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"Electrostatic Exhaust Eliminator" Rohan Sakhare [1], Shardul Patne [2], Abhishek Sethi [3], Jagdish Pachore [4], Wasim Shaikh [5]

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Abstract: **Our system consist of electrical power supply, cathode connection, anode connection & to club this up rounded rectangular shell. Air is drawn into the unit to capture particles by connecting it to the manifold. The airborne particles experience an electric field and receive an ionized charge. The charged particles move in a collector section where each alternate filter is charged with the identical polarity. This drives the particles to the second filter of opposite charge to draw in and collect the particles. The clean air is released in the atmosphere**.

I. INTRODUCTION

In the last few decades, electrostatic precipitators ESP have been modernized and many new methods have been implemented to increase the cleaning efficiency of particles in the sub micrometer size range. The concept of ESP is that ESP is based on the electrolysis process .The result of the project is that ESP can achieve 99 percent removal efficiency. In Electrostatic precipitator, an electrical force has been implemented for removing the particulate matter coming from the IC engines. It is a system where the smoke or exhaust partials are collected with the help of current .It is a filtration system which is generally used in power plants, production industries and industrial engineering .But then our aim is to improve the smoke elimination efficiency of vehicles. Based on results of particle properties and health effects studies, measurement system are being discussed. We have limitations, but then to push those limits is a main goal of every engineer. The concept of ESP is that the ESP's works on electrolysis process. The gases meet up with the chamber which end in particle stockpiling. Therefore, the value will be lowered by the opposite filtration systems like cyclonic (chemical) & mechanical filtration. So as to accumulate the charge by the particles, several factors are taken under consideration like particle size, dielectric constant & continuance in ESP. Also there are two forms of charging mechanism which are diffusion & field charging. The results of the study is that ESP can do 99% of removal efficiency for a specific style of particulate. The converter, muffler exist already in IC engine systems try to prevent the harmful emissions. But they still don't do the work perfectly. To bridge the gap between the traditional methods of smoke elimination we are making this project.

II. OBJECTIVES

- To reduce the pollution caused by HC & CO which have harmful effects on human health.
- To reduce pollution levels, to ensure better environmental conditions.
- EEE is having a low operating cost, so to produce a device which is cost efficient.

III. PROBLEM STATEMENT

The dependency on traditional sources of energy originated as an immense complication on the surrounding environment and also on human health. One of the main problems is air pollution. Air pollution can harm us when it accumulates in the air in high enough concentrations. Millions of people live in areas where urban smog, particle pollution, and toxic pollutants pose serious health concerns. People exposed to high enough levels of certain air pollutants may experience; Irritation of the eyes, nose, and throat Wheezing, coughing, chest tightness, and breathing difficulties, worsening of existing lung and heart problems, such as asthma increased risk of heart attack.

Along with harming human health, air pollution can cause a variety of environmental effects: Acid rain is precipitation containing harmful amounts of nitric and sulfuric acids. These acids are formed primarily by nitrogen oxides and sulphur oxides released into the atmosphere when fossil fuels are burned. Eutrophication is a condition in a water body where high concentrations of nutrients (such as nitrogen) stimulate blooms of algae, which in turn can cause fish kills and loss of plant and animal diversity. Haze is caused when sunlight encounters tiny pollution particles in the air. Haze obscures the clarity, color, texture, and form of what we see. Some haze-causing pollutants (mostly fine particles) are directly emitted to the atmosphere by sources such as power plants, industrial facilities, trucks and automobiles, and construction activities.

The main pollutants which contribute to air pollution are Carbon monoxide (CO) & Hydrocarbon (HC). Carbon monoxide (CO) is a colorless, odorless gas. It results from the incomplete combustion of carbon containing fuels such as natural gas, gasoline, or wood, and is emitted by a wide variety of combustion sources, including motor vehicles, power plants, wildfires, and incinerators. Nationally and, particularly in urban areas, the majority of outdoor CO emissions to ambient air come from mobile sources. Carbon monoxide can also be formed through photochemical reactions in the atmosphere from methane and non-methane hydrocarbons, other volatile organic hydrocarbons in the atmosphere, and organic molecules in surface waters and soils. There are also a number of indoor sources of CO that contribute to total exposure.

Another harmful pollutant is Hydrocarbon (HC). The combustion of hydrocarbon fuels releases carbon dioxide (CO_2), as well as other greenhouse gasses that contribute to atmospheric pollution and climate change. Unlike fossil fuel impurities that result in by-product emissions, CO_2 is an unavoidable result of hydrocarbon combustion. The energy density and CO_2-footprint of a fuel depends on the hydrocarbon chain length and the complexity of its hydrocarbon molecules.

IV. METHODOLOGY

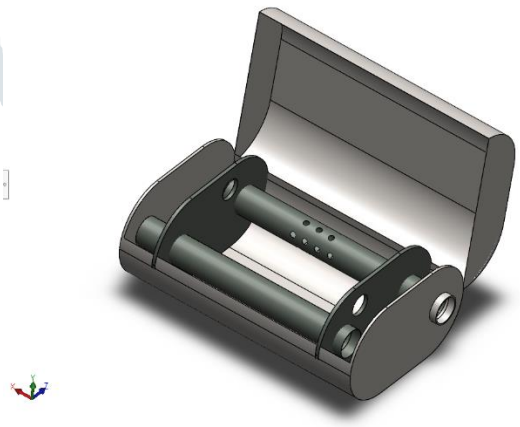
In Electrostatic Exhaust Eliminator (EEE), inlet pipe is provided to accept the exhaust gas coming out of exhaust pipe. Exhaust gas flows through inlet pipe and enters in EEE. At the end of inlet pipe, our first stage of contaminant collection is provided. The exhaust gas then flows through it and HC, CO are collected on filter. We have provided path for exhaust gas in case of back pressure or chocking situation, this arrangement is provided to avoid back pressure on engine or any other mishaps.

After passing first stage we have added sections in the EEE to reduce the velocity of gas for better collection of pollutants. Passing those sections, exhaust gas with reduced velocity enters in the second stage. Exhaust gas coming from first stage and gas coming from the provision provided for back pressure reduction is collected together at second stage, filtered exhaust is then released to the atmosphere.

To check the difference between pre and post values of pollutants obtained is verifies by exhaust gas analyzer system. The efficiency which we have achieved is around 70% and can be varied from present situations (environmental, vehicle). Since we have tested the petrol engine of 110 cc, we have achieved these values. To implement this system in bigger engines we can increase or change voltage input, current input, transformer, number of stages, etc.

The power source for EEE is a 80,000 Volts transformer (Arc Generator) which is connected to 4 heavy duty cells, each one containing 1.5 Volts ratings. Further we can add battery of car with few electrical components for better performance.

V. DESIGN



It is a CAD model which is done using the design software Solidworks 2018 version. We have used the assembly command to club various sections of this system. We have selected material for the model according to the real material specifications. For example - We have used Cast Iron material for pipes and partition and we have used Steel for shell, shell cover.

Dimensions:

Box – 36 X 22.5 X 13.5 cm.

Pipes – 32 X 4 cm.

28 X 4 cm. 0.80 cm holes

Compartment – 13.5 X 22.5 cm.

All fillets are 6.75 cm in radius

VI. CALCULATIONS

We have referred the pollution occurs by 60,000 vehicles in a city per day. Also, we derived efficiency of our system by checking Pollution Under Control (PUC) ratings with our system on vehicle & without our system on vehicle. We tested 110CC petrol engine (BS IV) of a bike & we found significant difference in the values of CO & HC. Before implementing EEE, the bike was giving 0.11 reading of CO & 114 reading of HC. After implementing EEE those values leaped 0.03 of CO and 41 of HC. So, by predicting this efficiency we derived following data of a city traffic.

CONDITIONS	CO	HC
IN AIR POLLUTION BEFORE TEST (%)	3.0107	0.5796
IN AIR POLLUTION AFTER TEST (%)	0.8128	0.20286
PPM READING BEFORE TEST	1866.42	20868000
PPM READING AFTER TEST	503.93	7303800
EFFICIENCY (%)	73	65

VII. FUTURE SCOPE

As we are progressing, we found that not only cars are polluting the environment but other transportation facilities too. Like huge cargo ships, cruise ships, airplanes, locomotives etc. Now to tackle air pollution our project can extend its arms in these modes also. Anyway, CO and HC elements are common in all kinds of engines. So, we find EEE is the best thing to have on-board. In IC engine, the high voltage requirement for the efficient working of the EEE module which could be generated from the automotive system itself with lead to development innovative, feasible after treatment device replacing the costly device like diesel particulate filter, NSR, De-NOx systems.

Aircraft operations consume increasing amounts of fuel and produce more emissions and noise. Today, the environmental impacts of aircraft, mainly engine noise and emissions, are a small but significant fraction of the total consequences of fossil fuel consumption.

SOx and PM environmental regulations for marine vessels have been reinforced since 2015. We have developed an electrostatic precipitator for marine vessels as a device to collect dust and particulate matter (PM). The device is part of the regulation-compliant exhaust gas cleaning system (EGCS), and is to be installed in front of the SOx removal scrubber.

VIII. ADVANTAGES

- Versatility – Effective performance on a large scale of commercial processes are often designed to fulfill any required efficiency & sized for any gas flow rate.
- Designs are often produced to hide the temperature range from ambient up to 850^{o} C can collect particles over the entire size range spectrum.
- Dust is typically recovered in its original state but plants will be designed to control as a wet phased device if required, particularly for gases near, or at temperature.
- Low pressure loss – typically but 1 mbar. Acceptable wattage consumption for specified efficiency level.
- Robust and reliable construction – Lifetime > 20 years
- Low maintenance requirement

IX. ACKNOWLEDGEMENT

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