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Design and reduction of carbon monoxide and NO_x in petrol engine Aqua silencer

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Abstract – *Purity of air is heart of the living being. Now-a-day's Air pollution is the major problem occurs in the modern era. The main pollutants which were come from the exhaust gases are carbon monoxide and oxide of nitrogen (NO_x) etc. So it is necessary to reduce the pollution which is caused by the engine exhaust gas. As considering the effects, Aqua silencer project made to reduce the carbon monoxide and nitrogen oxides. This Aqua silencer will help to reduce the emission which were comes out from petrol engine exhaust. Petrol has less density when compared to diesel engine and lime water can easily react rapidly with petrol thus why we choose the petrol engine. Perforated tube, lime water and charcoal layer are used in this technology. Silencer is immersed in the lime water. Due to this water noise also get reduced. Abusively noise pollution is one of the irritating pollution. Aqua word is named from which water was used in this technology.*

Key Words: **Lime water, Aqua, Perforated tube, Emission control, Charcoal.**

1. INTRODUCTION

It is hard to say that our environment globe is surrounded b the air pollution. Statement said that every individual person breathes approximately 2300 a day, inhaling about 17 to 24kg of air daily. Natural pollutants include dust, pollen, salt particles, smoke from forest fires, and gases from organic waste. Most pollution caused by human activates is directly or indirectly the result of burring of fuels in furnaces or engines. Polluted air causes physical ill effects decide undesirable aesthetic and physiological problems. Considering the available fuel resources and the present technological development, petrol fuel is evidently indispensable. In general, the consumption of fuel is an index for finding out the economic strength of any country. The main pollutants contribute by automobile are carbon monoxide (CO), unburned hydrocarbons, oxides of nitrogen (NO_x) and lead. In order to avoid this type of gases we made aqua silencer. Aqua silencer is fitted to the exhaust pipe of the engine. Sound produced under water is less hear able than is produced in atmosphere. So it is used to control the noise in IC engines. This is mainly because of presence of small sprockets in water molecules, which lower its amplitude, thus lowers the sound level. The emission can be controlled by using the activated charcoal layer which is having high absorption. Lime water chemically reacts with the exhaust gases easily. The activated charcoal filters the harmful sulphur and nitrous content produced from the engine. The noise and smoke level is considerable less than the conventional silencer further there is no need of catalytic convertor. In this silencer, the charcoal and water is used, so it is also called as hybrid aqua silencer. "The consumption of fuel is an index fir finding the economic strength of any country". This aqua silencer having the desirable deigns to replace the current silencer.

1.1 LITERATURE REVIEW

A] Literature survey

[1]S.Raffek et.al (March 2017) that they determine the amount of exhaust gases relives from the automobile vehicles and they also determined the amount of hydrocarbons, nitrogen present in the gases. They testes the exhaust gases in their silencer (without lime water) and later they tested in their aqua silencer (with lime water) and they taken their readings. They also proved that their silencer is better than the conventional silencer. They tested their project using with charcoal and without charcoal. Smoke analysis also taken in that project.

[2]Rahul.S.Padval et.al (March 2016) they concluded this project had an effective emission control than the present conventional silencer and reduced the exhausted gases toxic like unburned hydrocarbons, nitrogen using lime water and charcoal. They said that fuel requirements for the conventional silencer are same as to the aqua silencer. Due to the medium of water it will also reduce the smoke and noise. They also said that contamination of water is very less in aqua silencer. They also showed that how chemically react to that lime water and to charcoal. They also added an extra chemical reagent as chlorine which will coagulation power of the process. In this project they also showed the comparison between conventional silencer and to this aqua silencer.

[3]Akhil Anil Kumar et.al (May 2016) this projects that they redesign the aqua silencer as in square shape they also showed the emission control comparison in form of graph. In this project the water is used as the major medium than the lime water. They tested this silencer using charcoal, lime water, limewater with activated charcoal and concluded that is effective silencer.

[4]Sarath Raj et.al (March 2016) their project title is fabrication and testing of portable twin filter aqua silencer. Their projects title told that the fabricated the aqua silencer with double filter which is more effective than the single filter aqua silencer. They also fabricate the silencer with twin filter and introduce the baffle type muffler and also they used the wave cancellation type muffler due to this muffle the wave which is present in the gases will eliminate and reduce the sound which is created inside the silencer. They combined two types of muffler like resonance type muffler and absorber type muffler, due this combination of muffler will tends to reduced both the emission and sound.

[5]Sagar Gite et.al (Feb 2017) in this survey they reconstruct the silencer with the inverted funnel and showed the emission control and reaction which is taken inside the medium. They used their medium as lime water and activated charcoal. They also showed the comparison between the emission controls of unburned hydrocarbons. They used four inverted funnel to reduce the emission by filtration process. In this project they explained that lime water would change once in a year. They also explained that when the chemical is done their reaction minute particles of water will spray over the edge of outer shell, so that they will eliminate carbon which is deposited on the end of outer shell of silencer.

B] Points to remember while taking design.

- ✓ Major pollutants by the automobile are;
  - Carbon monoxide (CO)
  - Oxides of Nitrogen (NO_x)
  - Carbon dioxide (CO_2)
  - Unburned hydrocarbons (UBHC)
  - Oxides of Sulphur (SO_x)
- ✓ Sources of Air pollution are;
  - Automobiles
  - Electrical power generation
  - Industrial and domestic fuel consumption
  - Refuse Burning
  - Industrial processing etc,

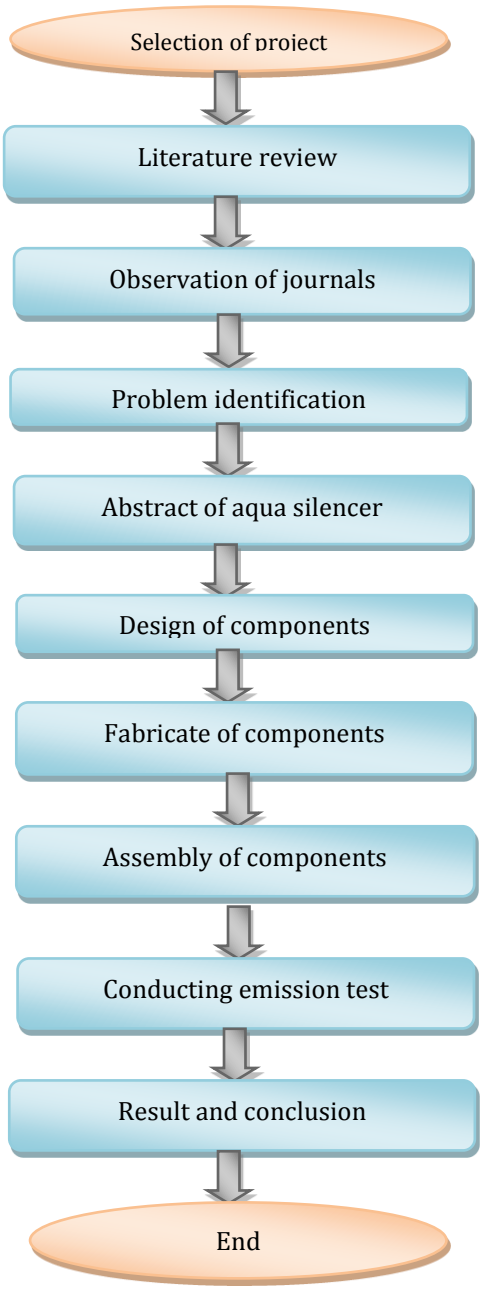
Consumption of fuel is an index of finding out the economic strength of country

2. OBJECTIVE AND METHODOLOGY

2.1 Objective

Now a days, transportation and industrial areas are goes on increasing and along with them various pollutions are also increasing. It affects the environment of world very badly. The main contributor in this pollution is automobiles i.e. exhaust gases for removal of this content or to convert them in harmless gases, various techniques are developed by some countries but they are expansive and in developing country like India, we need cheep and effective technique. An aqua silencer is one of them. Hence it is used to reduce the pollutants and noise of emission from engine.

2.2 Methodology



3] CONSTRUCTIONAL DETAILS

3.1 Engine

Fig.-3.1 two stroke petrol engine

In this project we are using the 2 stoke petrol engine having 98.2cc and 50×50 mm Bore/stroke Aqua silencer is also applicable for both 2&4 stroke petrol and diesel engine.

3.2 Perforated tube

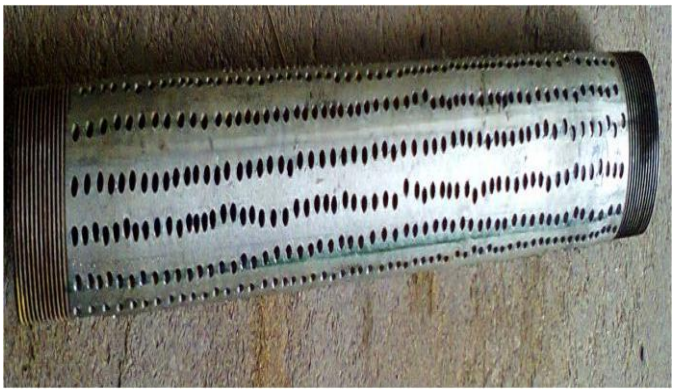


Fig- 3.2 Perforated tube

The perforated tube is the main components in this Aqua silencer. This perforated tube is cylindrical in shape and having length of approximately 250mm and circle in cross sectional. It has different type of diameter like 6mm to 11mm which is in irregular position. Generally 8 set of holes are cut on the tube. The purpose of having this perforated tube is that when the exhaust gas is emitted by engine the gas molecules is having a large diameter and having high mass due to this heavy mass it is difficult to eradicate the gas molecule fully, so that this tube will break the large molecule bubbles into small molecule bubbles which is easy to react with chemical. The main function of perforated tube is converting large mass bubbles into small mass bubbles. Inside the perforated tube layer of charcoal is pasted over it.

3.3 Charcoal

Fig-3.3 charcoal

Charcoal is another essential component in this silencer. Basically it is an activated charcoal. It is made by burning a coal on burner at 1500^0 c for several hours. It has high absorbing capacity as its surface area get increasing and it will absorb several molecules. It is very porous and having extra free valance electrons hence gases will trapped by this charcoal. This activated charcoal will trap the oxides of sulphur and fluoride when the sulphur present in exhaust gases. It has the diameter of about 2 to 40nm which is mesopores. This activated charcoal is pasted over the perforated tube.

3.4 Lime stone

Fig- 3.4 Limestone

Lime water is the common name for a saturated solution of calcium hydroxide. Calcium hydroxide, $Ca(OH)_2$ is sparsely soluble in water (1.5 g/L at 25 ^{0}C) Pure limewater is clear and colorless, with a slight earthy smell an alkaline better taste of calcium hydroxide. Limewater is prepared by stirring excess calcium hydroxide in pure water, and filtering off the excess insoluble $Ca(OH)_2$. Excess of Calcium hydroxide is added to the water with an accurate temperature milk of lime will obtain. Milk of lime is an alkaline solution with of pH of 12.3. This lime stone will absorb the nitrogen present in the exhaust gas and sulphur too.

3.5 Non-return valve

Fig-3.5 non-return valve

This non-return valve allows the flow of fluid only in one direction. As in aqua silencer water and gases are presented hence to avoid the back flow of the fluid, it is used.

3.6 Flange

Fig- 3.6 Flange

It is the component which is used to join between the exhaust pipe of engine and to the aqua silencer pipe.

3.7 Outer shell

Inside the outer shell all the components are placed. Inlet and outlet port are available in this outer shell.

4] WORKING PRINCIPLE

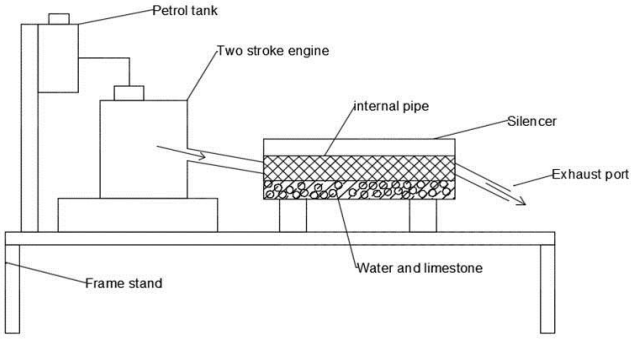


Fig-4.1 Schematic diagram 1

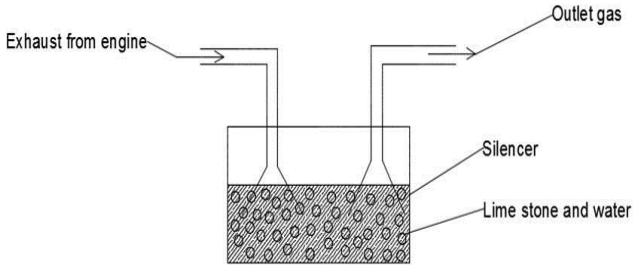


Fig- 4.2 Schematic diagram 2

In the two schematic diagrams said the working principle of aqua silencer. As the exhaust gases enter into the aqua silencer, the perforated tube converts high mass bubbles into low mass bubbles due to the presence of charcoal layer present over it will eradicate the sulphur after that they come into contact with lime water they chemically react with it and pass through charcoal layer which again purify the gases. It is highly porous and posses extra free valences so it has high absorption capacity. Since the charcoal layer is covered with outer shell which is filled with water. Sound produced under water is less amplitude and hearable that it produced in the atmosphere. This is mainly because of small sprockets in water molecules, which lowers its amplitude thus, lowers the sound.

5] EFFECT OF DISSOLVED GASES ON WATER

In this system water is very good absorbing medium. In aqua silencer gases made to dissolved in water when these gases from engine get dissolved in water they form acid, carbonates and bicarbonates etc.

1. Action of dissolved SO_x
2. Action of dissolved CO_2
3. Action of dissolved NO_x

5.1 Action of dissolved SO_x;

When SO_x is treated with water, it forms SO_2, SO_3, SO_4, H_2SO_4, i.e. sulphuric acid (H_2SO_4), it produces hydrogen sulphide which causes egg smell and causes corrosion of metals.

5.2 Action of dissolved CO_2;

The dissolved carbon dioxide forms bicarbonate at less pH and carbonates at greater level pH. These levels 40 to 400mg/L. form a scale in pipes and boilers. The carbon dioxide mixes with water to form carbonic acid.

5.3 Action of dissolved NO_x;

The nitrogen in water undergoes oxidation to form ammonia, nitrate, and nitric acid. This synthesis of protein

and amino acids is get effect by nitrogen. Nitrate usually occurs in trace quantities in surface water. A limit of 10mg/L nitrate is affordable.

6] METHODS TO CONTROL THE WATER POLLUTION

6.1 Lime water wash method

The water is treated with the calculated quantities of slaked lime after mixing the heavy precipitates settle down as sludge at the bottom of the tank are removed from time. Lime can neutralize any acid present in the water. SO2, gases are removed from the flue gases forming calcium sulphate. The precipitate dissolved carbon dioxide and converts bicarbonate ions into carbonates

6.2 Absorption process

Activated charcoal is available in granular or powdered form. As it is highly porous and possess free valences. It has 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.

6.3 Advantages of absorption process

- It increases the coagulation power of the process.
- Chlorine demand is reduces by use of these method.
- The excessive does of activated carbon is not harmful.
- The excessive dose of activated carbon is not harmful
- The treatment process is very simple.
- It can be easily regenerated.

7] CHEMICAL REACTIONS

7.1 Chemical 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.

$$NO_2 + 2H_2O \longrightarrow 2HNO_2 + 2HNO_3 \text{ (Diluted)} \ldots. (1)$$

7.2 Chemical reaction 2;

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

$$Ca(OH)_2 + 2HNO_3 \longrightarrow Ca(NO_3)_2 + 2H_2O$$
$$Ca(OH)_2 + 2HNO_2 \longrightarrow Ca(NO_2)_2 + 2H_2O \ldots\ldots\ldots (2)$$

7.3 Chemical reaction 3;

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

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + 2H_2O$$
$$CaCO_3 + H_2O + CO_2 \longrightarrow Ca(HCO_3)_2 \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

7.4 Chemical reaction 4;

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

$$Ca(OH)_2 + SO_2 \longrightarrow CaSO_3 + H_2O \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

7.5 Chemical reaction 5;

$$CaCO_3 + SO_2 + H_2O \longrightarrow CaSO_3 + CO_2 + H_2O \ldots. (5)$$

From calcium carbonate, calcium sulphite will precipitate and CO_2 will be by-products. 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 calcium carbonate to form calcium bicarbonate.

8] EMISSION ANALYSER TEST IN PETROL ENGINE

Fig-8.1 Final product of aqua silencer

The above shows the final view and assembled view of aqua silencer. This aqua silencer is made into emission test that is must compare to the conventional silencer,

Table- 1: Emission comparison

Types	Prescribed standard CO	Measured level CO	Prescribed standard HC	Measured level HC
Ordinary silencer	3.50	0.93	6000	269
Aqua silencer	3.5	0.22	6000	212

Sound level also measured in this silencer to reduce the sound and control noise pollution

Table-2: Sound level comparison

Load	Sound level ordinary silencer	Sound level in aqua silencer
Without any load	104.5 db	75.4db
50% load	106.5 db	76.5 db
100% load	107.3 db	78.1 db

Table-3 Test result after 1hr

Pollution gases	Without aqua silencer	With aqua silencer
CO%	0.028	0.007
HC	0.051	0.025
CO_2%	15.55	15.11
O_2%	00.23	0.09
NO_x%	0.002	0.0001

Also we have tested the silencer by running the engine for 1 hour and observed;

The above comparison is experimentally tested and analysis the emission of gases in our silencer, it made a good output that it could control the emission. This aqua silencer is also used for diesel engine because the diesel engine having high emission gases this aqua silencer will control the emission and reduce the pollutants gases.

9] MODIFICATION TO BE DONE TO IMPROVE EFFICENCY

1. Chemical reactions can be intensified the oxides of nitrogen by providing water sprayer immediately after the exhaust manifold of the engine. This allows more time for the chemical reaction to take place. To certain extent, this will compensate the loss of the water level inside the outer shell due to evaporation.

2. To reduce the surface temperature of the exhaust gas pipe, asbestos rope could be coiled over, so that there may not be direct contact surface with the inflammable atmosphere around.

3. The lime water must be cleaned once a year and replace a new lime stone into the outer shell and also add some catalytic convertor to increase the chemical reaction fast. It will improve the efficiency of silencer.

10] ADVANTAGES AND DISADVANTAGES

10.1 Advantages

- CO is reduced 60 to 70% compared to ordinary silencer
- Control emission in greater level
- Reduce noise pollution
- No vibration when the engine is running
- Chemical reaction will be fast
- Carbon is precipitated
- It is light in weight
- Outer shell will not rust because of lime water
- No need of catalytic convertor
- Low cost
- Easy in construction
- Easy starting

10.2 Disadvantages

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

11] SCOPE OF THIS PROJECT

An aqua silencer system is designed in such a way as to substitute for conventional single unit engine silencers installed on industrial engines and heavy vehicles. Its construction is simple and it has a slender design in addition to having a minimal footprint it also optimizes the engine exhaust system for reducing backpressure and decreasing noise level. It is used to control the noise and emission in IC engines. The reason why we optimize for aqua silencer is that in our world air pollution is contributed major. Methodology is a very important element to be consideration to make sure the fluent working of the project and to get expected results. In other words a good framework can present the overall view of the projects and be used to arrange or extract this qua silencer easily. It will easily adapt to the environment.

12] RESULT AND DISSCUSION

The results which are obtained from the project analysis are given in the table 1,2,3. Emission and noise control

tests are successfully conducted in this project. During these tests, it is observed that the amount of hydrocarbons and CO are reduced. This is because of the lime water and activated charcoal 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.

13] ENHANCEMENT

At the present stage the Aqua silencer is used to reduce the noise and emission level, and is suitable for automobiles and heavy vehicles but it affects the aerodynamics properties of vehicle as well as the efficiency of the engine. Hence R&D departments are taken this problem in consideration and going to redesigning the aqua silencer.

14] CONCLUSION

By using activated charcoal and perforated tube if effectively eliminates the pollutants in the exhaust gases and reduces the noise, also backpressure remains constant, fuel consumption is same that of conventional silencer. It is a smokeless and pollution free emission to our environment.

15] REFERENCES

[1]Alen. M. A, Akshay. M, Prem sankar. R, Mohammed shafeeque. M (Aug-2015), "Fabrication and testing of aqua silencer", International Research Journal of Engineering and Technology, Vol. 2, Issue 5.

[2]Akhil Anil Kumar, Anoop N, Aquib Jawed p.p, Bijoy E, Midhun T.V, Mohammed shiyas. N.P, Ranjith Krishna P.T (May-2016), "International Journal of Engineering and Innovative Technology", Vol. 5, Issue 11.

[3]Sarath Raj, Ajbin k Aniyan, Akshay Aji, Anandhu Raj, Anandu Mohan, Sharon T.R (Oct-2015), "Fabrication and testing of portable twin filter aqua silencer", International Journal of Mechanical and Industrial Technology, Vol. 3, Issue 2.

[4]Rahul.S.Padval, Nitin.V.Patil, Mahendra.P.Pachare (Mar-2016), "Aqua silencer", International Journal of Science Technology and Management, Vol. 5, Issue 3.

[5]J.Soundhar, R.Rastrapathi, S.Sugavanam, M.Venkatesan (Aug-2015), "New Trends of Emission Control System Used In Silencer", International Journal on Application in Mechanical and Production Engineering, Vol. 1, Issue 8.

[6]P.Balashanmugam, G.Balasubramanian (Jan-2015), "Developments of Emission and Noise Control Device (Aqua Silencer)", International Journal of Modern Trends in Engineering and Research, Vol. 2, Issue 1.

[7]S.Raffek, S.Rohit, R.Mathivanan, M.Muthaiah (Mar-2017), "Pollution Control Using Aqua Silencer in Automobile", International Conference on Latest Innovations in Applied Science, Engineering and Technology.

[8]Prof H.A Khande, Karansingh K.Naglot, Shubham B.Lutade, Akshay K.Pardeshi, Ruthuja S.Patil (May-2016), "Reduction in Emission and Noise Using AQUA SILENCER", International Journal of Scientific Development and Research, Vol. 1, Issue 5

[9]S.Santhosh Sathish Kumar, S.Richard Brinton, G.Sarath kumar, S.Saravanamanoj (Apr-2017), "Design and Fabrication of Eco-Friendly Aqua Silencer", International Journal of Science Technology & Engineering, Vol. 3, Issue 10

[10]R.Sharavanan, R.Sabarish (2017), "Design and Fabrication f Aqua Silencer Using Charcoal and Lime Stone", International Journal of Pure and Applied Mathematics, Vol. 116, Issue 14