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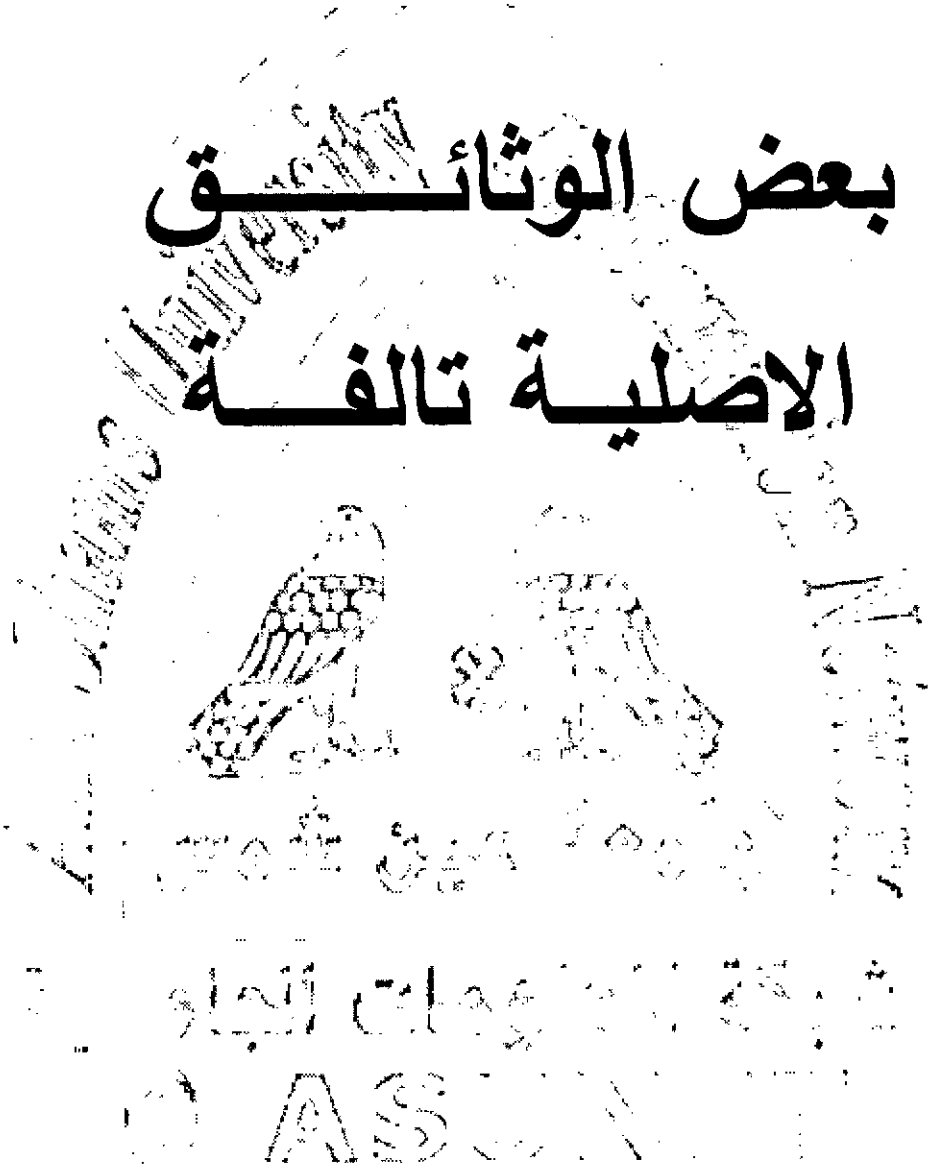

ENGINEERING AND ENVIRONMENTAL STUDIES ON AMMONIA EMITTED FROM POULTRY HOUSES

By

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In the name of God, Most Gracious, Most Merciful

"O my Lord! so order me that I may be grateful for Thy favours, which thou hast bestowed on me and on my parents, and that I may work the righteousness that will please Thee: And admit me, by Thy Grace, to the ranks of Thy righteous Servants."

An Naml (The Ants): (19).

To
My Beloved Mother
&
My Lovely Wife

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ABSTRACT

The main purpose of this research work is to investigate, study and analyze aerial ammonia volatilization inside poultry houses and ammonia emission outside houses escape to the surrounding environment. Furthermore, studying the potential of using relatively new air pollution control technology, (biofiltration system), as one of biological treatment techniques that are used for the amelioration of odorous gases compounds emitted from poultry houses (concentrating on ammonia gas).

In present work, poultry houses field data were collected and measured for two commercial laying hens breeds, ***COBB^{TM}500*** and ***ROSS^{TM}308***, at two different ages (41 and 26 weeks) throughout four periods of continuous three days. Ammonia concentrations verses different environmental factors such as temperature, relative humidity and air velocity was measured. Ammonia volatilized inside the house and emitted or escapes to the outside environment from the house and comparison of ammonia emission rates between different breeds and ages were performed also. Field results showed that ammonia concentrations and ammonia emission rates vary with location, the size and type of poultry housing, temperature, relative humidity, air velocity, time of day, and bird ages. So as to study the potential of using biofilter for reduction of ammonia emitted from poultry houses, two directions were staged. Nitrification process, firstly, was performed by soil perfusion method. Nitrification is the biological process in which ammonium (NH_4^+) is converted to nitrate (NO_3^-), with nitrite (NO_2^-) being an intermediate step in the oxidation process. Nitrification experiment results had identical tendency at the first periods of experiments, hence the results showed disagreement with the process natural behavior curve. This was referring to increasing loading rate (inlet concentration) and presence of organic material (compost) in the soil column. Organic material contained many types of microorganisms and increasing loading rate that reflected in the rising of competition for space and oxygen among heterotrophic organisms and autotrophic one (*Nitrosomonas* and *Nitrobacter,* that are primarily responsible for ammonia conversion) and affected the efficiency of the process to complete the two-step bacterial conversion of ammonia to nitrate.

Secondly, ammonia concentration gradient along the biofilter medium height is studied and modeled by using proposed mathematical model describing ammonia concentration gradient and biomass film along the biofilter column length. Recent model differed from earlier models in some aspects and was similar to them in the others. The flow through the biofilter has been modeled as a one-dimensional flow and it has been done through an ideal plug flow reactor (PFR) concept. The differential equation including the terms of diffusion, convection and kinetic reaction are developed also, finite element method is used to obtain the solutions of theses differential equations. Replacing its proposed parameters by that published in the previous literatures to recent model carries out the validation of proposed model. Direct agreement between proposed model and previous models could be easily noticed in the time that un-complete agreement with another different models is clearly illustrated. Disagreement with recent model referred different gases; different assumption, concepts and approaches used in previously research works.

M. Hatem

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TABLE OF CONTENTS

IST OF TABLES..... ix

IST OF FIGURES..... xii

IST OF ABBREVIATIONS AND SYMBOLS..... xx

CKNOWLEDGEMENT..... xxvii

BSTRACT..... xxviii

ONTRIBUTION TO KNOWELAGE..... xxix

INTRODUCTION..... 1

OBJECTIVES..... 11

SCOPE..... 12

LITERATURE REVIEW..... 14

4.1 Air Pollution..... 14

4.2 Odor..... 15

4.3 Main Source Of Odor Compounds Emission..... 18

4.3.1 Building and Holding Facilities..... 18

4.3.2 Manure Storage and Treatment Systems..... 18

4.3.3 Land Application of Manure..... 19

4.3.4 Carcass Disposal..... 20

4.4 Gaseous Compound Produced From Manure Animal Buildings..... 21

4.4.1 Methane (CH_4)..... 21

4.4.2 Carbon Dioxide (CO_2)..... 23

4.4.3 Ammonia (NH_3)..... 24

4.4.4 Hydrogen Sulfide (H_2S)..... 30

4.4.5 Carbon Monoxide (CO)..... 32

4.4.6 Nitrogen Oxides (NO_x)..... 33

4.5 Poultry Waste Management..... 34

4.6 Poultry Waste Characteristics..... 37

4.6.1 Physical Characteristics..... 38

4.6.2 Thermal Characteristics..... 42

4.6.3 Chemical Characteristics..... 42

4.6.4 Microbiological Characteristics..... 45

4.6.5 Biological Characteristics..... 45

4.7 The Nitrogen Cycle..... 47

4.8 Factors Affecting Ammonia Emission..... 57

4.8.1 Indoor Air Temperature..... 57

4.8.2 Indoor Relative Humidity..... 59

4.8.3 Moisture Content of Litter..... 60

4.8.4 Acidity (pH)..... 61

4.8.5 Ventilation System..... 62

4.8.6 Keeping System and Stock Density..... 65

4.8.7 Nutrient and Animal Age..... 66

4.8.8 Waste Characteristics and Management..... 68

4.8.9 Season of Year and Time of Day..... 70

4.8.10 Microbial Activity..... 71

4.9 Odor from Livestock and Poultry Facilities..... 72

4.9.1 Odor Characteristics..... 72

4.9.2 Odor Emission From Livestock Building..... 76

4.10 Ammonia Measuring Technique..... 77

4.10.1 Air Sampling Methods..... 77

4.10.1.1 Nessler reagent method..... 78

4.10.1.2 Indophenol method..... 79

4.10.1.3 Nitrite method..... 80

4.10.1.4 UV spectrophotometry method..... 80

4.10.1.5 One-step method for ammonia..... 83

4.10.2 Direct Measurements..... 83
4.10.2.1 Olfactory methods..... 83
4.10.2.2 Chemical methods..... 86
4.10.2.3 Instrument methods..... 89
4.10.3 Closed Chamber System..... 91
4.11 Ammonia Reduction Technology..... 92
4.11.1 Flushing..... 92
4.11.2 Aeration..... 93
4.11.3 Acidification..... 97
4.11.4 Quick Removal of Urine Faeces..... 100
4.11.5 Using Covering and Bedding Materials..... 101
4.11.6 Using Chemical Amendments..... 103
4.11.7 Using Feed/Drinking Water Additives..... 104
4.11.8 Using Deferent Floor Types..... 105
4.12 Biofiltration..... 106
4.12.1 Historical Background..... 106
4.12.2 Theory of Biofilter..... 109
4.12.3 Types of Biofilters..... 114
4.12.3.1 Air purification biofilters..... 114
4.12.3.1.1 Open soil bed biofilters..... 115
4.12.3.1.2 Open single-bed biofilters..... 117
4.12.3.1.3 Engineered multiple open-bed biofilters..... 122
4.12.3.2 Wastewater treatment biofilters..... 126
4.12.3.2.1 Submerged biofilters..... 126
4.12.3.2.2 Trickling biofilters..... 129
4.12.3.2.3 Rotating biological contactors (RBCs)..... 132

4.12.3.2.4 Pressurized-bead biofilters..... 134

4.12.3.2.5 Fluidized-bed biofilters..... 136

4.12.3.2.6 Mixed bed reactors..... 141

4.12.4 Designing Parameters of Biofilters..... 143

4.12.4.1 Sizing of biofilter..... 143

4.12.4.1.1 Volume of packing material and contact time..... 143

4.12.4.1.2 Biofilter media..... 146

4.12.4.1.2.1 Type of biofilter media..... 146

4.12.4.1.2.2 Selecting of biofilter medium..... 152

4.12.4.2 Engineering the physical biofilter system..... 157

4.12.4.2.1 Ducting and mechanical air handling systems..... 157

4.12.4.2.2 Air pretreatment systems..... 159

4.12.4.2.3 The biofilter reactor vessel and internal components..... 164

4.12.4.2.4 Process control systems..... 165

4.12.5 Controlling and Operating Parameters of Biofilters..... 168

4.12.5.1 Retention time..... 168

4.12.5.2 Moisture content..... 171

4.12.5.3 Temperature..... 173

4.12.5.4 pH and alkalinity..... 174

4.12.5.5 Pressure drop..... 176

4.12.5.6 Nutrients..... 179

4.12.5.7 Inlet concentration..... 181

4.12.6 Removal Efficiency and Elimination Capacity..... 183

4.12.7 Installation, Maintenance and Operating Costs..... 188

4.12.8 Biofilter microbiology..... 193

4.12.8.1 Microbial populations in biofilters..... 196

4.12.8.2 Nitrifying bacteria 197

4.12.8.3 Microbial growth..... 201

4.12.8.4 Microbial decay..... 211

4.12.8.5 Carrying capacity..... 211

4.12.8.6 Biomass clogging..... 212

4.12.9 Biofilter theoretical models..... 214

4.12.9.1 Biofilter earlier models..... 214

4.12.9.2 Lumped models..... 219

4.12.9.3 Uniform biofilm models..... 220

4.12.9.4 Tow phase equilibrium models..... 223

4.12.9.5 Two phase biological kinetics models..... 229

MATHEMATICAL MODEL DEVELOPMENT 233

5.1 Plug Flow Rector..... 234

5.2 Mass Balance Over The Gas Phase..... 234

5.3 Mass Balance Over The Biofilm 241

5.4 Reaction Kinetics 244

5.4.1 Ammonia oxidizer (Nitrosomonas) (Russel et al., 1998)..... 245

5.4.2 Nitrite oxidizer (Nitrobacter) (Russel et al., 1998)..... 246

5.5 Relation Between Inlet and Outlet Gas Phase Concentrations 249

5.6 Biofilter Design Parameters..... 250

5.6.1 Empty bed residence time (EBRT)..... 250

5.6.2 Surface and volumetric loading rates..... 251

5.6.3 The mass loading rate (surface or volumetric) 252