroke engine

=18.34Hz EFR = n *(CFR)

=1 *18.34

=18.34 Hz

The first 4 harmonics are to be suppressed as higher order has very little effect on noise. The diameter of the holes drilled should suppress these frequencies.

Volume swept by each cylinder:

Swept volume (V,)

V, = (3.143*D*D* L)/4

= (3.14*0.080*0.080*0.062)

= 0.3116 lit

Silencer volume: Volume of silencer must be at least 12 to 25 times the volume considered. Volume can be adjusted depending on the space constraint.

Factor consider is = 16

Silencer Volume = Factor Consider x Volume = 0.3116 * 16 = 4.98Lit

Diameter of hole to be drilled(d) = 1.29 * n" ^{5} =1.29 * 1" ^{5}=1. 29

i.e. d > 1.29mm

5.1.1 PERFORATED TUBE:

Diameter of perforated tube ID:-40mm OD:- 44mm

And length= 10 * Pipe diameter < L< 16 * Pipe diameter 440< L<704

Therefore L= 500mm

lt's made up of stainless-steel grade 304 of outer diameter 42 mm, inner diameter 38mm and length 600 mm. stainless steel is selected because the perforated tube is directly in contact with the exhaust gas so it can with stand high temperature and will not rust easily.

Perforated tube consists of holes of four different sizes i.e.

96 holes of 3 mm diameter

100 holes of 5 mm diameter

68 holes of 8 mm diameter

24 holes of 10 mm diameter

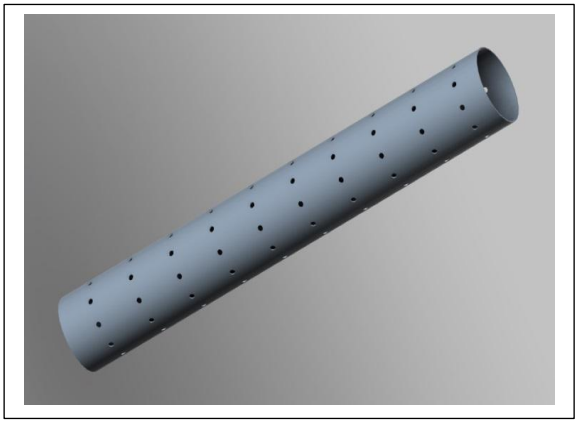


Figure 5.1: PERFORATED TUBE

5.1.2 CHARCOAL LAYER:

As the diameter of perforated tube is selected as 44mm OD. The diameter of charcoal layer is selected accordingly

I.D.:- 44mm OD:-52mm

Length :- Same as the length of perforated tube. i.e. 500mm

Here activated charcoal is used to purify the exhaust i.e. the carbon and other polluting contaminate. This contaminates get absorbed by the charcoal layer.

Figure 5.2: CHARCOAL

Size of the activated charcoal layer particles is 8 mm 12 mm in size

Also in the earlier systems there was no method of refilling the activated charcoal after the maintenance period without destroying the mesh which leads to again make the mesh every time the maintenance is done but here we have made an arrangement which will be easy for refilling the activated charcoal without destroying the mesh.

5.1.3 OUTER SHELL:

It is made up of mild steel width 95 mm hight 140 mm and 500 mm in length box arrangement is done for maintenance purpose thirteen tapped holes are drilled on the box is used between the nut with gasket for making the system leak proof.

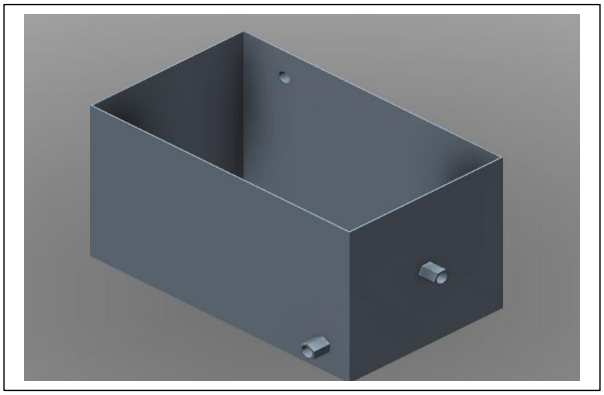


Figure 5.3: OUTER SHELL

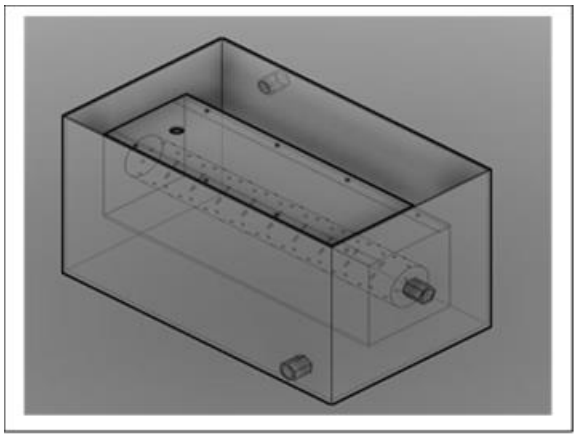


Figure 5.6: Assembly X-ray View

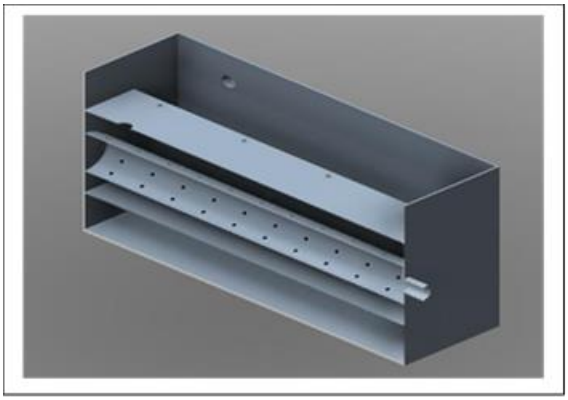
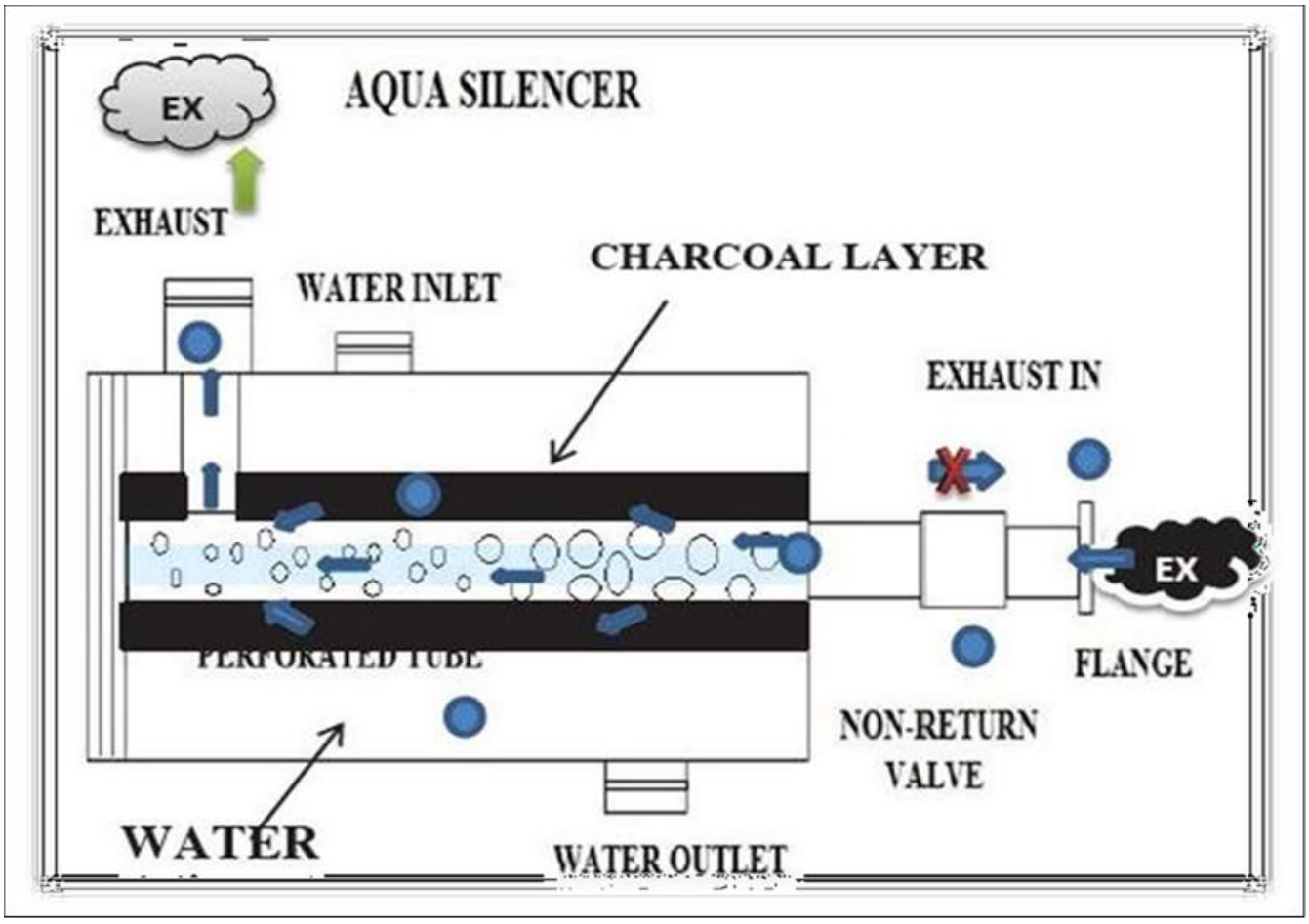


Figure 5.5: Assembly Section View

5.2 Concept Diagram:



CHAPTER NO 6
MATERIAL SELECTION

6.1 Material Selection

The proper selection of material for the different parts of a machine is the main objective in the fabrication of the machine. For a design engineer it is a must that be familiar with the effect that the manufacturing process and heat treatment have on the properties of materials. The Choice of material for engineering purposes depends upon the following factors:

1. Availability of the materials.
2. Suitability of materials for the working condition in service.
3. The cost of materials.
4. Physical and chemical properties of a material.
5. Mechanical properties of a material.

The mechanical properties of the metals are those, which are associated with the ability of the material to resist mechanical forces and load. We shall now discuss these properties as follows:

1. Strength: It is the ability of a material to resist the externally applied forces
2. Stress: Without breaking or yielding. The internal resistance offered by a part to an externally applied force is called stress.
3. Stiffness: It is the ability of the material to resist deformation and unstress. The modules of elasticity measure of stiffness.
4. Elasticity: It is the property of a material to regain its original shape after deformation when the external forces are removed. This property is desirable for materials used in tools and machines. It may be noted that steel is more elastic than rubber.
5. Plasticity: It is the property of a material, which retain the deformation produced under load permanently. This property of material is necessary for forging, in stamping images on coins and in ornamental work.
6. Ductility: It is the property of a material enabling it to be drawn into wire with the application of a tensile force. A ductile material must be both strong and plastic. The ductility is usually measured by the terms, percentage elongation and percent reduction in area. The ductile materials commonly used in engineering practice are mild steel, copper, aluminum, nickel, zinc, tin and lead.

7. Brittleness: It is the property of material opposite to ductile. It is the property of breaking of a material with little permanent distortion. Brittle materials when subjected to tensile loads snap off without giving any sensible elongation. Cast iron is a brittle material.
8. Malleability: It is a special case of ductility, which permits material to be rolled or hammered into thin sheets, a malleable material should be plastic but it is not essential to be so strong. The malleable materials commonly used in engineering practice are lead, soft steel, wrought iron, copper and aluminum.
9. Toughness: It is the property of a material to resist the fracture due to high impact loads like hammer blows. The toughness of the material decreases when it is heated. It is measured by the amount of absorbed after being stressed up to the point of fracture. This property is desirable in parts subjected to shock an impact load.
10. Resilience: It is the property of a material to absorb energy and to resist rock and impact loads. It is measured by amount of energy absorbed per unit volume within elastic limit. This property is essential for spring material.
11. Creep: When a part is subjected to a constant stress at high temperature for long period of time, it will undergo a slow and permanent deformation called creep. This property is considered in designing internal combustion engines, boilers and turbines.
12. Hardness: It is a very important property of the metals and has a wide verity of meanings. It embraces many different properties such as resistance to wear scratching, deformation and much inability etc. It also means the ability of the metal to cut another metal. The hardness is usually expressed in numbers, which are dependent on the method of making the test. The hardness of a metal may be determined by the following test.
    a) Brinell hardness test
    b) Rockwell hardness test
    c) Vickers hardness (also called diamond pyramid) test and
    d) Share scaler scope.

The science of the metal is a specialized and although it overflows in to realms of knowledge it tends to shut away from the general reader. The knowledge of materials and their properties is of great significance for a design engineer. The machine elements should be made of such a material which has properties suitable for the conditions of operations. In addition to this a design engineer must be familiar with the manufacturing processes and the heat treatments have on the properties of the materials. In designing the

various part of the machine, it is necessary to know how the material will function in service. For these certain characteristics or mechanical properties mostly used in mechanical engineering practice are commonly determined from standard tensile tests. In engineering practice, the machine parts are subjected to various forces, which may be due to either one or more of the following.

1. Energy transmitted
2. Weight of machine
3. Frictional resistance
4. Inertia of reciprocating parts
5. Change of temperature
6. Lack of balance of moving parts

The selection of the materials depends upon the various types of stresses that are set up during operation. The material selected should with stand it. Another criteria for selection of metal depend upon the type of load because a machine part resist load more easily than a live load and live load more easily than a shock load.

Selection of the material depends upon factor of safety, which in turn depends upon the following factors.

1. Reliabilities of properties
2. Reliability of applied load
3. The certainty as to exact mode of failure
4. The extent of simplifying assumptions
5. The extent of localized
6. The extent of initial stresses set up during manufacturing
7. The extent loss of life if failure occurs
8. The extent of loss of property if failure occurs

Materials selected in m/c

Base plate, motor support, sleeve and shaft

Material used

Mild steel

Reasons:

1. Mild steel is readily available in market
2. It is economical to use

3. It is available in standard sizes
4. It has good mechanical properties i.e., it is easily machinable
5. It has moderate factor of safety, because factor of safety results in unnecessary wastage of material and heavy selection. Low factor of safety results in unnecessary risk of failure
6. It has high tensile strength
7. Low co-efficient of thermal expansion

Properties of Mild Steel:

M.S. has a carbon content from 0.15% to 0.30%. They are easily wieldable thus can be hardened only. They are similar to wrought iron in properties. Both ultimate tensile and compressive strength of these steel increases with increasing carbon content. They can be easily gas welded or electric or arc welded. With increase in the carbon percentage weld ability decreases. Mild steel serves the purpose and was hence was selected because of the above purpose

Bright Material:

It is a machine drowned. The main basic difference between mild steel and bright metal is that mild steel plates and bars are forged in the forging machine by means is not forged. But the materials are drawn from the dies in the plastic state. Therefore, the material has good surface finish than mild steel and has no carbon deposits on its surface for extrusion and formation of engineering materials thus giving them a good surface finish and though retaining their metallic properties

TABLE 01: RAW MATERIAL & STANDARD MATERIAL

SR NO	PART NAME	MAT	QTY
1	TANK	**MS**	**1**
2	PERFORATED TUBE	**MS**	**1**
3	MS RING	**MS**	**2**
4	DRAIN VALVE	**MS**	**1**
5	GLASS WOOL FILTER	**GW**	**1**
6	CHARCOAL	**CC**	**1**
7	FELT FILTER	**FE**	**1**
8	600 MESH NET	**SS**	**2**
9	TOP CAP	**MS**	**1**
10	NOZZEL	**BRASS**	**2**
11	PIPE	**SI**	**1**
12	NUT BOLT WASHER M 10	**MS**	**8 NOS**
13	WELDING ROD	**-**	**1 50 NOS**
14	COLOUR	**-**	**2 LIT**

CHAPTER NO 7

COST ESTIMATION

7.1 Cost Estimation

Cost estimation may be defined as the process of forecasting the expenses that must be incurred to manufacture a product. These expenses take into a consideration all expenditure involved in a design and manufacturing with all related services facilities such as pattern making, tool, making as well as a portion of the general administrative and selling costs.

7.2 Purpose of Estimating:

1. To determine the selling price of a product for a quotation or contract so as to ensure a reasonable profit to the company.
2. Check the quotation supplied by vendors.
3. Determine the most economical process or material to manufacture the product.
4. To determine standards of production performance that may be used to control the cost.

Basically, the Budget Estimation is of Two Types:

1. Material cost
2. Machining cost.

7.3 Material Cost Estimation:

Material cost estimation gives the total amount required to collect the raw material which has to be processed or fabricated to desired size and functioning of the components.

These materials are divided into two categories.

1. Material for fabrication:

In this the material in obtained in raw condition and is manufactured or processed to finished size for proper functioning of the component.

2. Standard purchased parts:

This includes the parts which was readily available in the market like allege screws etc. A list is forecast by the estimation stating the quality, size and standard parts, the weight of raw material and cost per kg. For the fabricated parts.

7.4 Machining Cost Estimation:

This cost estimation is an attempt to forecast the total expenses that may include to manufacture apart from material cost. Cost estimation of manufactured parts can be considered as judgment on and after careful consideration which includes labour, material and factory services required to produce the required part.

7.5 Procedure for Calculation of Material Cost:

The general procedure for calculation of material cost estimation is

1. After designing a project, a bill of material is prepared which is divided into two categories.
    a. Fabricated components
    b. Standard purchased components
2. The rates of all standard items are taken and added up.
3. Cost of raw material purchased taken and added up.

7.6 Labour Cost:

It is the cost of remuneration (wages, salaries, commission, bonus etc.) of the employees of a concern or enterprise.

Labour cost is classifying as:

1 Direct labour cost

2 Indirect labour cost

Direct labour cost:

The direct labour cost is the cost of labour that can be identified directly with the manufacture of the product and allocated to cost centers or cost units. The direct labour is one who counters the direct material into saleable product; the wages etc. of such employees constitute direct labour cost. Direct labour cost

may be apportioned to the unit cost of job or either on the basis of time spend by a worker on the job or as a price for some physical measurement of product.

Indirect labour cost:

It is that labour cost which cannot be allocated but which can be apportioned to or absorbed by cost centers or cost units. This is the cost of labour that doesn't alters the construction, confirmation, composition or condition of direct material but is necessary for the progressive movement and handling of product to the point of dispatch e.g., maintenance, men, helpers, machine setters, supervisors and foremen etc.

The total labour cost is calculated on the basis of wages paid to the labour for 8 hours per day.

Cost estimation is done as under

Cost of project = (A) material cost + (B) Machining cost + (C) labour cost

(A) Material cost is calculated as under: -

i) Raw material cost

ii) Finished product cost

i) Raw material cost: -

It includes the material in the form of the Material supplied by the "Steel authority of India limited" and 'Indian aluminum co.,' as the round bars, angles, square rods, plates along with the strip material form. We have to search for the suitable available material as per the requirement of designed safe values. We have searched the material as follows: -

TABLE 02: RAW MATERIAL & STANDARD MATERIAL COST

SR NO	PART NAME	MAT	QTY	COST
1	TANK	**MS**	**1**	**1200**
2	PERFORATED TUBE	**MS**	**1**	**350**
3	MS RING	**MS**	**2**	**200**
4	DRAIN VALVE	**MS**	**1**	**250**
5	GLASS WOOL FILTER	**GW**	**1**	**600**
6	CHARCOAL	**CC**	**1**	**700**
7	FELT FILTER	**FE**	**1**	**350**
8	600 MESH NET	**SS**	**2**	**300**
9	TOP CAP	**MS**	**1**	**360**
10	NOZZEL	**BRASS**	**2**	**250**
11	PIPE	**SI**	**1**	**400**
12	NUT BOLT WASHER M 10	**MS**	**8 NOS**	**75**
13	WELDING ROD	**-**	**1 50 NOS**	**150**
	COLOUR	**-**	**2 LIT**	**100**
			TOTAL	**5285**

CHAPTER NO 8

WORKING AND MANUFACTURING PROCESS

8.1 Working Process:

Basically, an aqua silencer consists of a perforated tube which is installed at the end of the exhaust pipe. The perforated tube -different diameters hole is to break up gas mass to form smaller gas bubbles. Generally, numbers of holes are drilled on the perforated tube. 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. 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 in to the atmosphere. 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 & a drain plug is provided at the bottom of the container for periodically cleaning of container.

Figure- 8.1: TANK MS

Figure- 8.2: PERFORATED TUBE

Figure -8.3: CHARCOAL

Figure- 8.4: GLASS WOOL FILTER

8.2 Charcoal:

Charcoal is the dark grey residue consisting of carbon, and any remaining ash, obtained by removing water and other volatile constituents from animal and vegetation substances. Charcoal is usually produced by slow pyrolysis, the heating of wood or other substances in the absence of oxygen (see pyrolysis, char and biochar). It is usually an impure form of carbon as it contains ash; however, sugar **charcoal** is among the purest forms of carbon readily available, particularly if it is not made by heating but by a dehydration reaction with sulfuric acid to minimize introducing new impurities, as impurities can be removed from the sugar in advance. The resulting soft, brittle, lightweight, black, porous material resembles coal.

Types

Commercial charcoal is found in either lump, briquette, or extruded forms:

- Lump charcoal is made directly from hardwood material and usually produces far less ash than briquettes.
- Briquettes are made by compressing charcoal, typically made from sawdust and other wood by-products, with a binder and other additives. The binder is usually starch. Some briquettes may also include brown coal (heat source), mineral carbon (heat source), borax, sodium nitrate (ignition aid), limestone (ash-whitening agent), raw sawdust (ignition aid), and other additives like paraffin or petroleum solvents to aid in ignition.[6]
- Extruded charcoal is made by extruding either raw ground wood or carbonized wood into logs without the use of a binder. The heat and pressure of the extruding process hold the charcoal together. If the extrusion is made from raw wood material, the extruded logs are then subsequently carbonized.
- Japanese charcoal removes pyroligneous acid during the charcoal making. Therefore, when burning, there are almost no stimulating smells or smoke. The charcoal of Japan is classified into three kinds.
    - White charcoal (*Binchōtan*)
    - Black charcoal
    - *Ogatan*, Black charcoal that is made from hardened sawdust. Used in the Izakaya or Yakiniku restaurant.

The characteristics of charcoal products (lump, briquette, or extruded forms) vary widely from product to product. Thus, it is a common misconception to stereotype any kind of charcoal, saying which burns hotter, etc.

- Bamboo charcoal
- Activated carbon

Charcoal may be *activated* to increase its effectiveness as a filter. Activated charcoal readily adsorbs a wide range of organic compounds dissolved or suspended in gases and liquids. In certain industrial processes, such as the purification of sucrose from cane sugar, impurities cause an undesirable color, which can be removed with activated charcoal. It is also used to absorb odors and toxins in gases, such as air. Charcoal filters are also used in some types of gas masks. The medical use of activated charcoal is mainly the adsorption of poisons, especially in the case of suicide attempts in which the patient has ingested a large amount of a drug. Activated charcoal is available without a prescription, so it is used for a variety of health-related applications. For example, it is often used to reduce discomfort (and embarrassment) due to excessive gas in the digestive tract.

Animal charcoal or bone black is the carbonaceous residue obtained by the dry distillation of bones. It contains only about 10% carbon, the remainder being calcium and magnesium phosphates (80%) and other inorganic material originally present in the bones. It is generally manufactured from the residues obtained in the glue and gelatin industries. Its decolorizing power was applied in 1812 by Derosne to the clarification of the syrups obtained in sugar refining; but its use in this direction has now greatly diminished, owing to the introduction of more active and easily managed reagents. It is still used to some extent in laboratory practice. The decolorizing power is not permanent, becoming lost after using for some time; it may be revived, however, by washing and reheating. Wood charcoal also to some extent removes coloring material from solutions, but animal charcoal is generally more effective.

8.3 Absorption Process:

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 saddled before filtration. Feeding devices are similar to those used in feeding the coagulants.

Advantages of Absorption Process.

- It increases the coagulation power of the process.
- Its use reduces the chlorine demand.
- The excessive dose of activated carbon is not harmful.
- The treatment process is very simple and it requires nearly no skill.
- The efficiency of removing color, odor and taste is quite high.
- It can be easily regenerated
- It has excellent properties of attracting gases

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

Action of dissolved SO2: -

When Sox is mixed in water, it forms SO2, SO3, SO4, H2SO4, H2SO, i.e., sulfur Acid (H2SO3,), it forms Hydrogen Sul hide which causes for l rotten egg smell, acidify and corrosion of metals.

Action of dissolved CO2: -

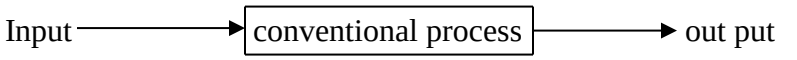
The dissolved carbon dioxide forms bicarbonate at lower PH and Carbonates at higher PH. This levels 40-400 mg/liter. The form a scale in pipes and boilers. The carbon dioxide mixes with water to form Carbonic acid. It is corrosive to metals and causes greenhouse effect.

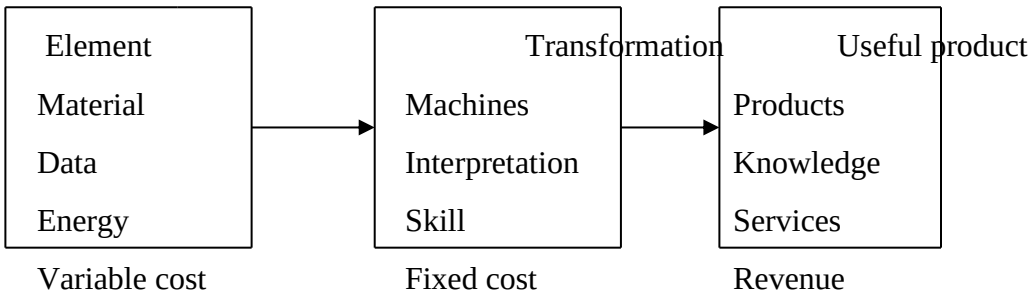
Effect of dissolved NOx: -

The Nitrogen in water 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 surface water. A limit of 10 mg per liters Nitrate is affordable in drinking water.

8.4 Manufacturing:

The process of conversion of raw material in to finished products using the three resources as Man, machine and finished sub-components. Manufacturing is the term by which we transform resource inputs to create Useful goods and services as outputs. Manufacturing can also be said as an intentional act of producing something useful. The transformation process is Shown below-





It's the phase after the design. Hence referring to the those values we will plan

The various processes using the following machines: -

i) Universal lathe
ii) Milling machine
iii) Grinding machine
iv) Power saw
v) Drill machine
vi) Electric arc welding machine

8.5 Manufacturing Process:

The following are the various manufacturing process used in mechanical engineering.

1) Primary Shaping Process: The process used for the preliminary shaping of the machine component is known as primary shaping process.

2) Machine Process: The process used for giving final shape to the machine component, according to planned dimensions is known as machining process. The common operation drilling, boring etc.

3)**Surface Finishing Process**: The process used to provide a good shape surface finish for the machine components are known as surface finishing processes. The common operation used for the process are polishing, buffing, lapping etc.

4) Joining Process: The process used for joining machine components are known as joining process. The common operation used for this process are soldering, brazing, welding etc.

5) Process Affecting Change in Properties: These are intended to import specific properties to material e.g., heat treatment, hot working, cold rolling etc.

❖ Welded Joints:

A welded joint is a permanent joint, which is obtained by the fusion of the edges of the two parts, to be joined together, with or without the application of pressure and a filler material. Welding is intensively used in fabrication as an alternative method for casting or forging and as a replacement for bolted and reverted joints. It is also used as a repair medium.

- **Advantages:**
    1. The welded structures are usually lighter than riveted structures.
    2. The welded joints provide maximum efficiency which to impossible innervated joints.
    3. Alteration and addition can be easily made.
    4. As the welded structure is smooth in appearance, it is good looking.
    5. In welded structures, tension members are not weakened.
    6. In a welded joint has high strength often more than parent metal.

- **Disadvantages:**

1. Since there is uneven heating and cooling during fabrication therefore the members may get distorted as additional stresses may develop.
2. It requires a highly skilled labour and supervision.
3. No provision for expansion and contraction in the frame, therefore there is possibility of cracks.
4. The inspection of welding work is difficult than riveting work.

COMPONENT : - FRAME

MATERIAL : - M.S. ANGLE

QUANTITY : - 1

TABLE 03: DESCRIPTION OF OPERATION MACHINE USED

SR. NO	DESCRIPTION OF OPERATION	MACHINE USED	CUTTING	MEASUREMENT	TIME
1	Cutting the angle in to length as per dwg	Gas cutting machine	Gas cutter	Steel rule	15min.
2	Cutting the angle in to number of pieces as per dwg	Gas cutting machine	Gas cutter	Steel rule	15min.
3	Filing operation can be performed on cutting side and bring it in perpendicular C.S.	Bench vice	File	Try square	15 min.
4	Weld the angles to the required size as per the drawing	Electric arc welding machine	-------	Try square	20 min

NAME OF THE PART – HOLLOW PIPE

MATERIAL – M. S

QUANTITY – 1

TABLE 04: DETAIL OPER MACHINE USED

SR.NO.	DETAIL OPER.	M/C. USED	TOOL USED	ACCES	MEA.INST.
1.	Marking on pipe	-	-	-	Scale
2.	Cutting as per dwg	Power hack saw	Hock saw blade	Jig & fixtures	Scale
3.	Facing both side of pipe	Lathe machine	S.P.C. T	Chuck	Vernier caliper
4.	Turning as per dwg size	-	-	-	-
5	Filling on both end	Flat file		Vice	
6	Drill number of holes on pipe	Drilling m/c	Drill bit	Clamp	Vernier caliper
7	Weld rectangular pipe on tank	Welding m/c	Welding rod	----------	----------

CHAPTER NO 9

FINAL PROJECT VIEW

9.1 Our Final Project View

After Making Silencer

Conventional Silencer

Aqua Silencer

Figure 9.1: Final Project

9.2 Advantages:

- Control air pollution.
- Reusable
- Maintenance cost is less.
- Operating cost is less.
- Compact in size.
- Same concept can be used for heavy vehicle.

Disadvantage:

- Lime water should be filled once a year
- Weight is more compare to conventional silencer
- Space is required

9. 3 Results:

TABLE 05: Result: 1. Conventional Silencer**:**

CONSTITUENTS	AMOUNT
CO (%vol)	0.06
HC hexane (ppm vol)	41
CO2 (%vol)	2.40
Vibrometer Reading (Avg)	113.66db

TABLE 06: Result: 2. Aqua Silencer:

CONSTITUENTS	AMOUNT
CO (%vol)	0.03
HC hexane (ppm vol)	38
CO2 (%vol)	1.10
Vibrometer Reading (Avg)	99.33db

9. 4 Comparisons:

TABLE 07: Comparison between the conventional and aqua silencer Readings:

Parameters	Before Installation of Aqua Silencer	Considered after Installation Aqua Silencer	Difference
CO (%vol)	0.06	0.03	0.03
HC hexane (ppm vol)	41	38	3
CO2 (%vol)	2.40	1.10	1.3
Vibrometer Reading (Avg)	113.66db	99.33db	14.33

9.5 Discussion:

The results which are obtained from the project analysis is given below in the Table 5 and 6. Comparison between the conventional and aqua silencer Readings are given table 07. Compa 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 four stroke petrol engine is analyzed using a gas analyzer. During these tests, it is observed that the number 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 has absorbed 74% of the gases.

CHAPTER NO 10

CONCLUSION

10.1 Conclusion:

- The aqua silencer is more effective in the reduction of emission gases from the engine reduction of emission gases from the engine
- Exhaust using perforated tube and charcoal, by using perforated tube the backpressure will remain constant and the sound level is reduced.
- By using perforated tube, the fuel 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.
- 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.

10.2 Future Enhancement: There has understandably been an increasing concern in recent years over the increasing rate of transportation and discharge of industrial waste waters into environment as well as the release of toxic emission into the atmosphere from automobile and industrial engines. Technological breakthroughs like the Aqua Silencer can be the answer to the reduction of toxic emissions into the environment from engines. Currently, the Aqua Silencer is only suitable for use in industrial engines and heavy weight vehicles. But R&D departments have taken the subject into consideration and are going into developing and redesigning the Aqua Silencer to make it possible to be fitted in to automobiles keeping its aerodynamic

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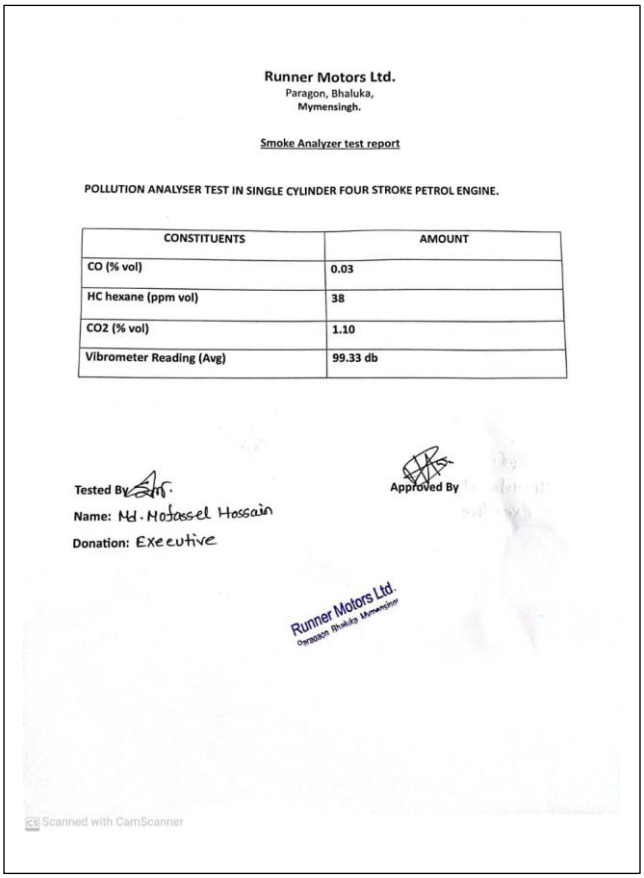
APPENDIX

Test Report:



Runner Motors Ltd.
Paragon, Bhaluka,
Mymensingh.

Smoke Analyzer test report

POLLUTION ANALYSER TEST IN SINGLE CYLINDER FOUR STROKE PETROL ENGINE.

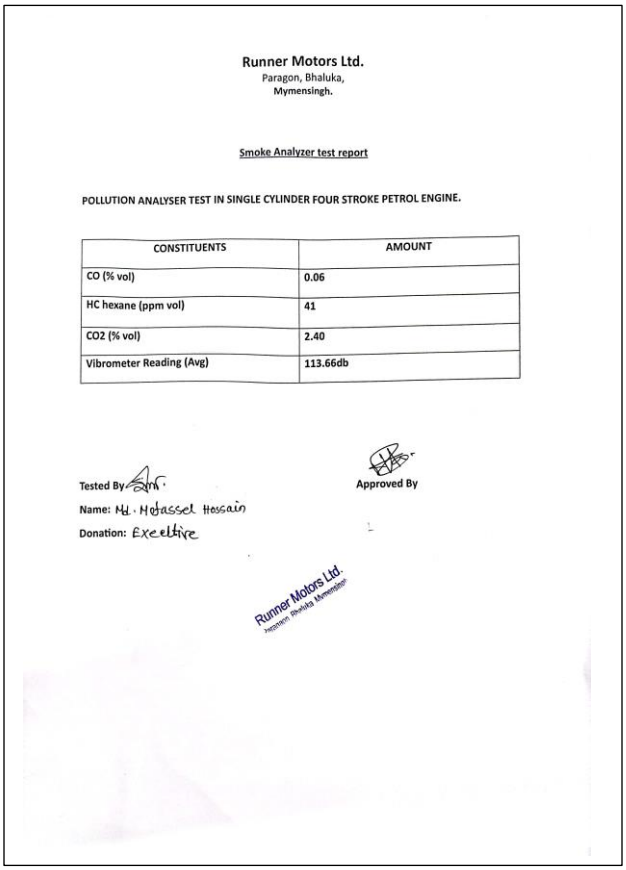
CONSTITUENTS	AMOUNT
CO (% vol)	0.03
HC hexane (ppm vol)	38
CO2 (% vol)	1.10
Vibrometer Reading (Avg)	99.33 db

Tested By
Name: Md. Mofassel Hossain
Donation: Executive

Approved By

Runner Motors Ltd.
Paragon Bhaluka Mymensingh

Scanned with CamScanner



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