Improving Air Quality in Broiler Houses Using an Electrostatic Precipitator

Electrostatic precipitators (ESPs) are air cleaning devices that use a high voltage current to ionize airborne particles, and then remove them from the air through electrostatic forces. These devices have been effectively used for decades in industrial plants (e.g., cement plants, coal-fired power plants) for particulate matter (PM) removal. Though several studies (Mitchell and Baumgartner, 2007; Cambra-Lopez et al., 2009; Jerez et al., 2013; Manuzon et al., 2014) have explored the potential application of this technology in livestock facilities, the influences of many factors (e.g., ventilation rate, management system) on its performance, as well as its impacts on animal health and productivity, have not yet fully investigated. The Development and Assessment of Emerging Green Technologies to Reduce Aerosol Hazards in Livestock project is examining the performance of an ESP system in removing dust, bacteria, odour, and NH3 in medium-scale poultry houses. Impacts on birds’ mortality and productivity were also evaluated.

One of the experiments of the project was conducted at the Research and Development Institute for the Agri-Environment (IRDA) in Quebec to evaluate the use of ESP in broiler chicken houses. Two trials were carried out: Trial 1 was conducted in June 2020, while Trial 2 was in August 2020. Both trials used two environmentally-controlled rooms: one served as the control room, while the other served as the treatment room, where the ESP was installed. The ESP system was composed of a stainless-steel corona pipe, 1.8 m long and 25 mm outer diameter, with 25-mm long stainless steel corona points (spaced at 50-mm distance and welded in “V“s along the length of the pipe) (Fig. 1). The corona pipe was hung 1.7 m above the floor and connected to a -30 kV (current < 2 mA) DC high voltage power supply.

Fig. 1. Corona pipe (ESP system) in the treatment room.
The rooms used in the study were identical, which had dimensions of 5.2 m x 3.4 m x 1.9 m (L x W x H); however, only a portion of the floor area (11.1 m²) was used for the birds. In both trials, 150 chicks (75 males and 75 females) were brought into each room on day one. Each trial lasted for 35 days. For the duration of each of the trials the following variables were monitored:

- Dust levels using a DustTrak DRX Aerosol Monitor 85330
- Bacteria concentrations using a Coriolis µ biological air sampler
- Odour using the dynamic olfactometry technique
- NH₃ using a non-dispersive infrared analyzer

Additionally, the temperature, relative humidity, and ventilation rate in each room were also monitored.

The average reductions obtained in both trials for PM₁₀, PM₂.₅, PM₄, PM₁₀, and total dust were up to 44%, 42%, 40%, 39%, and 45%, respectively. Reductions of up to 59% for odour and 69% for both culturable and total bacteria were observed. However, no substantial difference in NH₃ concentration, as well as in feed conversion ratio (1.3 kg feed/kg body weight gain), was observed between the treatment and control. The data collected for mortality was not sufficient; hence, the impact of the technology on mortality needs further investigation. The results of this experiment in the Development and Assessment of Emerging Green Technologies to Reduce Aerosol Hazards in Livestock Production project show that the ESP system can potentially reduce dust, as well as odour and bacteria, in poultry barns. More experiments will be ongoing through the project as the research team continues to evaluate the effectiveness of ESP for dust reduction.

References:

