

**METHANE PRODUCTION FROM CO – DIGESTION
OF CHICKEN MANURE WITH DECANTER CAKE
FROM PALM OIL INDUSTRY WASTE**

SITI MASYITA BINTI NORAZIMAN

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

SUPERVISOR DECLARATION

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

Signature

Supervisor: **MR. MOHD HAIZAL BIN MOHD HUSIN**

Date: JUNE 2015

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WASTE**

SITI MASYITA BINTI NORAZIMAN

**This thesis is submitted in fulfillment of the requirements for the award of
Bachelor of Mechanical Engineering
(Thermal – Fluid)**

**Faculty of Mechanical Engineering
Universiti Teknikal Malaysia Melaka**

JUNE 2015

DECLARATION

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

Signature:

Author: **SITI MASYITA BINTI NORAZIMAN**

Date: JUNE 2015

Special for

Anugerah terindah buat ku:

Abahanda, Ibunda dan keluarga tersayang

ACKNOWLEDGEMENT

First, I would like express my sincere gratitude to my supervisor, Mr. Mohd Haizal Bin Mohd Husin. Without fail, he has provided me detailed guidance and encourage throughout the research. He always had been enthusiastic in solving, reflecting, and advising my problems. I appreciate for the countless time he had spent having discussion with me regarding my final year project and offering numerous suggestions to improve my work.

I wish to express my deep gratitude to my colleagues, SAUJANAs for being my friends, giving me suggestions, support and encouragement and helping me whenever I needed.

My sincere thanks are especially to my parents Noraziman bin Khalil and Rukiah binti Ahmad and obviously my sisters and brothers for their immeasurable sacrifices, support in hard time and infinite love.

Finally, I would like to include all of my friends who were with me whenever I needed giving me support and encouragement.

ABSTRACT

Carbon based fuels such as propane and natural gas are acknowledgeable to be running in short supply. Depletion of energy and power resources for future generation becomes the world favourite topic recently. Effects of the gaseous release of hydrocarbons into the atmosphere on the degradation of the ozone layer and consequential health effects and global warming has been concerns to the nation recently. Livestock such as chicken, dairy animals is agreeable to be one of the biggest producers of gas, particularly in methane as they are constantly produces waste that is in manure form. Chicken manure disposal managements are a relevant issue in many countries of Asia due to the constantly increasing demand for chicken products. This study is to investigate the methane producing efficiency of anaerobic co – digestion influenced by different chicken manure with decanter cake mixing ratios. Samples of mixtures of chicken manure and decanter cake with different mixing ratio are assembled and its methane efficiency is measured by Gas Chromatography. Mixing up chicken manure and decanter cake has the potential on increasing the methane efficiency. With different mixing ratio tested, the best mixing ratio is found at ratio of (100:0) as the methane efficiency is the highest at 1.998% and it is comparable to others ratios.

ABSTRAK

Karbon berasaskan bahan api seperti propana dan gas asli adalah diketahui ramai telah semakin berkurangan. Kekurangan tenaga dan sumber kuasa untuk generasi akan datang menjadi topik kegemaran duniabaru-baru ini. Kesan pelepasan gas hidrokarbon ke atmosfera pada degradasi lapisan ozon dan kesan kesihatan yang berbangkit dan pemanasan global telah menjadi isu kepada negara baru-baru ini. Haiwan ternakan seperti ayam, haiwan tenusu menjadi salah satu pengeluar terbesar gas, terutamanya dalam metana kerana mereka sentiasa menghasilkan sisa yang dalam bentuk najis. Pengurusan pelupusan tahi ayam adalah isu yang berkaitan di kebanyakan negara Asia disebabkan oleh permintaan yang sentiasa meningkat untuk produk ayam. Kajian ini bertujuan untuk menyiasat kecekapan pengeluaran metana dari anaerobik bersama - penghadaman dipengaruhi oleh tahi ayam yang berbeza dengan nisbah pencampuran kek botol. Sampel campuran tahi ayam dan kek botol dengan nisbah pencampuran yang berbeza dipasang dan kecekapan metana yang diukur oleh Gas Chromatography. Mencampurkan tahi ayam dan kek botol mempunyai potensi untuk meningkatkan kecekapan metana. Dengan nisbah pencampuran yang berbeza diuji, nisbah pencampuran yang terbaik didapati di nisbah (100: 0) kecekapan metana adalah yang tertinggi pada 1.998% dan ia boleh dibandingkan dengan nisbah yang lain.

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LIST OF SYMBOL

N_2	- Nitrogen Gas
CH_4	- Methane Gas

LIST OF ABBREVIATION

CM	-	Chicken Manure
AD	-	Anaerobic Digestion
DC	-	Decanter Cake
TS	-	Total Solid
VS	-	Volatile Solid
GC	-	Gas Chromatography

CHAPTER I

INTRODUCTION

1.1 BACKGROUND STUDY

The demand of chicken meat (broiler) had arisen. In Asian countries a high number of small-scale chicken farms exist without controlled husbandry and treatment options for the manure. In general the size of chicken farms ranges from 1000 to more than a million birds per farm (Glenn, 1998).

Almost 90 percent of production occurs in Peninsular Malaysia, with the rest in East Malaysia. In terms of bird numbers, commercially bred broilers comprise 67 percent, while layers make up around 25 percent and breeders make up 8 percent of the total. Peninsular Malaysia has about 3,200 broiler farms, which includes, contract and independent farmers, as well as large vertically integrated farms. Almost all the broilers are derived from Cobb and/or Ross breeding lines. Backyard and free-range poultry production has declined significantly, and commercial production is insignificant

In the farming segment, 292 broiler farming establishments were officially registered as businesses by the Companies Commission of Malaysia in 2008. However this number is only about 12.1 per cent of the 2,402 broiler farms for which data has been collected by DVS. The vast difference between the formally recorded number of broiler business establishments and broiler farms may be due to two factors that are multiple farm ownership and operation by integrators and the non-registration of independent farmers as commercial.

In the past decade alone, it has become increasingly essential that consumers find alternative energy resources to provide some liberation for the environment. Carbon based fuels such as propane and natural gas are acknowledgeable to be running in short supply and it do not take a long period till another fuel source will be needed to sustain the energy necessary for a growing world (Hall, 2009).

Natural resources such as coal, gas and oil are non-renewable but the world enormous dependency on them is of real fear. Every aspect of most humans life requires burning the natural resources for the usages of; can be it electricity, vehicles, industries that are still depends majorly on natural resources (Manral et al.,2013).

Anaerobic digestion of animal waste produces renewable energy that can be used for heat and power, reduces greenhouse gas and ammonia emissions from livestock waste; substantially reduces odor, potentially reduces pathogens in manure, reduce surface and groundwater contamination, digested manure is high quality fertilizer. The limited application of manure anaerobic digestion systems in the U.S. is mainly attributed to high capital cost, operation and maintenance costs, lacking of management and technical expertise, and potential safety issues (Wei, 2008).

1.2 PROBLEM STATEMENT

Chicken manure disposal managements are a relevant issue in many countries of Asia due to the constantly increasing demand for chicken products. An application without treatment or non-appropriate disposal can become risky for environment and humans. Foul odors and flies due to the presence of millions of poultry which are not systematic in Kampung Parit Batu Putih, Simpang Lima, Parit Sulong near here since more than 15 years ago has caused anger among residents of six villages in the vicinity. (Utusan Melayu, 2008). A recent concern over the effects of the gaseous release of hydrocarbons into the atmosphere on the degradation of the ozone layer and consequential health effects and global warming has led to an increased awareness of the release of methane from animal waste production facilities.

Problems related to depletion of energy and power resources for future generation become the world favourite topic recently. IEA 2011 report that total electricity generation by 2009 pictures humans' dependency percentage on depleting resources. As per reports concerns have been raised regarding increasing population and increased individual power consumption which is estimated to double by 2030 (Manral et al. 2013).

Therefore, based on these upbringing issues, development on methods of finding alternative energy and power source as well as managing chicken manure is highly required. This research is pursuing to the development of alternative ways to discover substituted approach on surviving future and managing chicken manure and achieves maximum comfort of human being.

1.3 RESEARCH OBJECTIVE

Investigate the methane producing efficiency of anaerobic co – digestion influenced by different chicken manure with decanter cake mixing ratios

1.4 SCOPE OF STUDY

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

1. Determine the best ratio between chicken manure with decanter cake by comparing the result of methane production efficiency.
2. Optimize the co – digestion condition for methane production and the results are being analyzed consequently.

1.5 SIGNIFICANCE OF RESEARCH

The significance of conducting this research is to improve the production rate of methane gas by finding the best mixing ratios of chicken litter and decanter cake. The issues of finding alternative source in generating electricity can be solved as methane can be used in power generating. Thus, future concern regarding minimization or limitation of power source can be reduced.

By using the renewable energy to turn biomass outputs into methane, the renewable energy itself is not wasted as it would be without any form of storage available.

CHAPTER II

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, the literature review will be based on the power consumption in Malaysia, alternative energy, poultry demand in Malaysia, chicken manure characteristics, conventional methods of chicken manure treatment, anaerobic digestion, co-digestion, enhancing methane production and mixing ratio.

2.2 POWER CONSUMPTION IN MALAYSIA

Malaysia is a developing country that has a rapid growth in economic development. In contrast with the fast economic development, its final energy consumption is also mounting at a dramatic rate. It is observed that the growth rate of energy consumption in

between 2000 to 2005 was 5.6% and reached 38.9 M.toe in 2005 (Saidur et al., 2009). Najib, (2009).said Malaysia final energy consumption is expected to reach to 98.7 Metric tons in the year of 2030, which will be nearly three times than the 2002 level.

Malaysia has been experiencing a growing electricity demand from 336 MW in 1965 to 15, 476 MW in 2011 for the past 42 years (Alam et al., 2013). There are some factors that contribute to increment in energy demand Malaysia. Some of them are population growth, subsidized fuel prices, rising domestic incomes and the inexpensive cost of electrical appliances. These perks all have encouraged energy demand in Malaysian domestic sectors and caused people to consume more electricity (Malaysia, 2010). Data in 2011 has shown that fossil fuels have a substantial role in electricity generation in Malaysia, where it is mainly generated from non-renewable resources and dominates 94% of total energy mix (Alam et al., 2013). The record shown in Figure 2.1 that electricity in Peninsular Malaysia is powered by resources of natural gas (45%), followed by imported coal (44%), hydro (5.7%), oil and petroleum (2.5%), distillate resources (2.5%) and small portion of imported resources (0.3%) (Alam et al., 2013)

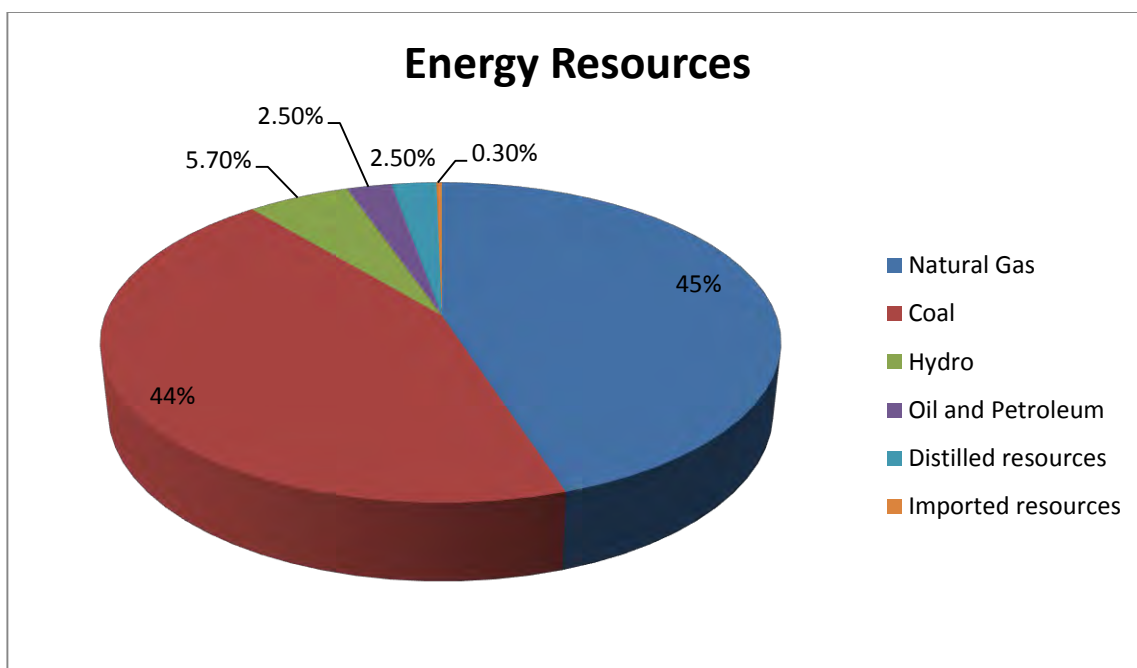


Figure 2.1: Energy resources percentage in Malaysia

Malaysia's electricity consumption continues to escalate every year. A record from The Energy Commission of Malaysia has shown that the electricity demand for the housing sector only has experienced about 4.9 percent growth per year for over the past 10 years (Suruhjaya 2007). This proved that the population has become largely dependent on cheap electricity. Malaysia had among the lowest electricity tariffs for households' worldwide (7.42 US cents/1kWh) as stated by The Energy Commission of Malaysia in June 2007 (Suruhjaya 2007).

However, satisfying the growing demands of electricity for the nation has become very challenging due to the existence of fossil fuels depletion issues. There is a risk of an insufficient supply of electricity with the main resources for generating electricity are based on non-renewables energy and under threat due to the peak oil issue. This will possibly raise issues of power rationing or load shedding which will affect many people,

2.3 ALTERNATIVE ENERGY

Experts predicted that the reservation of natural gas will be over in 70 years in Malaysia. It also expected that oil is to be used up at current usage rate for about 16 years (Shigeoka, 2010). Thus, awareness in the matter of energy security and change of climate are leading this research to be done.

Renata De Winter-Sorkina, a writer for Atmospheric Environment, stated that creating holes in the ozone layer will lead to an increase in UV radiation that reaches the Earth's surface. Sequentially, this will also intensification in the incidence of skin cancer, cataracts, and impaired immune systems, cause damage to forests and aquatic organisms, and lead to a decrease in crop yields.

Recent studies have examined the potential use of the gas that livestock give off as a renewable energy source. The manure and animal slurries produced each day represent a constant pollution risk to ground water and air. Excess nitrogen and phosphorus are in such high levels from this waste that it can pollute drinking water to levels that are harmful to humans. The manure can also emit greenhouse gasses, which are detrimental to the ozone layer. Livestock can produce enough carbon dioxide, methane, and nitrous oxide to even play a role in global warming (Chase 2009).

Methane gas is a tetrahedral molecule with four equivalent carbon and hydrogen bond. Methane is a colorless and odorless gas when present in room temperature. It is a combustible gas and mixture of about 5 to 15 percent in air is explosive. Anaerobic bacterial decomposition of plant and animal matter under water produces marsh gas, which is also methane. Combustion of methane is highly exothermic and produces large amount of heat. Gas is fed as fuel to engine which indeed can be connected to generators to produce electricity.

2.4 POULTRY DEMAND IN MALAYSIA

The demand of poultry in Malaysia had arisen for the past few decades. From the report of United State Department of Agriculture, the poultry markets in Malaysia show rapid growth from 1996 till 2014. In sequence with the increasing demand of poultry, there is increment in poultry manure as well. This is shown in the Figure 2.2 and Table 2.1 below. The graph illustrates ascending trend for poultry demand and consumptions, where the table presented the estimated number of growth of chicken demand till year 2015.