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Emission Test Analysis of Aqua Silencer

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Abstract: ***Air pollution is a mixture of solid particles and gases in the air. Emissions from automobile, chemicals from factories, dust, pollen and mold spores may be suspended as particles. Children, older adults and people with heart or lung disease have greater risk from air pollution. An aqua silencer is an attempt, in this direction to reduce the emission and noise from the engines. Sound produced under water is less hearable than it produced in atmosphere, because of small sprockets in water molecules which lowers the amplitude of sound. Smoke level is also reduced considerably comparing with conventional silencer. The main pollutants in the exhaust are the carbon monoxide (CO), unburned hydrocarbon (UBHC), oxides of nitrogen (NOx) and carbon dioxide. Lime water, urea solution in normal method and atomization method are used here in aqua silencer. In this analysis exhaust gas emission from the normal silencer is compared with aqua silencer. Emission test is conducted to determine the amount of Carbon monoxide (CO), Hydrocarbon (HC) Carbon Dioxide (Co_2) and Oxygen(O_2) present in the exhaust gas from the engine.***

Keywords: Aqua silencer, water, lime solution, urea solution, atomization

I. INTRODUCTION

Air pollution is a mixture of solid particles and gases in the air. Emissions from automobile, chemicals from factories, dust, pollen and mold spores may be suspended as particles. Children, older adults and people with heart or lung disease have greater risk from air pollution. CO, UBHC, No_x, Co_2 and lead are the main pollutants contributed by automobiles. To conserve earth's environment from degradation, serious attempts should be made. Petrol and diesel engines are major contributors in various fields, so we cannot neglect the harmful effects of burnt gases which affect the purity of our environment.

In the above aspect an aqua silencer is designed to replace conventional engine silencer. It offers minimum emission, low noise and reduced back pressure in IC engines. An aqua silencer is fitted to the exhaust pipe of IC engines. The activated charcoal absorbs the harmful nitrous and sulphur contents produced from the engines. In order to improve the efficiency of aqua silencer, instead of normal water we can use lime water with activated charcoal. There are many expensive techniques are available to reduce the emissions from engine, but absorption technique is less expensive and economically feasible.

Supriya Morye et.al[1] conducted experimental analysis on aqua silencer by using water and charcoal to reduce noise and atmospheric pollutants respectively. Shweta B et.al[2] designed aqua silencer. It uses the charcoal layer, perforated tube and water to eliminate the pollutants in the exhaust gases and reduces the noise. Dr. P. K. Sharma et.al[3] designed aqua silencer for 2 stroke petrol engine. It is used to control the noise and emission in IC engines by using water and charcoal.

In the current situation, aqua silencer is designed by using activated charcoal layer, perforated tube and water to eliminate the pollutants in the exhaust gases and reduces the noise. The pollutants in the exhaust gas can be further reduced by using lime water (slacked lime) and urea solution instead for normal water. Also in the current situation, aqua silencer is designed such that exhaust gas is surrounded by activated charcoal, again surrounded by water. The design of the aqua silencer can be improved if the lime water or urea solution is sprayed into the silencer.

In this paper we are using lime water and urea solution instead of water. Also compared the performance of aqua silencer by using normal method and atomization method (spraying the solution)

II. AQUA SILENCER

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Aqua silencer is designed in such a way that it can be placed at the end of the vehicle exhaust pipe or at the end of any industrial exhaust. The end of the exhaust pipe is made as perforated tube. Perforated tube is a tube with different types of hole, which can be of different shapes and sizes. By using perforated tube the high mass bubbles is converted into low mass bubbles. The entire system is divided into two different compartments. In the first compartment, the end of the exhaust tube is made as perforated tube. About 75% of total volume of first compartment is filled with lime water or urea solution. The exhaust gas from the engine passes through lime water or urea solution and reduces the noise and pollutants to some extent.

A small opening is provided at the top of first compartment, so that exhaust gas passes through this small opening and reached the second compartment. In the second compartment is filled with layers of charcoal. Charcoal has high adsorption capacity, so it adsorbs the pollutants from the exhaust gas. Thus Pollutants from the exhaust gas will reduced considerably. Small opening at the bottom acts as drain plug for cleaning of the container. And filler plug at the top for filling the solution. The non-return valve is provided at the entry of aqua exhaust which prevents the back flow of water and gases into the engine. In the atomization method, an atomizer is provided in the first compartment for spray the solution into the exhaust gas.

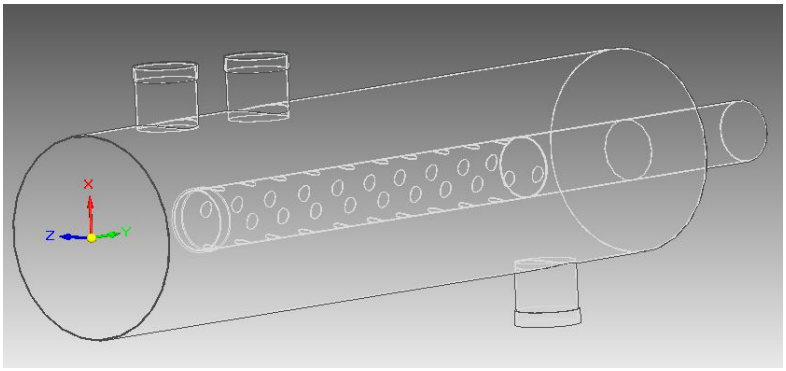

Figure 1 Aqua exhaust test rig

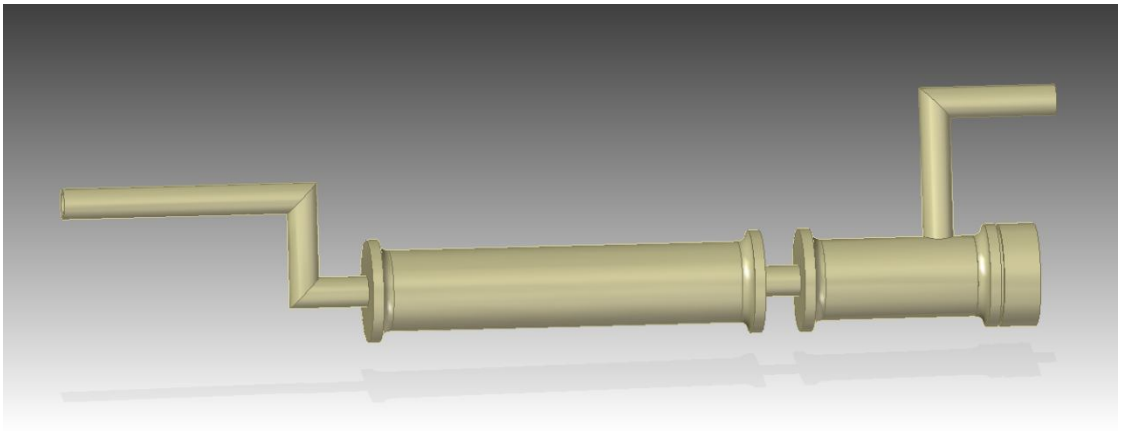

Figure 2 Aqua exhaust test rig using normal method

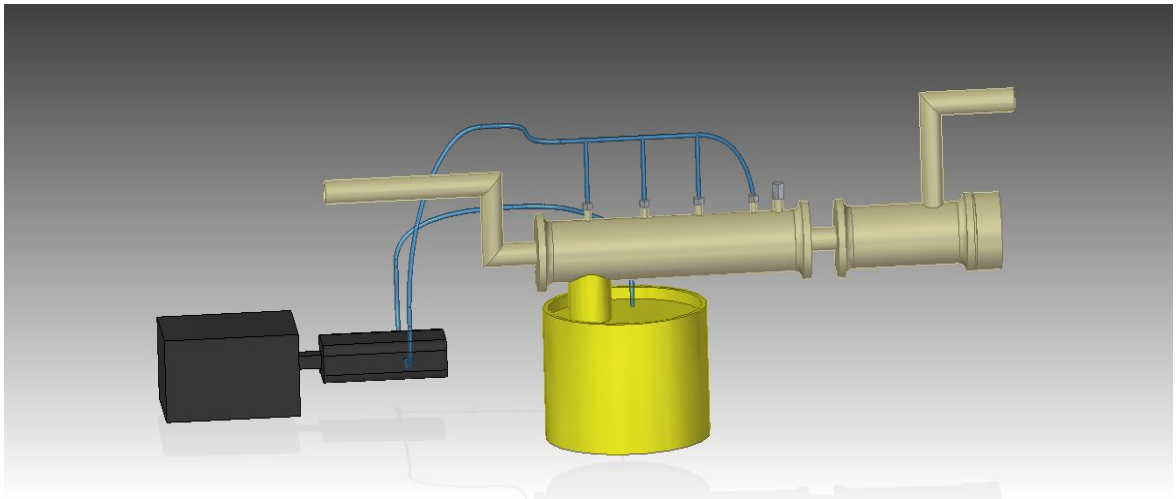

Figure 3 Aqua exhaust test rig using atomisation method

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A. Preparation of solution

Lime wash is a mixture of slaked lime with water. 250gms of slacked lime is mixed with 5 litres of water. After mixing the heavy precipitates, they settle down as sludge at the bottom of the tank and they can be removed from time to time. Lime can neutralize any acid present in the water. Urea solution is a mixture of urea with water. 250gms of urea is mixed with 5 litres of water. The amount carbon dioxide, carbon monoxide and unburned hydrocarbons can be reduced by these methods. The test is conducted on a TVS Victor GX 4 stroke single cylinder petrol engine.

Figure 4 Aqua exhaust test rig (Normal Method)

Figure 5 Aqua exhaust test rig (Atomization Method)

III.RESULTS

TABLE I

EMISSION TEST RESULT

	WITHOUT AQUA SILENCER	NORMAL METHOD		ATOMIZATION METHOD	
		LIME SOLUTION	UREA SOLUTION	LIME SOLUTION	UREA SOLUTION
CO (% vol)	6.509	2.809	2.346	4.45	2.036
HC (103PPM)	2.926	1.006	.691	.823	.163
Co2 (% vol)	2.6	1.27	1.1	2.2	2.1
O2 (% vol)	10.7	18.98	19.4	13.27	14.27

The tables show the emission test results of aqua silencer using normal method and atomization method. Results show that amount CO, HC, Co_2 is reducing and O_2 is increasing in the exhaust gas.

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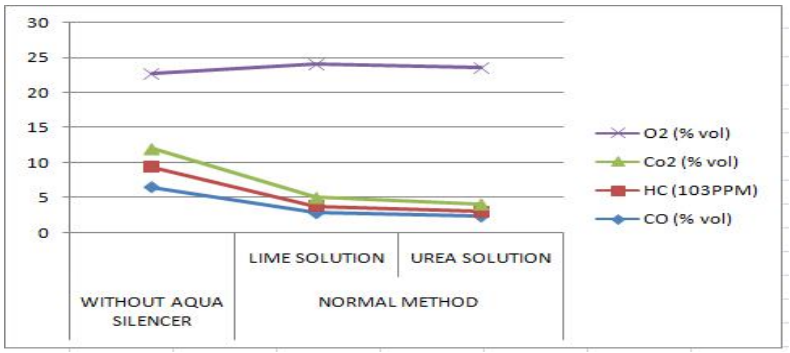

Figure 6 Comparison of exhaust gas of an engine without aqua silencer and with aqua silencer(Normal method using lime solution and urea solution)

Results shows that amount CO, HC, Co_2 is decreasing and O_2 in increasing when aqua silencer(normal method) is fitted to the exhaust pipe of an engine. Comparing lime solution and urea solution, urea solution is showing better results

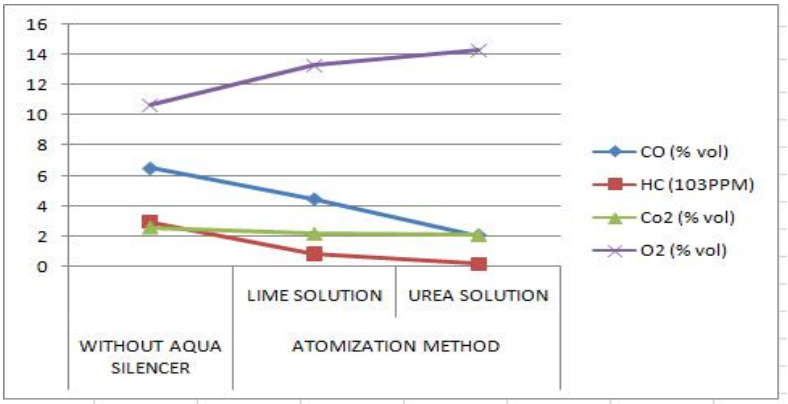

Figure 7 Comparison of exhaust gas of an engine without aqua silencer and with aqua silencer(Atomization method using lime solution and urea solution)

Results shows that amount CO, HC, Co_2 is decreasing and O_2 in increasing when aqua silencer(atomization method) is fitted to the exhaust pipe of an engine. Comparing lime solution and urea solution, urea solution is showing better results.

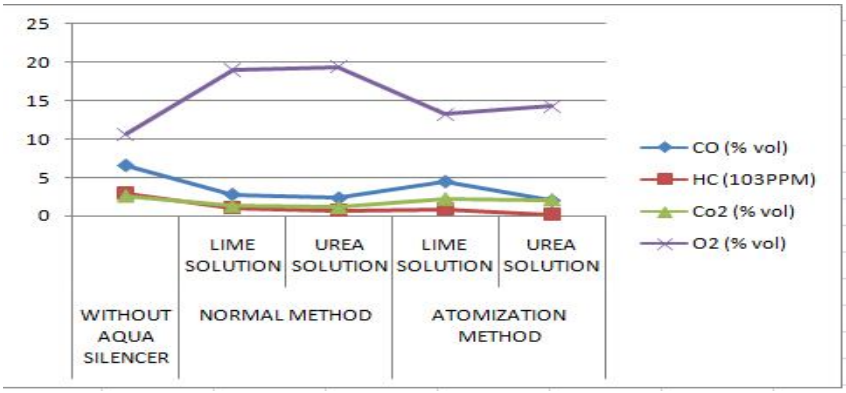

Figure 8 Comparison of exhaust gas of an engine without aqua silencer and with aqua silencer (Normal and atomization method using lime solution and urea solution)

Comparing normal method and atomization method, normal method is showing better results. By atomization method, the amount of contact with the solution will be less for the exhaust gas, but for normal method amount of contact with the solution is greater. That is why normal method shows better results than atomization method. While comparing the entire four method normal method using urea solution is showing better results

IV. CONCLUSION

The aqua exhaust test rig is effective and economical method to decrease the amount of emission gases from the engine exhaust. In this work, aqua exhaust test rig is fabricated and lime solution, urea solution, charcoal are used to absorb the harmful emission from the exhaust gas. Solutions are applied to exhaust gas using normal method and atomization method. Engine performance will not be affected by fixing this aqua silencer. Comparing normal method and atomization method, normal method is showing better results. Comparing lime solution and urea solution, urea solution is showing better results. While comparing the entire four methods normal method using urea solution is showing better results. So the aqua exhaust test rig is a cost effective method to reduce harmful emission in the exhaust gas from engine, generator, furnace etc.

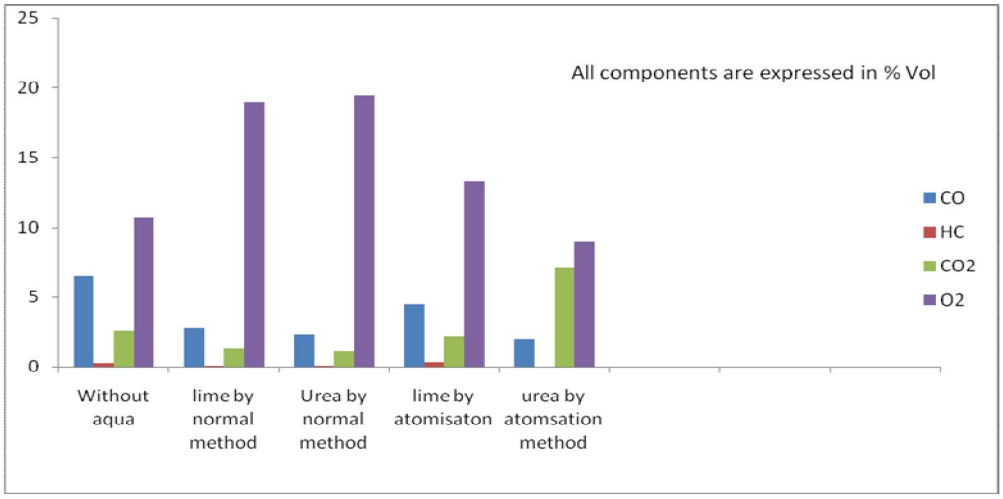

Figure 9 Comparison of different methods in aqua silencer

V. ACKNOWLEDGMENT

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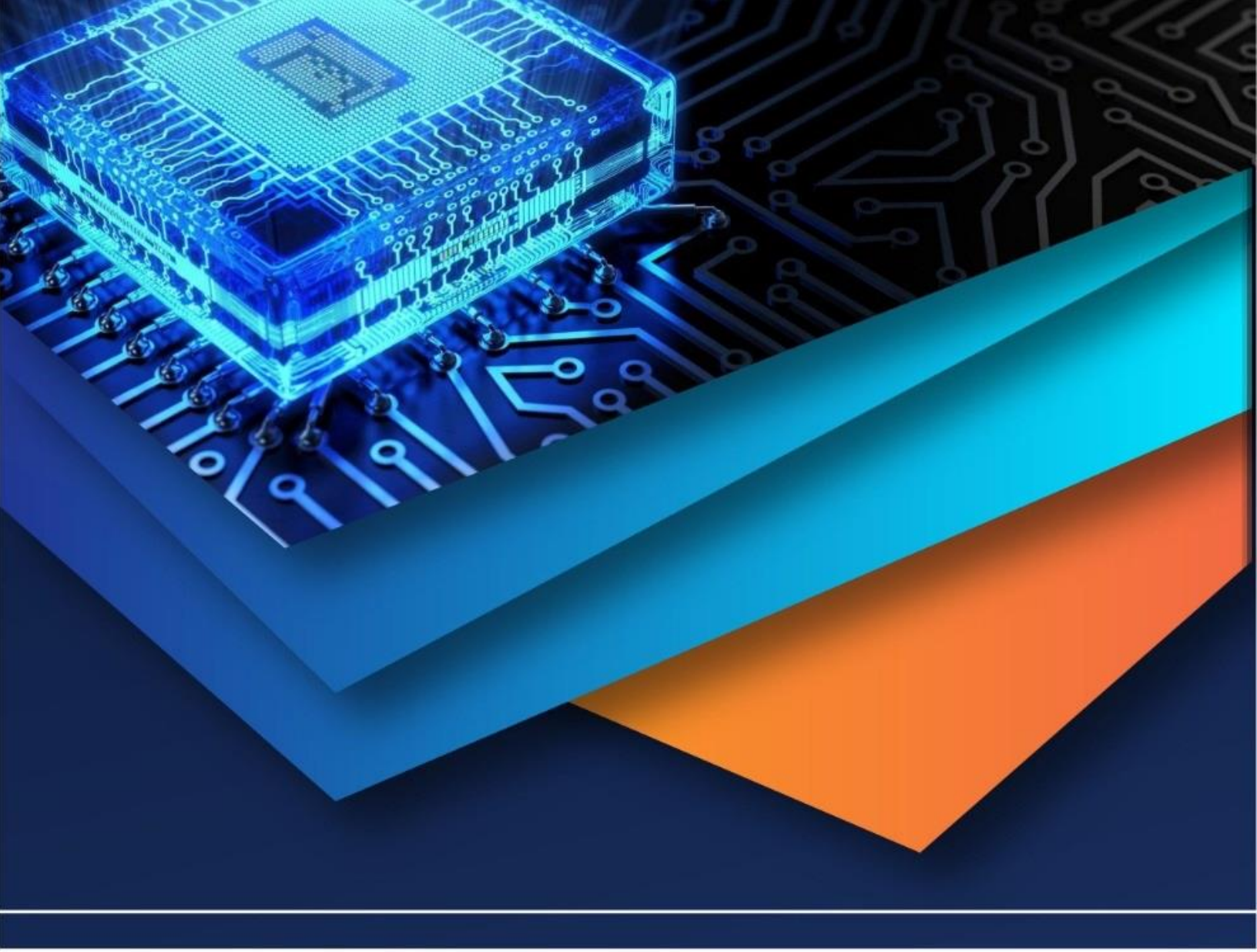

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