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An introduction to precipitators

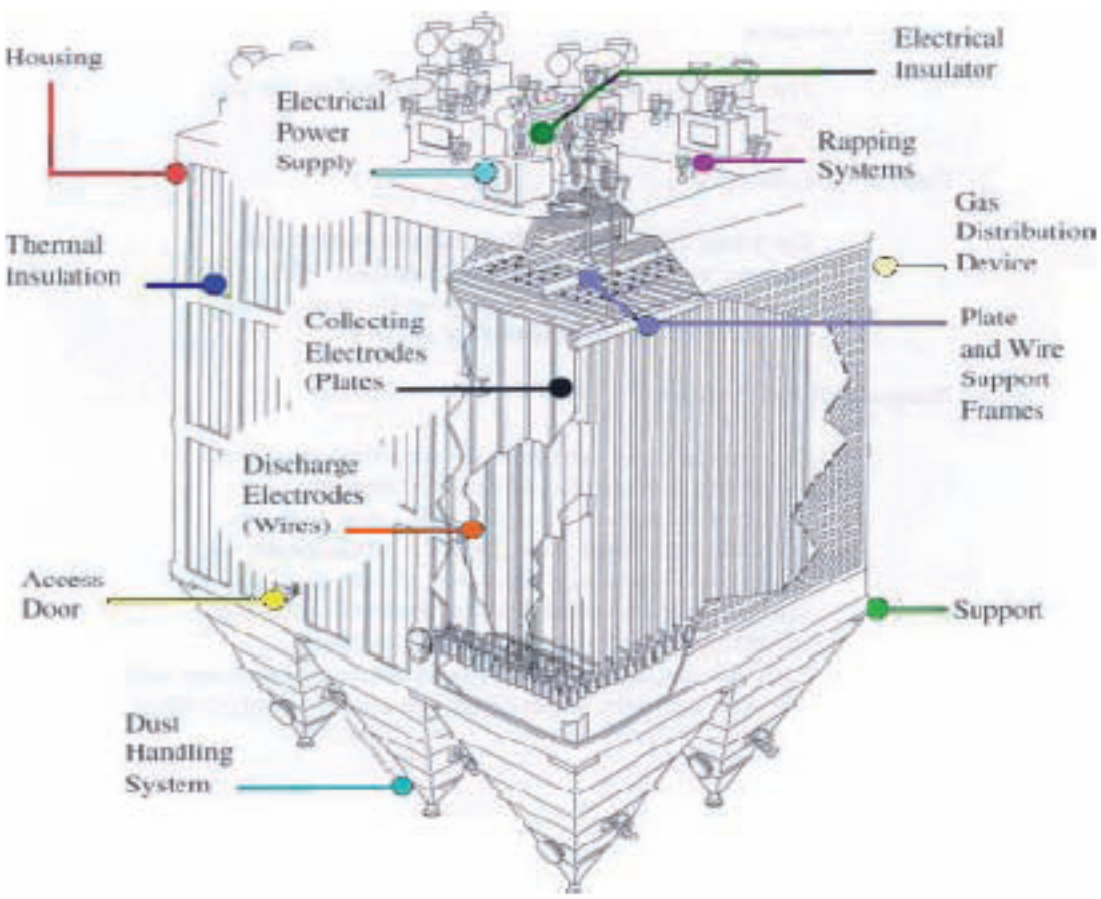
Electrostatic precipitators are a standard piece of equipment in today's cement plant, providing long-term reliable dust separation. Here Nitin Agarwal describes the basic layout of standard electrostatic precipitators in the cement industry.

The first use of corona to remove particles from an aerosol was by Hohlfeld in 1824. However, it was not commercialised until almost a century later. In 1907 Dr. Frederick G. Cottrell applied for a patent on a device for charging particles and then collecting them through electrostatic attraction — the first electrostatic precipitator.

An electrostatic precipitator is a large industrial emission-control unit. It is designed to trap and remove dust particles from the exhaust gas stream of an industrial process. Precipitators are used in the power, electric, cement, chemicals, metals and paper industries amonst others.

In many industrial plants, particulate matter created in the industrial process is carried as dust in the hot exhaust gases. These dust-laden gases pass through an electrostatic precipitator that collects most of the dust. Cleaned gas then passes out of the precipitator and through a stack to the atmosphere. Precipitators typically collect 99.9% or more of the dust from the gas stream, although plants may actually have multiple precipitators for each unit.

Below: Basic parts of a modern ESP.



The effect of gas temperature on precipitator collecting efficiency, given its influence on particle resistivity, can be significant.

Discharge electrodes

Discharge electrodes emit charging current and provide voltage that generates an electrical field between the discharge electrodes and the collecting plates. The electrical field forces dust particles in the gas stream to migrate toward the collecting plates. The particles then precipitate onto the collecting plates.

Common types of discharge electrodes include straight round wires, twisted wire pairs, barbed discharge wires, rigid masts, rigid frames, rigid spiked pipes and spiral wires. Discharge electrodes are typically supported from the upper discharge frame and are held in alignment between the upper and lower discharge frames. The upper discharge frame is in turn supported from the roof of the precipitator casing. High-voltage insulators are incorporated into the support system. In weighted wire systems, the discharge electrodes are held taut by weights at the lower end of the wires.

Collecting plates

Collecting plates are designed to receive and retain the precipitated particles until they are intentionally removed into the hopper. Collecting plates are also part of the electrical power circuit of the precipitator. These collecting plate functions are incorporated into the precipitator design. Plate baffles shield the precipitated particles from the gas flow while smooth surfaces provide for high operating voltage.

Collecting plates are suspended from the precipitator casing and form the gas passages within the precipitator. While the design of the collecting plates varies by manufacturer, there are two common designs. In one case plates are supported from anvil beams at either end. The anvil beam is also the point of impact for the collecting rapper plates supported with hooks directly from the precipitator casing. In the other case two or more collecting plates are connected at or near the center by rapper beams, which then serve as impact points for the rapping system.