Experimental study of a louvered electrostatic precipitator

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Due to global warming, many countries are committed to reducing carbon emissions by increasing the efficiency of energy use. The drawbacks of air conditioners include high energy consumption and increased level of indoor pollutants trapped in a relatively sealed home. General ventilation increases the indoor air temperatures by expose to radiant energy (sunlight). The louvered window can reduce indoor temperature by blocking radiant energy and the ESP structure similar to the louvered window (Hatamipour and Abedi, 2008). The main purpose of the present study was to design and characterize a louvered electrostatic precipitator (ESP) that can reduce the aerosol concentration coming in from outdoors and block radiant energy at the same time, while permitting natural ventilation.

A lab-scale louvered ESP was built to carry out the aerosol filtration test, as shown in Figure 1. The discharge wire was made of stainless steel with a diameter of 0.3 mm. Particle number concentration and size distribution were obtained in the power on and power off modes. These data were then employed to evaluate the aerosol penetration of the ESP. The particle size distribution and ozone concentration were recorded by APS, SMPS and Ozone meter. The major operating parameters include the length of the collection plate, the filtration velocity and the flow rate through the ESP unit, the position of the discharge wire and the louver angle. The energy quality index considers both aerosol penetration and energy consumption was used to evaluate the louver ESP performance.

The results showed that the louver adjustment significantly affected the ESP performance. The discharge wire should be positioned in the middle to provide optimal ESP performance, although moving around the electrode did not significantly change the energy consumption and ozone generation. The collection plates with excessive length were proven to be ineffective. The wire-to-plate distance decreased with increasing louver angle. The louver adjustments resulted in changes of the effective collection area, electric field strength and air velocity. The field strength should be as low as possible to obtain a high energy quality index. For a given energy consumption, the energy quality index was not significantly affected by the louver angle. This phenomenon was due to a trade-off between the electric field strength and the effective collection area. Therefore, all aerosol penetration curves showed within a narrow band.

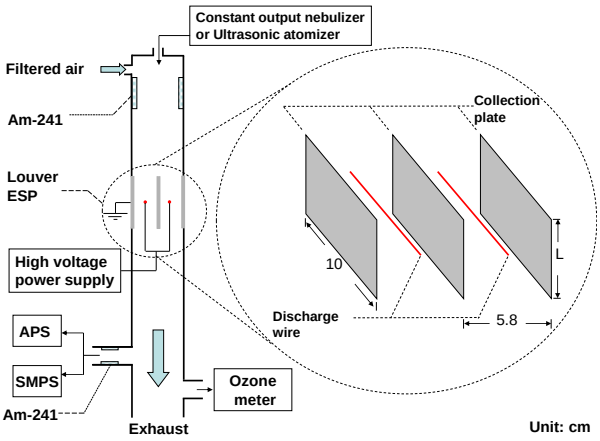

Fig 1. Schematic diagram of the experimental setup.

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Hatamipour, M.S. and Abedi, A., (2008). *Energy Conversion and Management*, 49(8): 2317-2323.