Fabrication and Analysis of Electrostatic Precipitator for I.C Engine

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Abstract: An ESP uses a high voltage electrostatic field to separate dust, fume or mist from a gas stream.The precipitator consists of vertical parallel plates (collecting plates/electodes) forming gas passages 12 to 16 in.(30.5 to 40.5cm) apart. Discharge electrodes are electrically isolated from the plates and suspended in rows between the gas passages. Every particle either has or can be given a charge positive or negative.A high voltage system provides power to the discharge electrode to generate an electrical field. The particulate is then attracted to the grounded collector plate,and forms a dust layer on the plate.

***IndexTerms* - ESP, NOx, PM, ANSYS.**

I. INTRODUCTION

An ELECTROSTATIC PRECIPITATOR (ESP) has been extensively used for cleaning of industrial process flue gases, combustion flue gases, and ventilation flue gases of buildings, etc., because of is high collection efficiency. One of the applications of ESP is decontaminating polluted gases and improves the visibility index in road tunnels to save the air environment around tunnels and drivers.In generally, the high collection efficiency between 0.01 to 10 µm on an ESP is achieved. However, the collection efficiency of sub-micron particles, whose size is between 0.1 to 1 µm, is lower than that of the others. Therefore, the efficiency of the ESP in collecting submicron particles has been investigated. The collection efficiency in the ESP to remove the particles with a high resistivity decreases due to the back corona. On the other hand, it is very important to prevent the particle re-entrainment for the ESP for road tunnels to remove the particles with a low resistivity.

There is the problem, which is particle deposition onto walls downstream, the ESP for road tunnels. The watching performance at tunnel observation points decreases due to particle deposition on cameras, lights and walls, etc...It also spoils the beauty of surround a tunnel. One of the causes is that particles downstream ESP is charged. However, the authors have been investigated the influence of particle re-entrainment on particle deposition.In this paper, the experiment were carried out to clear the effect of neutralizing the gases downstream ACESP on decreasing more the particle deposition. There were three types in experimental ESP, which were ESP under DC operating mode (DC ESP), ACESP and ACESP with neutralizer.

II. NEED OF RESEARCH

The use of electrostatic precipitator in thermal power plant & cement factory has been an active field of inquiry in the past decades and extensive studies have been carried out. Most of the reports are based on the collection efficiency of ESP in thermal power plants and cement factory. In our project electrostatic precipitator is used in diesel engine.

Literature on the ESP basic principle, operation and collection efficiency of ESP in thermal power plant and cement factory are very scanty. Electrostatic precipitator (ESP) in diesel engine has not been focused in the past studies. Therefore, it is necessary to develop to control the Nano & Nano level emission particles in diesel engine.

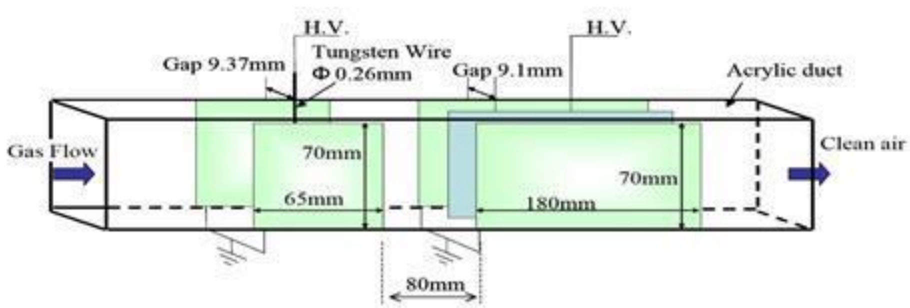
III. LITERATURE REVIEW

JEVANANTHAM.S et al (2018) An ESP uses a high voltage electrostatic field to separate dust, fume or mist from a gas stream.The precipitator consists of vertical parallel plates (collecting plates/electodes) forming gas passages 12 to 16 in.(30.5 to 40.5cm) apart. Discharge electrodes are electrically isolated from the plates and suspended in rows between the gas passages. Every particle either has or can be given a charge positive or negative.A high voltage system provides power to the discharge electrode to generate an electrical field. The particulate is then attracted to the grounded collector plate,and forms a dust layer on the plate.

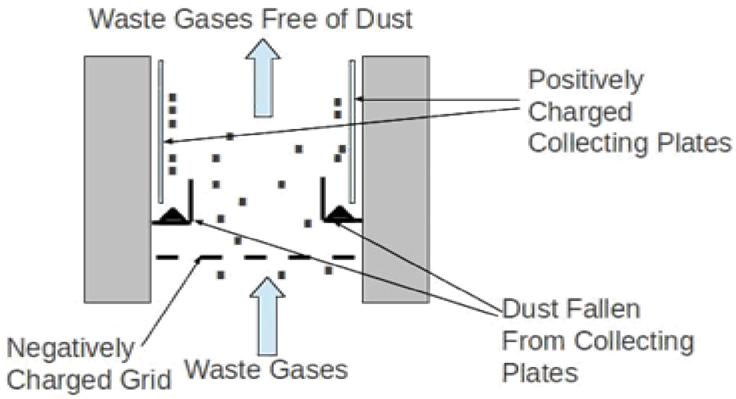
S.MAHESHWARAN Electrostatic precipitator (ESP) is the device used for dominant for air pollution. This can be used for boiler cleansing method gases. Process gases contain suspended mud particles. This mud particles square measure collected on collection electrodes. The effectiveness of Electrostatic Precipitators is littered with numerous factors. Continuous cleansing of collection system plays a serious role. Mud gets deposited on collection electrodes and is extracted by vibrations made by the collection electrodes. For immense volume of method gas the scale of ESP will be massive. Since there is a restriction in the area, the final word resolution can to travel vertically i.e. increase the peak and consequently the gathering space. Since the peak is inflated recent strategies of rapping are ineffective and thus the new strategies introduced to extend the vibration. Time is another major constraint for checking of such continuous enhancements. Therefore simulation and additional physical calculations are to be performed. This project presents FEA idea of modelling with analysis of collection electrodes of an ESP by Implicit Transient Dynamic Analysis.

ELECTROSTATIC PRECIPITATOR

An Electrostatic precipitator (ESP) is a filtration device that removes fine particles, like dust and smoke, from a flowing gas using the force of an induced electrostatic charge minimally impeding the flow of gases through the unit. The collection efficiency of ESP achieved by 99.9%.



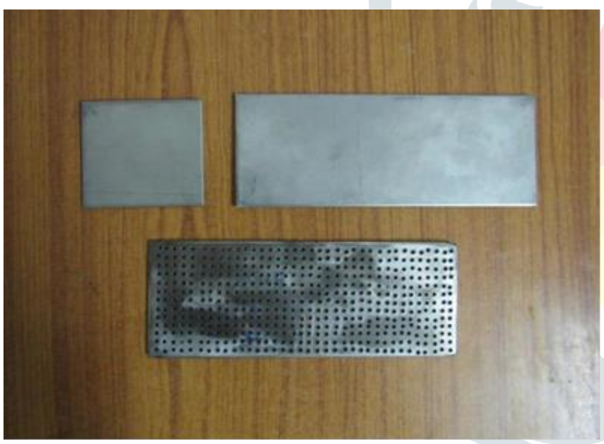
ESPswork by creating a high voltage electrical field (corona) around the discharge electrodes, which causes the gases and the dust particles being carried by the gases, to get ionized. The dust particles, once charged, migrate to and deposit themselves on the neutral collecting plates, from which they are dislodged by periodic rapping and guided to dust hoppers for removal

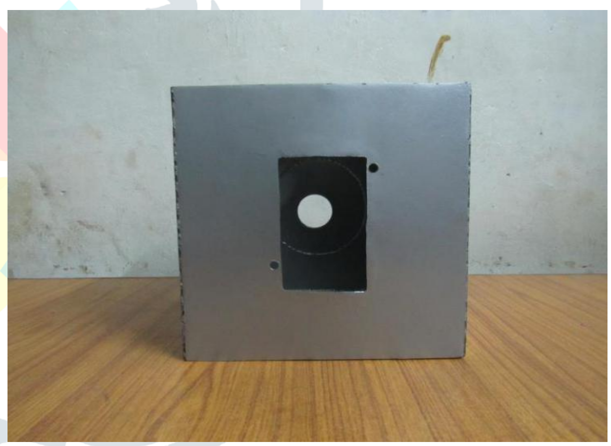


ELECTRODE PLATE

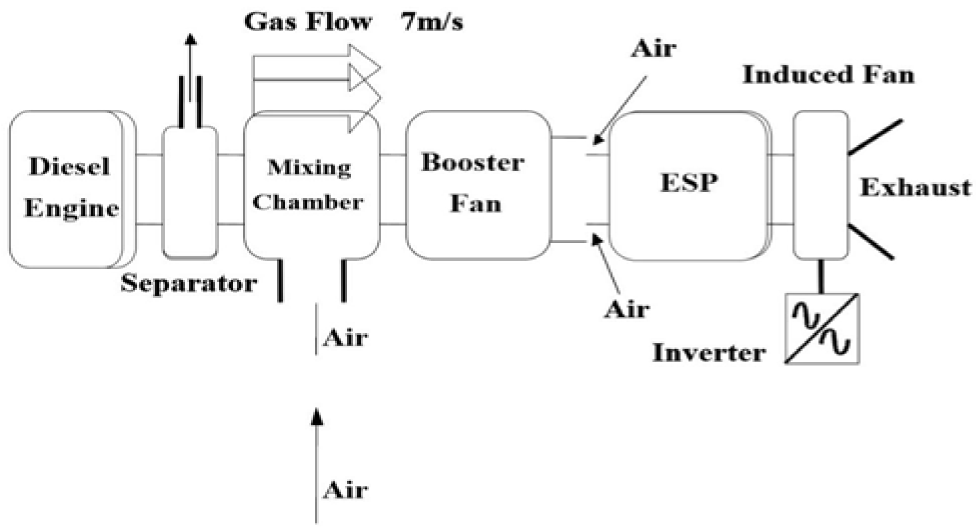
The collector had a parallel-plates configuration, including a grounded electrode and a high voltage electrode. A hole-punched stainless plate was used as the high voltage electrode in order to improve Nano-particle collection efficiency. The size of electrode is 70

by 180 mm. The electrode has holes, which are 2.5 mm in diameter. The aperture rate is 17.2%. The trapezoid AC high voltage was applied to collector for preventing particle re-entrainment. There are two types of electrodes these are discussed below.





SUMMARY OF EXPERIMENTAL SYSTEM

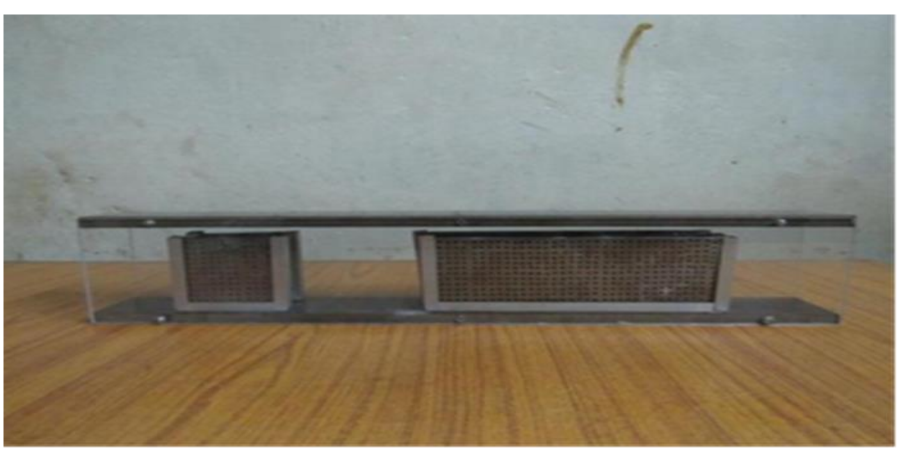


ESP ARRANGEMENT AND SAMPLING LOCATION

The ESP arrangement is shown in Fig. The two-stage-type ESP consisted of a pre-charger and a collector. The electrode of the pre-charger consisted of wires and plates. The wire of tungsten was 0.26 mm in diameter, and plates were made of stainless. The upstream and downstream particle concentrations were measured to estimate the ESP performance by a scanning mobility particle seizer (SMPS, TSI, and Model3080) and particle counter (PC, RION, KC-01C). The SMPS can measure the particle concentration between 20 to 500 nm. The PC can measure it between 500 nm to 5000 nm. The collection efficiency is calculated by $\eta = (1-ND/NU) \times 100$ [%] (1) where NU is the upstream particle concentration and ND is the downstream particle concentration in the ESP.

EXPERIMENTAL PROCEDURE

Structure of Collecting Electrode The collector had a parallel-plates configuration, including a grounded electrode and a high voltage electrode.The experiments were done in two cases of collectors. The condition of two cases is shown in Table.



CASE 1

It is DC ESP, which has plate electrodes and is applied DC high voltage to the collector.

CASE 2

It is DC ESP with hole-punched electrode, which has hole-punched electrodes and is applied DC high voltage in the collector. A hole-punched stainless plate was used as the high voltage electrode in order to improve Nano-particle collection efficiency.

Case	Voltage In Precharger	Structure Of Electrode	
		Grounded Electrode	High Voltage Electrode
1	- 9.2 kV DC, 0.06 mA	Plate	Plate
2	- 9.2 kV DC, 0.06 mA	Plate	Hole Punched Plate

Experimentation and Analysis

Now the pollution analysis test has been carried out with and without fitting the electro static precipitator. And the pollutants percentage values has been recorded and tabulated. From the tabulated results it is observed that the pollutants released from the diesel engine has been extensively reduced after fitting the electro static precipitator and the results are depicted.

SL.NO	POLLUTANAT	BEFORE ESP	AFTER ESP	REDUCTION in %
1.	**CO in %**	**0.023**	**0.0102**	**56.52**
2.	**HC in PPM**	**40**	**27**	**32.5**
3.	**CO2 in %**	**1.58**	**0.85**	**46.20**
4.	**NOx PPM**	**134**	**68**	**49.52**

IV. CONCLUSION

Electrostatic precipitators use electrostatic attraction to control particulate matter and can handle large volume of gases at low pressure drops. In an ESP, pollutant particles are electrically charged and then collected on collection electrodes. When the discharge and collection electrodes are rapped, the collected particles fall into a hopper and are removed. In this paper we introduce the two types of electrostatic precipitator, but all types of electrostatic precipitator are their own importance in their places. In modern world the pollution is a great problem which affect every body indirectly. To reduce the pollution by dust particles, the ESP is very effective dust collection device

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