SUPERVISORY CONTROL OF ENVIRONMENTAL PARAMETER AMMONIA (NH3) OF CLOSED HOUSE SYSTEM MODEL FOR BROILERS

Alimuddin[1,2], Kudang Boro Seminar[3], I Dewa Made Subrata[3], Sumiati[4]
[1] Doctoral student in Agricultural Engineering Department, Bogor Agricultural University (IPB)
and [2]Department of Electrical Engineering, University of Sultan Ageng Tirtayasa, Banteng Indonesia
[3] Lecturer in Agricultural Engineering Department, Bogor Agricultural University (IPB)
[4]Lecturer in Nutrition and Feed Technology Departemen, Bogor Agricultural University (IPB)

ABSTRACT

The research objectives namely; evaluating the effects of various influencing factors on ammonia emissions environmental from broiler litter, and supervisory control amount of ammonia in closed house for broilers. Statistic approach modeling of linear regression using. A dynamic flow-through chamber system was designed for this ammonia emissions model development study to evaluate model components individually or in designed combinations. Supervisory control of ammonia is tested with tools controlled air impinger and temperature, humidity use Kestrel 3000. Conclusion of supervisory control Environmental Parameter Ammonia (NH3) of Closed House System Model For Broilers has been tested with tools controlled air impinger. Result of ammonia control results for 0.05-3.25 ppm. Result of ammonia supervisory control results for 0.05-3.25 ppm at temperatuture 25-32C^0, humidity 73-77.5 %, and Air Velocity 1.7-27m^3/h. The amount of NH3 is influenced by temperature, humidity and air velocity.

INTRODUCTION

Ammonia (NH3) is a common substance playing an important role in the nitrogen cycle. Since the 1980s, agricultural NH3 emission has become one of the major worldwide air pollution problems and has attracted more and more attention from the public and government regulators.(Ji-Qin Ni,at al, 2001)

Ammonia is considered the most harmful gas in broiler chicken housing (Carlile, 1984). The importance of ammonia emissions from animal feeding operations (AFOs) has been well recognized (Van der Hoek, 1991; Zhao et al., 1994; Sutton et al., 1995; Aneja et al., 2000; Arogo et al., 2001; Hutchings et al., 2001; Lee and Park, 2002; Battye et al., 2003; Hyde et al., 2003; Xin et al., 2003; Wheeler et al., 2003; Liang et al., 2003; and Gates et al., 2004). However, the contributions of ammonia emission from large poultry operations to the national emission inventory have not been properly documented. Accurate estimation of ammonia emission rate from individual operations or sources is important and yet a challenging task for both regulatory agencies and animal producers. Numerous studies have been reported throughout the world on ammonia emissions from broiler houses, and wide variations have been found among different studies. The differences in ammonia emission fluxes from broiler houses under different conditions have been reported as high as 55 fold (Redwine et al., 2002). Variations in ammonia emissions result from the dependence of ammonia emissions on seasonal and regional conditions, house design, and management practices.

Broiler chickens are normally raised on litter made up of wheat straw or wood shavings above an earthen floor. The litter serves as manure absorbance. The mixture of litter and manure represents the most significant source of ammonia emissions. The mechanisms related to ammonia emissions from manure involve many processes and have been summarized by Ni (1999). Theoretically, the processes involved in ammonia emissions from litter based manure include conversion of uric acid to urea, hydrolysis of urea, enzymatic and microbial generation of ammonia, partitioning between the adsorbed and dissolved phase ammonia, the chemistry of ammonia in aqueous solution, partitioning between solid/aqueous phase and gaseous phase ammonia, and the convective mass transfer of ammonia gas from the surface into the free air stream. Factors that may influence ammonia emissions from broiler litter include: air and litter temperature, ventilation rate, air velocity, litter pH, litter nitrogen content, and litter moisture content.

Determining ammonia emissions is both expensive and difficult using currently available technologies for measuring ammonia concentrations and ventilation airflow rates under commercial broiler house conditions. In order to improve the accuracy and simplicity of estimating ammonia emissions, development of emission models is desired. Emission models allow users to calculate site-specific emissions, using the local design and operating parameters. Emission models can also be used to quantify and evaluate the effectiveness of various emission control strategies. Evaluating effects of these control strategies on emissions from livestock buildings for full-scale operations can be quite expensive and labor intensive using current measurement methodologies (NRC, 2003).

The influences of management factors and litter conditions on ammonia emission have been documented (Nicholson et al., 2004; Redwine et al., 2002; Reece et al., 1985; Elliot and Collins, 1982; Elwinger and Svensson, 1996; Carr et al. 1990; Brewer and Costello, 1999), but they have not been adequately incorporated into current emission models. Much work remains to be done because of the number of variables in practice. Further evaluation of these variables is needed for enhanced understanding of the wide variation in ammonia emission rates. The research objectives namely : 1) evaluating the effects of various influencing factors on ammonia emissions environmental from broiler litter, 2) Controlling amount of ammonia in closed house for broilers.

MATERIAL AND METHOD

Environment parameter NH3 for closed house system for broilers

NH_3 is uncolored gas, its heavy of lighter is compared by air, water –soluble and tangible. NH_3 concentration in poultry house is diversified inter 15 – 90 ppm. This gas is formed by wasted product from biologic process of fesses composition, so that many problems on dirt condition are accumulated by litter.

Ammonia (NH3) can be detection by processing at consentration aloft 20 ppm. > 10 ppm to cause lung surface damage. >20 ppm increase susceptibility towars breathing disease. > 50 ppm to reduce growth rapid. (Alchalabi Dhia, Poultry International, Sept 2001).

High concentrations of NH3 inside the animal houses also represent potential health hazards to humans and animals (Reece et al., 1980; Carr et al., 1990; Crook et al., 1991; Wheeler et al.,2000a). Chronic respiratory diseases of swine production facility workers have been attributed to dust and NH3 (Donham et al., 1995). Animal respiratory diseases, such as sneezing, coughing, or pneumonia, increased when NH3 concentrations were 20–40 ppm as compared with 5–15 ppm (Busse, 1993).Tendon acid is farmed N most many in poultry manure, and it will be conversion by form alantoin by urease microbe and alantoin is processing by consistently become ammonia of below figure evident.

A potential exists for large house NH_3 emissions even with low house NH_3 concentration, because large volumes of ventilation air used for thermal comfort and environment control. Ventilation is closely coupled with weather events and size of birds (i.e. interior heat and moisture loads on the thermal environment). A typical (as defined with dimensions above) ◂broiler▸ house ventilation system design uses sidewall fans (92 cm, 36 in.) and static pressure controlled eave inlets for cold and mild weather environmental control, and end-to-end airflow with large inlets and fans (122 cm, 48 in.) for "tunnel" ventilation. During the hottest weather, the ventilation system switches from using sidewall inlets and fans to the tunnel ventilation mode, with a volumetric capacity of at least 0.8–1.2 $m^3\ h^{-1}\ kg^{-1}$ market weight (1–1.5 cfm lb^{-1}). A typical U.S. ◂broiler▸ house will have a total of 11–15 fans, with design fan capacity of about 270,000 $m^3\ h^{-1}$ (160,000 cfm). Supplemental heat is provided by gas-fired furnaces, brooders, or radiant heaters. Some form of evaporative cooling is prevalent in southern producing regions, using either open-cell evaporative cooling pads at the air inlets and/or fogging or misting nozzles distributed inside the house (Gates R.S.et al, 2007).

Supervisory Control for Poultry House

In a treatise on poultryhouse climate and its control, the poultry represents, but also the most complex element of the poultryhouse production. Due to this complexity a supervisory control system is designed to provide option control modes and parameters. The system is also equipped with an optimal poultry growth selection to determine control values of all controlled variables for various types of broilers. The system should take care of defining adequate regulatory and supervisory frameworks to control a poultryhouse, equipped with a heating system, an automatic watering system and external and internal independent variables such as temperature, humidity, ammonia and magnitude, and rain drop level are monitored to support the poultryhouse operation. Sensors and actuators IN/OUT signals must be of analog and digital standard systems.

The architecture of the proposed supervisory poultryhouse control is shown in Figure 1 a user interacts with the supervisory system to perform selection or determination of control modes, controlled parameters, and optimality criteria for a certain poultry cultivated in a set of poultryhouses. Afterwards, the user preference specifications are passed to the *Supervisory Control Engine* (*SCE*) that performs the main supervisory computation scenario by utilizing the knowledge-base (i.e., control, climatic, crops, and I/O knowledge). The SCE then produces set of control instructions to array of controllers that directly control and monitor a set of poultryhouses.

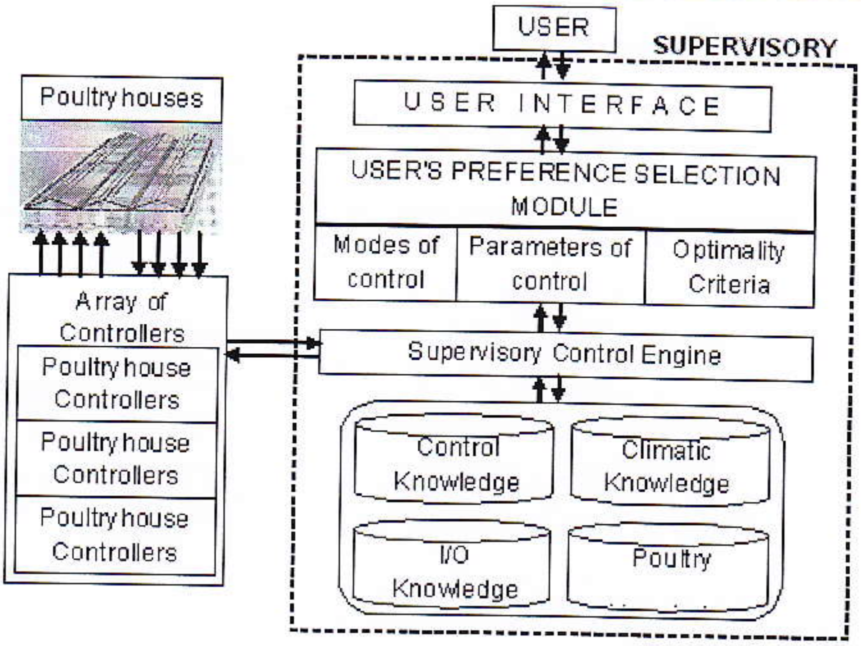


Figure 1. The architecture of poultryhouse supervisory control system (adopted from Seminar *et al*, 2006.)

The *Control Knowledge-Base* is a knowledge repository of various control methodologies, constraints, tools, and requirements. The *Climatic Knowledge-Base* stores all information about climatic parameters and characteristics. The *poultry Knowledge-Base* is a knowledge repository of poultry requirements, poultry types and characteristics. The *I/O Knowledge-Base* stores all relevant characteristics and usage requirements of I/O devices (sensors, transducers and actuators) that may be involved in a certain control scenario.

Implementation of taking amission amonia by using In spectrophotometer method. Closed house volume: 120 m long, 12 meters wide and 2.6 meters high, number of 8 fan 50 inch fan size The number of 20,000 one-time chicken production. Pruductifity level so that 98% mortality 2%. First sampled using a 9 point impenger air samples taken three times the volume: length of middle 12 meter, right and left 3-4.5 meters, the next ammonia emissions put into the air box and then tested in the laboratory using a spectrophotometer.

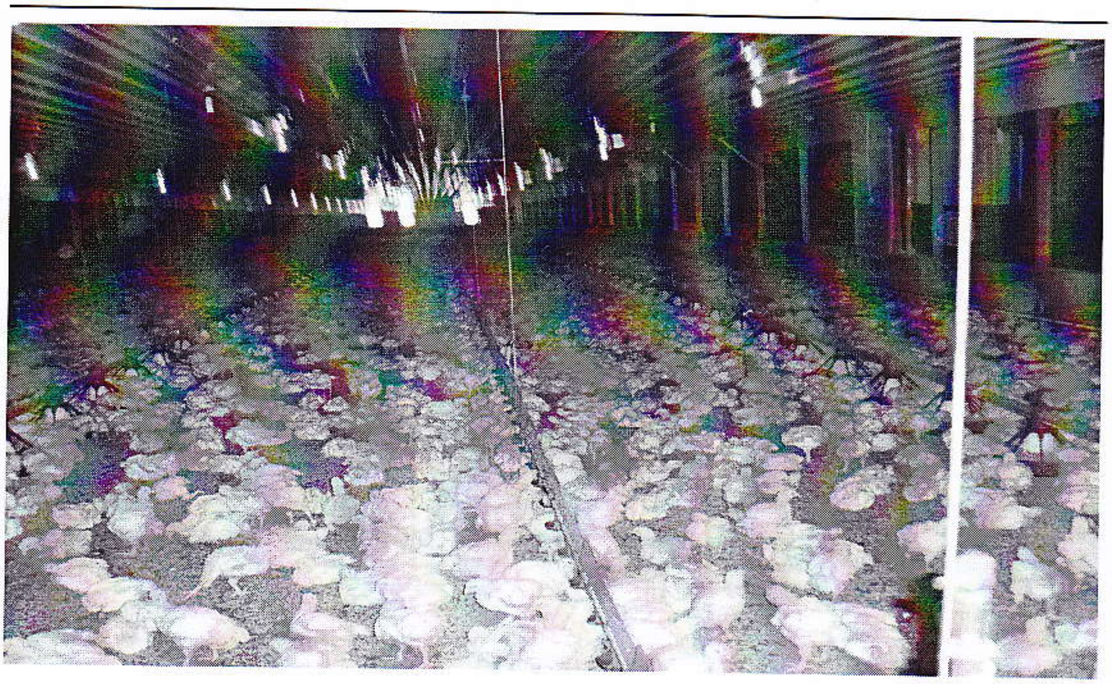


Figure 2. Closed house system for broilers (University of farm IPB,Bogor,2008)

The ammonia fluxes from the litter surface inside the chamber can be calculated using the following equation:

$$d[C]/dt = QC_0/V + JA/V - QC/V \quad (1)$$

In which,

C : ammonia mass concentration in the chamber, mg m^{-3};
Q : flow rate of the carrier gas through the chamber, $m^3\ h^{-1}$;
C_0: ammonia concentration in the carrier gas stream, mg m^{-3};
V : volume of the chamber, m^3;
J : ammonia emission flux, mg $m^{-2}\ h^{-1}$;
A: chamber bottom surface area, m^2.

Since background ammonia was removed from the carrier gas, $C_0=0$. At steady state, d[C]/dt=0. Therefore, the ammonia emission flux J can be obtained from the following equation:

$$J = (Q/A)\ C_{g,\ chamber} \quad (2)$$

In which, $C_{g,\ chamber}$ is the ammonia concentration in the chamber at steady state.

The dynamic flow-through chamber was built to simulate the convective conditions in an actual broiler house. The ventilation rate and air velocity at the litter surface has been recognized as two important factors that affect ammonia emissions. Based on the ventilation rates reported by Lacey et al. (2003) and Guiziou & Beline (2005), the air residence time has been estimated in the range of 59 to 191 seconds for a tunnel-ventilated broiler house in Texas and in the range of 260 to 36000 seconds for a broiler house in France. The ventilation rates of the chamber (air flow rates through the chamber) in this reported preliminary study were set from 10.0 to 74.0L/min, which caused residence time of air in the chamber to be 40 to 300 seconds. Although the ventilation rates can vary widely in practice, Brewer and Costello (1999) reported that the mean air speed at a 25 cm height is 0.24 m/s with a standard deviation of 0.14 m/s in a typical broiler house. In a tunnel-ventilated broiler house, air velocity at the litter surface is believed to be higher, but no reported data has been found. In this reported study, a hotwire anemometer was placed at about 2.5 cm height above the litter surface in the chamber to measure air velocity profile in the chamber. It was found that, the RPM of the stirring impeller was the only significant factor that determines the air velocity at the litter surface when the ventilation rate (air flow rate) of chamber was less than or equal to 74 L/min. Therefore, in the chamber system, ventilation rate and air velocity at the litter surface can be set independently. At 110 RPM, the air velocity at the litter surface was measured in the range from 0.10 to 0.99 m/s at various distances from the center to the wall of the chamber. Understanding and control of NH3 at animal facilities depend on sampling/measurement techniques, including devices, instruments, and procedures. Accurate and reliable techniques provide high quality data that are essential to research as well as abatement of NH3 emissionsThe Place of experiment in University Farm, Cikabayan Field Unit, IPB Bogor and Analisys of ammonia in laboratory of Ergonomic and Electronic, Agriculture Engineering Science, Bogor Agricultural University. Control of ammonia is tested with tools controlled air impinger and temperature, humidity use Kestrel 3000.

Modeling Approach with Statistic

Say we have a set of data, (Xi,Yi), shown at the left. If we have reason to believe that there exists a linear relationship between the variables x and y, we can plot the data and draw a "best-fit" *straight line* through the data. Of course, this relationship is governed by the familiar equation $y = mx + b$. We can then find the slope, m, and y-intercept, b, for the data, which are shown in the figure below.

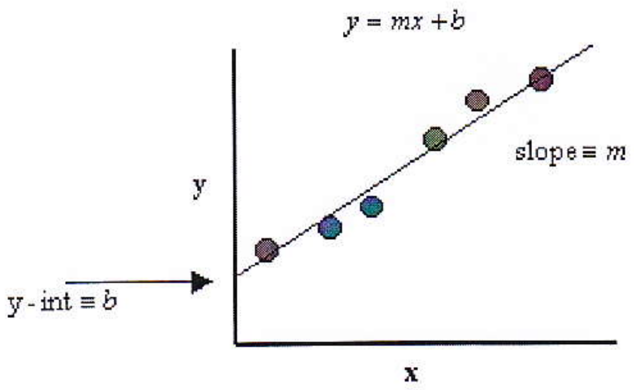


Figure 3.Linear regression of relationship between the variables x and y (Bloch .C.S, 2005)

Let's enter the above data into an Excel spread sheet, plot the data, create a trend line and display its slope, y-intercept and R-squared value. Recall that the R-squared value is the square of the correlation coefficient. (Most statistical texts show the correlation coefficient as "*r*", but Excel shows the coefficient as "*R*". Whether you write is as *r* or *R*, the correlation coefficient gives us a measure of the reliability of the linear relationship between the *x* and *y* values. (Values close to 1 indicate excellent linear reliability.))

If we expect a set of data to have a linear correlation, it is not necessary for us to plot the data in order to determine the constants m (slope) and b (y-intercept) of

the equation. Instead, we can apply a statistical treatment known as linear regression to the data and determine these constants. (Bloch .C.S 2005)
Given a set of data with *n* data points, the slope and y-intercept can be determined using the following:

$$m = \frac{n\sum(xy) - \sum x \sum y}{n\sum(x^2) - (\sum x)^2}$$ ....(3)

$$b = \frac{\sum y - m\sum x}{n}$$ ....(4)

(Note that the limits of the summation, which are *i* to *n*, and the summation indices on *x* and *y* have been omitted.) (Bloch .C.S 2005)

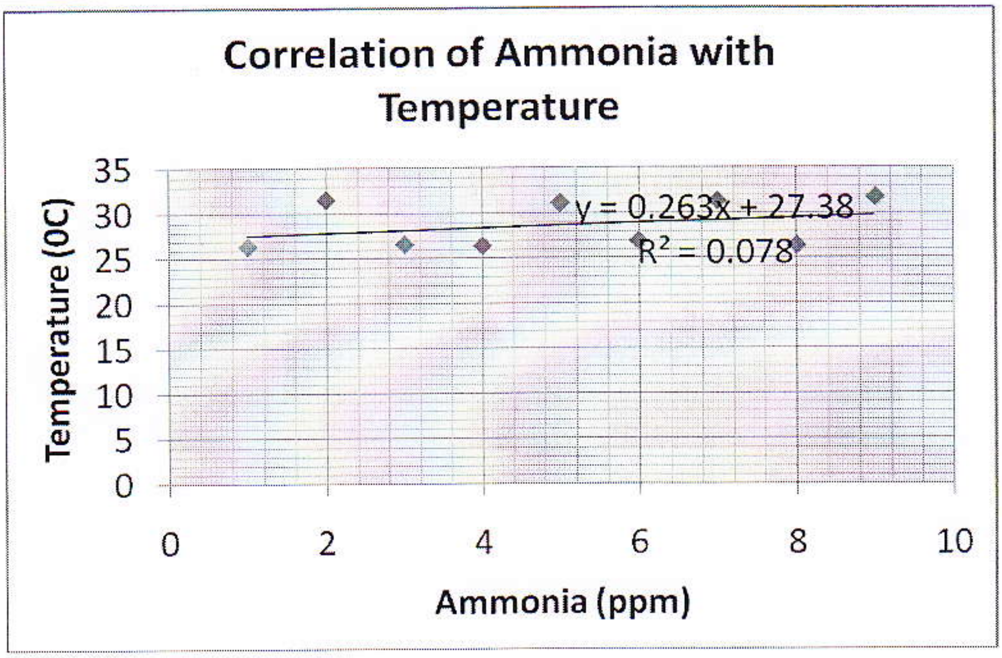
It is also possible to determine the correlation coefficient, *r*, which gives us a measure of the reliability of the linear relationship between the *x* and *y* values. A value of $r = 1$ indicates an exact linear relationship between *x* and *y*. Values of *r* close to 1 indicate excellent linear reliability. If the correlation coefficient is relatively far away from 1, the predictions based on the linear relationship,y=mx+b, will be less reliable.

Given a set of data (Xi,Yi) with *n* data points, the correlation coefficient, *r*, can be determined by

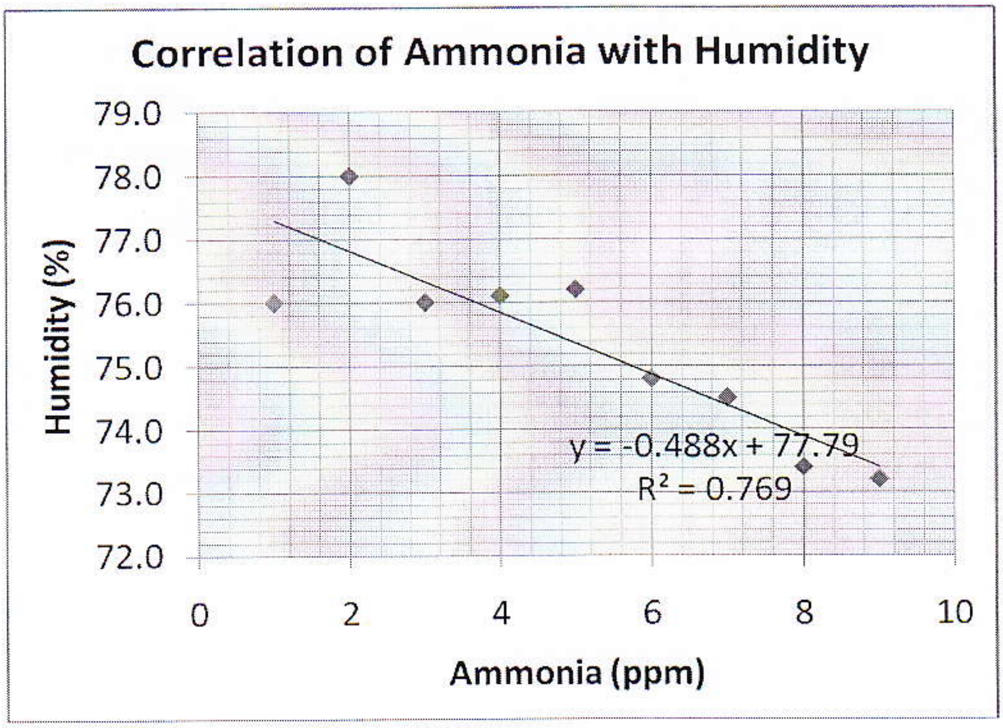
$$r = \frac{n\sum(xy) - \sum x \sum y}{\sqrt{\left[n\sum(x^2) - (\sum x)^2\right]\left[n\sum(y^2) - (\sum y)^2\right]}}$$ ....(5)

RESULTS AND DISCUSSION

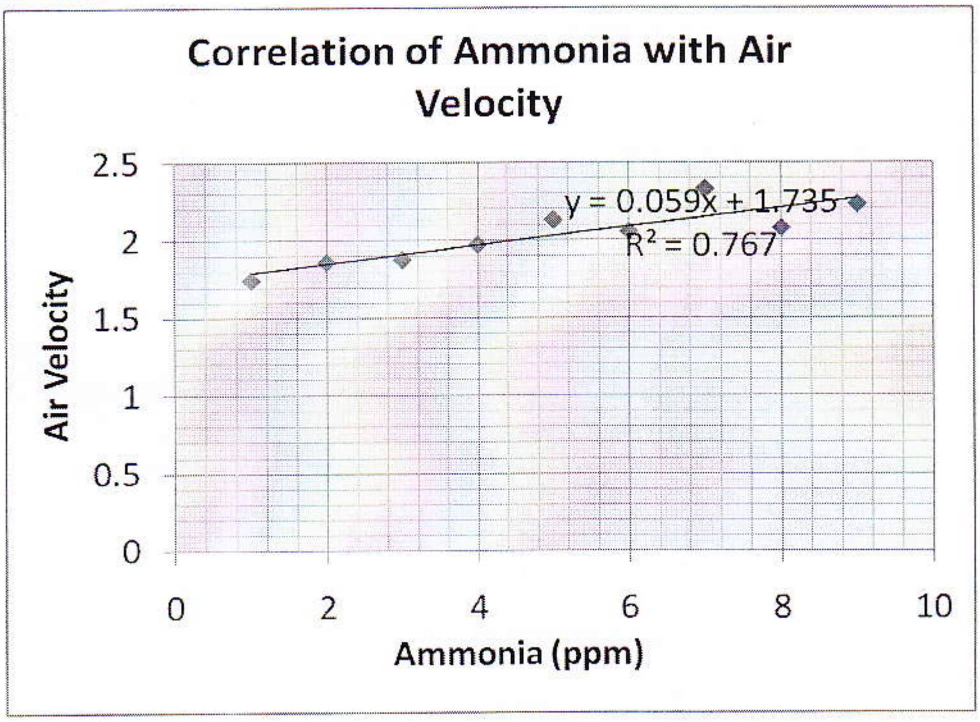
Examining of data taken from an experiment in which the circumferences and radii of several circular objects were measured. The data is displayed in the screen shot to the right. For more information on forThe R-squared value is actually the square of the correlation coefficient. The correlation coefficient, R, gives us a measure of the reliability of the linear relationship between the *x* and *y* values. A value of R = 1 indicates an exact linear relationship between *x* and *y*. Values of R close to 1 indicate excellent linear reliability. If the correlation coefficient is relatively far away from 1, the predictions based on the linear relationship, $y = mx + b$, will be less reliablematting the data and displaying the text see the previous tutorials.(Bloch. C. S., 2005)



Relation ammonia with temperature result of distance between dot perception 6m and 12 m correlation ceffficient R <1



Relation ammonia with humidity result of distance between dot perception 6m correlation ceffficient R still is small but 12 m to approach R=1



Relation ammonia with air velocity result of distance between dot perception 6m correlation ceffficient R still is small but 12 m to approach R=1

CONCULATION

Supervisory Control of Environmental Parameter Ammonia (NH3) of Closed House System Model For Broilers has been tested with tools controlled air impenger and temperature, humidity use Kestrel 3000. Result of ammonia control is amount 0.05-3.25 is influence by temperature, humidity and air velocity.

Result of ammonia supervisory control results for 0.6-9 ppm at temperatuture 25-32C^0, humidity 73-77.5 %, and Air Velocity 1.7-27m^3/h. The amount of NH3 is influenced by temperature, humidity and air velocity

RECOMMENDATIONS

This research in designing a supervisory environmental parameter ammonia control of closed house system model for broilers has been done and tested ammonia with statistic analysis in the next recommendation have to do research control of environmental parameter ammonia with analysis artificial Intelegence.

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