

Research Article

# Traditional and Hybrid Method of Rapping Systems in Electrostatic Precipitator

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Accepted 10 Aug 2014, Available online 25 June 2014, Vol.4, No.4 (Aug 2014)

## Abstract

Electrostatic Precipitator is an air pollution control equipment which separates the dust particles from flue gases. It is basically used for Boiler applications. Dust is collected on Collecting electrodes and gets separated by means of excitation of Collecting Electrodes. The excitation is nothing but the displacement of Collecting electrodes from its mean position. The different methods of rapping i.e. Traditional rapping, Modified rapping and Hybrid rapping methods and relative comparison of advantages and disadvantages are reviewed in this research paper.

**Keywords:** Collecting electrode, Discharge Electrode, Rapping, Plunger, Rapper Rod, Hammer

## 1. Introduction

Electrostatic Precipitator is the air pollution control equipment which separates dust from flue gases. The duct separation is done by electrostatic effect. The Collecting plates are the panels made up of thin sheets of 0.2 to 0.5mm. Panels are kept in hanging condition. In one module there are various collecting plates kept parallel to each. A specific gap between each collecting plate is maintained.

The vertical parallel set of collecting plates provide a way to gas travel. The way is generally called as 'Gas Passage'

Discharge Electrode is kept between collecting electrode. The Discharge Electrode is connected to -ve polarity and Collecting Electrode is earthed.

The Discharge Electrode Continuously emits the electrons which further gets accumulated to dust particles and attracted towards collecting plates. The dust particle in this way accumulated on the surface of Collecting Electrodes. The process is continuous and a layer of dust gets deposited on Collecting electrode. External force is applied to Collecting Electrode. Due to this external force, Collecting Electrodes vibrates and dust layer get sheared off. Dust layer dislodge and fall down into hopper which further removed through rotary airlock valve. The process of applying external force to Collecting Electrodes is called "Rapping". The research reviewed in this paper focus on the Different methods of Rapping.

## 2. Rapping Methods

There are different methods of collecting plate rapping as follows:

### 2.1 Traditional Top Rapping Method

In top rapping method, the plunger is pulled up by means of electromagnetic force. When the power cut off, the plunger get fall down and hits the rapper rod.

Fig1. gives the schematic arrangement of Collecting Electrode and Top rapping system.

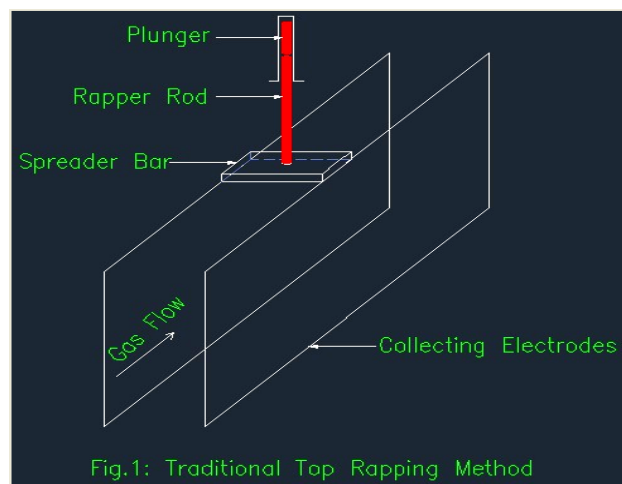


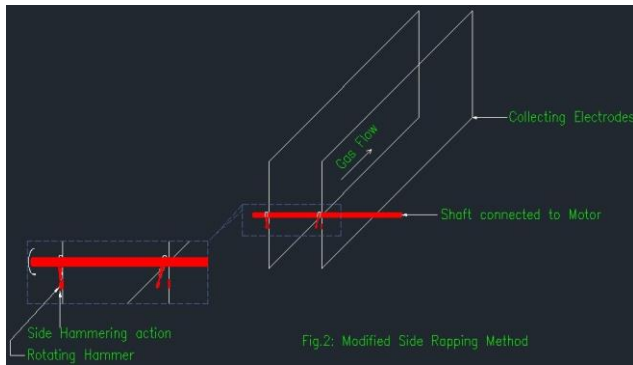
Fig.1: Traditional Top Rapping Method

This is the simplest method which is used for vibration of Collecting Electrodes.

### 2.2 Side Rapping Method

This is modified method of rapping. Here the hammers are assembled on rotating shaft. One end of shaft is connected with Geared Motor which further rotate the shaft. The hammers are assembled on shaft in such a way that the rapping action take place on alternate collecting electrode. Fig 2. shows the modified method of Side Rapping Method.

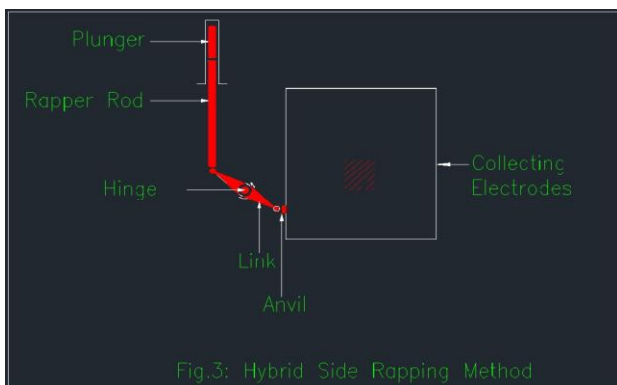
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As shown in Fig2, the rotating hammers hits the anvil assembled on side of collecting plates. The impact force is thus applied to collecting Electrodes. the Collecting Electrodes are vibrated due to impact force and dust layer on collecting Electrode gets sheared off and fall down in to hopper.

### 2.3 Hybrid Rapping Method

From above point no. 2.1 and 2.2 we have seen the Top Rapping and Side Rapping. Considering the Maintenance point of view of side rapping method and power consumption as compared to Top Rapping Method, a Hybrid Method is proposed in this paper. Fig3. shows the Hybrid Method of Rapping.



Hybrid Rapping Method is the combination of Top Rapping and modified Side Rapping Method. Here the Top rapping coil is used in which plunger and rapper rod are used. The rapper rod kept on the link which is hinged as shown in Fig3. The Link is nothing but hammer which rotates at hinge point. The plunger hits the rapper rod and impact force transferred to the link and another end of hammer hits the anvil at collecting plates.

The impact force transferred to Collecting Electrode allows the Collecting Electrode to vibrate and thus the dust layer dislodge due to vibrating effect.

### 3. Impact Force

Te peak value of impact force is calculated by following formulae

$$a = \frac{dv}{dt} = \frac{dv}{t_{pulse}} = \frac{v_{initial} - v_{Final}}{t_{pulse}} = 2x \frac{\sqrt{2gh}}{t_{pulse}} \quad (1)$$

Further the impact force is calculated through following equation:

$$F = ma \quad (2)$$

### 3. Advantages

The Hybrid Method of Rapping is having multiple advantages over the top and side rapping system.

**Table 1** Experimental procedure parameters

S. No	Method of Rapping	Advantages
1	Top Rapping	1. Simple in construction. 2. Low maintenance cost.
2	Modified Side Rapping	1. Useful for higher height of Collecting Electrodes as compared to Top Rapping System.
3	Hybrid Side Rapping	1. Useful for higher height of Collecting Electrodes as compared to Top Rapping System. 2. Low maintenance as compared to Modified Side Rapping Method. 3. Relatively Low power consumption as compared to Modified Side Rapping Method. 4. Simple in Mechanism.

### Conclusions

The overall review gives the positive sin of Rapping Method. The research allows to conclude for Hybrid method of rapping as follows-

- 1) The impact location plays the major role in rapping.
- 2) The Side rapping action by using Top Rapping arrangement made the system maintenance free or less maintenance occur as compared to Modified Side Rapping Method.
- 3) Suitable to higher vertical height of Collecting Electrode.
- 4) Since the dust particle normally get deposited on middle and lower side of Collecting plate. Due to Side Rapping the vibration level in the middle and bottom region is higher and hence the dust dislodges from collecting electrodes.

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