DETERMINATION OF AMMONIA (NH_3) CONCENTRATION IN ABU TURAB POULTRY FARM

BY

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2000/9500EA

A PROJECT REPORT SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELLOR OF ENGINEERING (B.Eng) DEGREE IN AGRICULTURAL ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, NIGERIA

November, 2006.

DECLARATION

I hereby declare that this project is a record of a research work that was undertaken and written by me. It has not been presented before for any degree, diploma or certificate at any University or Institution. Information derived from personal communication, published and unpublished works of others were duly referenced in the text.

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Ogunfunmilayo, Abiodun K. 15/11/2006
Date

CERTIFICATION

This Project entitled "Determination of Ammonia Concentration in Abu Turab Poultry Farm" by Ogunfunmilayo, Abiodun K. meets the regulations governing the award of Bachelor of Engineering (B.ENG) of the Federal University of Technology, Minna, and it is approved for its contribution to scientific knowledge and literary presentation.

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DEDICATION

To the glory of God Almighty, I dedicate this project to my dear parents, Engr and Mrs Joseph Ogunfunmilayo for their parental assistances.

ACKNOWLEDGEMENTS

At his own time He made everything beautiful. In spite of all the trouble, trial the Lord saw me through.

To the glory of my Lord God Almighty, I give thank to my Lord whom all blessing, strength, and grace flows for always been there for me. My thanks goes to my supervisor Engr. Dr. B. A. Alabadan for his kind support in all aspect of this project, the Lord bless you. Also to my H.O.D Engr. Dr.(Mrs) Z. Osunde, Prof E.S.A Ajisegiri, Dr. M.G Yisa, Dr. D. Adgidzi, Dr. O. Chukwu, Engr P Adeoye, Engr Solommon Dauda . I also thank my other lecturers who took it upon themselves to see that the best knowledge was impacted in me. Nevertheless, I must not forget the kind support of Engr. P. Ndoke, Civil Engineering department, Federal University of Technology, Minna .

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ABSTRACT

The study involves determination of NH_3 concentration emitted in a poultry farm of both broiler and laying houses using Abu Turab poultry Farm as a case study. The method used was colorimetric method using LP-1200 hand pump with glass gas detection tube which simply involve changing of colour of the solid reagent in the gas glass detector tube when air is been pulled inside the detector tube. Different gases were tested for but only NH_3 reagent tube changes colour, this shows that NH_3 is the only gas emitted from poultry house. From the results, NH_3 concentration in the laying house was found to be 50ppm while that in the broiler house was found to be 25ppm, this shows the NH_3 concentration in the laying house is greater than that of the broiler house due to some factors. Due to the consequences of ammonia to human health, there are limits for acceptable ammonia concentration. For example 25ppm for 8 hours working day and 50ppm for a maximum of 5 minutes exposure. It is therefore advisable to the poultry farmers to know the concentration of ammonia in the houses and to take proper preventive measures to reduce the health hazard effect.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 General Information

It is generally accepted that pollution prevention is better than cure and in the phrase that Rayston (1979) has popularised, that "pollution prevention pay". Rasystem gave many aneedstal example of this maxim and the European commission stated, "several shedies show that cost of preventing pollution and nuisances is less than the cost of repairing the damage caused and introducing antipollution measures.

Pollution is an inevitable consequence of most human activities. The commission of the European Committees has put is succinctly, "almost all human activities makes same impact on the natural environment. The problem of air pollution is as old as the first time man ever learnt that art of marking fire, downs the ages, this problem has steadily increased with the evolution of technology and more complex cultural systems.

Odours (odorants) and gases production which may affect the animals, the workers and people living nearly as well as the ecosystem. Ammonia contributes to large scale entroplication and acidification of ecosystems and may cause toxic injuries on the vegetation near the source (Fangmeier et al, 1994). Some years ago 99% of the ammonia emission in Western Europe was estimated to come from Agriculture (ECETOC, 1994). Odour emission is a major issue of Poultry production, which causes air pollution to the environment as well as for pig production and dairy operations.

Poultry keeping of livestock are domesticated animals kept under human control and they depend on him solely for protection, food and shelter. The main purpose of keeping livestock is to convert the energy in food into products, which can be utilised by man.

Regarding laying hens, floor-housing systems are being re-established in Sweden. Since animal welfare legislation stipulates that system for laying hens must include laying nests and perches and provide access to letter. Compared to traditional cage systems the air in floor housing systems may be more polluted since gases are emitted from large exposed surfaces of manure and litter. Measurements at commercial Swedish operations with low-density floor systems for laying legislated maximum of 25ppm (Swedish Natural Board of Occupation Safety and Health, 2000; Swedish Board of Agriculture, 2003). In a majority of 18 randomly selected houses and concentration up to 80ppm were measured (Von Wachenfelt et al, 2002). These concentrations are bed for the workers as well as for the animals and there is a need to reduce the levels.

Normally, poultry houses are kept some distance away from the cities or mostly in the rural area due to the emission of the odour and the pollution of the air with some unpleasant gases released into the air (Atmosphere).

1.2 Problem Statement

The recent growth in the Nigerian meat chicken industry has conceded with rising community interest in environmental issues. To ensure the environmental sustainability of the industry and individual farms, it is important to carefully manage environmental concerns.

Meat chicken processing plants have traditionally been located in large cities for economic reasons. The meat chicken farms that supply these plants have thus been located in rural residential areas on the outskirts of these cities for economic reasons related to transportation costs. Farms in many of these areas have suffered from urban encroachment by people looking for cheaper land and a rural lifestyle. Consequently, interference to community amenity (particularly through odour) is an important issue. Even with very well managed farms, odour will still be generated and many detected off site. This off site impact however, can be minimised with appropriate planning and management.

1.3 Objectives

The objectives of the study were to evaluate the concentration of ammonia emitted from poultry house.

1.4 Justification

The hypothesis of the study was that different ventilation and climate control strategies for poultry houses may result in differences in ammonia emission. Furthermore, correlation between the ammonia emitted from poultry houses.

1.5 Scope of the Work

The scope of this project work will be limited to only ammonia gas emitted from the poultry houses. Nevertheless, brief discussions on the principles of generation, control of the generation will also be included in the literature review.

In this project work, Minna was taken as a case study in which Abu Turab farm Chanchanga was taken as a point of reference since it is sited at the outskirt of the town.

Also included in this project are: Emission rate, effects of the emitted NH_3 to both poultry workers and the birds. All in this project was limited to pollutants like ammonia (NH_3) ad some other gases in the poultry houses (Broiler and Layers).

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Air Pollution

Air pollution may be defined as any atmospheric condition in which certain substances are present in such concentrations that they produce undesirable effects on man and his environment (Treshow and Anderson, 1991). Air pollution can be classified into Natural and Anthropogenic types.

Natural air pollution includes windblown dust, volcanic ash and gases, smoke and trace gases from forest fires while Anthropogenic air pollution includes products from combustion such as NO_x. CO_x, SO_x, etc.

2.2 Air Pollution Standards

Ideally, controls over individual sources of pollution should be set at level where the cost of increasing or decreasing control are both positive. However, while the concept of balancing the costs and benefits of pollution control and hence determining the type or degree of technological or other controls to be applied is very attractive (Ridkar, 1967).

Standards may relate either to air pollution concentration or to the emissions of wastes and may be determined rationally, regionally or locally (Wood, 1988). It is possible to classify the various types of standard as:

(I) Environmental quality standards

(ii) Source emission standards

(iii) Area emission standards

Environmental quality standards; refers to limits of ambient environmental quality that cannot be exceeded without infringing statutory

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law (wood 1988). It is apparent that if an area has pollution level higher than the environmental quality standards, then no new emission in that area should be permitted and strenuous action should be taken to reduce existing emissions (Brail, 1975).

Source emission standards: These refer to a numerical limit to the amount of a particular pollutant per ton of product, weight of emission per ton raw material, weight of emission per unit time, percentage removal of emission etc (Wood, 1988).

Area emission standards: Relate to the total emissions from a given area of land (i.e. a collection of sources) (Wood, 1988). One variant is emission density Zoning, in which maximum legal rate of emission of air a pollutant from any given area is limited by the size of the area (Roberts et al, 1975, Venezia, 1976).

Another variant is emission allocation in which a maximum legal emission rate is assigned to a large area (often the area controlled by a local jurisdiction) with provisions for sanctions, such as construction, to ensure the area's allocation is not exceeded (Wood, 1988).

2.3 Effects of Air pollution on Human health

Sulphur dioxide (SO_2) gives rise to irritative reactions, which cause pulmonary blood vessels (capillaries) to dilate and exude fluid. This leads to tissue fluid accumulation and swelling, (edema), bronchail spasms, and shortness of breath. In a chronic situation the gas contributes to and aggravates lung diseases like chronic bronchitis, pulmonary fibrosis via irritation leading to decreased pulmonary function and increasing stress on the heart.

Nitrogen dioxide (NO_2) at concentrations higher than acceptable level is responsible for respiratory tract edema due to cell membrane disruption. In chronic cases, it causes cell membrane damage and acid-induced irritation leading to or contributing to diminished pulmonary function and right-heart stress.

2.4 Effects of Air pollution on Plants and Animals

The air pollutants most responsible for plant damage are sulphur dioxide and acids derived from the oxides of both sulphur and nitrogen. Plants that are susceptible to these kinds of pollutants include vegetables, fruits and other kinds of agricultural crops, grasses, shrubs, tress, and commercial flowers. For example, sulphur dioxide at levels above permissible causes bleached spots on leaf. Nitrogen dioxide at a concentrations above optimal causes brown spots on leaf and suppression of growth in sunflower.

The effects of acid rain on wildlife can be far-reaching, if a population of one plant or animal is adversely affected by acid rain, animals that feed on that organism may also suffer.

2.5 Principles of Generations

Decomposing waste production such as manure, features, dust and bedding causes odours in intensive meat chicken buildings. This degradation takes place under two different conditions in terms of oxygen requirements: aerobic and anaerobic conditions. The breakdown of sulphide. The breakdown of nitrogen containing compounds produces ammonia, amines, indole and skatole. At the same time, some odours compounds such as volatile fatty acids, alcohols and aldehydes might also be produced through breakdown of other compounds. Aerobic biodegradation can be expected to break nitrogen containing compounds down into odorous compounds nitrogen. Anaerobic biodegradation can be expected to produce sulphide containing odours compounds that are perceived as odours at very low chemical concentrations (Jiang, 2000).

As biological degradation of organic material progress, odours compounds are produced in the liquid and solid phases. The volatilisation rate of these odours compounds is controlled by the concentration difference between liquid/solid and gas phases. Ventilation rate and temperature significantly influence the concentration in the gas phase. The higher the ventilation rates, the higher the volatilisation rates and vice-versa. Due to the high levels of odours compounds in the litter, the volatilisation process becomes a dominant factor in the generation of atmosphere odour emission (Jiang 2000).

The sources and factors affecting the odour generation from a meat chicken shed are summarised in Table 2.1

Table 2.1: Factors affecting Odour Generation in Meat Chicken Sheds

Process	Affecting Factors
Breath, flatus and faeces	Bird number and diet
Degradation of waste	Temperature, PH and Water content in the litter
Volatilisation of Odorous compound in the litter	Ventilation rate, climate, litter PH and temperature.

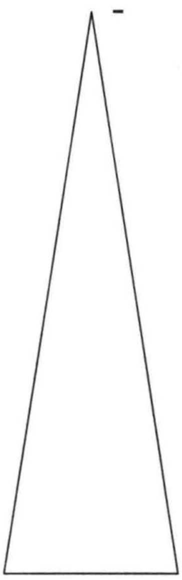
Moisture, in conjunction with high temperature, promotes bacterial growth, which will decomposes organic material producing ammonia in the process. Because ammonia production is so intimately linked to litter is responsible for a large number of health and density related welfare problems in poultry (Figure 2.1). For example, the occurrence of ascites, gastrointestinal irritation, and respiratory diseases has been correlated with high level of ammonia. At levels above 50ppm, increased levels of kerotoconfuntivities and tracheitis have been observed. These trachea and lung lesions render the birds more susceptible to bacterial infection such as E. coli.

Ammonia levels have also been associated with a high incidence of contact dermatitis: Foot, hock, and breast burns. If the foot lesions are serious, lameness and leg problems may result. Many of these pathologies can be quite painful and stressful for the birds, therefore control of ammonia welfare guidelines established by organisations and private comprises such as; The American Humane Association, The National Chicken Council. In addition to the Welfare consequences, ammonia levels above 50ppm have an important effect on growth rate and performance. Ammonia level rather than behaviour at high rearing densities.

The effects of ammonia are highly dependent on exposure time. It should therefore be noted that any effect demonstrated at rather high concentrations with longer exposure time.

Because of the consequences of ammonia for human health, many European countries have regulations regarding human exposure, which set the upper limits for acceptable ammonia concentration. For example, the limit in the UK is 25ppm, in Sweden and Germany the limit is 25 and 20 respectively, for an 8 hours working day. Sweden also has a second limit of 50ppm for a maximum of 5 minutes –exposure. High concentration of NH_3 inside the poultry houses also represent potential health hazard to Human and animals (Reece et al, 1988; Carr et al, 1990; Crook et al, 1991, Wheeler et al, 2000)

Ammonia Levels and Consequences



- 10ppm: Trachea irritation (in Turkeys)
- 20ppm: Increased rate of infection of Newcasttle disease vaccination.
- 25ppm: Impaired growth rate and feed version reduced final body weight
- 25ppm: 50ppm: Air sac inflammation
- 50ppm: Increased levels of keratoconjuctivities
- 100ppm: Increased chick mortality

Figure 2.1: Main known consequence of ammonia levels to poultry health.

2.6 Controlling of the generations.

Odour can be controlled via three broad categories

(i) at the source

(ii) between the source and the receiver

(iii) at the receiver

The most effective way of controlling odour is at the source. The control of odours can be achieved by managing the odour generating process (e.g. maintaining optimum litter moisture) or removing odour from air before it is released from the sheds.

Wind break walls help to disperse odour and provide a means for controlling odour and dust emission between the source and the receiver.

Controls at the receiver only warrant consideration where other approaches fail. Air conditioning for receptor houses is an example of a control approach. However, this may be expensive if there are many houses to treat. It also provides no co ntrol over odour outside the treated building(s). Controls at the receiver are rarely a viable odour reduction strategy.

Ammonia is generated by microbial activity on fecaluric acid when the litter is most, therefore any affecting litter moisture and manure production will also affect the rate of ammonia within the house (figure 2.2).

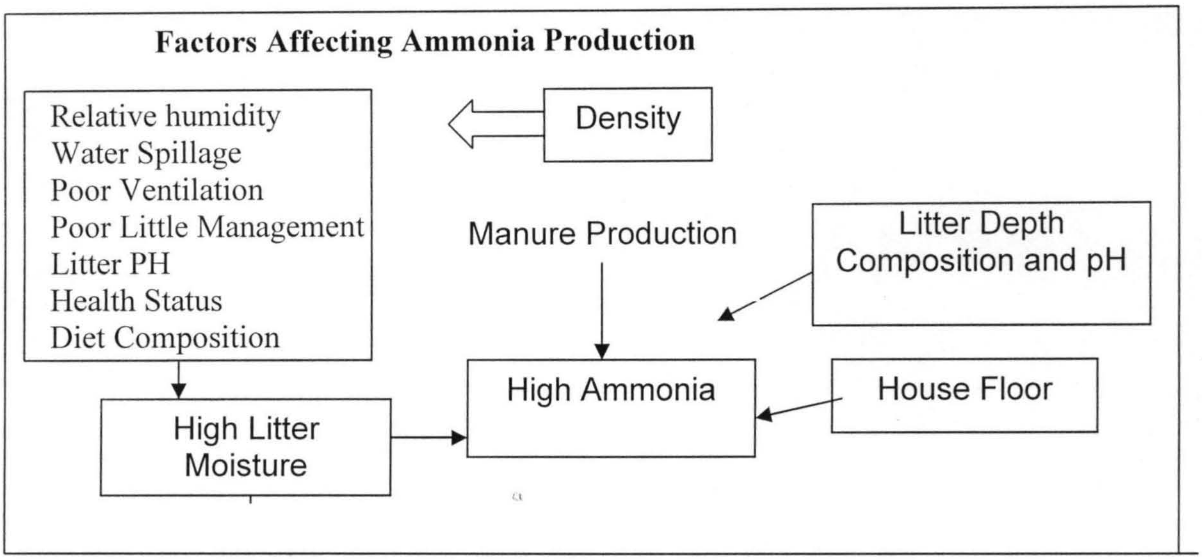


Figure 2.2: factors affecting ammonia production

Moisture: Water spillage will seriously affect litter moisture content, this is why the use of ripple drinkers is highly recommended. The majority of the chicken houses in the Delmark Pennisule are equipped with ripple drinkers.

Diet: Diet composition may also impact on ammonia production and bird health in several ways.

Health: Bird health status is another factor to consider. Outbreaks of diarrhea resulting from intestinal disorders may cause littler deterioration. The problem is more severe at high densities because the litter may easily become wet as a result of larger deposites of focal content, spilled water and in adequate ventilation.

An additional factor to consider is the capacity of the litter to absorb water. The higher the capacities of litter to retain water the lower the impact of density on litter quality. Litter management practise that maintains a low moisture level dramatically help to lower ammonia levels in the poultry house.

2.6.1 Good practise, Design and Management

The most effective way of minimising odour and ammonia impacts is by minimising the odour generated at the source. With meat chicken farms the predominant source is the litter in the sheds (houses/buildings). However, this can only be achieved by a combination of good practise, design and management and adequately managing the litter, providing optimum ventilation and controlling temperature.

Good practise, design and management should always be considered before other odour and gases control-strategies are implemented. These practices are generally part of normal meat chicken production as they are quite often implemented with the primary purpose of optimising production.

2.6.2 Managing Shed Litter

Odour, ammonia and other gases levels from meat chicken sheds/houses depends primarily on the moisture content of the shed/houses litter. The optimum shed/house litter moisture content is between 15 percent (15%) and 30 percent (30%) (Wet basis). Litter with this moisture content is relatively dry and friable.

When the litter is too dry it becomes dusty and can cause dust nuisances. Poor health and discomfort or health problems for farm workers. When litter becomes too wet it can begin to decompose aenerobically, producing increased odour, ammonia and other gases emissions. This can also lead to odour nuisance, poor bird health and possibly health problem for farm workers.

Very wet shed litter emits significantly more odour than dry litter. The key factor in controlling litter moisture is the minimization of spills from watering systems. Waters should be carefully adjusted for height and water depth. Reducing water spillage has a number of benefits including saving water, improving bird quality, improving the shed environment, reducing ammonia levels, reducing the time between litter cleanup.

Other shed maintenance factors that will help to maintain the optimum litter moisture content includes:

Promptly repairing leaks in shed walls and roofs

1 Insulating shed roofs to prevent condensation

2. Regularly inspecting and maintaining drinkers and foggers.

3 Providing adequate roof overhang and solewall height to prevent rainwater from entering the shed.

2.6.3 Providing adequate shed ventilation

Ventilation influences odour emission rates by affecting the rate and extent of drying of the litter. The flow pattern of the ventilation system and the temperature gradient between the shed and the outside air are the most important parameter influencing the drying process.

Ventilation removes excess heat, water vapour and odorous compound from the sheds. The concentration of odours compounds in the air depends on the degree of dilution of the odours substances with air in the shed or in the ventilation system. Maintaining the maximum possible airflow through the shed will assist in keeping the litter as dry as possible and promote aerobic condition. It will also dilute odours gases as they are released to the outside air. Shed ventilation is closely related to shed temperature. By providing appropriate ventilation, temperature can be regulated inside the shed, which assists the control of odour generation.

2.6.4 Controlling Shed Temperature and Humidity

Temperature has an important influence on the degradation of manure and the volatilisation of odours compounds in the litter. Roof insulation prevents large net heat gain from external radiation and assists the regulation of the temperature inside sheds. For sheds with inadequate roof insulation, the air beneath the shed roof may radiate heat into a meat chicken shed at significant rates during the hot part of the day.

Most chicken houses in warm to hot climates require good roof insulation. This can be achieved by 4mm Polyurethane foam board, spray on Polyurethane foam or blankets and pads. Reflective roof cladding or white paint can provide some benefit but are not considered as effective as under roof insulation as they can only reflect part of the sun's radiation.

There is a number of strategies that will assist in controlling shed temperature including:

1. Building sheds with a large overhang.
2. Minimising exposure of solar radiation by aligning the meat chicken shed along an east-west axis.
3. Reducing heat levels in open sheds using air movement with large diameter ventilators or using evaporative cooling in environmentally-controlled sheds as long as the relative humidity does not exceed 70 percent (70%) (Ketelaars, 1984 and DPI 1988).
4. Painting shed roofs white or insulating roofs to reduce the radiant heat incident on the birds.

5. Keeping ventilation openings free of obstructions

6. Shading ventilation openings.

7. Reducing stocking density in summer

2.7 Odour Reduction Technologies

Relationship between odour concentration and odour intensity suggest that over 90 percent (90%) reduction in concentration is needed for effective abatement of odour nuisance problem (Pain, 1993, Misselbrok et al, 1993). In other words, reduction even 50 percent (50%) in odour are unlikely to be significant in reducing the impact. An effective large reductions in the odours concentrations emitted from the chicken shed.

There are generally three mechanisms to reduce odour nuisance from a meat chicken shed.

(i) Biological: These controls either inhibit biological activity causing odours gases, or utilise biological interactions of eliminate the odours gases.

(ii) Chemical: These controls eliminate the odours gases through chemical reactions

(iii) Dispersion: These controls promote the dispersion of odorous gases to an extent where they are not regarded as offensive at sensitive receptions such as at a neighbour's property.

There are a number of systems that have the potential to reduce the community amenity impact of meat chicken sheds. These technologies include:

(i) Odour neutralising agents

(ii) Wind break walls

(iii) Air scriber

(iv) Biofilter

(v) Short Stacks

(vi) Active Oxygen

(vii) Ozone treatment

(viii) Incineration

Odour Neutralising Agent: Chemical agents are added to the litter and feed (depending on type of chemical agent) to reduce the moisture content of the waste and inhibit anaerobic microbial degradation.

Windbreak walls: Odour impact walls at the exhaust and of tunnel ventilated sheds. These walls can be made from plywood, shade cloth, straw bales or vegetative screening. If constructed of vegetative screens, windbreak walls can improve visual amenity.

Air scrubber: Air is passed through a film or mist of water to remove the odours compounds through Chemical absorption, or chemical/ biological reaction with an additive such as Sodium hypochlorite.

Biofilter: Air is passed through a damp porous medium such as plat, soil or wood chipping, which provides an environment where high numbers of odour reducing bacteria can live.

Short stacks: Odours compounds are released from low heights above the building height (approximately 5m). This aids the dispersion process prior to reaching sensitive receptors such as neighbours.

Active oxygen: Odorous compounds are oxidised by oxygen (O_2). Energy is provided to oxygen to increase the energy level of stable O_2 molecules and promote the oxidising potential of oxygen.

Ozone treatment: Odorous compounds are oxidised by ozone at room treatment.

Incineration: Odorous are oxidised at high temperature ($>600^0c$).

2.8 Equipment for Measuring Pollution

Various equipments are available for the measurement and detection of a wide variety of dangerous atmospheric contaminants and conditions oxygen deficiencies and toxic gases such as carbon-dioxide, hydrogen sulphide, ammonia and many and other commonly encountered atmospheric hazards.

2.8.1` Brief History of Equipment

Gas detection tubes were first developed at Harvard University in early 1900's for measuring Carbon-monoxide. Early tubes were designed mainly for confined space entry, such as in the mining industry, where carbon monoxide and hydrogen sulphide are the main toxic gases. Since then, a large number of tubes have been developed for a broad number of tubes have been developed for a broad range of chemicals. With the coming of OSHA regulations in the workplace in the 1970's, these compounds have expanded from mostly inorganic, acutely toxic compounds to include a large number of organic compounds whose health effect tends to be more long term.

A few important factors limited the accuracy of early tube/hand pump systems. First, the tubes had no pre-calibrated markings. Some tubes were read using a colour comparison chart, which depended on user's interpretation of the colour. Other tubes came with an external scale that was slid into position by the user. This introduced potential error in the position of the scale, but more importantly did not allow for variations in the length importantly did not allow for variations in the length of stains produced by different batches of the same tubes. Modern tubes avoid such errors by having calibrations performed on each batch, which are then marked directly on the tube.

A second error source was in the volume of air sampled. Early pumps were variations of rubber squeezed bulb that gave poor reproducibility in the amount of compression and were added to the bulbs to ensure a uniform compression and thus a fixed pumps and are familiar to many in the form of the dragger and MSA hand-pumps.

Air sampling can also be performed using piston pumps, which latch, into a precisely defined position to fix the volume. These pumps pull a strong vacuum initially and this create substantially higher flow rate than below pumps.

2.8.2 Types of Equipment for Measuring Air Pollutant Concentration

Given below is a list of equipments that can be used in detecting and measuring the amount of air pollutant in an air.

(i) LP-1200 hand pump and gas detection tubes.

The LP-1200 is a piston type hand pump that draws a fixed volume of gas, selectable at either 50ML or 100ML by rotating the handle. A tight vacuum seal is formed by a greased plunger gasket. The tapered rubber in let accommodate a range of tube diameters for different type of tubes. The inlet filter prevents glass pieces and dust from entering the shaft. An end of flow indicator in the handle turn white when the gas sampling is complete. A pump stroke counter is rotated to keep track of the number of stroke completed.

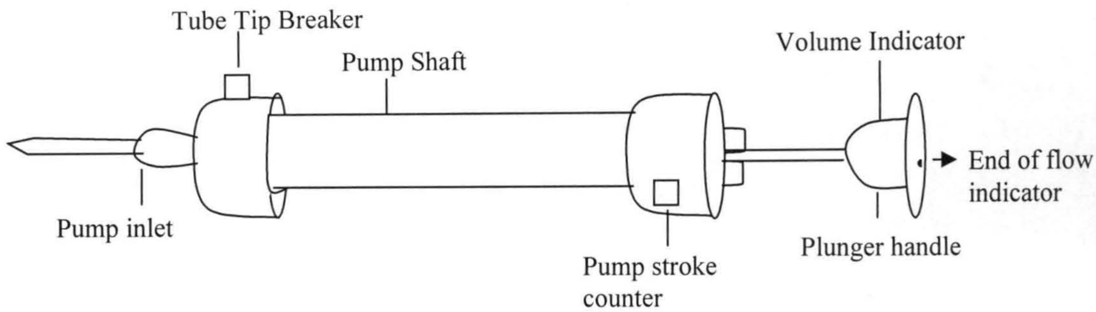


Fig. 2.3:LP - 1200 RAE Hand Pump

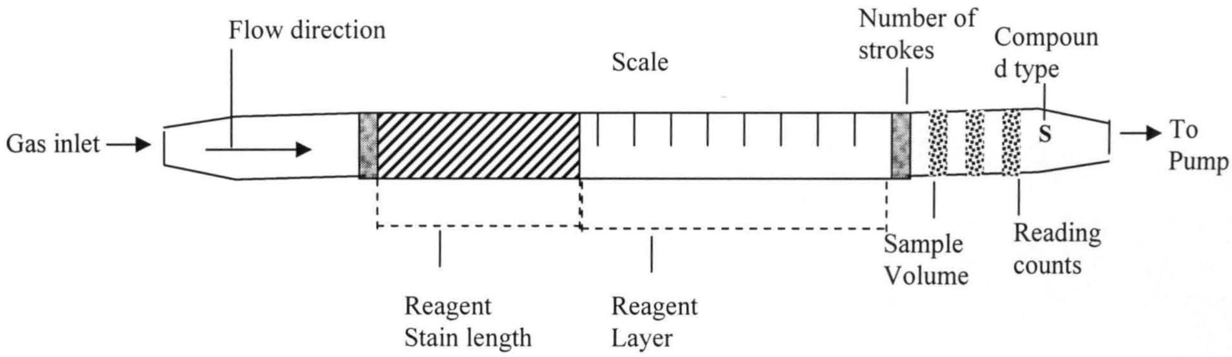


Fig. 2.4:Glass Gas DetectorTube

(ii) Toxi RAE Pid (PGM-30)

The toxi RAE PID is light (180g) and so compact that it confortably fits in a shirt pocket. Toxi RAE Pid features include a full range of 0-2,000ppm VOC, with resolution down to plus or minus 0.1ppm.

(iii) D RAE (PGM-6000)

This is a robust, pocket sized, personal 1 or 2 gas monitor for measuring combustible gases (percent LEL) plus a choice of O_2, CO or H_2S sensors for the measurement of these specific hazards.

(iv) Q RAE (PGM –50Q)

This is a high performance economical, compact, 4-gas monitor designed specifically for confirmed space entry. QRAE are equipped with sensors of for the defection of oxygen, percent LEL combustible gas, and carbon-monoxide and hydrogen sulphide.

(v) Multi RAE IR (PGM – 54)

This is an extremely flexible one to five-sensor instrument for use in door air quality, industrial hygiene, and other monitoring applications.

(vi) Sentry RAE (PGM-501)

This is a multi sensor area monitorable to include photo ionisation detector (PID) for parts per-million measurements of volatile organic compounds (V_oC_s) as well as LEL, O_2 and up to two electrochemical toxic sensors for measurement of specific substances such as CO and H_2S .

(vii) Area RAE (PGM – 5020)

Area RAE detectors are rugged, weather proof one to five sensor multi gas instrument that can run over 24 hours at a time: Sensors available for Area RAW detectors includes oxygen, H_2S, SO_2, NO, NO_2, Cl_2, HcN, NH_3, or PH_3.

(viii) CD RAE (PGM – 800)

This is a robust, low maintenance and sensitive portable gas monitor for VOCs with ionisation potentials (IP) up to 11.5ev.

2.9 Data Sheets of Various Pollutants Measured

Sulphur Dioxide SO_2

The temperature range for the tube measuring SO_2 is 0-40^{0}C (32-104^{0}F) and the relative humidity should be between 5 – 90% RH.

Colour change: Blue green – Yellow

Ammonia NH_3

The temperature range for the tube measuring NH_3 is 0 –40^{0}c (32-104^{o}F) and the relative humidity should be between 10-90% RH.

Colour change: Purple – Beige

Hydrogen Sulphide H_2S

The temperature range for the tube measuring H_2S is 0-40^{0}c and the relative humidity should be at 5% RH.

Colour change: Pale Orange – Pink

Nitrogen Oxide NO_2

The temperature range for the tube measuring NO_x is 0-40^{0}c. It should be noted that 100% RH reduces the response of the tube by about 20%.

Colour change: White – Yellow.

2.10 W.H.O Guidelines on Air Pollution

The new WHO Air quality guidelines help to protect public health, to eliminate or reduce to a minimum concentration of air pollutants both indoors and outdoors, to make risk management decision and to guide governments in setting standards and developing national and regionsla action plan.

The global annual death rate due to air pollution is estimated at more than 2.7 million, with 900,000 in the cities and 1.8 million in rural settings. Indoor air pollution from biomass full burning, particularly in rural households is extorting the largest death toll.

Pure air comprises oxygen (21%) and nitrogen (78%) and a number of rare gases of which argon is the most plentiful.

Table 2.2 WHO guide values (1999) for common pollutants

Pollutant	Amount of ambient air concentration ($\mu g/m^3$)	Guide line valve ($\mu g/m^3$)	Concentration at which effect on health start to be observed	Exposure time
CO	50-7000	100,000	Not applicable	15 Min.
		60,000		30 Min
		30,000		1 Hour
		10,000		8 Hours
Lead	0.01-2.0	0.5	Not applicable	1 Hour
NO_2	10-150	200	365-565	1 Hour
		40		1 Year
O_3	10- 100	120	Not applicable	8 Hours
SO_2	5- 400	500	1000	10 Min.
		125	250	24 Hours
		50	100	1 Year
NH_3	10-200	250	200-250	8hours

CHAPTER THREE

3.0 MATERIALS AND METHODS

The method adopted in the analysis of the air samples is a colorimetric method whereby a gas sample reaction between the gas and solid reagent forms a colour that is related to the concentration of the gas. The concentration is read from the length of the colour stain in the reagent. The glass tubes containing the reagent are known as gas detectors tubes and are fitted unto the sample pump.

3.1 Measurement Procedure

In carrying out the analysis, three person were required, one person handled the equipment another did the timing and the last person taken the reading of the reagent.

Procedures for taking measurement for each of the pollutant concentration were essentially the same, which is as follows:

i. The pump to be used was first tested for leaks by inserting unopened tube snugly into the inlet of aspirating pump. The plungers was pulled one stroke and after two minutes, the plunger dot was rotated away from the pump shaft alignment mark as it was observed that the plunger returned to within 3mm of its original position which indicated that there were no leaks.

ii Both ends of a new detection tube was broken using the tip breaker on the sides of pump and the tube was inserted until it stops and then back off for about 1mm before breaking. The latter procedure allows the top to fall into the tip reservoir at the end of the pump shaft.

iii In the case where a pre-tube was provided (e.g. NO_x 10-109-20), the pre-tube was connected to the measurement tube using a rubber connector in the direction indicated on the tube.

Iv The measurement tube was inserted securely into a rubber pump inlet with the tube arrow pointing towards the pump.

V The desired sample volume was selected and the red dot on the plunger was aligned with the red dot on the pump shaft. The handle was quickly until it latched at half or full stroke (50ml or 100ml). Immediately this was done, the person reading and timing starts counting and timing simultaneously until the sampling time required was reached i.e. when the end-of-flow indicator on the handle of the pump turned to its full brightness.

Vi The corresponding reading was taken by observing the length of stain or change of colouration on the precaliberated gas detection tube for each gas.

Vii For additional pump strokes, the handle was rotated ¼ turn clockwise or counter clockwise and pushed back fully without removing the tube from the pump. The step 5 was repeated again.

Vii Reading were taken at 10meters subsequences starting point (edge of the poultry house).

The gas pollutants tested for are as follows:

(a) Ammonia NH_3

(b) Hydrogen Sulphide H_2S

(c) Nitrogen oxide N_2O

(d) Sulphur dioxide SO_2

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

4.1 RESULTS

All reading taking at 1 metre (1 m) to the ground level at temperature of 32^{0}C.

Table 4.1 Reading for Ammonia (NH_3) In A Laying House

Sampling Distance (m)	Sampling Time (Min)	NH_3 Concentration (ppm)
10	11:15-11:18	50
20	11:19-11:22	46
30	11:23-11:26	42
40	11:27-11:30	37
50	11:31-11:34	34
60	11:35-11:38	32
70	11:39-11:42	29
80	11:43-11:46	26
90	11:47-11:50	24
100	11:51-11:54	20

Table 4.2 Reading for Ammonia (NH_3) In a Broiler House

Sampling Distance (m)	Sampling Time (Min)	NH_3 Concentration (ppm)
10	12:30-12:33	25
20	12:34-12:37	22
30	12:38-12:41	20
40	12:42-12:45	16
50	12:46-12:49	13
60	12:50-12:53	12
70	12:54 – 12:57	10
80	12:58 – 1:01	8
90	1:02 – 1: 05	7
100	1:06 – 1:09	5

4.2 Reading taken at a project colleague Farm (Maizube Farm), all procedure been equal with mine are as follows:

Table 4.3 Morning Reading of NH_3

Sampling Distance (m)	Sampling Time S(Min)	NH_3 Concentration (ppm)
10	10:25 – 10:25	20
20	10:29 – 10:32	18
30	10:33 – 10:36	17
40	10:37 – 10:40	14
50	10:41 – 10:44	12
60	10:45 – 10:48	10
70	10:49 – 10:52	9
80	10:53-10:56	8
90	10:57 – 11:00	6
100	11:01 – 11:04	5

Table 4.4 Evening Reading of NH_3

Sampling Distance (m)	Sampling Time (Min)	NH_3 Concentration (ppm)
10	4:00 – 4:03	16
20	4;04 – 4:07	14
30	4:08 – 4:11	13
40	4:12 – 4:15	12
50	4:16 – 4:19	10
60	4:20 - 4:23	8
70	4:24 – 4: 27	7
80	4:28 – 4:31	5
90	4:32- 4:35	3
100	4:36 – 4:39	2

No colour change was observed on the tube throughout the duration pf the analysis taken for sulphur-dioxide, Hydrogen Sulphate, and Nitrogen-oxide.

Table 4.5 Source Data Points For Broiler House

Private	Distance	Concentration
1	10	25
2	20	22
3	30	20
4	40	16
5	50	13
6	60	12
7	70	10
8	80	8
9	90	7
10	100	5

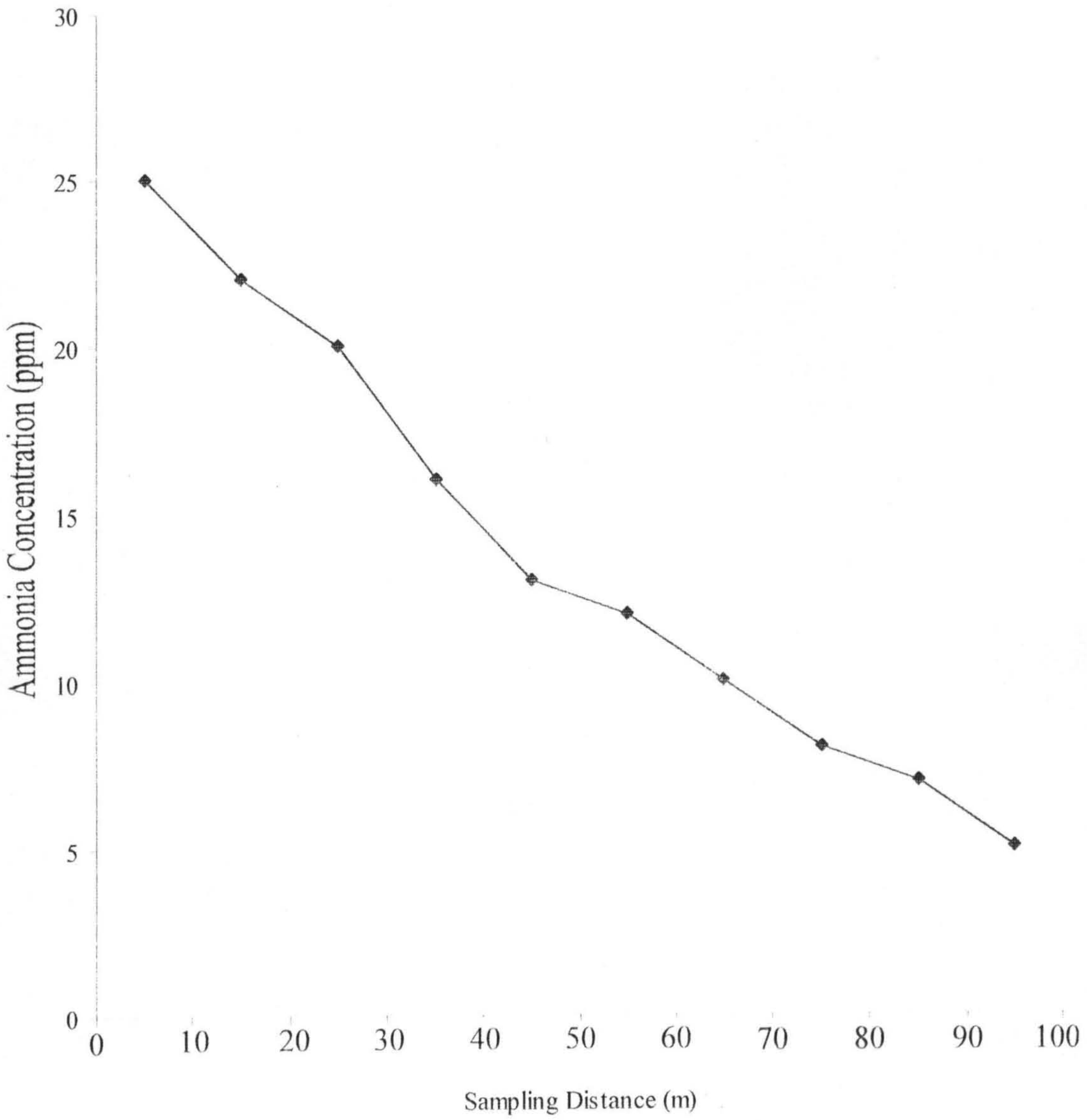


Fig 4.1: Graph of Ammonia Concentration against Sampling Distance In A Broiler House

Table 4.6 Source Data Points For A Laying House

Private	Distance	Concentration
1	10	50
2	20	46
3	30	42
4	40	37
5	50	34
6	60	32
7	70	29
8	80	26
9	90	24
10	100	20

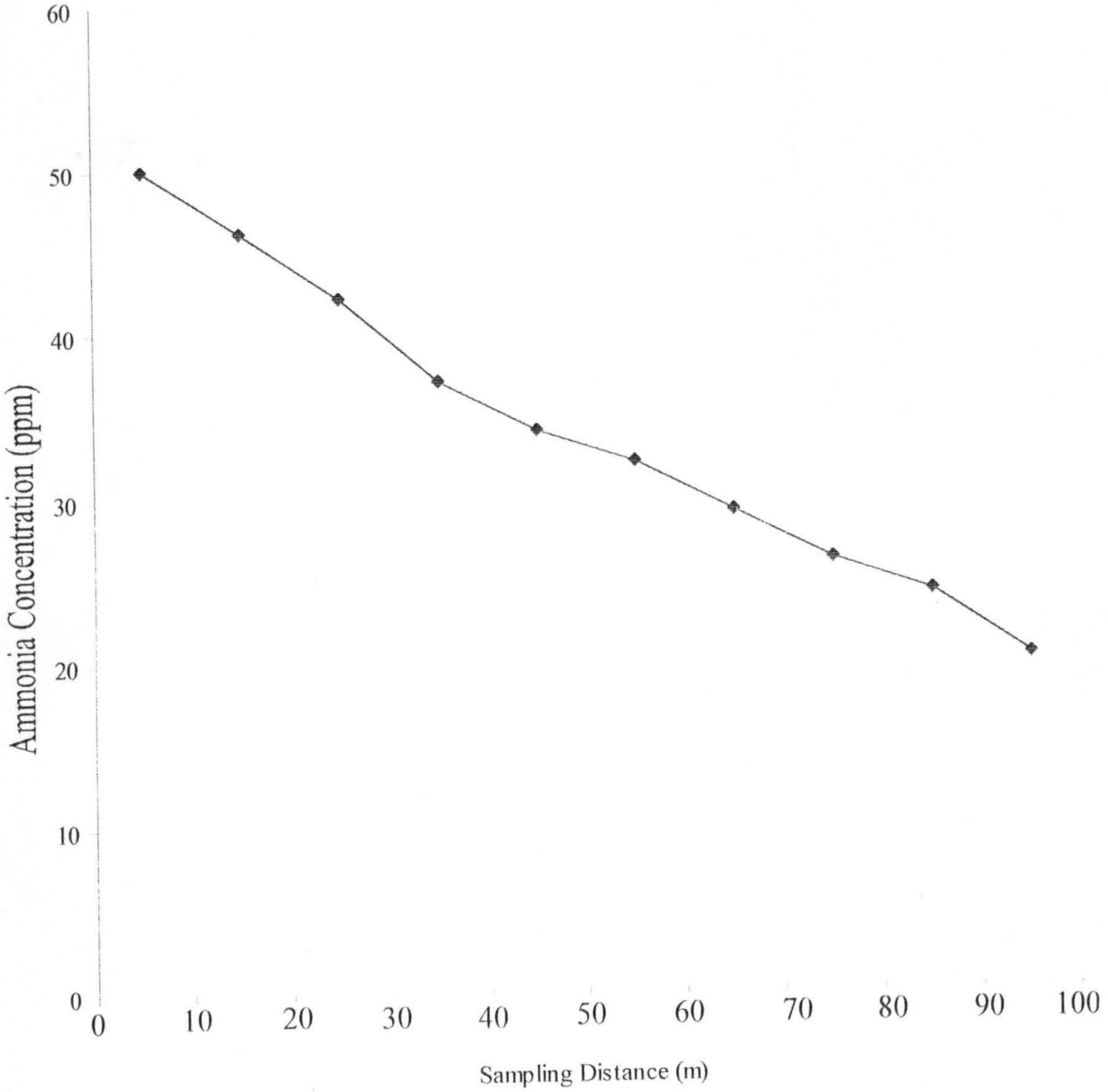


Fig 4.2: Graph of Ammonia Concentration against Sampling Distance In A Laying House

4.4 Discussion of Result

The results obtained from the analysis reveals that there were no readings for pollutants like NO_2, SO_2, H_2S, this indicates that these pollutants are not emitted from poultry houses.

Poultry houses emitted mostly NH_3 gas in different rate due to the method(s) admitted by the poultry management in the handling and controlling of odour emitted from the source. Due to the consequences of ammonia for both human and animal health, many European Countries have regulation regarding human exposure. In the case, the higher the ammonia concentration, the lower the exposures time. Example are : For 8 hours working period, the ammonia concentration most not exceed 25ppm with adequate protective measure taken by the workers and for ammonia concentration between 25ppm – 50ppm , exposure time most not exceed 5 minutes.

Regarding laying hens house reading, it was observed that ammonia concentration was high, exceeding the legislated maximum of 25ppm (Swedish National Board of Agriculture, 2003). Higher concentration of NH_3 inside the poultry houses also represent potential health hazard to Human and animals.

Reason for high ammonia concentration in laying house was due to the congestion of the laying hens in the house and the moisture content of the litter.

The graph obtained for NH_3 in a laying house was linear and the corresponding mathematical model was determined for each of the sampling distances where measurements were taken by the use of polymath linear regression and also for graph obtained for NH_3 in a Broiler house was linear.

There were slight disparities in the actual valves gotten from the models, these disparity can be attributed to a variety of factors like errors from inaccurate interpretation of colour change to errors due to the sampling time.

It was also observed from the results gotten that the concentration of NH_3 was inversely proportional to the sampling distance from the starting point.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In accordance to the data obtained and analysed from poultry house in Abu Turab farm, Minna, it can be concluded that the classes of pollutant that is majorly contributed by Agriculture (Poultry Farm) result to be NH_3 only. Graphs were obtained for the gas emitted from each poultry house (Laying and Broiler houses) and their corresponding mathematical models were also developed by polymath report. Control of the climatic factors will help in the reduction of the ammonia generated.

5.2 Recommendations

In order to reduce further increase in the levels of pollution in the metropolis and also the outskirts of the town, proper measures must be taken, measures in the following ways:

1. There should be preventive measures to reduce the exposure of the poultry workers to the gas emitted. Measures like the use of noise covering hand glove e.t.c.
2. There should be proper handling of the litter generated from the meat chicken house because prevention is better than cure.
3. Also the poultry house structure have to be properly constructed.
4. There should be proper and adequate management practice.

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