Jazan University

College of Engineering

Chemical Engineering Department

“Production of an organic fertilizer from palm fronds“

By

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in Chemical Engineering

(May 2014)
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قسم الهندسة الكيميائية

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“Production of an organic fertilizer from palm fronds”

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DEAN, COLLEGE OF ENGINEERING

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DATE
ABSTRACT

This project is provided to design batch mixed fermented tank to produce organic fertilizer from palm fronds. This study covers the importance, benefits, specifications and related issues that occurred in designing the fermented tank mixer. The data was obtained from several methodologies included the observation. The data was observed and analyzed by using excel software. The Chemical mixing process is an effective processing and its application can be implemented for other mixing purposes. Improper solid waste disposal poses a major threat to the environment and high risks to human health. Most of these wastes are biodegradable and can be converted into valuable resources that reduce their negative impacts. Generally, the project aimed to promote proper waste management via organic fertilizer production specifically, it aimed to develop and disseminate technology on solid waste composting for the production of organic fertilizer and to carry out detail design of the mixed reactor incorporated into the plant. Material balance was carried out across the plant. From the balance, Organic fertilizer is produced from 0.5kg of palm fronds, 1gram biotrine, 60 gram clay, 7.5 gram nitrogen fertilizer, 5gram phosphorus fertilizer. The dissolved oxygen, temperature and pH are measured and compared to the ideal ones and the results are acceptable. In the detailed design of mixed reactor, the volume of the cylindrical vessel is about 0.02m$^3$ (20 liter), while vessel length is 0.3m, the vessel diameter is 0.3m, the impeller diameter 0.26m and the impeller height is 0.29 m. Finally the nitrogen content in the compost for 10 days is about 2%, the distillation flask and titrate apparatus are used in the determination of nitrogen.
DEDICATION

To our beloved family especially my mother and father, we would like to thank our parents for their continuous support to us in completing this task, and the journey does not end here.
ACKNOWLEDGEMENT

In the name of Allah, the creator of all creations, all praises to Him, the Most Merciful the Most Blessing. Alhamdulillah, We had completed this study successfully.

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We would like to convey my heartiest thanks to all other staff members of Chemical Engineering Department for being a very kind and helpful in this project.

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For being receptive and critical, and challenging me to be a better student.
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<tr>
<td>$P_0$</td>
<td>Power number</td>
<td>----</td>
</tr>
<tr>
<td>N</td>
<td>The rotational speed</td>
<td>rpm</td>
</tr>
<tr>
<td>$D$</td>
<td>The diameter of the impeller</td>
<td>m</td>
</tr>
<tr>
<td>$K_p$</td>
<td>The laminar Power constant</td>
<td>----</td>
</tr>
<tr>
<td>$\mu$</td>
<td>The viscosity of the fluid</td>
<td>kg .m/s</td>
</tr>
<tr>
<td>$\rho$</td>
<td>The density of the fluid</td>
<td>kg/m³</td>
</tr>
<tr>
<td>Q</td>
<td>Flow rate</td>
<td>m³/s</td>
</tr>
<tr>
<td>FL</td>
<td>Flow correction factor</td>
<td>----</td>
</tr>
<tr>
<td>m</td>
<td>Composting mass</td>
<td>kg</td>
</tr>
<tr>
<td>k</td>
<td>Composting Process Rate constant</td>
<td>hr⁻¹</td>
</tr>
<tr>
<td>Xi</td>
<td>Environmental factor</td>
<td>----</td>
</tr>
<tr>
<td>t</td>
<td>Time</td>
<td>hr</td>
</tr>
<tr>
<td>$m_e$</td>
<td>Equilibrium mass</td>
<td>Kg</td>
</tr>
<tr>
<td>R</td>
<td>Mass ratio</td>
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CHAPTER (1)

INTRODUCTION

Fertilizers are the most important input that ensures optimum crop production and are broadly classified into chemical and organic fertilizers. The use of organic fertilizer dates back to man’s early farming activities. Fertilizer (or fertilizer is any organic or inorganic material of natural or synthetic origin (other than liming materials) that is added to a soil to supply one or more plant nutrients essential to the growth of plants. Conservative estimates report 30 to 50% of crop yields are attributed to natural or synthetic commercial fertilizer.

The Global market value is likely to rise to more than US$185 billion until 2019. The European fertilizer market will grow to earn revenues of approx. €15.3 billion in 2018. Mined inorganic fertilizers have been used for many centuries; whereas chemically synthesized inorganic fertilizers were only widely developed during the industrial revolution.

Many organic materials serve as both fertilizers and soil conditioners—they feed both soils and plants. This is one of the most important differences between a chemical approach and an organic approach toward soil care and fertilizing. Soluble chemical fertilizers contain mineral salts that plant roots can absorb quickly. However, these salts do not provide a food source for soil microorganisms and earthworms, and will even repel earthworms because they acidify the soil. Over time, soils treated only with synthetic chemical fertilizers lose organic matter and the all-important living organisms that help to build a quality soil. As soil structure declines and water-holding capacity diminishes, more and more of the chemical fertilizer applied will leach through the soil. In turn, it will take ever-increasing amounts of chemicals to stimulate plant growth.
The manufacturing process of most chemical fertilizers depends on nonrenewable resources, such as coal and natural gas. Others are made by treating rock minerals with acids to make them more soluble. Fortunately, there are more and more truly organic fertilizers coming on the market. These products are made from natural plant and animal materials or from mined rock minerals. However, the national standards that define and distinguish organic fertilizers from chemical fertilizers are complicated, so it’s hard to be sure that a commercial fertilizer product labeled “organic” truly contains only safe, natural ingredients. [1]

The Organic fertilizers may contain pathogens and other disease causing organisms if not properly composted. The contents of nutrient are variable and their release to available forms that the plant can use may not occur at the right plant growth stage. Comparison with inorganic fertilizer: Organic fertilizer nutrient content, solubility, and nutrient release rates are typically all lower than inorganic fertilizers.

A study found that over a 140 day period, after 7 leaching the organic fertilizers had released between 25% and 60% of their nitrogen content controlled release fertilizers (CRFs) had a relatively constant rate of release soluble fertilizer released most of its nitrogen content at the first leaching.

1. Problem Statement

Due to the high cost of chemical fertilizers it is necessary to use the local substance (palm fronds) as a basic material which contains 92.99% organic matter which indicates the viability for producing organic fertilizer. The project provides successful producing an organic fertilizer from available material in Saudi Arabia.

Further the study focuses on increasing current knowledge of methods to improve practical composting and this was achieved through theoretical and experimental investigations.
1.1 Literature Review

Natural fertilizers like manure have been in use for centuries as these were the only form of nutrition that could be provided to crops before the invention of chemical fertilizers. Chemicals were added to natural fertilizers after the Second World War. Post the war, with advancement of technology there was an explosive growth in artificial fertilizers due to improved productivity. But of late, there has been mass awareness of the eco friendliness of the use of organic fertilizers and many are using those methods again.

Fertilizers are used to provide nutrients to the plants for their good growth. Soil nutrients’ deficiency is the prevalent problem among home-garden owners. One of the distinct advantages of chemical fertilizers over organic fertilizers is that chemical fertilizers are rich equally in all three essential nutrients: nitrogen, phosphorous, and potassium. On the other hand, organic fertilizers may be rich in one of the three nutrients, or may have low levels of all the three nutrients.

Organic fertilizers are generally much more expensive than chemical fertilizers, mostly because chemical fertilizers have more concentrated levels of nutrients per weight of product than organic fertilizers do. One needs several pounds of organic fertilizer to provide the same soil nutrient levels that a single pound of chemical fertilizer provides, and the higher cost of organic fertilizer is one of the biggest reasons that organic produce is more expensive than non-organic. (The other big reason being lower organic yields, on average.) Although it is possible to make a lot of one's own organic fertilizer as well, once the labor, time, and other resources are accounted for, homemade organic fertilizer is usually more expensive than store-bought chemical fertilizer.

One aspect of the organic fertilizers is their slow-release capability. Slow-release capability of organic fertilizers has both advantages and disadvantages: Slow-release means there is less risk of over-fertilization but sometimes this slow-release
of organic fertilizers is not able to fulfill to needed supply of the nutrients, whenever required. In contrast to organic fertilizer, chemical fertilizers are always there to provide immediate supply of nutrients to plants if situation demands.

Chemical fertilizers always have a high total NPK (nitrogen:phosphorous: potassium), from 20 to 60 percent or more. The total NPK for organic fertilizer blends will always be low. Fourteen percent is about as high as it gets.

There are two ways to measure fertilizer use in a country. One is by nutrient content — how much nitrogen, phosphate and potash are contained in the fertilizer applied. In fiscal year 2004, 23.4 million tons of nutrients were applied in the US. Another way to measure is in total tonnage — the total tons it takes to deliver the nutrient content. In fiscal year 2004, 57.8 million total tons were used in the United States. The world's largest producers and users of fertilizers are the United States, China, India, Russia and Brazil.

Some reports suggest the US Fertilizer market to be around $40 Billion of which organic fertilizers occupy only about $60 Million. The rest of it is the share of the various artificial fertilizers. [2]

The inorganic fertilizers nearly always are readily dissolved and unless neither added have few other macro and micro plant nutrients nor added any 'bulk' to the soil. Nearly all nitrogen that plants use is in the form of NH₃ or NO₃ compounds. The usable phosphorus compounds are usually in the form of phosphoric acid (H₃PO₄) and the potassium (K) is typically in the form of potassium chloride (KCl). In organic fertilizers nitrogen, phosphorus and potassium compounds are released from the complex organic compounds as the animal or plant matter decays. In commercial fertilizers the same required compounds are available in easily dissolved compounds that require no decay they can be used almost immediately after water is applied. Inorganic fertilizers are usually much more concentrated with up to 64% (18-46-0) of their weight being a given plant nutrient, compared to organic fertilizers that only provide 0.4% or less of their weight.
1.1.1 Problems with Inorganic Fertilizers

1.1.1.1 Water Pollution
The nutrients, especially nitrates, in fertilizers can cause problems for natural habitats and for human health if they are washed off soil into watercourses or leached through soil into groundwater.

1.1.1.2 Fertilizer Dependency
Effectively farmers unknowingly became 100% dependent on 'bought in' water soluble, inorganic fertilizers since the sterilization of soil microflora including its mycorrhiza, reduced the availability of other natural and trace minerals within the soil.

1.1.1.3 Soil Acidification
Also regular use of acidulated fertilizers generally contribute to the accumulation of soil acidity in soils which progressively increases aluminum availability and hence toxicity. The use of such acidulated fertilizers in the tropical and semi-tropical regions of Indonesia and Malaysia has contributed to soil degradation on a large scale from aluminum toxicity, which can only be countered by applications of limestone or preferably magnesium dolomite, which neutralizes acid soil pH and also provides essential magnesium.

1.1.1.4 Over Fertilization
Over-fertilization of a vital nutrient can be as detrimental as under fertilization. "Fertilizer burn" can occur when too much fertilizer is applied, resulting in drying out of the leaves and damage or even death of the plant.

Fertilizers vary in their tendency to burn roughly in accordance with their salt index.[3]
1.1.2 Organic Fertilizers

Organic fertilizer - city compost is a dark brown, coarse powder made from biodegradable organic matter, vegetable waste and city waste etc., through microbial conversion process. It is free from foul smell, live weed seeds, plastics, glass, and also free as a source for spreading pests and diseases. Its moisture content is about 25% with a bulk density of 0.64gm / cm³. Organic - city compost is a bioorganic soil enriches that helps to improve soil productivity. It is a rich source of plant nutrients ( both macro and micro ) growth promoting substances and the bacteria present in organic fertilizer - city compost help in fixing atmospheric nitrogen and in making phosphorus available to the plants, ultimately leading to increased productivity of better quality.

1.1.2.1 Organic Fertilizers Advantages

Although the density of nutrients in organic material is comparatively modest, they have many advantages. The majorities of nitrogen-supplying organic fertilizers contain insoluble nitrogen and act as a slow-release fertilizer. By their nature, organic fertilizers increase physical and biological nutrient storage mechanisms in soils, mitigating risks of over-fertilization. Organic fertilizer nutrient content, solubility, and nutrient release rates are typically much lower than mineral (inorganic) fertilizers. A University of North Carolina study found that potential mineralizable nitrogen (PMN) in the soil was 182–285% higher in organic mulched systems than in the synthetics control.

Organic fertilizers also re-emphasize the role of humus and other organic components of soil, which are believed to play several important roles:

- Mobilizing existing soil nutrients, so that good growth is achieved with lower nutrient densities while wasting less.
- Releasing nutrients at a slower, more consistent rate, helping to avoid a boom-and-bust pattern
- Helping to retain soil moisture, reducing the stress due to temporary moisture stress
1.1.3 Inorganic vs. Organic Fertilizers

1. The difference in efficacy between organic and inorganic fertilizers is difficult to evaluate and this is mainly because of the lack of scientific data that is available to enable an accurate comparison. As a general statement the majority of orchards which apply organic fertilizers only are seen to possess less vigorous and healthy macadamia trees than those that rely on a combination of organic and inorganic fertilizers or inorganic fertilizers solely.

2. The difference in general between those orchards that apply organic fertilizers solely and those that do not is considered to be due to the following reasons:
   - Organic fertilizers are not applied at the required rates to adequately substitute inorganic fertilizers.
   - A lack of consistency in quality and therefore nutritional content of raw organic fertilizers imbalance.
   - The transformation of nutrient to a plant available form at a less than desired rate according to specific plant or crop growth stages.
   - Organic fertilizers often do not have nutrients in the required ratios and often there may be an imbalance. [4]
Table (1.1): Comparison of an Organic and Inorganic Fertilizer:[5]

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<th>Organic Fertilizer</th>
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<tr>
<td><strong>NPK Ratio</strong></td>
<td>20 to 60%</td>
<td>About 14%</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>Ammonium sulfate, ammonium phosphate,</td>
<td>Cottonseed meal, blood meal, fish</td>
</tr>
<tr>
<td></td>
<td>ammonium nitrate, urea, ammonium chloride</td>
<td>emulsion, and manure and sewage sludge,</td>
</tr>
<tr>
<td></td>
<td>and the like.</td>
<td>etc.</td>
</tr>
<tr>
<td><strong>Advantages</strong></td>
<td>Chemical fertilizers are rich equally in</td>
<td>Adds natural nutrients to soil,</td>
</tr>
<tr>
<td></td>
<td>three essential nutrients that are needed</td>
<td>increases soil organic matter,</td>
</tr>
<tr>
<td></td>
<td>for crops and always ready for immediate</td>
<td>improves soil structure and tilth,</td>
</tr>
<tr>
<td></td>
<td>supply of nutrients to plants if situation</td>
<td>improves water holding capacity,</td>
</tr>
<tr>
<td></td>
<td>demands.</td>
<td>reduces soil crusting problems,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>reduces erosion from wind and water,</td>
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<td></td>
<td></td>
<td>Slow and consistent release of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>nutrients,</td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td>Several chemical fertilizers have high</td>
<td>Have slow release capability;</td>
</tr>
<tr>
<td></td>
<td>acid content. They have the ability to</td>
<td>distribution of nutrients in organic</td>
</tr>
<tr>
<td></td>
<td>burn the skin. Changes soil fertility.</td>
<td>fertilizers is not equal.</td>
</tr>
<tr>
<td><strong>Rate of Production</strong></td>
<td>Immediate supply or slow release</td>
<td>Slow release</td>
</tr>
<tr>
<td><strong>About</strong></td>
<td>Chemical fertilizers are manufactured</td>
<td>Organic fertilizers are made from</td>
</tr>
<tr>
<td></td>
<td>from synthetic material</td>
<td>materials derived from living things.</td>
</tr>
<tr>
<td><strong>Preparation</strong></td>
<td>Artificially prepared.</td>
<td>Prepared naturally. One can prepare</td>
</tr>
<tr>
<td></td>
<td></td>
<td>organic fertilizers, themselves or can</td>
</tr>
<tr>
<td></td>
<td></td>
<td>also buy.</td>
</tr>
<tr>
<td><strong>Cost</strong></td>
<td>cheap</td>
<td>Expensive</td>
</tr>
<tr>
<td><strong>Nutrients</strong></td>
<td>Have equal distribution of three</td>
<td>Have unequal distribution of essential</td>
</tr>
<tr>
<td></td>
<td>essential nutrients: phosphorous, nitrogen,</td>
<td>nutrients.</td>
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<td></td>
<td>potassium.</td>
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1.1.4 Bio-fertilizers

Bio-fertilizers have emerged as one of the alternatives for transitions towards more sustainable development pathways through biological nitrogen fixation (BNF). Biological nitrogen fixation (BNF) refers to the process of microorganisms fixing atmospheric nitrogen, mostly within subsoil plant nodules, and making it available for assimilation by plants.

This process gains importance in the context of crop productivity because nitrogen supply is a key limiting factor in crop production. Investment in BNF research continues to be a high priority research area with expanding focus both on developing and as well as developed countries.

Use of bio-fertilizers in agriculture, in preference to chemical fertilizers, offers economic and ecological benefits by way of soil health and fertility to farmers. Field studies have demonstrated them to be effective and cheap inputs, free from conventionally adverse implications of chemicals. Bio-fertilizers are now being increasingly used as part of Integrated Plant Nutrient Systems (IPNS) that advocate involving a combination of fertilizers, organic/green manures and microbial inoculants as imperative to sustain crop production and maintain soil health and soil diversity in the long run. This is important for countries like India where farming will continue to be in the hands of small farmer.

In India, the demand for nitrogen fertilizers is expected to go up from the present level of 11.4 million t (2001-02) to 13.9 million t by 2006-07 and 16.2 million t by 2011-2012 AD). The economic burden and environmental cost of applying such a high quantity of additional fertilizers is obvious. Even if a part of this increase in demand for N is met through bio-fertilizers, the likely savings will be enormous (Rao et al. 2004). This holds importance for developing countries such as India where farming is practiced by a large number of small farmers and will continue to be in the hands of
Small farmers, who cannot afford high priced fertilizers (in spite of nearly 80% subsidy being given to the fertilizer industry).

Small farmers are dependent on government subsidies and suffer from both soil quality deterioration and declining yield response. Bio-fertilizers can play a major role in transition to sustainability for these farmers. They are affordable for majority of farmers, have the ability to take farmers out of total dependence on harmful chemical fertilizers and contribute to long term sustainability by strengthening of local production systems and improvement of natural resources (soil quality).

Bio-fertilizers are likely to result in improvement in soil and environmental health and savings for farmers.

The emphasis has largely been on promoting bio-fertilizers as safe and cheap products for resource poor communities and providing income generation prospects through decentralization of scientific and production processes that go into the development and production of bio-fertilizers through local participation.

The rationale is that such a pursuit will directly help in poverty alleviation among small farmers; enhance soil quality, leading to fulfilling needs of national food security.

1.1.5 Composting

Composting is a process that (fulfill) several waste management purposes - stabilization, volume reduction and sanitation by thermal inactivation of pathogens. The aim of the stabilization is to produce a material that does not putrefy, self-heat, deplete oxygen, produce odors or attract vermin. The compost product can be beneficial, supplying nutrients for plant growth, organic matter for soil improvement and agents for plant disease suppression. In spite of the benefits of composting, there are several environment issues to consider in composting. Ammonia emissions can be large, and ammonia contributes to eutrophication and acidification. The greenhouse gases methane and nitrous oxide are normally formed during composting, although in
small amounts (Beck-Friis, 2001; Zeman, Depken & Rich, 2002). Moreover, malodorous substances, which can cause severe problems, are also formed during composting. Composting is environmentally preferable to landfilling, but in Swedish environmental systems analyses of waste management based on substance flow analysis and life cycle assessment methods, composting has proved to be a less favorable option than incineration and anaerobic digestion for treatment of biodegradable household waste (Sundqvist et al., 2002; Eriksson, 2003). The incineration systems in these studies produced both electricity and heat for district heating, and had advanced gas cleaning systems. The anaerobic digestion systems produced biogas that was used either for electricity and heat or as vehicle fuel, and the digestion was used as a fertilizer in agriculture.

The composting systems were either open windrow systems or enclosed reactor systems. The compost was used in agriculture and was valued for replacing nitrogen and phosphorous fertilizer. Composting was judged to be less favorable because energy was not recovered, and because of larger emissions both during the process and from compost use. Contrary to this, a German environmental systems analysis concluded that for most environmental impact categories composting, especially home composting, and was a better treatment method for household biowaste than incineration or anaerobic digestion (Vogt et al., 2002). Important assumptions that differed from the Swedish studies were that only electricity, not heat, was utilized from incineration, that compost replaced peat as a soil amendment, and that peat was considered a fossil resource contributing to global warming. From an economic point of view, incineration is cost-effective if heat has an economic value, but not otherwise (Ayalon, Avnimelech & Shechter, 2000; Sonesson et al., 2000). Anaerobic digestion is a more costly treatment method than composting, but its economic viability depends on the price of energy. Thus, it is not possible to draw any general conclusion on whether composting is environmentally or economically preferable to incineration or anaerobic digestion. The results depend not only on the waste management technology as such,
but largely on local and regional external factors, especially the energy system. There are also other reasons for composting management. For example, it is a technology that can be performed at any scale from household to regional. This makes local treatment possible, which reduces waste transport. Furthermore, the compost product is dry and can be sold on the soil product market, whereas the product of anaerobic digestion is normally slurry which is only marketable to agriculture. Composting is also more flexible than anaerobic digestion and incineration in terms of size, time frame for planning and construction and pay-back time for investment. In Sweden, waste incineration technology has been optimized for both process efficiency and pollution reduction as a result of consistent work within the industry, driven by demands from the public and government to reduce emissions. The Swedish composting industry has just started to work towards process efficiency and emission reduction, and there is a large potential for improvement. Consequently, a systems analysis that compares today’s best practice in composting and waste incineration does not compare the two treatment options at to be an option for future waste optimized for both process a similar potential, and thus gives little guidance regarding the best choices to make for the future. [6]

1.1.5.1 Composting Technology

Composting is a multi-step, closely monitored process with measured inputs of water, air, and carbon- and nitrogen-rich materials. The decomposition process is aided by shredding the plant matter, adding water and ensuring proper aeration by regularly turning the mixture. Figure (1.2) shows home compost.
In addition to the traditional compost pile, various approaches have been developed to handle different composting processes, ingredients, locations, and applications for the composted product.

BSFL composts quickly convert manure or kitchen waste into organic compost. In a compost bin, it can take only twenty days to start to compost. The resulting compost can be used for soil and fertilizers. After the conclusion of the compost process, the larvae can also be harvested as feed for poultry, chickens, and possibly dogs. On average a household will produce a little under a kg of food waste per day. This food waste can be composted at home using black soldier fly larvae much faster than worms can do it. The BSFL will eat kilograms of scrap food a night in small composting units, eliminating your food waste before it can even begin to rot. This is probably the fastest composting technique. BSFL often appear naturally in worm bins, composting toilets, or compost bins. They can also be bought online. Without much added cost, these devices could be designed to also harvest BSFL.

Black soldier fly larvae often appear naturally in worm bins, composting toilets, or compost bins.
1.1.5.2.1 Cockroach Composting

Cockroaches produce fewer, more nutrient-dense droppings than other composting invertebrates. Additionally, the chitin from cockroach molts adds an excellent boost to the resulting compost.

![Bokashi bin](image)

Figure(1.3): Bokashi bin.

1.1.5.2.2 Compost tea

- Compost tea is being used increasingly as an alternative plant disease control measure in commercial horticulture. Compost tea is produced by mixing compost with water and incubating for a defined period, either actively aerating (aerated compost tea, ACT) or not (non aerated compost tea, NCT) and with or without additives that are intended to increase microbial population densities during production. [7]

Compost tea is a liquid extract or a dissolved solution but not simply a suspension of compost. It is made by steeping compost in water for 3–7 days. It was discovered in Germany and became a practice to suppress foliar fungal diseases by nature of the bacterial competition, suppression, antibiosis on the leaf surface (phyllosphere). It has also been used as a fertilizer although lab tests show it is very weak in nutrients with less than 100ppm of available nitrogen and potassium. Other salts present in the tea solution are sodium, chlorides and sulfates. The extract is applied as a spray to non-edible plant parts such as seedlings, or as a soil-drench (root dip), or as a surface spray to reduce incidences.
1.1.5.2.3 Vermicompost

Vermiculture or vermicomposting is derived from the Latin term vermis, meaning worms. Vermicompsting is essentially the consumption of organic material by earthworms. This speeds up the process of decomposition and provides a nutrient-rich end product, called vermicompost, in the form of ‘worm castings’.

For centuries, earthworms have been used for centuries as a means of decomposing wastes and improving soil structure. Increasing numbers of businesses worldwide are successfully employing vermiculture technology and marketing vermicompost as an excellent soil conditioner, to farmers and gardeners. The breeding and propagation of earthworms and the use of its castings has become an important method of waste recycling throughout the world. It is common to use earthworms on industrial scales to aerate, sanitise and deodorise types of contaminated waste sludge. For instance, Japan imports millions of tonnes of earthworms per annum for waste conversion. Worms are odourless and free from disease. Vermiculture looks set to emerge as a
significant waste management technology. Figures (1.5) and figure (1.6) show the vermicompost techniques. [8]

1.1.5.2. Composting Palm fronds

Composting palm frond is the process of controlled aerobic decomposition of biodegradable organic matter.

During composting, microorganisms break down organic matter into carbon dioxide, water, heat, and compost:

The composting occurs according to the following reaction:

\[
\text{Organic matter} + \text{O}_2 \rightarrow \text{Compost} + \text{CO}_2 + \text{heat}
\]  

(1.1)
Microorganisms are key to composting and its Classification according to the $O_2$ consuming:

- **Aerobic** – use oxygen for their metabolism
- **Anaerobic** – they are active in environment without oxygen

The composting of the palm frond is carried out using an aerobic method.

![Figure (1.7): The palm fronds](Image)

**1.1.6 Conditions and variable influencing Composting**

There are several conditions and variable that must be monitored in order to obtain proper composting:

**1.1.6.1 Temperature:**

Compost microorganisms are traditionally classified according to their temperature preferences. Microorganisms with optimum temperature for growth at 25-40 °C are called mesophilic and those with optimum temperature above 45 °C are called thermophilic (Madigan, Martinko & Parker, 2000). These terms can then be used to define temperature ranges, denoting temperatures below 40 °C mesophilic and
above 45°C thermophilic. In this thesis the range 40-45 °C is called the mesophilic-thermophilic transition temperature range. The term above mesophilic optimum is used to denote temperatures of about 40°C and higher. [9]

Aerobic composting can occur under two main temperature ranges:

- Mesophilic conditions, between 20-45°C
- Thermophilic conditions, between 50-65°C

The optimal temperature may vary depending on feedstock compositions.

Temperature rise and fall

A typical temperature change as a function of time is presented in Figure (1.8). As is indicated by the curve in the figure, the temperature of the material to be composted begins to rise shortly after the establishment of composting conditions, i.e., after the material has been windrowed or has been placed in a reactor unit. The initial change in temperature parallels the incubation stage of the microbial populations. If conditions are appropriate, this stage is succeeded by a more or less exponential rise in temperature to 60° to 70°C. The exponential character of the temperature rise is a consequence of the breakdown of the easily decomposable components of the waste. [10]

![Figure (1.8): Typical temperature variation in compost pile](image)
1.1.6.2 pH

The pH level of the composting mass typically varies with the passage of time, as is indicated by composting at several plants has been troubled by low pH during the process. The hypothesis that increased aeration during the beginning of the process would improve the process was tested in full-scale experiments at two large composting plants that have forced aeration indoor processes. Parallel runs with different aeration rates were compared.

1.1.6.3 Dissolved Oxygen

Oxygen is needed as a reactant and must be sufficiently supplied by aeration. If oxygen supply is too low to meet the demand, the oxygen shortage will result in a lower process rate and the production of odors. Mixing within the composting process improve disperse the oxygen.

1.1.6.4 Moisture

One of the most important considerations for successful composting is the moisture content of the ingredients. In general, you want to achieve a balance between materials high in moisture, such as fruit and vegetable scraps, with dry materials such as wood chips. A common rule of thumb is that the compost mixture has the right moisture content if it is about as wet as a wrung-out sponge, with only a drop or two expelled when it is squeezed. Composting proceeds best at a moisture content of 50–60% by weight. Table 1–2 lists typical moisture contents of common compost ingredients.
Drying of the composting waste leads to a lower composting rate in which case addition of water is beneficial. However, if the moisture content becomes too high a different limitation of the composting rate will occur as the aeration is hindered. A moisture content of 40-60% is generally considered optimal.

1.1.7 The finished products

1.1.7.1 Manures

Dried manures are slightly higher in the composition of nitrogen, phosphorus and potassium due to no water content. For example, dried cattle manure consists of 1.3 percent nitrogen, 0.9 percent phosphorus and 0.8 percent potassium. The composition of fresh beef steer is 0.73 percent nitrogen, 0.48 percent phosphorus, 0.55 percent potassium and 75 percent water.

1.1.7.2 Organic

Organic fertilizers consist of varying percentages of nitrogen, phosphorus and potassium. Bloodmeal, coffee grounds, oak leaves, cottonseed meal and pine needles are a few organic fertilizers that possess all three of these elements. Generally, organic fertilizers are not water soluble.

Table 1–2. Moisture Content of Common Compost Ingredients.

<table>
<thead>
<tr>
<th>Material</th>
<th>Moisture content (% wet weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetables and fruits</td>
<td>80-90</td>
</tr>
<tr>
<td>Grass clippings</td>
<td>80</td>
</tr>
<tr>
<td>Leaves</td>
<td>40</td>
</tr>
<tr>
<td>Sawdust</td>
<td>40</td>
</tr>
<tr>
<td>Shrub trimmings</td>
<td>15</td>
</tr>
</tbody>
</table>
1.1.7.3 Synthetic

Synthetic fertilizers are not water soluble and generally consist of one or two of the three essential elements, but not all three. An example of a nitrogen-based synthetic fertilizer is anhydrous ammonia, possessing 82 percent nitrogen. Potassium chloride consists of 62 percent potassium, and superphosphate has a composition of 20 percent phosphoric acid. Potassium nitrate fertilizer has a composition of 13 percent nitrogen and 44 percent potassium.

1.2 Problem Statement Objective

The objectives of the project are -:

1- To promote proper waste management via organic fertilizer production.

2- To design fermented mixed tank for the production of organic fertilizer from palm fronds.

1.3 Problem Justification and Outcomes

The investment in using of local material should be encouraged from the government. The use of organic fertilizers will provide an environmentally friendly, naturally sustainable, safe and affordable means for maintaining soil fertility and increasing crop production. It will also lower the cost on the importation of inorganic fertilizers. This will ensure food security and improve the standard of living of Saudi Arabia.

1.4 Problem Constrains

Controlling the controlled variable of the composting during the process consider as the main objective and one of the key goal has been achieved through monitoring the pH of the compost, the dissolved oxygen and temperature of the compost. May the adjusting the initial calculations provide the composting in the right direction.
2.1 Design Approach
The design and construction of mixed fermented tank depend on the skill of approaching these scale-up issues. So far, the design has to a large extent relied on classical chemical engineering approaches. Mostly, key components in the design, such as impellers has been designed and dimensioned based on experiences and descriptions of the properties of these design elements. Well established design methods in chemical engineering have been used for the design, but have also been strongly dependent on reliable measurement methods. When designing and developing products in the field of mechanical engineering, the design approach is largely different. Mostly, the design methodology is founded on genuine conceptual and systematic thinking. The principles of the systematic design for mechanical products have thoroughly been described in the engineering literature (Mandenius and Björkman, 2012;).

2.2 Design Methodology
The aim of this work was investigate the ability of designed mixed fermented for production organic fertilizer from palm fronds and to monitor the variable such as PH of the compost, the dissolved oxygen and the temperature of the compost. The proposed design in this project was described practically as a pilot mixed fermenter; meanwhile the data will be used as a basic in large scale.

2.2.1 Analysis of the compost
The method and procedure are the also used for estimation of total N in soil. The fertilizer sample size may vary between 0.2 and 0.5 g depending on the N content of the sample. A smaller amount of sample may be taken for high-analysis fertilizers (e.g. urea) and a larger amount for low analysis fertilizer (e.g. ammonium sulphate). [9]
The apparatus required consists of:

- a Kjeldahl distillation unit;
- some flasks, beakers and pipettes;
- a burette.

The reagents required are:

- Freshly ignited carbonate-free MgO.
- Standard acid (0.1M HCl).
- Standard alkali (0.1M NaOH).
- NaOH (40 percent) for distillation.
- Methyl red indicator.

### 2.2.2 The procedure:

1. Put 0.5 g of the sample in a 600 ml distillation flask with about 250 ml of water.
2. Add 2 g of freshly ignited carbonate-free MgO or 5 ml of NaOH solution (40 percent) by tilting the flask and through the side of the flask so that the contents do not mix at once.
3. Connect the flask to a condenser by a Kjeldahl connecting bulb and connecting tube.
4. Start heating, and distil about 100 ml of liquid into a measured quantity of standard acid (0.1M HCl).
5. Titrate the distillate with standard NaOH (0.1M) to determine the remaining amount of unused acid, using methyl red indicator. The acid used to neutralize ammonia is equivalent to the N content in the sample.
6. Carry out a blank.

### The calculations:

- 1 ml 0.1M HCl = 0.0014 g N

After titrating the amount of HCl is equivalent to 4.2ml

So the N₂ is 1.76% in the compost and this results during 10 days composting.
2.3 Mixed fermented design and control

The attention should be drawn to Control of many parameters in the mixed fermented such as temperature, agitation, pH, dissolved oxygen. In the project these parameters - were observed daily and their values compared to the data in literature and measured data are satisfied.

2.4 Estimation the dimensions of mixed fermented tank

- A stirred tank reactor will either be approximately cylindrical or have a curved base. A curved base assists in the mixing of the reactor contents. Stirred tank are generally constructed to standard dimensions. That is, they are constructed according to recognized standards such as those published by the International Standards Organization and the British Standards Institution.

- These dimensions take into account both mixing effectiveness and structural considerations.

- A bioreactor is divided in a working volume and a head-space volume. The working volume is the fraction of the total volume taken up by the medium,
microbes, and gas bubbles. The remaining volume is called the headspace. Typically, the working volume will be 70-80% of the total fermenter volume. This value will however depend on the rate of foam formation during the reactor. If the medium or the fermentation has a tendency to foam, then a larger headspace and smaller working volume will need to be used.

2.5 Stirred Tank Design

Many of the equations used for determining the output of mixers are empirically derived, or contain empirically-derived constants. Since mixers operate in the turbulent regime, many of the equations are approximations that are considered acceptable for most engineering purposes.

When a mixing impeller rotates in the fluid, it generates a combination of flow and shear. The impeller generated flow can be calculated with the following equation:

\[ Q = F l * N * D^3 \]  

Flow numbers for impellers have been published in the North American Mixing Forum sponsored Handbook of Industrial Mixing.

The power required to rotate an impeller can be calculated using the following equations:

\[ P = P_0 \rho N^3 D^5 \]  

(Turbulent) \hspace{1cm} (2-2)

\[ P = K_p \mu N^2 D^3 \]  

(Laminar Regime) \hspace{1cm} (2-3)

\( P_0 \) is the (dimensionless) Power number, which is a function of impeller geometry; \( \rho \) is the density of the fluid; \( N \) is the rotational speed, typically rotations per second; \( D \) is the diameter of the impeller; \( K_p \) is the laminar Power constant; and \( \mu \) is the viscosity of the fluid. Note that the mixer power is strongly dependent upon the rotational speed and impeller diameter, and linearly dependent upon either the density or viscosity of the fluid, depending on which flow regime is present. In the transitional regime, flow near the impeller is turbulent and so the turbulent power equation is used.
For the designed mixed tank the numerical values are given in table (2.1)

Table (2.1): The design dimensions of the mixed tank

<table>
<thead>
<tr>
<th>Items</th>
<th>Amount</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed tank volume</td>
<td>0.02</td>
<td>m³</td>
</tr>
<tr>
<td>Mixed tank Length</td>
<td>0.3</td>
<td>M</td>
</tr>
<tr>
<td>Mixed tank diameter</td>
<td>0.3</td>
<td>M</td>
</tr>
<tr>
<td>Impeller diameter</td>
<td>0.26</td>
<td>M</td>
</tr>
<tr>
<td>Height of impeller</td>
<td>0.29</td>
<td>M</td>
</tr>
</tbody>
</table>

Fig(2.2): Schematic diagram for the mixed fermenter
CHAPTER 3

THEORETICAL BACKGROUND

3.1 Design specifications
Typical characteristics of design of the vessel composting system incorporate the following elements:

1. Cylindrical vessel,

2. Motor (1hp) to drive the mixer.

3. Mixer with impeller


5. Portable temperature apparatus.

3.1.1 Analysis
The operational objective for the fermentation step is to keep the operating condition in certain limits. Analyzing the effects of process variables on the fermentation operation been observed during the operation. Table (3.1) shows the process variables that been observed are: temperature, pH and homogeneity in the fermenter.

Table (3.1): Analysis of Temperature and pH

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Measuring values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4&lt;sup&gt;th&lt;/sup&gt;.Day</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>28.1</td>
</tr>
<tr>
<td>pH</td>
<td>8.9</td>
</tr>
</tbody>
</table>
3.2 Mathematical Model

Composting kinetics is defined in this project as a comprehensive set of equations (mathematical model) that describes the dependence of the composting rate on environmental factors over a range of practical interest. The kinetic model to be developed should be able to predict the process rate in relation to the (actual) composition of the waste and (actual) conditions to which this waste is exposed in the reactor. The process rate is preferably expressed on the basis of a unit amount of waste and not of the total amount of the waste. [11]

\[ \frac{dm}{dt} = -k(x_1, x_2, \ldots, x_n)[m - m_e] \]  

(3.1)

m: Composting mass [kg]
k : Composting process rate constant [hr⁻¹]
Xj : Environmental factor e.g. temperature, oxygen, moisture, etc
t : Time [hr.]
m_e : Equilibrium mass, i.e. the residual mass after infinite composting time [kg]
R: Compost mass ratio

If the environmental factors remain constant in time, integration of the above equation by the following steps:

If the environmental factors remain constant in time, integration of the above equation by the following steps:

\[ \int_{m_0}^{m} \frac{dm}{m - m_e} = -k(x_1, x_2, \ldots, x_n) dt \]

\[ \ln (m - m_e) = -k(x_1, x_2, \ldots, x_n) t \]

\[ \ln(m - m_e) - \ln(m_0 - m_e) = -k(x_1, x_2, \ldots, x_n) t \]

\[ \frac{m - m_e}{m_0 - m_e} = e^{-k(x_1, x_2, \ldots, x_n) t} \]

\[ R = \frac{m - m_e}{m_0 - m_e} = e^{-k(x_1, x_2, \ldots, x_n) t} \]  

(3.2)
CHAPTER 4

DESIGN PROCEDURE AND IMPLEMENTATION

4.1 Design Procedures

Types of Processing Within Vessels

- Batch – materials are processed at the same time, without introducing new feedstock
- Continuous – raw materials are loaded periodically, and are composted as they move through the system to the opposite end to be discharged

The design involves the comparison of three categories:

- Enclosed Aerated Static Piles
- Agitated Beds and Vessels
- Rotating Drums

The rotating drum is selected in the design of the fermenter as initial step. Secondly selection of the batch process for the fermentation is selected. Thirdly evaluation of the mass balance for the mixed fermenter is carried for the design of the fermented mixed tank as it is consider as the basis for the design. The experimental procedures were conducted to measure for temperature, pH and agitation to achieve optimum production then the designed is compared and confirmed to the model in the literatures.
4.2 Design Implementation

4.2.1 Measurement of temperature

The temperature of compost in the vessel is a good indicator of what is happening at the microscopic level. Manure heats up because microorganisms are eating degradable material. If the microbes get too hot air, they will stop doing their job. And in the present designed case the temperature as shown in figure (4.1), the temperature ranges are (28°C-31°C) and this compost is a mesophilic so the slow composting rate occurred.

The temperature of the compost is measured by thermocouple during the process and its behavior similar to that obtained from the literatures.
4.2.2 Measurement of pH

The pH determines compost quality and stability. The optimum pH is between 6.0 and 7.5 for most bacteria. For the pH measured the observations show that the pH almost between 8-9 and in these values the odors are less and this confirms the process go in the right route.

Figure 4.2: PH variations in a compost pile
4.2.4 Measurement of Temp & pH

In figure (4.4) show the correlations between temperature and the PH. In the thermophilic aerobic composting, the pH is lower than mesophilic. The pH of compost decreases as the temperature increases.

Figure 4.3: temperature& PH variations in a compost pile
5-1 Economic Analysis

A number of findings were obtained from the study the most important of which is that agricultural residues amounted to 6.7 million tons; this can be converted to compost fertilizer that could represent 6.1% of the Kingdom’s needs of organic fertilizer which amounts to 110 million tons per year.

The expected impacts of the production of organic fertilizers reduce the use of chemical fertilizers which affects positively on production quality and production cost.

5-2 Marketing

The fertilizer demand is essential, both for companies producing, importing and marketing fertilizer and for governments in their efforts to monitor the development of agriculture. With the increased demand of the fertilizers, and expanding horizons of its marketing, the marketing operations of the fertilizers have also risen to new heights to meet the growing responsibilities and challenging marketing situation in the country.
CHAPTER 6
CONCLUSION AND RECOMMENDATIONS

A-1 Conclusion

The project was carried out to improve the environment through waste management by producing an organic fertilizer from the palm fronds, develop and disseminate technology on solid waste composting for the production of organic fertilizer and designed mixed fermented tank. Material balance was carried out across the plant. From the balance, Organic fertilizer is produced from 0.5kg of palm fronds, 1 gram biotrine, 60 gram clay, 7.5 gram nitrogen fertilizer, 5 gram phosphorus fertilizer. The dissolved oxygen, temperature and pH are measured and compared to the ideal ones and the results are acceptable. In the detailed design of mixed fermented tank, the volume of the cylindrical vessel is about 0.02 m$^3$ (20 liter), while vessel length is 0.3 m, the vessel diameter is 0.3 m, the impeller diameter 0.26 m and the impeller height is 0.29 m. Finally, the nitrogen content in the compost for 10 days is about 2%, the distillation flask and titrate apparatus are used in the determination of nitrogen.

A-2 Recommendations

- In the further study the off-gases should be collected and be emitted to the atmosphere after cleaning.
- Odor treatment is necessary in almost all cases as odor represents the biggest emission problem in composting. A high odor level is the biggest obstacle for public acceptance of the process.
- Gas cleaning can be performed with physical-chemical as well as with biological methods. If a biofilter is used, cooling of the off-gases is necessary to prevent overheating of the biofilter.
- The researches should focus on aerobic composting for the disadvantages of anaerobic digestion include the cost: Anaerobic composting is substantially more expensive than aerobic composting.
APPENDIXES

B- APPENDIXES

B-1: Project Team with assigned responsibilities, .............................

B-2: Faculty Advisers and Industry sponsors .................................

B-3: Project Budget and Expenses to date ...................................

B-4: Drawing package (if applicable) ...........................................

B-5: Manufacturing procedures, Test procedures and Test reports ...........

B-6: Technical reports or evaluations .............................................

C- REFERENCES ........................................................................

D- BIBLIOGRAPHY...............................................................
CAPSTONE DESIGN PROJECT
Project Submission

And

ABET Criterion 3 a-k Assessment Report

Project Title: “Production of an organic fertilizer from palm fronds” DATE: 12 / 5 /2014

PROJECT ADVISOR: Dr. Salah Eldeen Fadoll Hegazi

Team Leader: Khaled Ali Ibrahim Qouzi

Team Members:
Abdulh Ali Shoai Hjaji
Mohammed Ahmed Abo Ali
Abdul-salam Hassan Daihy
Ali Ahmed Ali Sharahili
Otaif Ali Otaif Qahtany

Design Project Information

Percentage of project Content - Engineering Science 40%
Percentage of project Content - Engineering Design 60%
Other content 0%

Please indicate if this is your initial project declaration
or final project form

• Project Initial Start Version
• Final Project Submission Version

Do you plan to use this project as your capstone design project? YES

Mechanism for Design Credit

• Projects in Engineering Design
Fill in how you fulfill the ABET Engineering Criteria Program Educational Outcomes listed below

Outcome (a),
An ability to apply knowledge of mathematics, science, and engineering fundamentals.

Please list here all subjects (math, science, engineering) that have been applied in your project.

Math., Introduction to chemical engineering, Plant design, Kinetics and reactor design.

Outcome (b).
An ability to design and conduct experiments, and to critically analyze and interpret data.

The experimental work includes measuring the main variables such as: Compost temperature, pH and the data obtained was taken into consideration in the design.

Outcome (c).
An ability to design a system, component or process to meet desired needs within realistic constraints such as economic, Environmental, Social, political, ethical, health and safety, manufacturability, and sustainability.

Outcome (d).
An ability to function in multidisciplinary teams.

This outcome is achieved automatically by the fact that all projects composed of at least 3 students. However, if the project involved students from other departments, that would be a plus that is worth to be highlighted. The project includes six students from same department. And hence no multidisciplinary.

Outcome (e).
An ability to identify, formulate and solve engineering problems.

The problem of the waste of the palm was solved by production of an organic fertilizer from palm frond and this was achieved by minimizing waste.
Outcome (f).
An understanding of professional and ethical responsibility.

Here professional and ethical responsibility depends on the project context.

Minimizing waste is the most ethic work for help in cleans the environment.

Outcome (g).
An ability for effective oral and written communication.

Good report and good presentation will fulfill this outcome

The students introduce good report.

Outcome (h).
The broad education necessary to understand the impact of engineering solutions in a global economics, environmental and societal context.

This outcome is usually fulfilled by highlighting the economic feasibility of the project, and emphasizing that the project would not harm the environment and does not negatively affect human subjects.

The economic success of the project was achieved for the low cost production compared to production of organic fertilizers of and has no harm to the environment.

Outcome (i).
A recognition of the need for, and an ability to engage in life-long learning.

This outcome is fulfilled by suggesting a plan for future studies and what else could be done based on the outcome of the current project.

- In the further study the off-gases should be collected and be emitted to the atmosphere after cleaning.

Outcome (j).
Knowledge of contemporary issues.

Extensive literature review by the “students” for the current state of the art will fulfill this outcome.

There are a lot of references were used in the project.

Outcome (k).
An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

List all technologies included in the project (hardware and software)

Excel program used for plotting and correlations.
By signing below certify that this work is your own and fulfills the criteria described above

Student Team Signatures

_________________________________  __________________________________

_________________________________  __________________________________

_________________________________  __________________________________

Project Advisor Signature_________________________  Date

College Coordinator of Capstone Projects__________________________

Approved By

_________________________
1. SUGGESTIONS ON MAKING ORAL CAPSTONE PROJECT PRESENTATIONS

1) Opening: Use a title overhead to open the presentation.

2) Organization: An early slide (probably the second one) should give an outline (Agenda) of the presentation. Be sure to include any assumptions made.

Problem statements are an excellent way to begin the actual presentation (after the outline). However, problem statements should describe the need not the solution. The solution is best presented in the objective of the design. Problem statements are an important part of this process.

3) Slides: Limit the amount of information on a slide and use large print (presentation-sized fonts). Usually, typed material will be too difficult to read from a distance.

Do not read a list from an overhead word-for-word to the audience. Just summarize the points being presented.

4) General: Limit your discussions as much as possible.

Be tolerant of questions. Most reviewers do not have intimate knowledge of your project and may even be a different discipline than your own.

Do not try to cover too much detail, just enough to describe the design process.
Be prepared before standing up. Sorting through papers, slides or setting up a demo while opening a presentation is too much of a distraction.

Practice enough so that you do not have to constantly refer to notes. This allows you to judge the time required for your presentation. Stay within the time guidelines provided (less than 20 minutes).

Include cost analysis information if your project involves construction or manufacturing. These cost estimates should include labor to build or assemble and not just be a summary of the cost of pa
Appendix C: The Project Budget and Expenses to date

<table>
<thead>
<tr>
<th>Items</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor</td>
<td>173.33 $</td>
</tr>
<tr>
<td>Impeller</td>
<td>80 $</td>
</tr>
<tr>
<td>Reel Motor</td>
<td>93.33 $</td>
</tr>
<tr>
<td>Tank</td>
<td>134 $</td>
</tr>
<tr>
<td>The manufacturing cost</td>
<td>240 $</td>
</tr>
<tr>
<td>The total cost</td>
<td>720.66 $</td>
</tr>
</tbody>
</table>
Capstone Project Check List

Information Needed

Title of Project : (Production of an organic fertilizer from palm fronds )

Instructor of record: Dr . Salah Eldeen Fadoll Mohammed

What semesters : Spring

How many credits : 04 Cr

Max number of students allowed : 07

Any special pre-requisites you want to have for the capstone (besides the CORE)

Items that should be in a Capstone

<table>
<thead>
<tr>
<th>Item</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant design</td>
<td>✓</td>
</tr>
<tr>
<td>Knowledge of at least 3 areas of specializations</td>
<td>✓</td>
</tr>
<tr>
<td>Level worthy of 6 hours</td>
<td>✓</td>
</tr>
<tr>
<td>Creativity and deductive reasoning</td>
<td>✓</td>
</tr>
<tr>
<td>Realistic Constraints: economic</td>
<td>✓</td>
</tr>
<tr>
<td>Environmental, sustainability</td>
<td>✓</td>
</tr>
<tr>
<td>Manufacturability, ethical</td>
<td>✓</td>
</tr>
<tr>
<td>Health &amp; safety, social, political</td>
<td>✓</td>
</tr>
<tr>
<td>Appropriate computer aided tools</td>
<td>✓</td>
</tr>
<tr>
<td>Teamwork: at least 3</td>
<td>✓</td>
</tr>
<tr>
<td>Description of product - deliverable</td>
<td>✓</td>
</tr>
<tr>
<td>Budget and where the money is coming from</td>
<td>✓</td>
</tr>
<tr>
<td>Time line</td>
<td></td>
</tr>
<tr>
<td>Schedule of milestone reports</td>
<td>✓</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---</td>
</tr>
<tr>
<td>Design review board (2 from EngM, ideally industry)</td>
<td>✓</td>
</tr>
</tbody>
</table>

Written & oral reports. The project should contain at least 2 reviews (if a 6 credit capstone) or at least 3 (if a two semester capstone). These reviews would include a Project concept review (people agree on what the project is), Preliminary Design Review (what are the major components and how they should be realized), and a critical design review (where the selected specs are reviewed and selected). Written and oral reports should be appropriate format (see dept. Format ). The written reviews (copies) should be turned in to the Undergraduate studies committee (USC) at the end of the semester.

<table>
<thead>
<tr>
<th>Final Review: Written and oral report using appropriate format (see dept. Format ).</th>
</tr>
</thead>
<tbody>
<tr>
<td>This should include the product specs, summary of the project, and a working product. An USC member should be present and will collect materials at the end of the presentation.</td>
</tr>
</tbody>
</table>
REFERENCES


3- http://www.differenc.com/difference/Chemical_Fertilizer_vs_Organic_Fertilizer


6- Cecilia Sundberg, (2005).” Improving Compost Process Efficiency by Controlling Aeration, Temperature and pH “,Faculty of Natural Resources and Agricultural Sciences -Department of Biometry and Engineering, Swedish University of Agricultural Sciences

7- Steven J. Scheuerell and Walter F. Mahaffee,(2004),Compost Tea as a Container Medium Drench for Suppressing Seedling Damping-Off Caused by Pythium ultimum


9- Cecilia Sundberg, (2005),”Improving Compost Process Efficiency by Controlling Aeration, Temperature and pH


11 - Hamelers, H.V.M.,(2001),”A mathematical model for composting kinetics”, Thesis Wageningen University, Wageningen
الملخص

يهدف هذا المشروع إلى تصميم مفاعل خلط دفعي لإنتاج سماد عضوي من جريد النخيل كمصدر للضوء.

يجب اختيار المواصفات والخصائص للمفاعل والبحث عن الطرق المبتكرة لتصميم الجهاز باستخدام البيانات المتوفرة.

إن التخلص من النفايات الصلبة يشكل خطراً كبيراً على البيئة وعلى صحة الإنسان ومعظم هذه النفايات القابلة للتحليل يمكن تحويلها إلى موارد ذات قيمة تقلل من أثارها السلبية.

إن الهدف من الدراسة هو تصميم مفاعل ذو الخلط المستمر لإنتاج سماد عضوي من جريد النخيل لاحتياطات النباتات، على مادة عضوية تقدر بحوالي 43% وكذلك لمراقبة استخدام السماد العضوي مقارنة بالسماد الكيميائي الأخرى التي لها آثار سلبية على صحة الإنسان والحيوان.

تم إجراء التصميم النثري للمفاعل حيث تم استخدام خلائط مكونة من جريد النخيل وإضافة منشط عضوي (بيوترين) 1جم وسماد نتروجيني 5.7جم وسماد فسفوري 4جم وطين 0.6جم. وقد تم قياس الريشة ودرجة الحرارة بصورة يومية وتمت مقارنتها مع التصميمات الم-xl حيث تم تصميم الخلائط بحجم 0.02m^3 وقطره 0.26m ومساره 30 سم وارتفاعه 29 سم. كما أن ارتفاع الريشة يعادل 0.29m وقطرها يعادل 0.26m.

في الختام تم قياس الريشة المحتوي النتروجيني باجراء تقطير باستخدام جهاز تقطير لعينة السماد وعمل معابرة لدقيقة 100 يوم حوالي 2%.
كلية الهندسة
قسم الهندسة الكيميائية

إنتاج سماد عضوي من جريد النخيل

طلاب فريق العمل

1- خالد علي إبراهيم قوزي
2- محمد أحمد أبو علي
3- عبد الله علي شوعي حجاجي
4- عبد السلام حسن ضانحي
5- علي احمد شراحيلي
6- عطيف علي قحطاني

مشرف المشروع
د.صلاح الدين فضل حجازي

تقرير مشروع التخرج مقدم للحصول على درجة البكالوريوس
في الهندسة الكيميائية

تاريخ التقدم (مايو/2014)