APATech™ ESP System

- The Most Efficient ESP System -

Basic Principles of ESPs

Electrostatic precipitators (ESP), use electrical fields to remove particulate from flue gas. Because precipitators act only on the particulate to be removed, and only minimally hinder flue gas flow, they have very low-pressure drops, and thus low energy requirements and operating costs. An ESP can achieve collection efficiency of dust as high as 99.9%. ESPs are placed as the priority dust collection equipments in power plants and boilers, which make up the major source of dust pollution. Large precipitators can cost millions of dollars.

While several factors determine ESP removal efficiency, precipitator size is of paramount importance. Size determines treatment time: the longer a particle spends in the precipitator, the greater its chance of being collected, other factors being equal. Precipitator size also is related to the specific collection area (SCA), the ratio of the surface area of the collection electrodes to the gas flow. Higher collection areas lead to better removal efficiencies, also higher costs.

Technology Key of ESP System

Particles migration velocity is a key parameter to determine precipitator size or the surface area of the electrical electrodes of the precipitators, and a major factor that affects the cost of the precipitators. Hence, particles size, size distribution and mineral properties determine their migration velocities.

Factors limiting precipitator performance are flow non-uniformity and reentrainment. Good gas quality will have less turbulence, and consequently reduce turbulent mixing and minimize reentrainment.

A key determinant of ESP collection efficiency is the resistivity of the particles to be collected. Particles with resistivity in the range of 10^7-10^{10} ohm-cm are amenable to collection with precipitators. High resistivity particles are difficult to collect, which result in poor performance of an ESP.

Maximizing electric field strength will maximize precipitator collection efficiency as it obviously increases the charging and collecting fields.

APATech™ ESP System

APATech™ ESP System has been developed to meet the above key requirements. At APA Environmental, we have pioneered to employ a novel design approach focusing on particle size and its distribution, and gas quality.

Traditional design uses empirical values of particle migration velocity or the value obtained simply by dividing the theoretical migration velocity by 2, based upon particle mass mean diameter, totally regardless of the particles themselves. The APATech™ addresses the issue of how to utilise a single particle diameter to represent polydisperse particles in terms of theoretical migration velocity. An equation to calculate the average theoretical migration velocity of polydisperse particles has been obtained by APA Environmental for the first time. Figure 1 shows a result in which particle size distribution is a normal standard one, and that particle mean diameter is its mass median diameter.

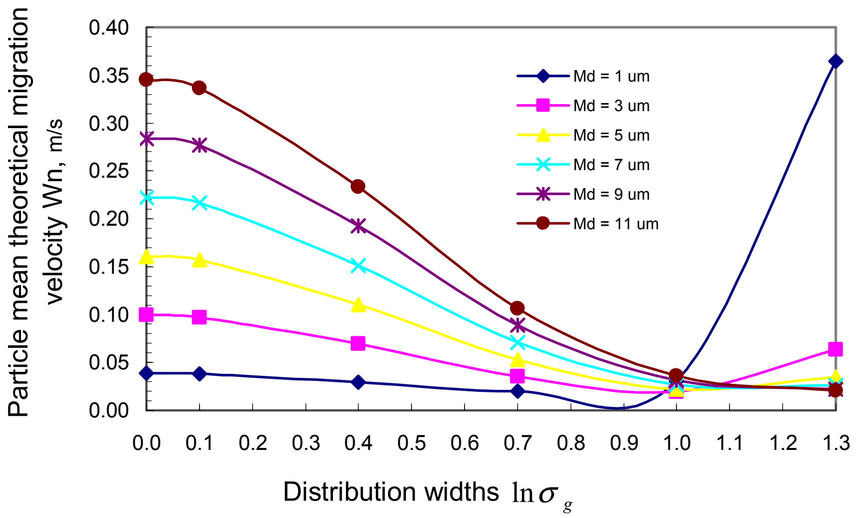

Fig. 1 Particle mean theoretical velocity w_m against particle size distribution widths $\ln\sigma_g$ for various particle mass median diameters M_d

This innovation also involves an engineering model for simulation of the effect of particle size and size distribution on collection field, corona current along the precipitator. This process can only be achieved after the particle average theoretical migration velocity is obtained as mentioned above.

At APA Environmental, we have created a new concept, net particle migration velocity, Wn, in terms of traditional effective migration velocity of particles, to describe the effect of gas flow quality or uniformity on particle deposition. We use friction coefficient of the precipitator channel to evaluate this effect. It has shown that the gas quality or uniformity has a significant influence on the performance of the precipitators. Figure 2 demonstrates a relationship of the ratio F (net particle migration velocity, Wn, to theoretical migration velocity W), with various gas velocities V and friction coefficients C_f. We have therefore developed a new type of flow scattering plate by using the principles of aerodynamics.

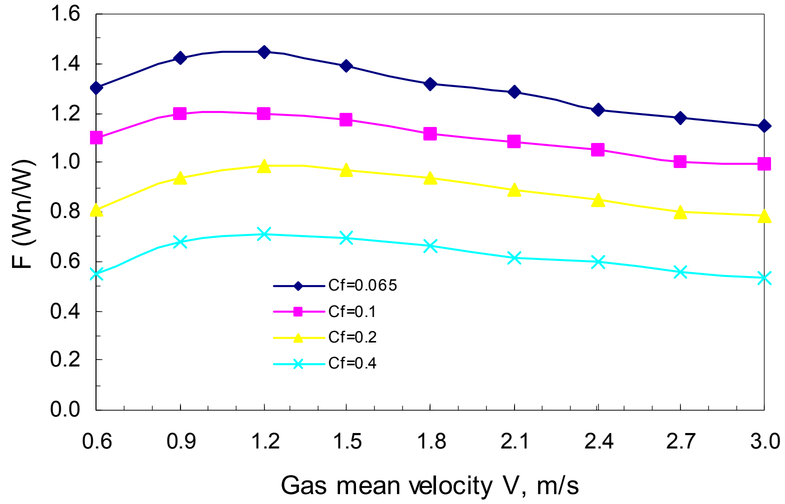

Fig. 2 Relationship of F, V and C_f

Applying this innovation, the number of electric field section, the total length of the precipitator, the voltage needed to apply to each electrical field section to achieve the required collection efficiency could be determined.

To maximize electric field strength or improve electric field in the vicinity of collection electrodes, we utilise automatic voltage controllers to maintain electric field strength as high as possible to ensure maximum particle charging and collection, consistent with preventing electrical breakdown of the gas and sparking between the discharging and collecting electrodes, which would extinguish the electric field. These controllers detect spark onset, and maintain voltages just below the level at which sparking would occur.

To achieve an increase on electrical field in the vicinity of the collection plates and to deal with high resistivity particles, we apply the latest pulse power generator. With this technology, the escaping dusts can be significantly reduced compared with conventional ones.

With APATech™ ESP Systems, we can improve the design accuracy of precipitators on each practical application. This innovation provides an ideal solution for diagnosing and upgrading old precipitators that show a poor performance.

Advantages and Benefits

- APATech™ provides convenience for designers to calculate the correct average theoretical migration velocity of polydisperse particles in terms of the physical properties of dust on sites rather than to guess it based on experience, being presented by a single particle diameter, which is related to mass median diameter, but not the mass median diameter itself.

- APATech™ takes particle size and property on sites as a priority: (a) number of particles per unit volume; (b) particle size and distribution; (c) particle mass per unit volume; (d) particle surface area per unit volume; (e) particle chemical components; and (f) particle mineral property. This provides the most accurate design parameters for the design of an ESP.

- Intelligent precipitator control with data acquisition, monitoring and control system is an exciting new development in precipitator operating process incorporated by APATech™.

- Applying an advanced pulse power generator to upgrade old precipitators in fume, dust and gas cleaning, an average of 30% reduction in escaping dusts has been achieved.

- APATech™ can improve design accuracy, with a significant saving in installation and operation costs of up to 25% with the collection efficiency of up to 99.9%.