

SUPERVISOR DECLARATION

“I hereby declare that I have read this thesis and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Thermal – Fluids)”

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METHANE PRODUCTION FROM CO DIGESTION OF CHICKEN MANURE WITH
AGRICULTURAL WASTE

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This thesis submitted in fulfillment of the requirements for the award of the degree
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DECLARATION

“I hereby declare that the work in this report is my own expect for summaries and quotations which have been duly acknowledged.”

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Special for

‘Cinta Hati’

MOHD NASIR BIN HAMZAH

ZAINUN BINTI IDRIS

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ABSTRACT

Poultry industry is the industries that bring profitable to the company. Due to increasing demand of chicken in Malaysia every year because the poultry meat is one of the Halal meat that easier to find. The increasing demand of chicken has increase the production of chicken in Malaysia. Hence, the production of chicken will bring impact to the environmental and human. The chicken manure causes of air pollution and water pollution. Methane gas that produces from chicken manure can be treated to produce biogas that can generate electricity. Thus, it can reduce the problem the pile of the chicken manure that had been wasted. The chicken manure and cabbage as the agricultural waste had been used as the main component. The mixing of the chicken manure and the cabbage will produce energy under process anaerobic digestion. The experiment was conducted through the different mixing ratio of the chicken manure and cabbage. The data was analyzed the by the Gas Chromatography instrument that appeared in form Area% that kwon as the methane efficiency as the result. Sample 5 which is the ratio CM: C, 100: 0 there was 500g of chicken manure only show the highest methane efficiency which is 1.9990% while 500g of the cabbage only was showed no sign of the methane gas exists. From the result, it can concluded the cabbage cannot act as catalysts for the chicken manure.

ABSTRAK

Industri ternakan merupakan industri yang boleh membawa keuntungan yang banyak kepada syarikat. Hal ini kerana permintaan ayam di Malaysia saban tahun semakin meningkat kerana daging ayam merupakan salah satu daging halal yang mudah didapati. Peningkatan permintaan ayam secara tidak langsung telah meningkatkan produksi ayam di Malaysia. Namun begitu, produksi ayam yang banyak telah membawa impak kepada alam sekeliling dan juga kepada manusia. Tahi ayam yang dihasilkan boleh membawa punca kepada pencemaran udara dan air. Untuk menangani masalah itu, tahi ayam telah menghasilkan gas metana yang boleh dirawat untuk dijadikan sebagai biogas yang boleh menjana elektrik. Justeru dapat mengurangkan masalah longgokan tahi ayam yang terbiar. Tahi ayam dan kubis sebagai sisa pertanian digunakan sebagai komponen utama. Campuran tahi ayam dan kubis boleh menghasilkan tenaga melalui proses pencernaan anaerobic. Kajian telah dijalankan melalui pelbagai campuran nisbah tahi ayam dan kubis. Data di analiskan melalui alat Gas Chromatography yang mengeluarkan keputusan dalam bentuk Area % yang dikenali sebagai kecekapan gas metana. Sampel 5 iaitu bernisbah CM : C , 100:0 dimana 500g tahi ayam sahaja menunjukkan paling tinggi kecekapan gas metana iaitu 1.990% manakala 500g kubis sahaja tidak menunjukkan sebarang kewujudan gas metana. Daripada keputusan, kesimpulan yang dapat dibuat bahawa kubis tidak boleh dijadikan sebagai pemangkin kepada tahi ayam.

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LIST OF SYMBOLS

%	Percentage
kg	kilogram
m³	metre per cube
°C	Degree Celsius
MWh	megawatt hour
ml	millilitre
min	Minute

LIST OF ABBREVIATION

GC	Gas Chromatography
SK	Sekolah Kebangsaan
KFC	Kentucky Fried Chicken
TS	Total Solids
VS	Volatile Solids
Na	Not Available
H₂O	Water
CH₄	Methane
CO₂	Carbon Dioxide
NH₃	Ammonia
H₂S	Hydrogen Sulphide
C₆H₁₂O₆	Glucose
CH₃COOH	Acetic acid
H₂	Hydrogen
CH₃CH₂OH	Ethyl alcohol
CH₃CH₂COOH	Propionic Acid
VFAs	Volatile Fatty Acids

CH₃CH₂CH₂COOH	Butyric acid
CH₃(CHCH₃)COOH	Carboxyl acid
CH₃CH₃OH	Ethanol
CH₃OH	Methanol
HRT	Hydraulic Retention Time
APHA	American Public Health Association
TN	Total Nitrogen
CM	Chicken Manure
C	Cabbage

CHAPTER I

INTRODUCTION

1.0 BACKGROUND

Year by year, the demand of the poultry has arisen. According to the report issued by Malaysia's Department of Veterinary Services, over the 2005 – 2013 periods, the local consumption of chicken livestock has increased from 980.05 metric tons to 1415.75 metric tons. Compare to other livestock consumption, the poultry shows the highest rate in the world. One of the causes the high rate consumption in the poultry demand is the rapid growth of the population chicken. The domestication of poultry took place several thousand years ago. The term poultry itself defined as domestic fowls where the domestic fowls including the chicken turkeys, ducks, geese, and capons (Rahman, 2009).

The high demand of poultry in Malaysia because it is most popular and cheapest source meat protein. Besides, it also the halal product to the Malay Muslim which are the majority population of Malaysian while for the beef and pork, it is non homogeneous to all regions and ethnic all around the world (Paragus, 2006). For

example, in Malaysia, Hindu has religious restrictions for the beef and for the pork; it is religious restrictions for Malay Muslim. Other than that, the poultry meat shows the best profitable in the industrialized production system (Teyand and Yeong-Sheng, 2009).

The energy that produces from livestock manure has potential amount of biogas that manure will produce. 80 % of the world's energy consumption still originates from combusting fossil fuels (Goldemberg and Johnson, 2004). Even though it not the fast population as global warming and climate change, it can be seen as of the key options to bio energy production from the biomass but we must know there are also another material that can be added in organic matter to produce more biogas from digester. The agricultural waste and livestock manure is used together to increase the rate of biogas production because of the greater balance between carbon and nitrogen and improves anaerobic digestion efficiency. Agricultural sector may play a significant role by producing renewable resources. Agricultural waste as major component of renewable energy is suitable for improving energy security and decreasing environmental disruption caused by carbon emissions (Field et. al. 2008; Yang et. al. 2008).

The rapid economic and population of growth of chicken meat may lead the increasing of chicken industrialized production. Due to the rapid development of chicken demand in Malaysia, may lead the increasing of the chicken manure that has potential to create the problem to the human and animal health (Fan et.al. 2000). It will lead to the pile of chicken manure that was wasted and spread of disease to the human. However if it treated properly it will become beneficial commodity.

As we know the methane gas will produce the energy that can generate the electricity capacity. Reported by Charles et.al. (1993) show that 535 hogs are required to heat up a 1500 square foot home while 800 hog need to heat up water heating, cooking range and refrigeration demand of a typical home. The methane may be feasible to fulfilling the energy demand of the household. However the storing off-season (summer) gas until winter probably is not feasible because storage application of methane would likely involve only short term accumulation of methane.

1.1 PROBLEM STATEMENT

The increasing of large livestock demand in develops and developing countries present major worldwide environmental problem (Güngör-Demirci, et al. 2004). In Utusan dated 30 June 2008, the residents from six villages which are Kampung Parit Lapis Batu Putih, Padang Sari, Asam Kumbang, Parit Bengkok, Parit Awang, Parit Haji Rasul and Sekolah Kebangsaan (SK) Padang Sari have complaints about the unpleasant flies that disturbed the nearby community about 15 years. This problem may be the pile of the chicken manure that not organized perfectly. The problem needs to overcome quickly and it will be no issues to the future as developing country.

The research is conducted to treat the chicken manure. Over the years, the demand of chicken is increasing. Thus the increase of demand chicken will increase the chicken manure. Therefore, the methane gas that produce from an anaerobic digestion and co digestion of chicken manure with agricultural waste will be used as electric generator. Determination of the methane gas from the chicken manure and the cabbage was important to specify the best ratio that can produced more methane gas for the biogas.

1.2 RESEARCH OBJECTIVES

The objective of this research is to determine the methane producing efficiency of anaerobic digestion where the co digestion is chicken manure. The research will conduct by influenced of different chicken manure with agricultural wastes mixing ratios.

1.3 RESEARCH SCOPE

In order to achieve this objective, the following scopes have been identified to limit the scope of study;

- a. To finding the best ratio of chicken manure and agricultural waste to produce methane more efficiency by anaerobic co digestion
- b. To analyse the result of producing methane accordingly by Gas Chromatography (GC).

1.4 RATIONAL AND SIGNIFICANT RESEARCH

The significant of conducting this research is to enhance the production rate of methane gas by using mixture of chicken manure and agricultural waste. As a result, the methane gas as the biogas can be used as the electric generator and environmental problem can be solved from unpleasant flies due to the pile of the chicken manure that can spread the disease to the human. Besides, this project was fulfill the demand of chicken manure the problem was like cannot be treated at all.

All in all, this research is win-win situation. However, it may contribute and beneficial a lot for environmental and society like reducing wasted the pile of chicken manure. It also will produce source of energy that required less cost.

CHAPTER II

LITERATURE REVIEW

2.0 INTRODUCTION

The best way to begin a project is to gather and collect the information about the title. Literature review is a preview on the published sources on a narrow topic. It is a way to capture which are major concept and minor concept of the work. It helps student to improve the understanding on the particular disciplines. Other than that, it helps student to build up their expertise and knowledge before demonstrating it in the project. Hence, literature reviews as the update information to the reader on the project. Literature review gives the background before the research begin the experiment and as the referring theoretical study to the project.

2.1 POULTRY DEMAND IN MALAYSIA

Over the years, time by time the demand of the poultry meat has increase. In Malaysia, the company that involve with multinational poultry enterprises is grow rapidly such as Kentucky Fried Chicken (KFC), Sin Long Heng and Ayamas Integrated Poultry Industry to fulfill the demand.

In the Figure 2.1, the poultry production shows the most demand in past 9 years in Malaysia compare to beef, mutton and pork productions. While, Figure 2.2

show the utilization of poultry in Malaysia has been on the increase more than 40 kg per capita in Malaysia in 2005 to 2013 (Malaysia : Per Capita Consumption of Livestock Products, 2004-2013, Jabatan Perkhidmatan Veterinar).

The increasing demand of poultry leads the rapid growth of poultry enterprises in Malaysia that be resulted the large amounts of poultry manure will produce. Thus, the poultry manure will create the problem to the poultry producer as well as general public. The success of the management and utilization of waste is the key to overcome the problem of poultry manure.

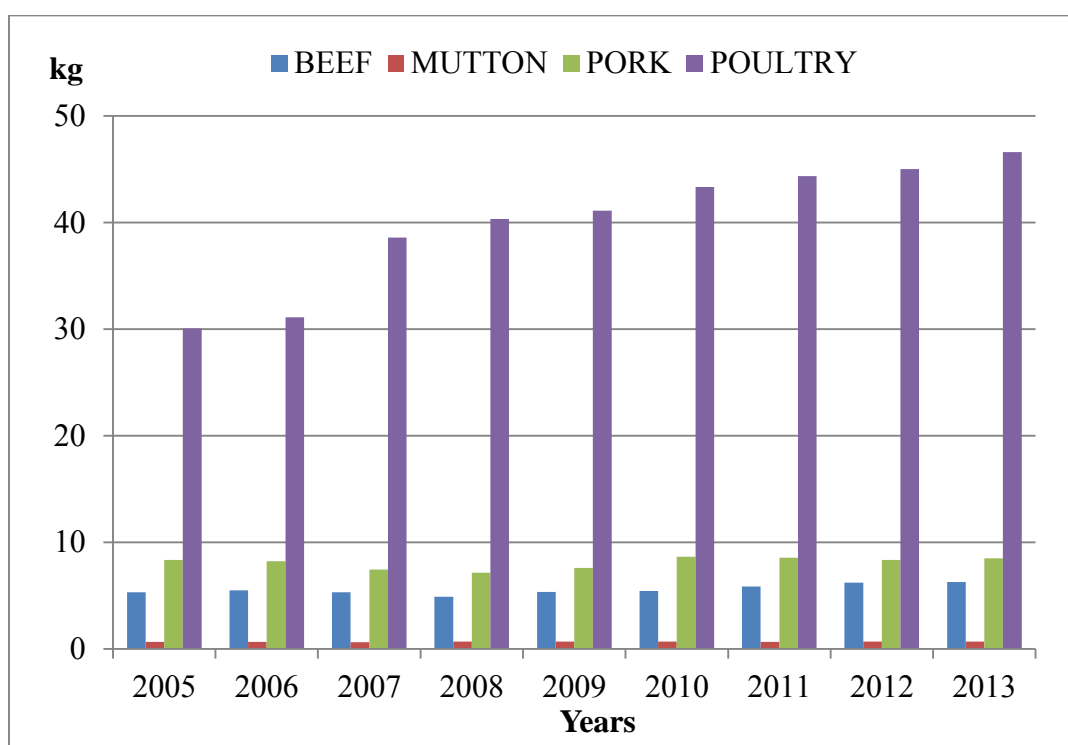


Figure 2.1: Beef, mutton, pork and poultry per capita in consumption in Malaysia in 2005 to 2013 (Jabatan Perkhidmatan Veterinar)

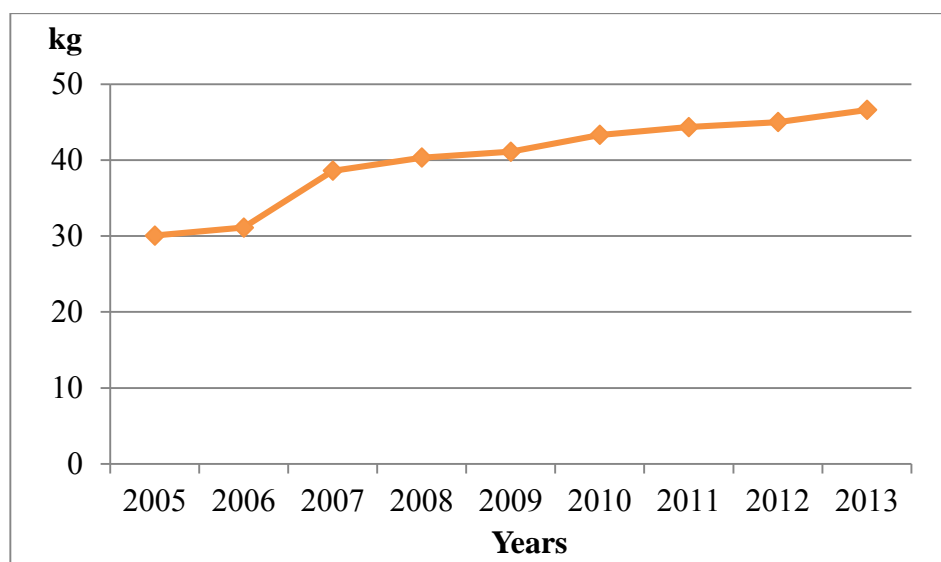


Figure 2.2: Poultry per capita in consumption in Malaysia in 2005 to 2013(Jabatan Perkhidamatan Veterinar)

2.2 CHICKEN MANURE AS BIOGAS POTENTIAL

The greenhouse effect that causes of the global warming had attention to the global. The solution for this problem was reduce anthropogenic emissions of the greenhouses gases (GHG) which are mostly methane (CH_4), Carbon dioxide (CO_2), and nitrous oxide(N_2O). By producing renewable resources, it will reduce it owns emissions but the agricultural sector must play role. Energy crops such as animal manure, biomass, and slurry can be renewable energy. It had largest potential as future energy bio energy sources.

The massive potential of biogas production also results from the possibility of using manure from the poultry. About 32% dry matter of chicken manure gas efficiency is estimated at $70m^3$ to $90m^3$ of biogas per ton of FM with 60% of methane (Mazur et. al (2014). According to Professor Zbignie (1993), the annual amount of manure created by poultry which is consists of 2.7 million tons of chicken manure, while 0.72 million tons of turkey manure and nearly 0.38 million tons of other poultry manure. The result shows a composite theoretical performance of 170, 38 and 20 million m^3 of methane per year. Thus, about 105MW of electrical capacity

produce. Approximately produce 80MWh of energy per year with the standard working time of cogeneration units of 8 hours.

2.3 CHICKEN MANURE CHARACTERISTICS

The characteristics and quantification of organic solid by-products and waste from poultry farming, however the information of treatment options for these materials is needed to evaluate. The characteristics are summarized in Table 2.1.

Table 2.1: Characteristics and quantities of organic solid wastes produced in poultry farming.

Characteristics	Manure
TS (%)	20 - 47 ^{a,d}
VS (%)	60 - 76 ^{a,d}
Kjedahl – N (% of TS)	4.6 - 6.7 ^{a,d}
Protein (% of TS)	Na
Lipids (% of TS)	1.5 - 2.1 ^b
Methane potential (m ³ /kg <i>VS_{added}</i>)	0.2 - 0.3 ^{a,c}
Methane potential (m ³ /kg wet weight)	0.04 - 0.06 ^{a,c}

Na: Not available

a: Huang and Shih (1981)

b: Mackie et al. (1991)

c: Safley et al. (1987)

d: Webb and Hawkes (1985)

2.4 CONVENTIONAL METHOD OF CHICKEN MANURE AND AGRICULTURAL WASTE TREATMENT

The pure methane from mixture of chicken manure and agricultural waste can be obtained by using the Gas Chromatography (GC). This chromatography is for separating and analyzing compounds that can be vaporized without decomposition. Hence, the testing the purity of methane or the relative amounts methane can also be determines. This is because the GC can identify methane by itself. In addition, GC is