Agricultural Ammonia Monitoring Technology

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As small, family animal farming has been replaced by large, corporate confined animal feeding operations (CAFOs) over the past 20–30 years, the issues of environmental pollution, worker occupational exposure and animal health surrounding significant emissions of noxious gases and particulates from these operations have grown as well. These issues are particularly serious for swine and poultry CAFOs, where the highest levels of noxious gases and respirable particulates are encountered.1 Inside confinement houses, animal and farm worker health and productivity are at considerable risk.2,4 This problem is exacerbated by utilization of tightly sealed confined structures, which makes the need for effective control of the environment inside the CAFO all the more critical.3 Outside the farm, the health and quality of life of residents living in close proximity to CAFOs are also negatively affected by poor air quality resulting from CAFOs.5 There is much productivity and profit to be recovered by the animal farming industry by controlling emissions in addition to the industry becoming good stewards of the environment.6 Our primary goal is to provide a cost-effective, simple to use tool to help the hog and poultry farming industry to control a major component of noxious CAFO emissions, animal manure ammonia. and to help agricultural researchers more clearly define the problems and solutions associated with manure control. The technology has to fulfill several important, user-specific criteria: (1) it must be extremely robust, especially in the presence of high humidity and high concentrations of dirt and dust; (2) it must be extremely inexpensive; (3) it must be technically uncomplicated.

We have demonstrated a unique colorimetric sensor system, capable of monitoring ammonia continuously from less than 1 ppm to hundreds of ppm. Maximum sensitivity was between 0–50 ppm NH₃, but linear response with reduced sensitivity up to 300 ppm was found. Negligible or minor interference from carbon dioxide, methane and hydrogen sulfide were observed. The sensor functioned well in high humidity and dusty environments. High ammonia concentrations, e.g. > 100 ppm, do not fatigue the sensor. Continuous monitoring with breadboarded components has been demonstrated. Low ammonia concentrations, 1–2 ppm, were readily monitored, with positive response in under 2 s. Detection limits were on the order of 0.5 ppm, well below what is required for CAFO needs. We are currently building prototype units for field testing to begin later in 2008.

References


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Figure 1. A TIS sensor exposed to progressive increases in ammonia concentration (dry air).