

“Charcoal Based Exhaust System”

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Abstract

Cooler is also this project shows how we can reduce the concentration of harmful content of the exhaust gases. To achieve this objective we have prepared a project “Charcoal Based Exhaust System” using the activated charcoal. As the exhaust is passed through the charcoal bed minimization of the harmful elements take place. In today’s developing world air pollution is increasing day by day, and automobile is one of the major reasons for this pollution. The automobile exhaust is responsible for more than 75% of total air pollution. With rapidly increasing population the total vehicles on the world’s road are more than 750 million. The main pollutants emitted by the vehicles are CO, HC, NOx and SOx. Automobiles are responsible for 80% of total co emissions, 36% of HCs, 44% of NOx, 4% of SOx and 18% of particulate matter.

We have used activated charcoal and silica gel as it has a property of adsorption. This property is very useful as when various carbon and nitrogen content passes through it, it sticks to its surface, reacts with it and results in release of non-pollutant gases. According to our theoretical analysis and practical approach we found that our system efficiently reduced the percentage of harmful content from the automobile exhaust system.

Key skills: Exhaust system, activated charcoal, silica gel, adsorption, automobile, non pollutant gases, etc.

1. Introduction: As air pollution due to vehicles is becoming a major threat for the society thus we aim towards eradicating this threat with the help of a modified exhaust system. The various pollutant gases coming out from the vehicles are very harmful to human health and environment. The motivation of this project comes from the Swachh Bharat Abhiyan, a scheme of central govt. of India for pollution free environment. We can minimize this problem by applying innovative techniques. Therefore, to suppress this problem we initiate a project which uses different chemical products i.e. charcoal and silica gel which is reliable and inexpensive. Exhaust system is part of an automobile which is used to control emissions and to reduce noise vibrations and harshness. It consists of numbers of parts namely manifold, catalytic convertor, flexible bellow, muffler, connecting pipe and tail pipe.

Automobile exhausts combine sunlight results in photochemical smog which effects human eyes and causes significant damage to plants. It is estimated that there are 500 million cars for 5.5 billion populations and demand is increasing rapidly. The exhausts of these automobiles release over 200 types of hydrocarbons after burning of gasoline. Automobiles are responsible for 80% of total co emissions, 36% of HCs, 44% of NOx, 4% of SOx and 18% of particulate matter. These gases are responsible for worsening the condition of asthma patients and also other health hazards like encephalopathy which often result in death or permanent brain damage.

We have replaced traditional exhaust system with our charcoal bed system. A charcoal based exhaust system is an effective filtration device that minimizes the concentration of pollutant gases. As charcoal and silica gel have properties like adsorption power and light in weight, we are able reduced the content of exhaust emissions. The gases from exhaust manifold flowing through the chamber passes over the charcoal bed, the pollutants present in exhaust like oxides of carbon (COx), hydrocarbons and oxides of nitrogen (NOx) adsorb on the surfaces and converted into less harmful gases like carbon dioxide and nitrogen.

2.0 Design Criteria:

2.1 Connecting Pipe:

The gases from exhaust manifold flow towards the adsorption chamber through connecting pipe. It acts as diffuser which decreases the velocity of the flow of exhaust. Material of the connecting pipe is stainless steel. One end of connecting pipe has diameter equal to the exhaust manifold while the other end has large diameter which results in reduction of velocity of exhaust gas.

2.2 Adsorption chamber:

It is cylindrical chamber consists of charcoal as primary component and silica gel as a secondary component where complete process of our system takes place. Material of the chamber is stainless steel. The gases coming out from the connecting pipe passes through the chamber.

2.3 Charcoal Bed:

Charcoal bed is also cylindrical in shape and placed exactly between the centres of the chamber. Charcoal bed is surrounded with activated charcoal and silica gel. Charcoal bed has holes that direct the gases in radially outward direction to react with activated charcoal. Material of the charcoal bed is chromoly.

2.4 Flanges:

Flanges are used to join the charcoal chamber with connecting pipe. Flanges are rectangular in shape and have holes at the corners. Flanges are connected to each other with help of nut and bolt assembly. These help us to connect and disconnect the connecting pipe and chamber, so that charcoal can be changed periodically and system can be recharged. This makes the system handy, portable and easy to use.

2.5 Muffler: A muffler is a device for decreasing the intensity of noise emitted by the internal combustion engine.



Fig:2.1 General Arrangements



Fig : 2.2 Charcoal based Exhaust Systems

3.0 Working: Physical adsorption is the primary means by which activated carbon works to remove contaminants from exhaust gas. Carbon's large surface area per unit weight allows for contaminants to adhere to the activated carbon media. The large internal surface area of carbon has several attractive forces that work to attract other molecules. These forces manifest in a similar manner as gravitational force; therefore, contaminants in exhaust gas are adsorbed (or adhered) to the surface of carbon from a gas as a result of differences in adsorbate concentration in the exhaust gas and in the carbon pores. Physical adsorption occurs because all molecules exert attractive forces, especially molecules at the surface of a solid (pore walls of carbon), and these surface molecules seek to adhere to other molecules. The dissolved adsorbate migrates from the exhaust gas through the pore channels to reach the area where the strongest attractive forces are located. Contaminants adsorb because the attraction of the carbon surface for them is stronger than the attractive forces that keep them dissolved in exhaust gas. Those compounds that exhibit this preference to adsorb are able to do so when there is enough energy on the surface of the carbon to overcome the energy needed to adsorb the contaminant. Contaminants that are organic, have high molecular weights, and are neutral, or non-polar, in their chemical nature are readily adsorbed on activated carbon. Besides physical adsorption, chemical reactions can occur on a carbon surface.

Silica is an adsorbent in granular, porous form of silicon dioxide. A micro porous structure of interlocking cavities gives a very high surface area (800sq meter per gram).\

Silica gel is a highly porous solid adsorbent material that structurally resembles a rigid sponge. It has a very large internal surface composed of myriad microscopic cavities and a vast system of capillary channels that provide pathways connecting the internal microscopic cavities to the outside surface of the "sponge".

For carbon mono oxide: When Activated Charcoal (C) reacts with carbon monoxides present in exhaust gas, carbon di oxide is produced along with energy.



For NO_x: When Activated carbon reacts with oxides of nitrogen present in exhaust gas, nitrogen gas is released.



4.0 Methodology Firstly the passage of exhaust is given an extended path to decrease the intensity of the pressure.

1. Then the divergent pipe is employed to give a much needed decrease in the velocity of the gasses.
2. Next is the diffuser pipe which has been employed in the compartment to diffuse the exhaust gasses towards the compartment where the adsorbing materials are kept.
3. Activated Charcoal has been employed as an adsorbent which will react with the gasses.
 1. Silica gel has been kept in the compartment to react with the hydrocarbons.
 2. Lastly the glass wool will be employed in the chamber to absorb the moisture and will also avoid surface heating because of it's thermal properties.



Fig : 4.1 Actual diagram after construction

4.0 RESULTS

We have successfully researched on exhaust system and come with following results:-

1. Designing of Cad mode.
2. Manufacturing of charcoal based exhaust system
3. Testing of our project at PUC centre on Honda Shine 125cc Engine on 13 October 2017 PUC Report shows that The System successfully reduces the COx and HC at the respective rates.

5.0 Conclusion:

The study of construction, operation and calculation of exhaust system and its parts has been completed. Along with this we have also completed the alternative system which enhances the efficiency of conventional exhaust system. We have also attached the pollution under control report of our system which has successfully showed the positive results of our project. We are still working on this project and will try to overcome the limitations in major project. Besides working on the project, the continuous teachings from our mentor increased our technical knowledge with more strong understanding of the theoretical concept through practical observation and working. Overall, working on this project was great learning experience and working gave us knowledge about our Exhaust system and pollution control.

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