Reusing Energy of Electrostatic Precipitator from Thermal Combustion by using Dilution Method

Dr. Parag Dalal

Assistant Professor School of Studies in Environment Management, Vikram University Ujjain, MP, India
E-mail: *paragdalal[at]rediffmail.com*

Abstract: ***The ESP (Electrostatic precipitator) has very defining particulate matter removal efficiency which is been dependent on the electrostatic charge at the particle gain time [10]. Generally, at 10 Hz electrostatic precipitate removes a large concentration of particles from range 5 nm to 10 µm. nowadays many electrostatic precipitators were present which can also measure the size and number of charges per particle used. In this paper, we try to use dilution method which in turn increases the temperature of the particles from whole which will increase the efficiency of an electrostatic precipitator. Secondly, the electricity is also been made as in the thermal power plant from coal combustion. The heat is intern recharge to the hot gasses passed through it by dilution method this reuses the energy for the electrostatic precipitator.***

Keywords: electrostatic precipitator (ESP), particulate matter (PM), electrostatic charge (Ø), and particle gain time, nanometers (nm), micro meters (µ m), efficiency (ŋ), and electricity generation, dilution.

1. Introduction

The electrostatic precipitator can be used for the removal of particulate matter from fluegas [1]. As these gases are very useful to us, the operation of an electrostatic precipitator is based on the static electricity [2]. These charges the particles present in the flue gas as soon as and effectively as it can [3]. The efficiency and the performance of an electrostatic precipitator vary with the various complex factors including the mechanical and the human errors [4]. This mechanical static filtration system poses a high efficiency which is about 99.5% if a Corona is generated around the electrode and is at its best proportion to the voltage [6]. The ŋ will be highest to about 99.5% and lowest to 98% [5].

This efficiency is been effected by the particle size, particle composition, fluegas temperature and humidity present in the system [7]. These parameters alter the charging capacity of an electrostatic precipitator, in turn effects, the efficiency of the whole system [8].

Due to this complex procedure of an electrostatic precipitator and various effects, it is clinically very important to be precise to measure directly the charging efficiency so as to improve or increase the performance and ŋ with the process what we are running [9].

The introduction of a low pressure impact or measures a particle number and the concentration mass with the size distribution of particulate matter in real time. The measurement ranges from 5 nm to 10 micro meters with evenly spaced size fractions. Also the charge of the different particles is also measured which lead us with a very positive data to increase the efficiency of ESP in real time. The technology has been better to ages so that we now can enable the direct charge studies and that too in the real working time.

In this paper, we will talk and analyze about the electrostatic precipitator charging efficiency with comparison to the particle emission characteristics of a coal-fired thermal power plant and a diesel that is oil fired thermal power plant both.

The study is very crucial as in a high-level thermal power plant. The electrostatic precipitator optimization increases or decreases the efficiency to a large extent and the complex nature alters the process very soon.

2. Material and Methods

The conditioning of a flue gas is been done by a fine particles sampler. This allows us to do the conditioning in different concentration, different ratios and different dilution temperatures. This dilution can be done in two or three stages that are in the first stage, it is done in a perforated tube. This helps us in the both cooled and high heat; in dilution the main is the second stage as in the second stage it is performed in an ejector tube. This leads us to the ambient temperature dilution. This velocity is also increase, so can we use instead of the pump of the dilution system, saving the valuable energy, both of these stages are been continuously monitored and analyzed. The dilators out of two types nowadays –

1) The primary diluter consisting of a perforated tube.
2) Secondary diluter at the injector pump.

The electrostatic precipitator operation is based on the size fraction changes in the particle charging technique with an impactor and electron meters. This Electro meter helps us in determining data. The charge difference in between electrodes and these too all alteration can be done in a real-time measurement and analysis.

3. Results and Discussion

All the measurement data we have taken is been corrected for the dilution ratio done that is 2:3. The particle size analyzed is between 5 nm to 10 µm of $PM_{2.5}$ only as PM_{10} is greater than 10 µm.

In the oil fired thermal power plant, the maximum concentration where is between the range 1×10^8 and 2.5×10^8 particles per cubic centimeter. The $PM_{2.5}$ concentration is most stable at about 200 mg data, the long time exposure of this concentration is too stable and a fluctuate, If a short duration time is taken so we can say that the average concentration is stable and varies over a long period of time.

The peak consists of the particles ranging from 20 nm to 50 nm. We observed a Trio at the peak with the particle sizes of 130 nm is 400 nm and surprisingly the max is at 2.4 micro meters. **Why is it so?**

This is because the largest made peak consist of the heavy load of a large fly ash particles. The peak is also due to the cake accumulation of the shoot and ash particles in an ESP, some ultra fine particles through their nucleation and helps the flue gas to cool as they vaporize in charge. This is stopped by the dilution method so a significant loss in the process can be turned down.

If you talk of sizes to accumulate around, then we have to keep an eye on the 20 nm particles as they peak in the concentration and contribute their significant effect in $PM_{2.5}$ removal technique of an ESP the particles about the 25 micro meters are best considered as no additional efforts are to be applied for their removal. As they become heavy by charge, they settle down in the harbor easily giving the pollution free fluegas.

In the coal-fired thermal power plant, the maximum P concentrations of particles come at 6×10^4 to 1.6×10^5 particles per cubic centimeter. The minimum concentration was of particles of 0.5 mg per cubic meter and the maximum or the peak is at 6mg per cubic meters. This concentration is stable for a long-term exposure and is its peak is observed in regular intervals.

In the coal thermal power plant, the baseline message distribution is modeled with a peek at 40 nm and 100 nm with a peak at 2 micrometers also. This is due to the cake formation at the time of the running ESP and add cleaning. The maximum concentration is between 150 nm to 200 nm particles in running condition.

When we compare the two results, the coal-fired thermal power plant and the diesel fired thermal power plant. Many surprisingly results were observed and the trend is almost similar but the concentrations are different in both the thermal power plants. The trend is not similar if the High charge technique is used for both fine and coarse particles; this high charge leads to the less concentration of the bigger particles.

Why? We can analyze it in the next paper.
When a high-voltage is use, we can see a big Grand Canyon at 110 nm and add 1.5 µm. These two dips can be due to the particle movement and also can be due to the particle formation process of the particle morphology.

4. Conclusion

This charging difference can be the key in the waste removal. As in the results we have already found out that more ultra fine particles are been formed in oil fired thermal power, plant and more course particles of $PM_{2.5}$ with the concentration at 0.5 mg per cubic meter, are at 2.0 µm in a cold fire, thermal power plant.

This low concentration of the coarse particles at oil-based thermal power plant leads to various errors and the performance optimization has to be applied again and again. The charge difference is also very clinical as it is directly proportional to the concentration of the $PM_{2.5}$ causing error margins to be larger

References

[1] Dalal P. Modeling and Sensitivity analysis of 10µm dust particle separation (PM_{10}) for Uniflow aerodynamic Dedusters Journal of Environmental Research and development Vol. 5(1) 2010 34–45 ISSN 0973–6921 Refereed & Indexed IF – 6.78
[2] Dalal P. Modeling and Environmental Impact Assessment Implementation by Noise and Air pollution reduction of Indian Heavy Diesel Trucks on Highways International Journal of Plant Animal and Environmental Sciences Vol. 4(1) 2014 370–375 ISSN 2231–4490 Refereed & Indexed IF – 1.03
[3] Dalal P. Pollution Monitoring in heavy traffic sites With Moss Sampling International Journal of Recent Biotechnology Vol 2 (4) 2014 49–51 ISSN 2322–0392 Refereed & Indexed IF – 0.78
[4] Dalal P. Modeling of Air Quality Index International Journal of Advanced Research in Engineering & Applied Sciences Vol 4 (9) 2015 1–11 ISSN 2278–6252 Refereed & Indexed IF – 5.795
[5] Dalal P. Sweet air Flux in Indian Savanna International Journal of Research Vol 2(4) 2016 34–39 ISSN 2455–6114 Refereed & Indexed IF – 0.78
[6] Dalal P. Proposal of Multi–Hazardous Wastes For On–Site Disambiguation Management In Ujjain, India International Journal of Chemical Studies Vol 5(4) 2017 01–06 ISSN 2321– 4902 Refereed & Indexed IF – 4.86
[7] Dalal P. Low Cost Dust Collector Model For Calcareous Shale Industry At Mandsaur Of Madhya Pradesh, India International Journal for science and Advance Research in Technology Vol 3(8) 2017 436–441 ISSN 2395–1052 Refereed & Indexed IF – 4.284
[8] Dalal P. Assessing The Air Quality In Ujjain By Artificial Neural Network International Journal for science and Advance Research in Technology Vol 6(11) 2020 44–54 ISSN 2395–1052 Refereed & Indexed IF – 6.224
[9] Dalal P. Disambiguation of Municipal Solid Waste to Syngas in Ujjain District by Plasma Gasification Technique International Journal of Novel Research and Development 2023 Vol 8(4) 359-364 ISSN: 2456-4184 Refereed & Indexed IF – 8.76
[10] Dalal P. Cost Effective Filter Cake Buster in Bag House International Journal of Global Science Research 2023 _Under Process_ ISSN: 2348-8344 Refereed & Indexed IF – 7.56