UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND CONSTRUCTION OF ORGANIC FOOD WASTE-FERTILIZER CONVERSION SYSTEM

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Maintenance Technology) with Honours.

by

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This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical and Manufacturing in Automotive (Automotive Technology) (Hons.). The member of the supervisory is as follow:

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ABSTRAK

Projek ini bertujuan untuk menyiasat dan membuat prototaip yang dapat menghasilkan baja dalam masa 24 jam dan menjadikan sistem berjalan secara automatik. Prototaip baja ini adalah item diubah untuk meningkatkan suasana, masa, kos dan sebagainya prototaip baja semasa. Tujuan projek ini adalah untuk memperbaiki dan mengubah suai mesin baja yang sudah wujud di pasaran. Beberapa perbandingan telah dilakukan dalam kajian literatur seperti perbandingan antara perkakas rumah yang sudah wujud di pasaran dan perbandingan antara kaedah reka bentuk kejuruteraan. Beberapa prosedur telah dijalankan bermula dengan pengumpulan sisa makanan, dimasukkan ke dalam mesin prototaip bersama dengan 2kg tanah. Baja mengandungi sisa makanan dan ia digabungkan dengan prototaip untuk kompos di dalam tanah. Baja mengandungi sisa makanan dan ia dimasukkan ke dalam prototaip untuk kompos di dalam tanah. Dua jenis ujian yang digunakan untuk menguji baja, iaitu ujian tumbuhan dan Fourier Transform Infrared Spectroscopy (FTIR). Ujian tumbuhan menghasilkan kadar pertumbuhan tanaman sehingga 15 hari pertama dan FTIR menghasilkan data graf yang perlu ditafsirkan dengan merujuk kepada carta Spektroskopi. Keputusan menunjukkan bahawa kandungan tinggi Amine C-N, Alkene CC, Phosphorus P-H dan Urea, NH di tumbuhan itu menjejaskan penyusutan tindak balas pertumbuhan tumbuhan.

ABSTRACT

This project aims to investigate and fabricate a prototype which is able to produce fertilizer within 24 hours and make the system run fully automatic. This fertilizer prototype is an altered item to enhance the atmosphere, moment, costing and so on of the current fertilizer prototype. The purpose of this project is to improve and modify the fertilizer machine that already exist in market. Several comparison had been perform in literature review such as comparison between home appliance that already exist in market and comparison between engineering design method. Several procedure were carried out started with collection of food waste, inserted into prototype machine together 2kg of soil. The fertilizer contains food waste and it blend by prototype to compost in soil. Two types of testing used to test the fertilizer, which are plant testing and the Fourier Transform Infrared Spectroscopy (FTIR). The plant testing produced the plant growth rate until first 15 days and FTIR produced graph data that should be interpreted by referring to the Spectroscopy chart. The results showed that the high content of Amine C-N, Alkene CC, Phosphorus P-H and Urea, NH in the plant affected the degradation of plant growth response.

DEDICATION

A special appreciation, I dedicated this thesis to my lovely mother Chninnakolanthai A/P Periasamy and lovely father Rajah A/L Elamalai. Thank you to my friends, who help me day and night to complete this thesis.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

CFT	-	Compost Free Technology
CO2	-	Carbon Dioxide
Etc.	-	Et Cetera (and other things)
FTIR	-	Fourier Transform Infrared Analysis
Kg	-	Kilogram
K	-	Potassium (Kalium)
Mil.	-	Million
N	-	Nitrogen
NPK	-	Nitrogen, Phosphorus, Potassium (Kalium)
n.d.	-	No date
RM	-	Ringgit Malaysia
WFF	-	Waste Food Fertilizer
USA	-	United State of America
UTeM	-	Universiti Teknikal Malaysia, Melaka
CF	-	Conventional Fertilizer

CHAPTER 1

INTRODUCTION

1.0 Background of study

The world faces many problems that can affect environment and also human. Food waste is one of the main problem that can affect environment. Food waste is cause of food that is failed uneaten or discarded by market. The leftover food waste smells bad and attracts rodents and insects which has significant impact on public health. The major cost of municipal waste management range from 75% to 80% of a municipal waste budget and additional 30% cost for landfilling (Unnisa, 2015). Food waste is global issue and threatening for human health and environment. The highest food waste produce by United Kingdom, United Kingdom is one of the leading country that produce waste food that approximately 6.7million tons annually which costs 10.2billion per year (Abayomi Jegede, 2019). While Malaysia was ranked on 3rd highest countries food waste production in world and 1st in Southeast Asia. At the same time, statistics show that every person produces waste in a life span of about 540 kg to 560 kg of meat, Malay spends energy developing farming and supporting the economy (Abayomi Jegede, 2019). Next estimated 88 million tonnes of food is wasted annually, which is around 20% of food produced, or 95–115 kilograms of food per person each year (Alert, 2016). Different groups of food waste such as crop and residues, fruits and vegetables, sugar and starch can be separated. Different forms of using the by-products of food processing industry may mainly be categorized as a carbon source for the agriculture of useful microorganisms, as a source of direct energy generation / biogas output, as fertilizer by the composting industry, and as a source of value added

products (Malik & Grohmann, 2012). Food production may double by 2050 due to amount of world population growth rise to 2 billion. Food waste including fruit and vegetable that helps to increase vitamin, reduce the risk of some cancers and heart disease especially for kids (Food and Agriculture Organization of the United Nations, 2017).

According to the World Hunger Index 2018, some nations still have food deficiencies, such as Yemen, Madagascar, and Africa, etc. In Africa, the demographic growth level is higher than the food manufacturing that produces food scarcity. African food shortages create individuals hungry and often interconnected by many variables. In particular, poverty, war, environment and weather, absence of investment in farming and volatile economies are the main causes of starvation (World Food Program, 2018). Food shortage also occurs in the environment. Climate shift has decreased the output of meat and triggered by human operations such as pollution and the manufacturing of meat. Low malnutrition is the effect of shortage of food and famine kills people. It indicates that the world consists of two types of people, people who eat and others who suffer from water shortages.

Next, nutrients very important to plant and soil to conduct metabolic reaction because soil consists of standard chemical for plant growth but the standard chemical is supply limited to plant and soil. Once the plant was harvested, the nutrient which is content in plant will reduce and it may causes reduce of quantity and quality of plant. Eventually, the purpose of fertilizer is replace the chemical material from the soil and used for plant growth and development (Miller, 2014). Different fertilizers usually improve plant growth and development for different crop types. Fertilizers can be classified by amount of nitrogen and other element contain and the composition should equal to how much plant needs nutrients (Joseph, 2014). Fertilizer contain sodium nitrates, ammonium sulphate and ammonium salts. Sodium nitrates fertilizer improve and strengthen growth of plant from root to leaf to provide nitrogen which is plant can easily gain (Joseph, 2014). Ammonium sulphate fertilizer consist of sulphur and nitrogen, and it maintain the pH value of soil to an alkaline soil. Furthermore, there is two type of fertilizer made from plant and animal (organic fertilizer) and produced artificially (inorganic fertilizer). Inorganic fertilizer are synthetic and chemical

fertilizer that are made up of various formulation to apply to different types of crops (Joseph, 2014). Advantage of inorganic fertilizer is fast growth and rich with malnutrition such as nitrogen, phosphorus and potassium, this is can help to dissolve a solid salt stage to plant and fast reacting growth in plant. Organic fertilizer are made by naturally decompose from animal, plant and mineral (Joseph, 2014). Similarly, organic fertilizer used widely in agricultural sector because organic made up naturally and plant growth up without damage soil and ground water (Joseph, 2014).In addition too, organic fertilizer also improve soil quality and composition decomposed by soil organism slower compare to inorganic fertilizer (Miller, 2014).

Food waste is food material that is unused, discarded and not safe to be consumed by human for avoidable reasons at production line (Pleissner & Carol, 2013). Food waste is technologies treatment such as ammonia stripping, evaporation, fertilizer granulating and membrane separation as well to create combination of nutrient-rich product. Fertilizers offer three major macronutrients which is potassium, phosphorus, and nitrogen. Plants need a lot of that stuff. NPK (nitrogen, phosphorus, and potassium) needs to be available on the plant in the right ratio to ensure a good balance of carbohydrates, protein and fats. Fertilizers may also add secondary nutrients such as sulphur, magnesium, and calcium to the soil or growing media (Birgit, B., 2017). According to Birgit, there are different types of fertilizers that can be used on specific plants to promote the plant growth, such as coffee grounds, commonly used for plants that thrive on acidic substances, for example roses and tomatoes. Eggshells are also used as fertilizing agents for produce like peppers and tomatoes. High percentage of calcium may help prevent rot while boosting the plant's growth. Organic fertilizers are made by mixing natural ingredients, which is naturally high in N or P or K or all of them, and that also contain trace elements. Chicken poo or blood and bone meal or fish extract and things like that. They contain the NPK in varying ratios, and some trace elements. However, it is possible to get the balance wrong, if there is less knowledge on what exactly is in the bag and what exactly the plants need (Birgit, B., 2017). There is so many ideas around the world and each country have their own method of solution for food waste. In India, they convert human and animal waste into fertilizer. To

overcome this issue, each person can contribute to turn the food waste into fertilizer that fully natural and improve nutrient in plant.

Food waste can be reduced by converting into useful organic fertilizer to reduce health problem caused by food waste disposal (Pleissner & Carol, 2013). By recycle the food waste it help to reduce pollution and it can convert into organic fertilizer to reduce amount of food waste in landfill and neutralize of greenhouse gas to environment (Morash, 2014). Forms this project, uses microorganisms to process fresh food, maintain a nutrient value, create a nutrient and maintain fertilizer for healthy soils that produce food rich in nutrients. This process is carried out inside closed system equipment to avoid bad smell spread while decompose occur and final product as solid soluble state to easily dissolve in water and land without harm to any species.

1.1 Problem Statement

Customer encountered several problems such as available devices consume energy and operate at elevated energy usage, which raises costs indirectly. Then, available machines in market are very bulky and consume more space in house. Waste food might be smelly if keep too long in house and not eco-friendly. Some food waste can be a fertilizer to plant such as egg shells, fruits wastes but it take time to compost the food waste to fertilizer, even some fertilizer machine need time to compost the food waste. Available fertilizer machine in market, have some issue that come are not portable and heavy in size and less amount of waste food turn to fertilizer. Few machine have been done without customer requirement and made a simple machine but sale costly (Chen, Y.-T, 2016)

1.2 Objective

The objective of this project is;

- To conduct survey and collect data of customer need to create prototype.
- To design the concept of fertilizer machine prototype.
- To fabricate a portable prototype that is use to create fertilizer from food waste, consummate the customer requirements.

1.3 Scope of Study

In order to achieve the objective the scope are prepared shown below:

1. According to survey, it can help to produce a product that is cheap and portable to keep in household as customer needs. The survey will be conduct in Ayer Keroh, Melaka and specific to house wife because to consummate customer requirement with house of quality.
2. Using SOLIDWORK software to draw a design the concept fertilizer prototype.
3. To construct food fertilizer machine that can store and produce fertilizer with automatic adding additive with amount of waste food insert into the machine.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Food waste has become recognized as a significant social, nutritional and environmental problem in recent decades and has serious consequences for the environment and community health (Bond et al, 2013). Fertilizer contain natural substance and mineral that is used to enhance plant growth and improve nutrition in plant. According to Birgit, B, 2017, fertilizer have contain with three main substance which is Nitrogen (N) Phosphorus (P) and Potassium (K) or another name known as NPK. Since food waste make contributions to the landfill pollution in the world, some have discovered on how to decrease the pollution. Instead of throwing away the food waste which may additionally lead to the pollution, the meals waste can be used as a fertilizer thru some process (FAO, 2011). Different nations and corporations comes with one of a kind methodology this to relying on the environment, suitability and the ease of the process. Somehow in order to convert the food waste into fertilizer, some investigation want to be finished to keep away from any waste, air pollution or damage in any perspective. Different type of food waste have to go through specific processes. Not all type of food waste can be used as a fertilizer and restored the macronutrition. Food waste such as meals packaging, bones or different animal-based waste have to be cast off since it will only entice the attendance of pests which would damage the plant life (FAO, 2011).

2.1 Way to Make Own Fertilizer from Food Waste

A fertilizer was set a long way from home and a long way from stuffs that may draw in the creature participation. Fertilizer normally draws in creatures. A 1 inch straw was utilized to line the base of the manure receptacle. Set a fertilizer holder in the kitchen to gather reasonable green waste, for example, egg shells and utilized espresso beans for fertilizer heap. Things that won't fertilizer, for example, waste in a pack, creature bones or other creature based waste must be maintain a strategic distance from. The waste is then being hack to a littler pieces. (Andrews, A.J., 2013.). As per BBG Staff, nutrients from the natural things can really be consumed by the plants. To get the correct fixings with the correct amount, the least complex way that may help is by fertilizing the soil. This should even be possible at home with a correct conditions. By one way or another there is not many material that may hurt the plant brought about by a bug because of wrong material use.

Material can be used	Material cannot be used
• Leaves and brush • Plant cutting, grass clippings • Fruit scraps • Breads and grains • Coffee ground and filters • Tea bags • Eggshells • Wood chips • Sawdust • Wood ash • Old potting soil • Cut flower	• Meat scraps • Fish scraps • Dairy products • Fats or oils • Grease • Dog feces • Kitty litter • Weed seeds • Charcoal ash • Non-organic materials

Table 2.1: list of material can be used and cannot be used