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Eco Friendly Device for Carbon Dioxide Adsorption

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ABSTRACT: Carbon dioxide is considered as a major contributor in the direction of global warming. The amount of carbon dioxide from automobiles is approximately sixty-five percent, which is higher than any other emission sources. Automobile vehicle engine exhaust design has become very important as exhaust emissions standards are ever increasing. There are challenging problems to the emission control designers majorly demanding high standards in exhaust gas conditions.

If we consider the upcoming stringent emission norms, this problem needs to be addressed appropriately. In this work, an attempt was made to capture CO₂ emission from automobile exhaust using Activated carbon. The concept of physical adsorption by Vander walls forces of attraction, Carbon di oxide found to be adsorbed on the surface of activated carbon. This device is an extension of the silencer. The device contains mainly bio degradable materials such as coconut coir, activated charcoal, corn cob etc.

Final results obtained shows that considerable amount of HC, CO, and CO₂ gets reduced. Activated carbon found to be a suitable one for CO₂ capture from engine exhaust and it has great scope to be implemented in a vehicle exhaust system.

KEYWORDS: Biomass, Biodegradable Materials, Carbon dioxide, Activated Charcoal

I. INTRODUCTION

In the current development, pollution is a word we get to hear often. Air pollution is a very dangerous form of pollution that affects environment as well as living organisms. Air pollution is caused by automobiles, transports, industrialization and in growing cities, which release harmful gases such as CO, NO_x, HC, CO₂ causing a grave threat to the environment and living organisms.

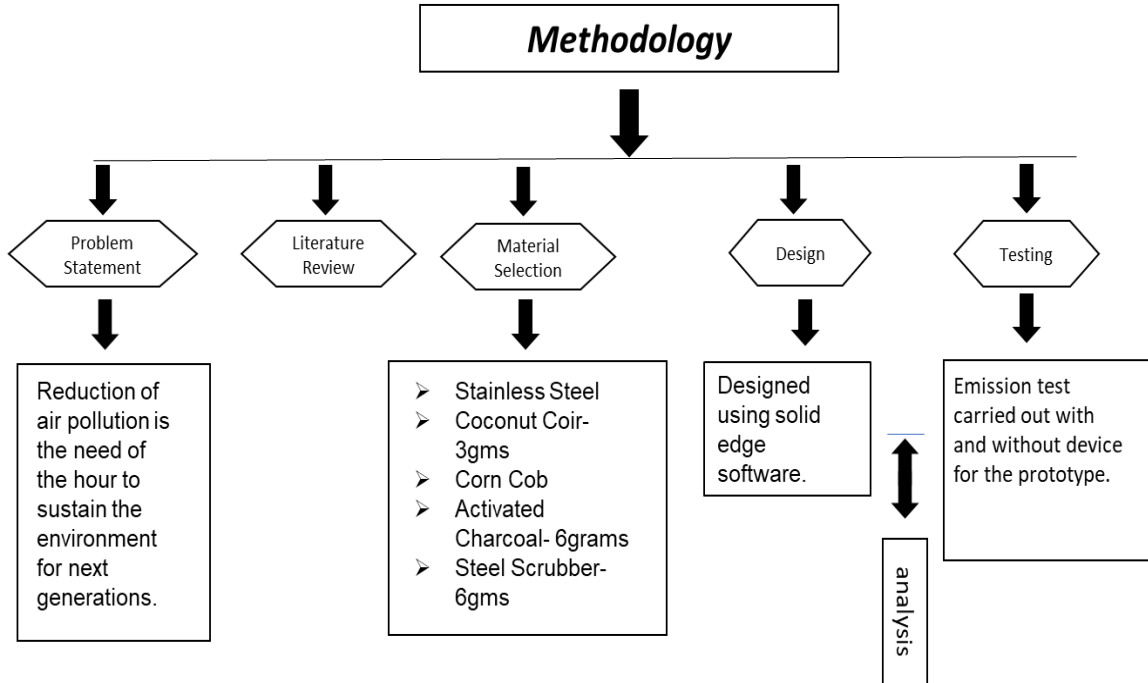
Augmented use of cars in some major cities had resulted in serious apprehensions about urban air quality caused by engine exhaust gas emissions and the three main exhaust gas pollutants are hydrocarbons, carbon monoxide and nitrogen oxides. Controlling the emission from internal combustion engine can be accomplished by designing the composition of the fuel and better combustion is possible with improved engine design combustion technology for combustion of fuels. Engine modifications alone were not sufficient to control them, so catalytic systems were introduced. Catalytic converter plays an important role in eliminating the pollutants from engine exhaust.

II. LITERATURE REVIEW

Suhendrayatna et al., has observed that, activated carbon mass variables, concentration of activator and gas velocity at the exit will have influence on adsorption time and amount of CO gas adsorbed. He has observed through experiments that at optimum conditions 55.02 ppm of CO will be adsorbed in 1266 seconds [1]. Marcos et al., has used granular activated charcoal for adsorption of carbon di oxide at atmospheric and subatmoaspheric pressures which was prepared by using low cost biomass residue. It was observed that this adsorption was similar to chemically activated carbon using KOH [2]. Yuliusman et al., has used durian peel activated charcoal modified by using Magnesium oxide with the intension of increasing the adsorption capability. This was used to evaluate the adsorption of CO and HC exhaust gases and gave the best adsorption performance [3].



III. METHODOLOGY



IV. SELECTION OF MATERIALS

- Comparison between biomass activated charcoal-1 and Coconut Activated Charcoal.

Biomass activated charcoal-1	Coconut Shell
It has more active centres	It has less active centres
It has more adsorption capability	It has less adsorption capability
It takes less time to enter into powder form	It takes more time to enter into powder form

- Comparison between Aluminum and Stainless Steel

Aluminium	Stainless Steel
Al has high strength to weight ratio but it is not stronger.	SS has less strength to weight ratio and it is stronger than Al.
Al is good conductor of heat and electricity	SS is poor conductor
It has high thermal conductivity	It has less thermal conductivity
Welding is difficult in Al	SS is easy to weld
Al become soft at above 400 degrees temperature	SS can be used at much higher temperatures than Al



Young's modulus is 70GPA	Young's modulus is 210GPA
Al is cheaper	SS is lightly costlier

- Comparison of Stainless Steel with Copper.

Stainless Steel	Copper
SS has less strength to weight ratio and it is stronger than Al.	Cu has high strength to weight ratio and is less stronger than SS
SS is made up of iron, chromium, nickel, manganese and copper. The chromium is added as an agent to provide corrosion resistance.	It has high a bit higher corrosion resistance than SS
It has less thermal conductivity	It has high thermal conductivity
SS is easy to weld	Copper is difficult to weld
SS can be used at much higher temperatures.	Copper cannot be used at high temperatures.
SS is poor conductor	It is good conductor of heat
SS is lightly costlier	It is more expensive than SS
Density of SS is $8 \times 10^3 \text{ kg/m}^3$	Density of Cu is $8.96 \times 10^3 \text{ Kg/cm}^3$
Young's modulus is 210GPA	Young's modulus is 139GPA

V. DESIGN DETAILS

- The prototype consists of three parts mainly cap, body and the exhaust chamber.
- All three parts are made using the Stainless-Steel material.
- The device is an eight-inch stainless steel pipe that could be made to fit the exhaust pipe of the silencer.
- The exhaust is provided with holes of dia 2mm using drill bit, for the exhaust gases to flow out.
- The total length of the prototype is of 12cm and dia of body is 4cm and that of cap is 2cm.
- The exhaust plate like structure is threaded internally so that it easily adheres to the body of the prototype.
- The dia of the exhaust pipe is of 4.5cm.
- The entire body of the prototype is made up of Stainless-Steel metal.
- The inner part of the prototype is filled with biodegradable materials which consists of
 - Coconut Coir = 2gms
 - Steel Scrubber = 4gms
 - Bio adsorbent = 10gms
- The weight of the prototype weighs about 250 gms.
- Prototype is designed by using Solid Edge Software. Prototype is shown in figure below



Fig:1 Prototype

VI. TESTING OF PROTOTYPE

To perform the Emission characteristics test, we made use of “Automotive Emission Analyzer (QRO-401 Series)” from Vemana Institute of Technology which is shown below.



Fig: 2 Emission test

With the help of this analyzer, we were able to test three prototypes of different composition.

- Prototype 1: Metal scrubber + Without Activation charcoal + Coconut coir
- Prototype 2: Metal scrubber + (Bio mass Activated charcoal-1) + Coconut coir
- Prototype 3: Metal Scrubber + (Bio mass Activated charcoal-2) + Coconut coir



VII. RESULTS AND DISCUSSION

- Biomass Activated Charcoal-1

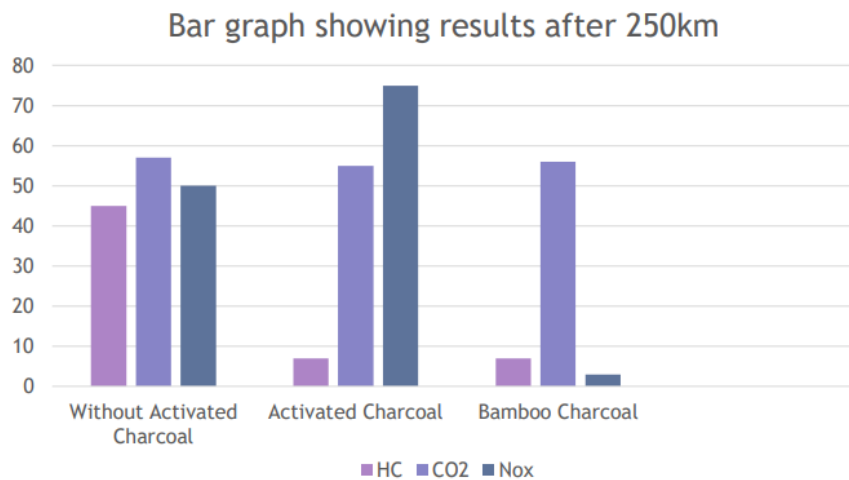
Emission	Without Product	With Product	%Increase/Decrease	After 250 kms	%Increase/Decrease
HC	383ppm	242ppm	-36.81%	357ppm	-6.78%
CO ₂	9.6%	9.4%	-2.08%	4.2%	-56.25%
CO	0.72%	0.11%	-84.72%	0.09%	-87.5%
NO _x	46ppm	38ppm	-17.39%	34ppm	-26.08%
O ₂	6.24%	6.89%	+10.41%	13.33%	+53.18%

- Biomass Activated Charcoal-2

Emission	Without Product	With Product	%Increase/Decrease	After 250 kms	%Increase/Decrease
HC	677ppm	723ppm	+6.36%	633ppm	-6.5%
CO ₂	9.7%	7.7%	-20.61%	4.4%	-54.63%
CO	5.96%	5.33%	-10.57%	2.38%	-60%
NO _x	7ppm	13ppm	+46.15%	28ppm	+75%
O ₂	2.3%	4.72%	+51.27%	12.39%	+81.43%

- Without activation charcoal

Emission	Without Product	With Product	%Increase/Decrease	After 250 kms	%Increase/Decrease
HC	595ppm	281ppm	-52.77%	322ppm	-45.88%
CO ₂	12.6%	9.6%	-23.8%	5.4%	-57.14%
CO	4.44%	3.21%	-27.70%	2.84%	-36.03%
NO _x	22ppm	31ppm	+29.03%	11ppm	-50%
O ₂	0.57%	3.93%	+85.5%	9.16%	+93.77%



From the experiment it is observed that biomass activated charcoal 2 has more adsorbing capacity compared to biomass activated charcoal 1 and wood activated charcoal. Because biomass activated charcoal 2 has more active sites compared to biomass activated charcoal 1 and wood activated charcoal.

VIII. CONCLUSION

In the course of time of the various phases of this project we have understood what it takes to model and build an actual working product. We conducted the tests initially for the prototype and later the same tests were performed on the device. What we observed from the above tests and experiments are across all the devices are: Decrease in the CO₂ emissions, Slight increase in NO_x emissions, No drastic or significant changes in the bike's efficiency, i.e., mileage.

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