Influence of Hole Diameter on Hole-type Electrostatic Precipitator

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Recently, the increasing worldwide environmental awareness, the air pollution problem has attracted attention as a problem to be solved of mankind. SOx, NOx and particulate matter (PM) have been pointed out to cause diseases such as asthma and lung cancer as a cause chemicals for the air pollution. The marine diesel engine is the main source of harmful substances. Fuel of the marine diesel engine is a heavy oil. The diesel engine exhaust the high concentration of PM. The collection of low resistive particles is difficult by the conventional electrostatic precipitators (ESPs). The low resistive diesel engine particles are detached from the collection electrode, which causes the particle re-entrainment, resulting in poor collection efficiency. Therefore, authors developed hole-type ESP for removal of PM emission from the diesel engine (Y. Ehara 2014). In this study, it was decided to apply the hole-type ESP suppress the re-entrainment phenomenon.

The exhaust gas with the engine load of 75% of the diesel engine generator using a light oil was allowed to flow directly into the hole type ESP. The particle size-dependent number densities the inlet and outlet of the ESPs were determined by the scanning mobility particle sizer (TSI, Model 3080) for the particle size ranged 20-800 nm and the particle counter (Rion, KC-01E) for the particle size of 300-5000 nm, respectively. Fig 1 shown the ESP structure. Hole diameter of the grounding electrode is 5-20mm, and the aperture ratio of the grounding electrode is 16%. There is the discharge electrode space between an discharge electrode and grounding hole electrodes. There is the collecting zone between a grounding hole electrode and grounding case. The hole-type ESP utilizes the ionic wind, combined with electrostatic force to transport the charged particles effectively into the collecting zone through the hole of the electrode. The collecting zones are designed as zero electrostatic fields, i.e., no electrostatic repulsion force acting on particles by induction charge, so that no re-entrainment takes place.

Fig. 2 shows the collection efficiencies of hole type ESP for the hole diameter and the electrode without a hole (Conventional ESP). There is not difference in the collection efficiencies for particle size of 40-240 nm. The collection efficiencies of small particle size is high. PM is collected on the outlet side of the hole by the gas flow. In the conventional ESP, re-entrainment phenomenon takes place in the collection efficiencies for particle size of 3000 nm. The collection efficiency is high with the hole electrode. As a result, the re-entrainment phenomenon is controlled using the hole

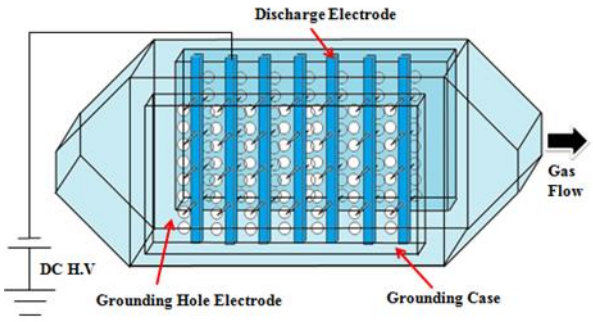

Figure 1. ESP structure

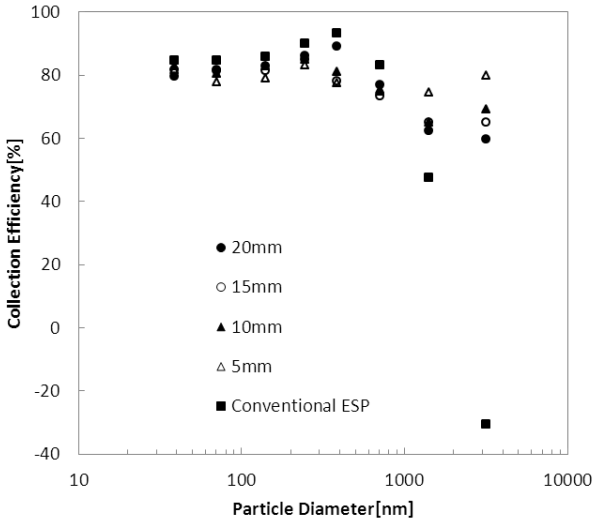

Figure 2. Collection efficiencies for the hole diameter

electrodes. In addition, since the aperture ratio is the same the number of small is diameter than that of large diameter. Therefore, the collection efficiency of small hole diameter was higher than that of large hole diameter.

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