Impact Factor Value 4.046 e-ISSN: 2456-3463
National Conference on Quality Up-gradation in Engineering, Science and Technology (NC-QUEST018)
Organized by College of Engineering and Technology, Dhanamgaon Rly-444709
International Journal of Innovations in Engineering and Science, Vol. 3, No.6, 2018
www.ijies.net

High Voltage Electrostatic Precipitator For Filtration Of Ultrafine Particle From Automotive Vehicle

Rahul K. Pataliya[1], Dinesh W. Darvekar[2], Sagar M. Chandane[3], Shriyash U. Shiraskar[4]

[5]*Bhusan S. Rakhonde, Assistant Professor*
DES's COET, DHAMANGAON RAILWAY, INDIA, 444709

Abstract – *In the era of modernization the needs of automobile vehicle increases day by day, due to this the world facing many environmental issues. Pollution is the major problem of society, its challenge for the world to overcome this pollution. This method is deals with the air pollution; air pollution is responsible for global warming and physical disease in the animals. This method is concerned with the electrostatic precipitator technique which is implemented in the automobile vehicle and also with the filtration of pollutants coming from engine. The exhaust is separated by means of a coil. The high voltage is taking from high tension coil. After power stroke the exhaust is produced and this exhaust is directly injected on the high voltage coil. Due to the high voltage about (25000 to 35000) volts this coil is acts as electrostatic precipitator. Mainly the unburned and burned exhaust is converted into the ions, because of high voltage this ion are deposited on the coil surface. When the supply is removed from the high voltage coil, all particles are collected on the bottom surface of the silencer. In this way the filtration is achieved***.**

Keywords- Filtration, Electrostatics, Power stroke, Exhaust, Volt.

INTRODUCTION

The pollutants from road traffic emission are such as CO, NMVOC, CH4, SO2, particulate matters, and other substance classified. In the sub-micrometer size range (PM1&PM2.5) particulate matters in terms of ultrafine And fine particles have been found are as the air pollutants emitted by combustion processes from many sources, e.g. vehicles. Ultrafine particles have a diameter less than 0.1μm and fine particles are as particles having the diameter between 0.1 μm-2.5 μm. Because of their different sizes, they were also have varied physical parameters, chemical profiles, and toxicological effects.

There are many studies identifying both those particles that have the potentials effects to human health due to their deposition capabilities in the body. Instead of this are many evidences presenting the effect on the human respiratory system. Moreover, due to the dimensions, ultrafine particles can insert deeply into the respiratory system. They having high the lung deposition efficiency causing inflammatory. In order to minimize the particulate emissions, many new methods have been implemented filtering systems. A filtering system is designed to less than sub-micrometer particles and can applied for diesel vehicles. Research in particulate technology indeed is to provide the impact full way to generate a low- cost particulate filter that will reduce their concentrations in low energy. In this research we have utilized a particle filter based on the high voltage electrostatic principle to reduction of the concentrations of ultrafine and fine particles emitted by vehicles smokes

METHOLOGY

Filters*:*

The filter are used in this method of high voltage electrostatics precipitator are made of cupper material of diameter is 10mm. There are two plates of the sizes in rectangles of dimension length 5 cm and breadth 3. The one rectangle plate is connected with the series of spark

plug of the engine and other one is grounded. This two plates were placed inside of chamber following figure shows same. The high voltage cable is used in assembly for the safety purpose. The filter was applied with the existing technology of catalytic converter system. In the catalytic converter the exhaust or smoke is filtrated by the REDOX reaction. In which the CO (carbon monoxide) is converted in to the carbon dioxide with intake oxygen in catalytic converter.

Fig. Filter Model

Block diagram:

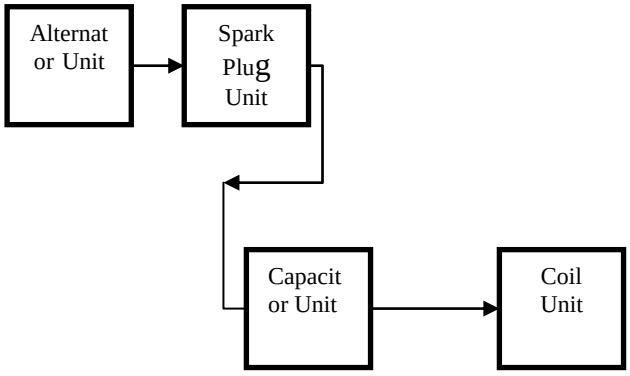


Fig.2: Block of high voltage precipitator

In this technique of smoke filtration, cupper coil is utilized for the filtration purpose. This cupper coil is placed in series with spark plug of the vehicle. The cupper coil is enclosed in the enclosure and this enclosure is implemented in the silencer of the vehicle. When the vehicle is moving on the road spark plug is operating on the supply that supply is taken from the H.T. (High Tension). As the coil is series connected with spark plug the same amount of current is present in that coil. The filtration is takes place in that enclosure. In this way the filtration is obtained from this method.

In this method a technique of electrostatic precipitator is implemented in to the automobile vehicle. In this technique the electrostatic filter coil is located in to the enclosure which having two ends, one is for the exhaust coming from the engine and other is to realize that exhaust in to the atmosphere. The coil is energized with supply taken from the spark plug of the vehicle. When the vehicle is in running at that time the coil acts as electrostatic precipitator and filtrate the smoke particles coming from the engine itself. In this way the filtration of the smoke is obtained. By this method the filtration of ultrafine particle can be achieved.

WORKING OF METHOD

The working of this method is based on filtration of exhaust of ultrafine particle from the vehicle. In the vehicle having spark ignition engine. It has four strokes such suction stroke, compression stroke, power stroke and exhaust stroke. The stroke is nothing but the event inside the engine that helps for providing the reciprocating motion. Power stroke is followed by the exhaust stroke. When the power stroke is occurs inside engine, the spark plug gets energized by the high tension coil and same amount of supply will goes from the coil placed inside filter chamber. When the coil energized at that same time the exhaust is gathered inside the same and impact ionization is takes place inside the filter chamber. Due to the electric supply the potential gradient is set up coil. The corona is form and discharge is gets occur, unburned harmfully gas gets converted in to the burned gasses.

The effect is harmfully gasses are converted in to the unburned gasses. The CO (Carbon mono-oxide) and other gasses are also converted in to the neutral gas. In this way high voltage electrostatic precipitator is works. The following diagram show the connection of plates in the chamber of filter.

Fig.3: Filter Plates

SMOKE DETECTOR

The smoke detector assembly is used in this method is based on the principle phenomenon of light. In this the photo-LED is used as source it is placed in the pipe shown in the following diagram. The same amount of light was falls on the photo-diode. There two steps in which reading is taken in the first step filter is not applied and in next step filter is applied reading was noted. In the first step the reading was found as with greater deflection it is due to the smoke present is not filtering up to mark by catalytic converter. In the second step deflection are found with less extended. The following figure shows the smoke detector assembly.

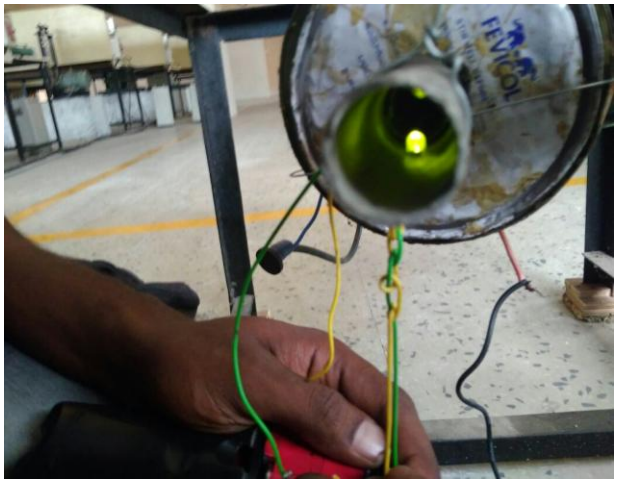


Fig.4: Smoke detector

RESULT

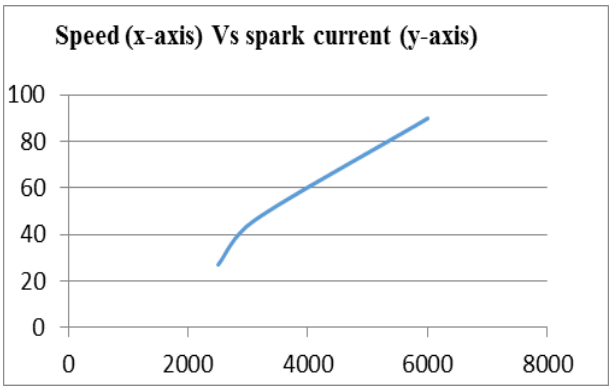
Table 1-When the filter is not applied (In OFF Engine condition is 30mv)

Sr. No.	Speed of Engine (RPM)	Spark plug Current (Ampere)	Photodiode Voltage Variation (mv)
1	2500	27	23
2	3100	46	25
3	6000	90	27

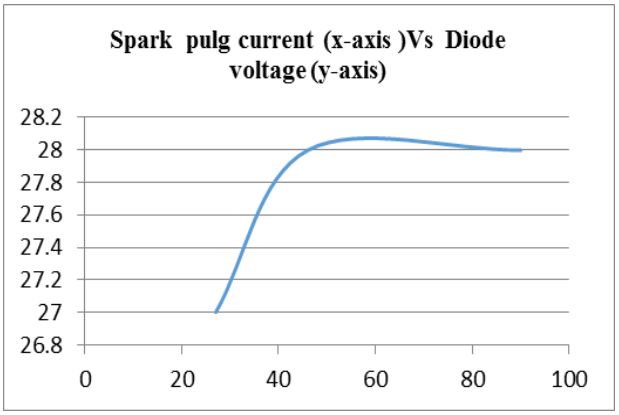
Table 2- When the filter is applied (In OFF Engine condition is 30mv)

Sr. No.	Speed of Engine (RPM)	Spark plug Current (Ampere)	Photodiode Voltage Variation (mv)
1	2500	27	27
2	3100	46	28
3	6000	90	28

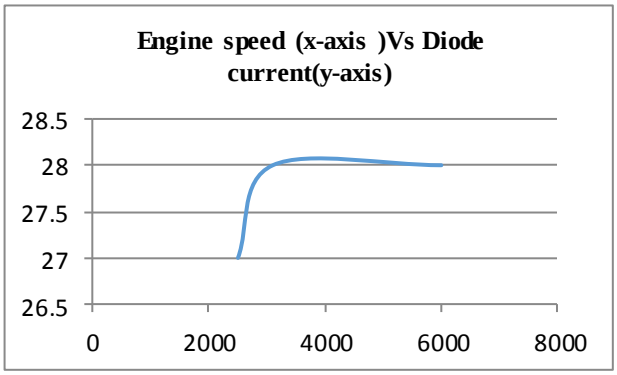
1) Engine speed Vs. Spark plug current characteristic



2) Spark plug current Vs. Diode current characteristic



3) Engine speed Vs. Diode voltage characteristics



DISCUSSION

There are two main parameter of the method are found during the study are as follows

1) Smoke velocity
2) Ambient temperature

1) Smoke velocity:

When the velocity of smoke increases with the increase in the speed of the engine at that time the current in the spark is also increases and the filtration rated is also increases on other hand in catalytic converter the surface is constant. Therefore, the rate of filtration in the catalytic converter remains same.

That drawback is mainly reduced in this technique.

2) Ambient temperature:

When the ambient temperature of the surrounding is increase at that instant, electrical resistance of precipitator plate of the filter increases slightly that leads in the power loss due this temperature.

CONCLUSION

The filter is based on the high voltage electrostatic phenomenon; efficiency is directly proportional applied voltage. The range of efficiency for the particle is in the 70% to 90% for PM1.0 particle and greater than 90% for the PM2.5 size particle.

REFERENCES

[1] Arif Budianto, Arinto Y. P. Wardoyo, " DC Low Electrostatic Voltage Particulate Filter PM0.1 And PM2.5 Emission Efficiency Measurment," *Atmos. Environ.*, 2016.

[2] A. Fushimi, Y. Kondo, S. Kobayashi, and Y. Fujitani, "Chemical composition and source of fi ne and nanoparticles from recent direct injection gasoline passenger cars: Effects of fuel and ambient temperature," *Atmos. Environ.*, vol. 124, 2016, pp. 77–84.

[3] A. Sudrajad and A. F. Yusof, "Review of Electrostatic Precipitator Device for Reduce of Diesel Engine Particulate Matter," *Energy Procedia*, vol. 68, 2015, pp. 370–380.

[4] B. Q. Ho and A. Clappier, "Road traffic emission inventory for air quality modelling and to evaluate the abatement strategies: A case of Ho Chi Minh City, Vietnam," *Atmos. Environ.*, vol. 45, no. 21, 2011, pp. 3584– 3593.

[5] C. Sioutas, R. J. Delfino, and M. Singh, "Review Exposure Assessment for Atmospheric Ultrafine Particles (UFPs) and Implications in Epidemiologic Research," *Environ. Health Perspect.*, vol. 113, no. 8, 2005, pp. 947–956.

[6] G. O. Duarte, G. A. Gonçalves, and T. L. Farias, "A methodology to estimate real-world vehicle fuel use and emissions based on certification cycle data," *Procedia - Soc. Behav. Sci.*, vol. 111, 2014, pp. 702–710.

[7] J. L. Abraham, G. Siwinski, and A. Hunt, "Ultrafine Particulate Exposures in Indoor , Outdoor , Personal and Mobile Environments : Effects of Diesel , Traffic , Pottery Kiln , Cooking and HEPA Filtration on Micro-environmental Particle Number Concentration," vol. 46, 2002, pp. 406– 411.

[8] M. Kampa and E. Castanas, "Human health effects of air pollution.," *Environ. Pollut.*, vol. 151, no. 2, 2008, pp. 362–367.

[9] Q. Zhou, K. Zhong, W. Fu, Q. Huang, Z. Wang, and B. Nie, "Nanostructured platinum catalyst coating on diesel particulate filter with a low-cost electroless deposition approach," *Chem. Eng. J.*, vol. 270, no. x, 2015, pp. 320–326.

[10] S. Yamamoto, Tin-Tin-Win-Shwe, S. Ahmed, T. Kobayashi, and H. Fujimaki, "Effect of ultrafine carbon black particles on lipoteichoic acid-induced early pulmonary inflammation in BALB/c mice.," *Toxicol. Appl. Pharmacol.*, vol. 213, no. 3, 2006, pp. 256–66.