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ADVANCED EXHAUST STREAM AIR FILTER FOR HEAVY DUTY TRANSPORT VEHICLES

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Abstract — *Air filters are generally assigned for getting a fresh quality air from the atmosphere. As we all know that the atmosphere is highly contaminated by pollutants from individual components causing emissions around the globe. Since this trend has called upon environmental hazards like global warming, it is a prior important to save our planet. This has lead us to an idea to develop a system that would filters the unwanted ingredients from exhaust systems with less complex mechanism.*

This system passes the exhaust gases through four sections of solid substrates that would treat the incoming gas chemically and hence it converts the high grade pollutants to low grade pollutants. This system works naturally when fixed to a continuously emitting exhaust stream pipes.

Hence, it is certain for us that this system would cost nothing for the period of usage extending to physical factors. Thus it is of sole important that our system to be retrofitted as an emission controller in highly polluting heavy duty diesel engines to secure our planet from further heating.

Keywords-*Pollution , Global warming, Exhaust gas filter, Diesel engines, Emission controller.*

I. INTRODUCTION

Carbonaceous gases are produced by combustion of coal or hydrocarbons, the fermentation of sugars in beer and winemaking and by respiration of all living organisms. It is exhaled in the breath of humans and other land animals. It is emitted from volcanoes, hot springs, geysers and other places where the earth's crust is thin and is freed from carbonate rocks by dissolution. It is also found in lakes, at depth under the sea and commingled with oil and gas deposits.

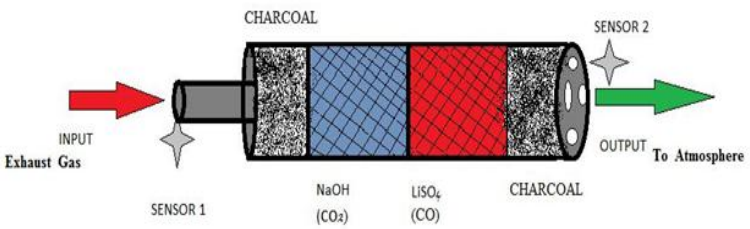
The environmental effects of carbonaceous gases are of significant interest. Atmospheric carbon dioxide is the primary source of carbon in life on Earth and its concentration in Earth's pre-industrial atmosphere since late in the Precambrian eon was regulated by photosynthetic organisms. It is also a major source of ocean acidification since it dissolves in water to form carbonic acid, which is a weak acid as its ionization in water is incomplete.

Filter systems (Chemical filters, Gas filters) are a diverse group of air pollution control devices that can be used to remove some particulates and/or gases from industrial exhaust streams. The first air filter was designed to remove carbon dioxide from the air of an early submarine, the Ictineo I, a role for which they continue to be used till today. Traditionally, the term "filters" has referred to pollution control devices that use liquid to wash unwanted pollutants from a gas stream. Recently, the term has also been used to describe systems that inject a dry reagent or slurry into a dirty exhaust stream to "wash out" acid gases. Air filters are one of the primary devices that control gaseous emissions, especially acid gases. Filters can also be used for heat recovery from hot gases by flue-gas condensation.

Here a filter system is designed to properly evacuate poisonous contaminants from exhaust stream pipes in heavy duty diesel engines using less complex mechanism. This system has ensured of less cost and favours the usage for an extended period of time.

II. EXPERIMENTAL SETUP

2.1. Proposed model



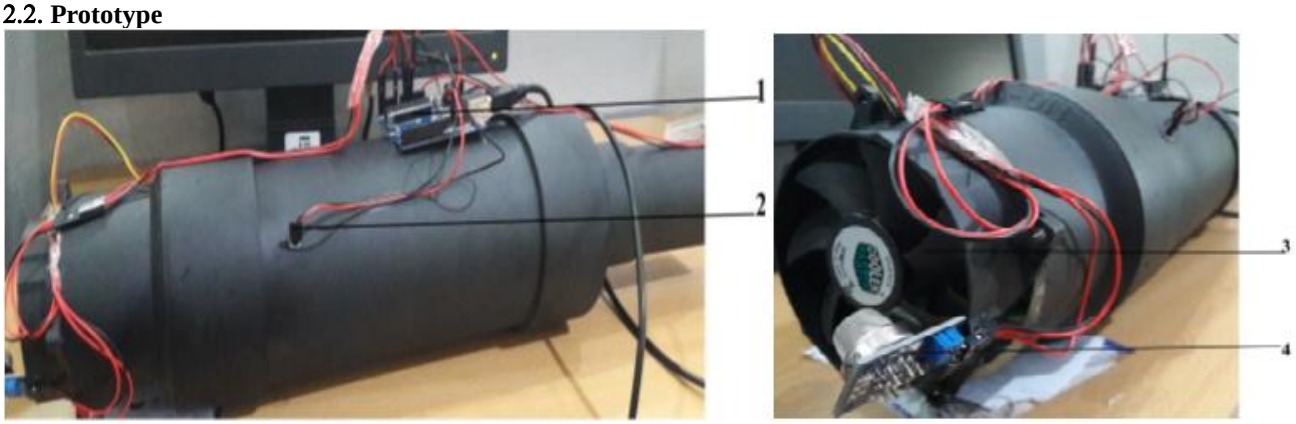
The system has four sections each encapsulated in a definite proportions depending upon the amount of purification it demands. Each sections demand a variable amount of adsorption method that would generously produce a better purified gas at the exit.

Here a trace of activated charcoal (303k to 333k) would grasp carbon from polluting gases. Based on this the first section of the system is filled with a layer of activated charcoal. Then the idea to react a substrate with the gaseous carbonaceous mixture has come to a conclusion with the usage of NaOH substrate and Li_4SO_4 substrate. Thus a perforated idea of bringing up with a system containing all the three sections has been arranged.

Thus a cylindrical hollow tube is being stuffed with three sections of activated charcoal , NaOH substrate and Li_4SO_4. When the results are analysed with a microcontroller there attains a result of about 60percent decrease of carbon content in the exhaust stream. Then an addition of fourth section with activated charcoal can manage to increase the purification rate.

Thus the resultant product is finalized with exhaust cylindrical pipe having four sections consists of Activated charcoal , NaOH , Li_4SO_4 and again a section of Activated charcoal.Thus the resultant will produce about 80 percent purification on exit exhaust. This result is verified on a arduino based micro controller board.

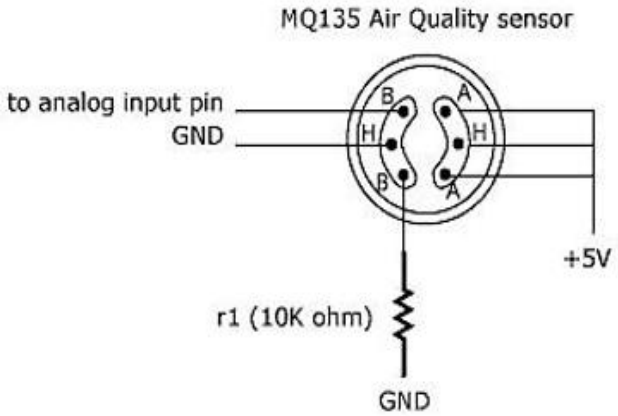
2.2. Prototype



1. ARDUINO MICROCONTROLLER
2. TEMPERATURE SENSOR
3. 12V DC FAN
4. MQ135 AIR QUALITY SENSOR

The exhaust stream of air exits into the inlet of filter system. Firstly, the system scrubs out carbon content of air partially by raw activated charcoal layer. Then the air is lead to second section of sodium hydroxide(NaOH) solid substrate. This will scrubs out some more carbon content of waste stream of air. The third section of lithium orthosilicate Li4SO4again scrubs out some more carbon. The purity of air is increased by placing another layer of charcoal at the exit.The dc fan at the exit will provide the gas flow through the channel with more easiness. Thus forming a structure of four sections having complete relief of carbon from highly contaminated diesel exhaust. MQ135 air quality sensor are placed in both the input and output of the filter machine and hence by analyzing the data we can find the air quality of the input and the output of the system.The result of the process is analyzed in the computer and this is done by the max232 circuit with the Atmega 328 controller, the software named terminal or arduino is used to monitor the values from the air quality sensors.

- *MQ135 AIR QUALITY SENSOR*



Reads values from an air quality sensor connected to the analog input pin 0. The value read from the sensor is proportional to the air quality measured by the sensor. The value read is printed to the serial monitor.
Description:

- The main chip: LM393, MQ135 gas sensing probe
- Operating voltage: DC 5V

➢ *328 MICRO-CONTROLLER*

The ATMEGA 328 Microcontroller IC is the main brain of the system. It acts as the central control of the system. Without the IC the system won't work. Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language and the Arduino development environment. Arduino projects can be stand-alone or they can communicate with software on running on a computer.

III. RESULTS

A test has conducted on a heavy duty diesel engine of a loaded truck at normal terrain in a specific time intervals and recorded. This machine is fitted on the exhaust pipe of this truck engine and made to run for about some distance and hence resulting data has been obtained henceforth :

Series 1 at 20 sec
Input air quality attained as : 1100 ppm (parts per million ; normal atmospheric air quality : 350 – 450 ppm)
Output air quality attained as : 450ppm
Series 2 at 40 sec
Input air quality attained as : 1150ppm
Output air quality attained as : 468ppm
Series 3 at 60sec
Input air quality attained as : 1165ppm
Output air quality attained as : 472ppm
Series 4 at 80 sec
Input air quality attained as : 1130ppm
Output air quality attained as : 420ppm
Series 5 at 100 sec
Input air quality attained as : 1142ppm
Output air quality attained as : 450ppm
28
Calculated efficiency at series 3 : (1165- 472) / 1165 = 0.59
About 59 % efficiency. If it is fabricated in a galvanized iron pipe it would gives an efficiency of about 80% at continuous usage.

Thus from the results it is notified that this system provides a good extraction of carbonaceous gases from the stream of gases. Hence by constructing this experiment, resulted in a conclusion that if our system is used in all the heavy load vehicles would cost not much but can save our planet in a very generous and effective manner.

IV. CONCLUSION

By implementing this system, we can reduce the excess carbonaceous contaminants from heavy duty diesel engine exhaust stream and hence save for earth and the economy from highly absorbing poisonous mixture into it. This when implemented in a whole series of heavy duty diesel engines in transportation applications will result in a major impact on total atmospheric air quality. Also this system is implemented at less cost and ensure guaranteed working for a convienient period. The replacement and maintainance cost are also less with more reliable operation procedures.

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