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Exhaust Gases Purifier of I.C Engine with Electricity Generation

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1. ABSTRACT

Now a day as pollution is increasing we are using wet scrubber technique as a part of our project work. In this technique there are three chambers. The first chamber is of wet scrubber type In second chamber there is cotton and net attached to it and the third chamber is for reservoir of water and NaOH mixture. By this technique ,absorption of pollutants such as carbon dioxide (CO_2), unburned hydrocarbons(UHC),oxides of nitrogen(NO_X), lead and other particulate emissions from the diesel engines. These pollutants are the root cause for the air pollution. So this is a device used to control the solid and gaseous pollutants from stationary Internal Combustion Engine exhaust streams. In this project scrubber was designed and fabricated. After that the setup was used in the IC Engine to reduce the pollution by chemical absorption method. Also we are simultaneously generating Electricity which we can be used in Electricity supply. The various chemical absorbents such as Sodium Hydroxide (NaOH), Potassium hydroxide (KOH), Magnesium hydroxide ($Mg(OH)_2$) are used for experimental works. But in our project we are using NaOH as an absorbent. Finally, the results were compared with the performance of diesel engine with and without experimental setup.

Keywords: Scrubber, Pollutants, Emission rate, Absorption, spray, Gas analyzer, solution preparation, Spray tower, Electricity Generation.

2. INTRODUCTION

In today's world, the environmental pollution is a major problem. The exhausts generated by vehicles contains pollutants such as carbon dioxide, unburned hydrocarbon, oxide of nitrogen and lead and other particulate emissions which are the root causes of the air pollution. These pollutants are harmful to atmosphere as well to humans especially the children and those having lung diseases. These gases are responsible for acid rain formation. Hence the research towards the emission control has to reach the peak. Hence several emission control devices have been developed by several researchers.

Here a technology named Scrubber technology is used to control the emission from various sources. Wet Scrubbers are generally the only single air pollution control device that can remove both type of pollutants if the exhaust gases contain both particles and gases.

Wet scrubbers are used when dry dust collection creates excessive explosion hazards. Wet scrubbers are capable of removing the pollutants by chemical absorbers .The generation of erosion, corrosion, and a wet plume of entrained droplets that can only be eliminated by high efficiency fibrous mat demisters.

Scrubber system is a widely used pollution control device that can be used to remove particles and/or gases from industrial exhaust streams.

Wet scrubber is a term which is used to describe the devices that use liquid to remove pollutants. In this technology the dirty gas stream is brought into contact with the scrubbing liquid by spraying it with the liquid by forcing it through a pool of liquid.

The design of wet scrubber system depends on the industrial process conditions and the nature of the air pollution involved and dust properties. Scrubbers can also be designed to collect Particulate matter layer larger than 5 micrometers. A high energy device such as venturi of augmented devices such as condensation scrubber can be used to obtain high efficiency removal of 1 micrometer or less.

Wet scrubbers can attain high removal efficiencies for either particles or gases and in some cases can also achieve high removal efficiency for both pollutants in the same system.

Wet scrubbers can serve two different purposes namely the absorption of water soluble gases or vapour and arresting dust.

3. Literature Review

3.1 David Gabriel and Marc A. Discusses

In contrast to regular air contamination controlled strategies, Organic treatment is a promising option. However there is a constant requirement of bigger reactor volume for bio treatment forms for smell control. In this project we have changed over a current full scale compound scrubber to a natural streaming channel and demonstrated that compelling treatment of hydrogen sulphide (H_2S) in the changed over scrubber was conveyable even at gas contact times as low as 1.6s. that is 8-20 times shorter than past bio tricking filtration reports and practically identical to regular contact times compound scrubber. Huge evacuation of demised Sulphur mixes with , alkali and unpredictable natural mixes present in follows noticeable all around was likewise watched nonstop task for >8 months indicated stable execution what's more powerful

conduct for H_2S treatment with poison expulsion exhibits that bio tricking channels can supplant compound scrubber and be a more secure and more efficient for control.

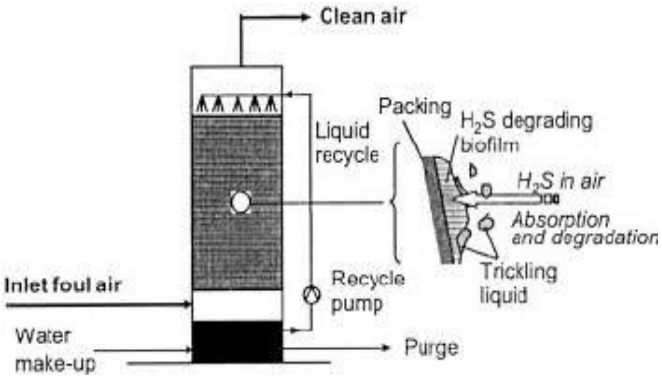


Fig. Sketch of a biological trickling filter for air pollution control. Gaseous pollutants are absorbed and degraded by immobilized organisms.

3.2 P.S. Pathupathiraj, R. Suresh Arvind

A double compose scrubber setup for Outline and manufacture is utilized in this examination paper. It acts as a resource to reduce different Contamination from the discharge and to create agreeable condition . The different sponges for example NaOH , KOH, Mg(OH)2 were used to shower in the double short scrubber to reduce the emission of CO ; CO2 and HC. NaOH and Mg(OH)2 arrangement is a better decision to evacuate NOx and CO2 discharge and KOH and Mg(OH)2 setup is best decision for expel HC and CO outflow.

3.3 Hesketh, H.E

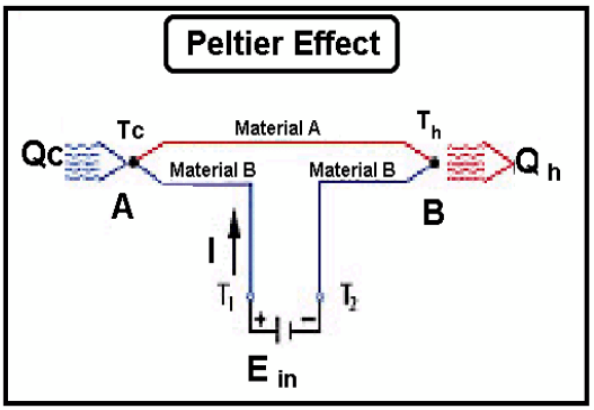
For cleaning the exhaust gases of the ship in the sea they specially use scrubbing technology. In the diesel engine the sulphur content in fuel oil "International Martime Organization (IMO)" and the European United(EU) have introduced are restriction of sulphur of more than 0.10% from January 2015 against the limit of 1.00% in fact up to until 31 December 2014 in SCCA areas (Sulphur Emission Control Area).By the use of scrubbing system they analyze that SO_x emission by it at least 95% and PM(Particulate matter) by at least 60%. It can also reduce NOx and GHG (Greenhouse gases) emission.

3.4 PrabhatKumarJha1, K. Karunamurthy2

To reduce exhaust gas temperature of a S.I. engine by injecting water in to intake manifold, an experimental study is carried out in this paper. The reduction of exhaust gas temperature reduces the NOx emissions. An experimental set up was conducted for spraying water using small compressor at the intake manifold. To regulate the water injection a solenoid valve is used which intern is controlled by an electrical circuit. The temperature of exhaust gas was measured continuously using J-type Thermocouple. Injection of water after carburetor in intake manifold reduce overall temperature due to higher latent heat vaporization.

3.5 NARDUCCI,

To create a heat flux between the junctions of two different type of materials, a thermo-electric cooling which uses the petlier effect is used. A petlier cooler heater or thermo electric heat pump is a solid state active heat pump in which consumption of electrical energy depends on the direction of the current. This type of instrument is also known as thermo-electric cooler. It can be used as a temperature controller that either heat or cools a vapour compression refrigerator and has very long life in vulnerability to leak small size and flexible shape. One of the disadvantage are high cost and poor power efficiency. A petlier cooler can also be used as thermo electric generator when it is operated as a cooler voltage is applied across the device and as a result the difference between two walls is built up.



In a circuit wherein there are two junctions between two materials A and B placed at temperatures T_h and T_c and the resulting voltage is given by:

$V=a(T_h-T_c)$
V: voltage difference between two dissimilar metals
a: seebeck coefficient
T_h-$T_{c:}$ Temperature difference

4. DIMENSION OF EXPERIMENTAL SET UP

4.1 FIRST CHEMBER:

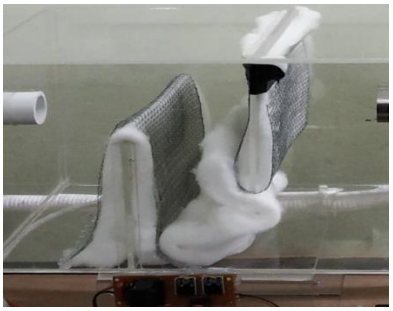
SR.NO	COMPONENTS	DIMENSION
1	CHAMBER-1	30*20*20
2	CHAMBER -2	30*20*20
3	RESERVOIR TANK	20*15*20
4	SS PIPE	Dia 4
5	PVC pipe	Dia 3.5
6	PUMP	Automotive
7	COTTON	Surgical
8	BATTERY	12 V
9	FLEXIBLE PIPE	1
10	TEG-1 12706 module	1 unit
11	WIRES	Copper
12	VOLT METER	1 unit

(All dimensions are in centimeters)

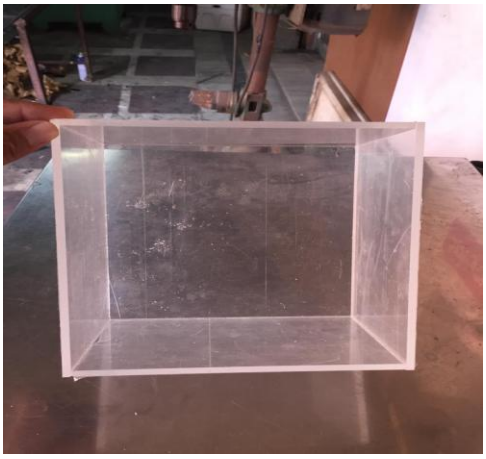
5. PARTS

5.1 CHAMBER 1

5.2 CHAMBER 2



5.3RESERVOIR

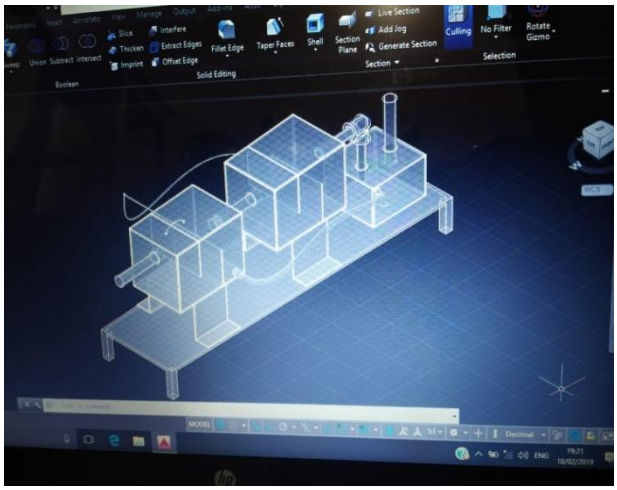


5.4 PIPES

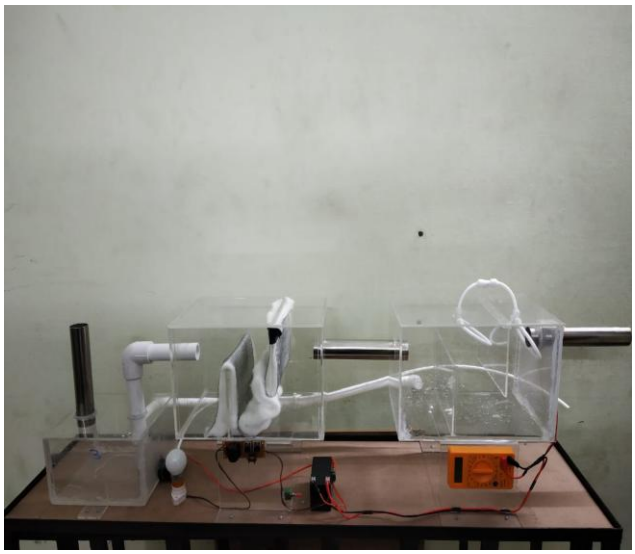
FIG: PVC pipe

FIG: SS pipe

5.5 CAD MODEL



6. ACTUAL MODEL



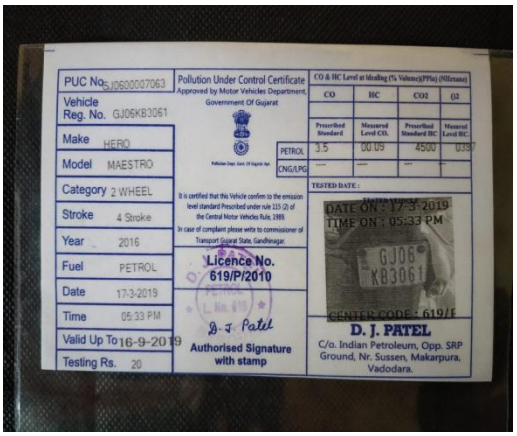
7.CHEMICAL REACTION

- When the sodium hydroxide solution is exceptionally weaken (pH < 8), carbon dioxide first reacts with water to form carbonic acid (H_2CO_3) slowly. The acid thus formed then reacts with the alkali to give sodium hydrogen carbonate ($NaHCO_3$).
- **$CO_2(g) + H_2O(l) = H_2CO_3$ (aq)**
- **$H_2CO_3(aq) + NaOH(aq) = NaCO_3(aq) + H_2O(l)$**
- When the alkali solution is a genuinely thought one (pH > 10), carbon dioxide directly reacts with it to shape the bicarbonate, which additionally responds with the alkali to form sodium carbonate (Na_2CO_3) as the main product by complete neutralization.
- **$NaOH + CO_2 = NaHCO_3$**
- **$NaHCO_3 + NaOH = Na_2CO_3 + H_2O$**

8. PUC TESTING

9. RESULT

BEFORE APPLICATION OF MODEL



AFTER APPLICATION OF MODEL

10. CONCLUSION

These measurements taken from HERO MAESTRO, as shown from figures CO% reduces from **0.09 to 0.03** and hydrocarbons fall from **397 to 159**.

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