UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND DEVELOPMENT OF AUTOMATIC OIL DISPOSAL GREASE TRAP SYSTEM WITH SOLAR TRACKER

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

by

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I hereby, declared this report entitled DESIGN AND DEVELOPMENT OF AUTOMATIC OIL DISPOSAL GREASE TRAP SYSTEM WITH SOLAR TRACKER is the results of my own research except as cited in references.

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APPROVAL

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 Engineering Technology (Maintenance Management) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Pada masa kini saluran paip tersumbat di premis makanan sering berlaku, terutamanya di restoran kecil. Lemak, minyak dan gris (FOG) yang dilupuskan daripada premis makanan menjadi punca utama untuk isu ini dan mencemarkan sistem saliran. Mereka memerlukan perangkap gris untuk mengatasi masalah ini di premis makanan. Projek ini adalah untuk membuang FOG dari air kumbahan dengan perangkap gris automatik yang menggunakan tenaga boleh diperbaharui. Tujuan projek ini adalah untuk merekabentuk dan membangunkan sistem pelacak suria bagi perangkap minyak automatik dengan menggunakan Arduino dan sensor sinaran cahaya (LDR) untuk meningkatkan sistem input kuasa yang digunakan untuk mengendalikan pelupusan minyak automatik dalam perangkap gris. Untuk memastikan objektif dicapai, sistem pelacak suria direka berdasarkan metodologi rekabentuk kejuruteraan iaitu, rumah kualiti (HOQ), kaedah Pugh dan carta morfologi untuk memastikan kriteria kejuruteraan dicapai dengan kebimbangan pelanggan kepuasan. Untuk meningkatkan kecekapan pelacak solar, menggunakan sensor sinaran cahaya untuk mengesan lokasi matahari dan Arduino untuk memberi arahan kepada motor berdasarkan isyarat yang diterima daripada sensor sinaran cahaya. Dengan menggunakan kaedah ini, dapat mengurangkan penggunaan masa yang digunakan untuk menyerap tenaga dari matahari dan meningkatkan keupayaan perangkap gris automatik untuk menggunakan mana-mana sahaja.

ABSTRACT

These days pipeline clogging in food premises frequently emerges, particularly in small range restaurants. Fat, oil and grease (FOG) disposed from food premises becoming root cause for this issue and pollute drainage system. They require a grease trap to overcome this issues in food premises. This project is to remove the FOG from wastewater and with automatic oil disposal system by using renewable energy. The purpose of this project is to design and develop the solar tracker system for automatic oil disposal grease trap by using Arduino and light radiation sensor to improve power input system used to operate automatic oil disposal in a grease trap. In order to ensure the objective is reached, the solar tracker was designed based on engineering design methodologies i.e., the house of quality (HOQ), Pugh method and morphological chart to ensure the engineering criteria achieved with the concern of customers satisfaction. To improve the efficiency of solar tracker, using light radiation sensor to detect the location of sun and Arduino to giving a command to the motor based on a signal received from a light radiation sensor. By using this method, able to reduce time consumption used to absorbing energy from the sun and improving the ability of grease trap to using anywhere.

DEDICATION

My parents, my supervisor, my co-supervisor and to all my friends.

Thank you for all the support and ideas.

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FOG	Fat, Oil and Grease
FPF	Food Processing Facilities
AGRU	Automatic Grease Removal Unit
PV	Photovoltaic
UV	Ultra Violet
RE	Renewable Energy
BOD	Biochemical Oxygen Demand
a-si	Amorphous Silicon
CdTe	Cadmium Telluride
CIGS	Copper Indium Gallium Selenide
OPC	Organic Photovoltaic Cell
TFPV	Thin Film Photovoltaic Cell
PIC	Programmable Interface Controller
PLC	Programmable Logic Controller
LDR	Light Depended Resistor

HoQ	House of Quality
M-Chart	Morphological Chart
QFD	Quality Function Deployment
CAD	Computer Aided Drawing
CD	Compact Disc
LCD	Liquid Crystal Displays
PVC	Polyvinyl Chloride

CHAPTER 1

INTRODUCTION

1.1 Background

Blockage in drainage systems of food processing facilities (FPF) just like as fast food restaurants, food courts and caterings become as a concern for long term which caused by the fat, oil and grease (FOG) deposits in sewer. Urbanization of an area causing growth of FPFs and increasing the amount of FOG consumption in that area (Popkin.B., 1999). Refer to the United States Environmental Protection Agency; roughly, 3 to 10 billion gallons of untreated wastewater is discharged to drainage systems (EPA, 2004).

Alkaline detergents used in FPFs (PH>10) acted as oxidizer and react with FOG to create the formation of saturated fat in sewer pipes through the chemical reaction called as saponification. Common cooking oils ranged from 7 to 20% and animal fat ranged from 33 to 48% contains in sewer FOG (Ducoste et al., 2008). The sewer FOG discharged from untreated wastewater becomes cooling down, harden, and stick inside the pipelines. This development of FOG, starting to reduce the diameter of pipes and reduce the flow rate of water. At a point, it is completely blocking the flow of water and causing flooding's or over flow. 25000 flooding events per annum in UK caused by sewer blockings (Scott et al., 2008). Flooding's are increasing the risk of water-borne and vector-borne diseases, which effect the healthy environment of human's. Water-borne disease are causing by mixture of dirty water in drinking water leads to the serious illness such as Guinea worm disease, typhoid and cholera. Flooding's are indirectly increasing the risk of vector-borne

diseases. Flooding is causing standing water which help to expand the vectors breeding (mosquitos), improving potential of spreading's of the disease's such as dengue, malaria and yellow fever.

Grease trap is a mechanical device used to prevent the discharge of FOG in a drainage system. Grease traps also known as grease abatement system, grease interceptors, grease separator's or grease recovery units used to separate FOG and food waste from wastewater which discharge to the drainage system through gravitational separation. Grease traps are having multiple sections to separate grease and solid particles such as rice and meat from wastewater. Greases which having less density then water will rise up and trap to surface of water and solid particles will trap in bottoms of water and wastewater will discharge to the sewer (Ragauskas, 2013). Hydromechanical is a one of it. This type of grease traps normally using principles of wastewaters heat and gravity to split up the FOG from it. The splitted grease need to be collected or cleaned manually and often to avoid mixtures of high thickness of greases with water again. Gravity Grease Separator is another type of grease trap. In this type, by using multi-compartments (usually two or three compartments) to reduce the speed of flow rate and separate the FOG and water based on gravitational principles. The combinations of mechanical and electrical parts in grease trap known as Automatic Grease Removal Units (AGRUs). This is the smaller size of grease trap and very efficient grease trap then others.

A method used to generate electricity from sunlight called as solar power. It is a un-pollutant renewable energy source and it is obtainable in every part of the world. A solar power system uses photovoltaic (PV) to collect the sun's energy. In Malaysia, especially, the solar based power generation potential is 6500MW, while in 2010, network

connected solar PV is just 1MW while off-grid is 6.1MW (Lulia S. et al., 2013). On the other hand, the Malaysian Government has boarded on continuous effort in the development of Renewable Energy (RE) through various support and promotion programs (Economic Planning Unit, 2010). PV cells utilize solar based energy to create a chemical reaction that produces power. Every cell contains a semiconductor; normally, silicon in one of a few structures (single-crystalline, multi-crystalline, or thin-layer), with polluting influences (either boron or phosphorus) diffused all through and is encased with a silk screen. Cells are merged together through a circuit and frame right into a module. Semiconductors allow the electrons freed from impurities by the sun's rays to move rapidly and into the circuit, generating electricity (Boziane K. et al., 2014). A PV module must have an inverter to alternate the DC current into alternating current that allows you to be serviceable by way of electrical gadgets and well suited with the electric grid (S.C. Bhattacharyya, D. Palit., 2014). Less efficient of solar systems initiated by fixed mounted and do not follow the variation of the solar position (D.R. Carvalho et al., 2013). By using, the solar tracker can improving the efficiency of energy generation. Usually, a sun tracker can be categorized in two types; passive trackers and active trackers. However, the most efficient and prominent sun trackers was found based on the form of polar -axis and azimuth-elevation types (Roth P. et al., 2005). Throughout these, they can be either single axis tracking or double axis tracking. The most frequently used configurations in double axis tracking are polar-axis and azimuth-elevation, which can improve amount of captured solar energy by 30 to 50% compared to fixed tilt device (Kelly N.A et al., 2009). There two different types of system using in solar tracker; open loop and closed loop. In

the open loop system, sun movement predict by using mathematical calculations but in the closed loop system, sun movement detect by using light radiation sensor.

1.2 Problem Statement

Grease trap system cannot be function properly if face with any of this problem. Most common problem occur in grease trap is blockage in pipeline between two compartments or outgoing pipeline. Blockage in pipeline between two compartments normally occur when FOG deposits or solid particles in wastewater stuck in pipelines. This is causing imbalance flow and water level between two compartments. Usually first compartment having higher water level then second compartments. High concentration of FOG has potential to create deposits in pipelines, which can lead to the blockage (Williams et al., 2012). Blockage in outgoing pipeline lead to more serious case, overflowing between compartments will occur and distract the separation grease from the wastewater. These problems can be increasing maintenance expenses of grease trap and time to troubleshoot. Full grease trap is also another problem, when FOG from primary compartment is not pumped in a timely manner; this will eventually have a full grease trap, which the waste from the first compartment spills over into the second one. This will clog the crossover, incoming, and outgoing lines. In this can check if the depth of the grease cap by using pole and if goes all the way to the bottom, it is the time for pump the grease. Mattsson et al. (2015) suggests that blockage “hot spots” can be categorized into three categories, grease loading, design or structural issues and sewer cleaning effectiveness.