PRINCIPLE OF ELECTROSTATIC PRECIPITATOR AND ITS MODIFICATION

Priyanka Dukare, Deepali Bondre Shubham More, Shubham Jadhav, Mohit Dhanjode, Bipinchandra khangar, Sanghpal meshram,

Department of Electrical Engineering
KDK College of Engineering
Rashtrasant Tukadoji Maharaj Nagpur University
Nagpur

ABSTRACT

A simple plot type electrostatic precipitator (ESP) was constructed in order test the efficiency of collecting smoke from coal combustion used in the inductive alternative HV and LV supply gives to the electrode according to the velocity of flue gas. The size and gap between the electrode is so selected that it attained maximum collection efficiency with efficient operation

Keywords:- *ESP; HV supply; smoke; velocity*

1.INTRODUCTION

Electrostatic precipitator (ESP) is the most widely used device for particulate emission control .ESP is a physical process by which particles suspended in gas stream are charged electrically ,and under the influence of electric field are separated from the gas stream .The precipitation system consists of charged collecting surfaces and a high voltage discharge electrode wire are placed centrally between the plates. An electrostatic precipitator consists of positive charge electrodes. The electric charge on the electrode creates a corona field which imparts a negative charge to the particulate. The charged plates are repeatedly struck by rappers to remove the particulate which falls into a hopper. Periodically, the particulate is removed from the hopper.
Electrostatic precipitator(ESP) was invented in 1907 by Cotter ll. The high voltage of power supply produce Electric Field which make flue gas ionized, particles in the flue gas are charged in the electric field. ESP are widely applied in coal-fired power plant, cement, steel, metallurgy, and many other industries for dust removal. By using high voltage DC power supply. This paper presents the model of ESP, which work on low dc voltage when any abnormal condition or thermal breakdown condition. due to this performance the operational power of ESP can be minimize. The working model of ESP for this experiment is shown in figure 1.

Fig1: Experimental model of modified ESP

2.METHODOLOGY

As per construction shown in figure 2 positive charge supply given to the electrode plates through the low and high voltage supply. When single phase supply is given to the step down transformer (6-0-6 volt) AC supply, the output of transformer i.e. 6 V supply is converted into DC supply with the help of rectifier. This DC voltage supply is given to high voltage generation booster circuit. It converted into 7kv dc supply. This 7kv dc supply is given to positive charge plate.

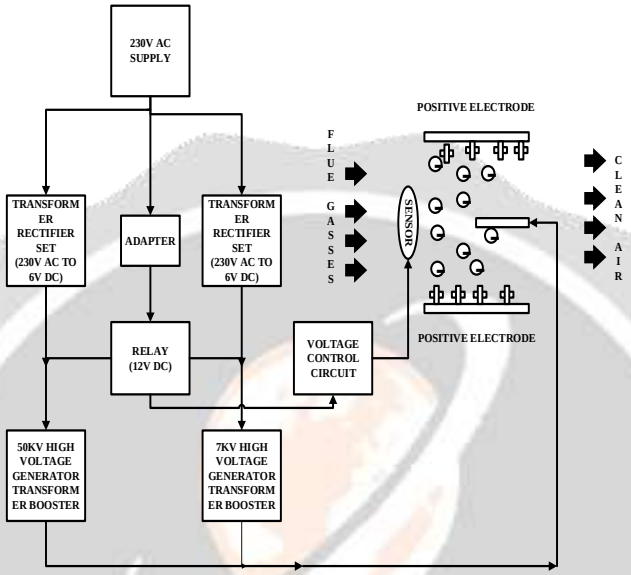


Fig2 : modified circuit diagram of ESP

When the intensity of dust particles increases the sensor gives the command to the relay and put the 50kv dc high voltage supply on circuit . At this time negative charge carrier dust particles attract towards positive charge carrier plates, in this way dust particles collect on the plates and flue gases out in atmosphere through the chimney. Deposited dust particles falls down in hopper by hammering the electrode plates by 230v operating Ac coil which is mounted at the top of plates hanger. The materials used in this modified ESP are as follows:

2.1Voltage Control Circuit

It is a electronic circuit, which mainly used for voltage control. The input of this electronic kit is 12 V dc supply. The fly ash sensor is mounted on the electronic kit. This sensor can be actuated when the fly ash is fall on the sensor. It can control the voltage as per the amount of fly ash falls on the sensor.

SR NO	SPECIFICATION	SIZE (cm)	COMMENTS
1	Height	122	Height from ground to top of ESP
2	Length	113	Length of model from left to right
3	Width	45	Width of model
4	Height	15.3	Electrodes height
5	Length	28	Electrodes length
6	Height	8.5	Inlet or Outlet hole height
7	Length	8.5	Inlet or Outlet hole length

2.2General Purpose Miniature Relay

This relay will operate at 12v dc supply. It has capacity to control the high voltage. In this project this relay can control low voltage I.e. 7 kv dc and high voltage I.e. 50 kv dc supply. this relay receive a signal or command from voltage control circuit or sensor and operate either at low voltage or at high voltage.

2.3Step Down Transformer

The two numbers of step down transformers are used for experiments. This transformer are utilize for step down the voltage from 230v Ac to 6V Ac.

2.4High Voltage And Low Voltage Circuit

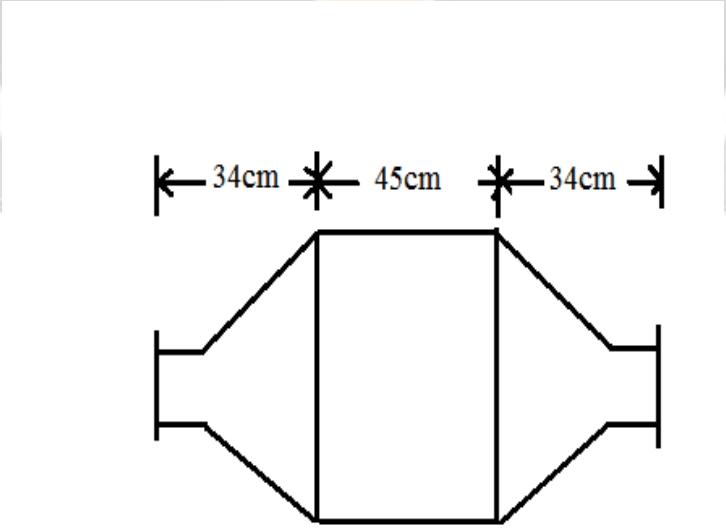
This high voltage circuit used as a step up booster. which boost up 50 kv Dc voltage. The input supply is given from transformer by using rectifier. And low voltage circuit boost up 7kv Dc voltage.

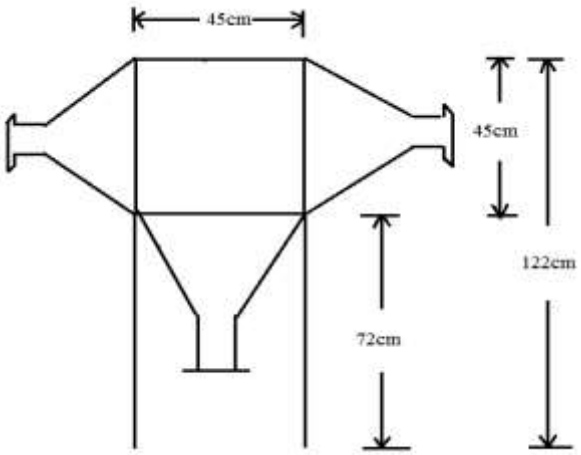
3.REASONS FOR ESP UPGRADES

A number of factor influence ESP upgrades including performance degradation,
increased maintenance, poor reliability, change in particulate resistivity, sodium ion depletion (primary for hot side ESP)
volumetric flow rate changes, increased inlet particulate loading (typically due to dry and orient injection), sticker emission regulation and even normal wear and tear such as plate warping and leaks in the casing. As ESP upgrade will improve performance and reliability, which will reduce the plants operating costs in the long run

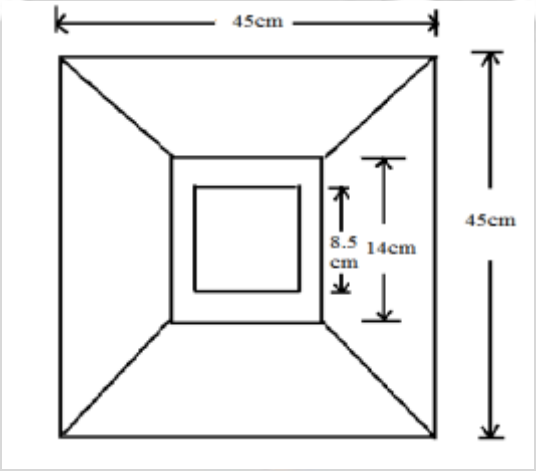
4.MODEL DESCRIPTION

In the experiment, an ESP has been built consisting of 7 electrodes in a series connection. The height, width and length of ESP are 122cm,45cm,and 113cm respectively. The size of various items is shown in table 1. The schematic illustration of ESP and images are provided below Table1 Main geometric parameter of ESP model.





SIDE VIEW



TOP VIEW

Fig. 3(b) Schematic illustration of ESP used in experiment.

5.CONCLUSION

An ESP plays an important rule of maintain a clean environment and to arrive more healthy air quality. Much flue gas clearing a device and employed for marinating emission level of fly ash and dangerous particles from the flue gases but ESP proves more reliable solution for purpose.

Wet ESP or dry ESP coupled with catalyst can remove small particle and gases pollutants. Due to the increasing concern to human health, such novel, high performance ESP will be used more commonly in the future.

High magnitude of voltage supply can cause problem during abnormal conduction such as a wire break, hopper blocking and misalignment of plate's conductors. Large amount of power losses taking place during these condition and operation of ESP get affected. In this paper we explored a design methodology for a conservation of power by reducing the applied voltage during abnormal condition.

Saving of power can be alieved without affecting the working condition and also haps to minimizing the fault level during different condition for ESP. efficient operation and conservation of power is our main goal in this project

6.REFERENCE

[1] Jingsong Zeng, "Approaches to Solve Problem of Electrostatic Precipitator High-Voltage Switch Box," Anhui Technical College of Mechanical and Electrical Engineering Wuhu, China 978-1-5386-0484-7/17 ©2017 IEEE.

[2] A.S.M Sayem, M.M.K. Khan, M.G. Rasul, Peter Wolfs, N.M.S. Hassan, " Experimental study of a High Voltage (HV) electrostatic precipitator to achieve higher collection efficiency," Central Queensland University Rockhampton, Australia.
[3] Yongjie Han, Ning Mao, Deqiang Chang, "Experiment of ozone forming in ESP used on power plant smoke control," Xi Sun Filter Test Center, Northeastern University, Shenyang, China ,978-1-4577-0547-2/12©2012 IEE.
[4] S. M. Haque, M. Rasul, M. M. K. Khan, A. Deev, and N. Subaschandar, "Influence of the inlet velocity profiles on the prediction of velocity distribution inside an electrostatic precipitator," *Experimental Thermal and Fluid Science*, vol. 33,pp. 322-328, 2009.
[5] S. Talukder, S. Park, and J. Rivas-Davila, "A portable electrostatic precipitator to reduce respiratory death in rural environment," in 2017 IEEE 18^{th} Workshop on control and , Jul.2017.
[6] Sandeep R Krishnan,Sethuraman K V,Anna Philo Antony,"Comparative Study of the Conventional Electrostatic Precipitator and the Proposed Smart Electrostatic Precipitator Based on the Various Electrical Erection Challenges",IGAREEIE, Vol.3 Issue 4 April2014.
[7] A Mizuno," Electrostatic Precipitation," IEEE Transactions on Dielectric and Electrical Insulation, Vol .7 No.5,October2000.
[8] A Kinori Zukeran , Paul C. Looy , Alokkumar Chakrabaeti, Alexander A. Berezin and Shesha Jayaram "Collection Efficiency of Ultratine Particles by an Electrostatic Precipitator Under DC and Pulse Operating Modes''. IEEE Transactions On Industry Application. Vol. 35 , No.5, September / October 1999.
[9] A Chandra , "Performance Improvement of Electrostatic Precipitator Some Experiment Studies " ICESPX-Australia 2006.
[10] Ms. G. Hemavathi , Dr. T.R. Rangaswamy , "Performance Enhancement of Electrostatic Precipitator Using Feed Forward Adaptive control", International Journal of Engineering Trend and Technology (IJETT)-Volume 57, Number 2, March 2018.