UNIVERSITI TEKNIKAL MALAYSIA MELAKA

GRAVITATIONAL EFFECT ON WATER FLOW OF VENTURI FERTILIZER SYSTEM (VFS) FOR AGRICULTURE FERTIGATION

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

by

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2019

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: Gravitational Effect On Water Flow of Venturi Fertilizer System (VFS) for Agriculture Fertigation

Sesi Pengajian: 2019

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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 (Automotive Technology) with Honours. The member of the supervisory is as follow:

Signature: …….

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ABSTRAK

Teknologi ini dibangunkan dan digunakan di Mexico pada tahun 1970-an. Ia pada dasarnya adalah sistem pengairan aliran graviti yang berselang-seli. Sistem ini telah digunakan hampir semata-mata untuk pertanian berskala kecil dan berkebun domestik. Dalam bidang pertanian, hasil baja tanaman yang lebih baik sangat penting. Adalah sukar untuk mengagihkan baja ke setiap tanaman dengan kadar yang betul kerana banyak sebab seperti mencampurkan baja dengan kadar yang tepat, tenaga manusia yang lebih banyak diperlukan, jangka masa yang panjang dan lain-lain. Oleh itu, ia akan memberi hasil tanaman yang rendah yang tidak menyenangkan terutamanya untuk ladang-ladang yang kekurangan sumber air. Kadang-kadang petani membekalkan air dan baja yang berlebihan ke setiap tumbuhan dan menyebabkan air yang tidak mencukupi dalam tangki ke kawasan tanaman lain. Sistem pengendalian konvensional Sistem Baja Venturi (VFS) menggunakan paip air langsung untuk mengalirkan air dari salur masuk ke saliran sistem pengairan. Dalam projek ini, tekanan graviti digunakan untuk menggantikan sistem operasi konvensional. Tangki air diletakkan pada ketinggian tertentu untuk mengkaji keberkesanan tekanan air di luar. Titik keluar kuantiti yang dibenarkan juga dianalisis pada ketinggian kedudukan tangki air yang berlainan.

ABSTRACT

This technology was developed and applied in Mexico during the 1970s. It is essentially intermittent gravity-flow irrigation system. It has been used almost exclusively for small-scale agriculture and domestic gardening. In the field of agriculture, better yield of crops fertilizers are very important. It is difficult to distribute fertilizer to each crop with proper proportion due to many causes such as mixing the fertilizer with proper proportion, more man power required, time span etc. Therefore, it will give low yield of crop which is unpleasant especially for the farms that lack the source of water. Sometimes, the farmers supply excessive water and fertilizer to each plants and cause insufficient water in the tank to other area of plants. Conventional operating system of Venturi Fertilizer System (VFS) uses direct water tap to flow the water from inlet to outlet of irrigation system. In this project, the gravity pressure is use to replace the conventional operating system. Water tank was placed at certain height in order to study the considerable effectiveness of the outlet water pressure. The permissible quantity outlet points were also analysed at different height of water tank position.

DEDICATION

In the name of Allah, The Most Gracious and The Most Merciful

I dedicated this work to:

My parent:

Mohd Sha'ari Bin Othman & Wan Noridah Binti Wan Mohamad

My siblings and friends

ACKNOWLEDGEMENTS

First and foremost, I thank Allah s.w.t, the Almighty God for his mercy and grace in enabling to complete this thesis work. I would like to take this opportunity to express my sincere acknowledgement to my supervisor Ts. Mohd Ruzi Bin Harun from the Faculty of Engineering Technology Mechanical and Manufacturing of Universiti Teknikal Malaysia Melaka (UTeM) for his essential supervision, support and encouragement towards the completion of this thesis.

Special appreciate also to the other lecturers that give extra knowledge and idea to improve my writing and also to the panel that help me to improve my presentation skill and my report. By following all the steps, I am able to finish my project on time with the objective achieved.

To my family, especially my parents Mohd Sha'ari Bin Othman and Wan Noridah Binti Wan Mohamad, thanks for all the moral support and unwavering belief in me. Without you, I would not be the person I am today. Finally, I would like to make an affectionate acknowledgement to all my colleagues and friends who had help and supported me during my research studied directly or indirectly.

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VFS	-	Venturi Fertilizer System
HGL	-	Hydraulic Grade Line
Gpm	-	Gallon per minute
Pa	-	Pascal
ρ	-	Density
g	-	Gravity
h	-	Height
P	-	Water Pressure
PLC	-	Programmable logic controller
PVDF	-	Polyvinylidene Fluoride
Gal	-	Gallon
Ft	-	Feet
psi	-	pounds per square inch
PC	-	Pressure Compensating
PP		Polypropylene
ml	-	Milliliter
KNO_3	-	Potassium nitrate
KCl	-	Potassium chloride
$Ca\ (NO_3)_2$	-	Calcium nitrate
NH_4NO_3	-	Ammonium nitrate

CHAPTER 1

INTRODUCTION

1.1 Background of Study

In the field of agriculture, better yield of crops fertilizers are very important. It is difficult to distribute fertilizer to each crop with proper proportion due to many causes such as mixing the fertilizer with proper proportion, more man power required, time span etc. Therefore, it will give low yield of crop which is unpleasant.

Venturi is a tube with a narrow size that develops negative pressure (vacuum) at its suction port when water flow through it at minimum velocity. The vacuum pulls the chemical solution into venturi port where it mixed with the water and passed into the system. The injection system must be specifically calibrated for the irrigation system.

The working principle of a Venturi injector is based on a fluid flow that causes low pressure at an inlet port. Thus, low pressure can be generated from a high pressure flow. A Venturi injector consists of pressure inlet, suction inlet, outlet and a convergent-divergent constriction. Low pressure is generated as air flows through the converging passage that gradually widens. The constriction causes a high velocity by which a low pressure at the suction inlet is caused. Thus, the fluid at the suction inlet is drawn into the nozzle and mixes with the inlet fluid.

Venturi injector is widely used in fertigation system due to its obvious advantages such as cheap system, simple structure, convenient to operation, labor saving, stable performance and does not need external energy for operation. Venturi injector is one of the basic types of injector in drip irrigation system.

Conventional operating system of Venturi Fertilizer System (VFS) uses direct water tap to flow the water from inlet to outlet of irrigation system. In this project, the gravity pressure is use to replace the conventional operating system. Water tank was placed at certain height in order to study the considerable effectiveness of the outlet water pressure. The permissible quantity outlet points were also analysed at different height of water tank position.

1.2 Problem Statement

Venturi tube usage often experience problems such as head losses, cavitation phenomena and sometimes cannot inject fertilizer solution. The farm that difficult to get the source of water can cause low yield of crops. Therefore, the quantity of outlet water pressure should be enough to supply to the plants. Sometimes, the farmers supply excessive water and fertilizer to each plants and cause insufficient water in the tank to other area of plants. This method can make sufficient quantity outlet water supply to the plants and can get specific height of the tank position.

1.3 Objective Project

The direction of this project is based on the following objectives:

- To study the permissible quantity outlet water pressure at the height of water tank positon.
- To get accurate water pressure from the height of water tank position

1.4 Scope of the Project

The limitation of this project is based on the following scopes:

- Analysed the permissible quantity outlet water flow from the tank and supply to the plants.
- Calculated the gravity pressure based on the height of water tank position.
- This system only for small area of land.
- This system is limited for 100 holes only.
- This fertigation system for automatic fertigation system.
- The height of water tank is fixed.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this literature review chapter will consist of information and summarizing about water flow, venturi fertilizer system and fertigation. In this section provided process of obtaining and summarizing the related information through the reviews on the journals, books, internet resources, articles and etc. It provides the background knowledge of this research and worked as a guide to the later part of this project. Besides that, this literature review will include the gravitational effect related to conventional operating system of Venturi Fertilizer System (VFS).

2.2 Gravity Tank Fertigation

Gravity irrigation systems are reasonable and effective thanks to provide water to a slender space of plants. This would be terribly price effective if the climate during this space could offer enough precipitation to fill the reservoir victimisation rain storage technology. The essential system is incredibly simple; it's all controlled by hand or from rock bottom that leads the water to the basic drip irrigation system controlled by a powered timer controller by a high power battery in dominant rate consists of an elevated reservoir with an outlet pipe. The parts needed for the project should be properly enclosed within the report.

Figure 2.1: A 1000 litres capacity drum mounted on a concrete form

2.2.1 Water Reservoir

A water reservoir that is far provided by the concept and generates tension on the project system is required. It needs to be adequately watered for at least one day to ensure longer fertilization duration. The more the reservoir's capacity is proportional to how often it has to be replenished in order to avoid flowers or plant production. The difficulty of getting a very large container is that you need to raise it above the plant and you need to empty a totally unnecessary box for the specific short amount of time by using a pump. In addition, the reason for raising the tank is that it provides strain that needs to be saved on a regular basis when the drip strains are fed so that the water is further dispatched.

In addition to the structure to support the water reservoir, anything that can guide the box's weight when it's miles full of water can be created. It must also be able to withstand external forces, including changes in wind and atmosphere. A full 880 gal box weighs 4 lots is sufficient to give the irrigation pressure. Estimating round tank quantity of stock tank volume in about = diameter x width x depth in feet x 6.

2.2.2 Piping of Irrigation System

It really is a great idea if the pipe is deployed at the bottom of the reservoir, allowing water to empty out at this connection and flip off the valve, and if the reservoir is really worth a few days of water.

There must be a pipe at the base of the reservoir that lets water flow out and having a shut off valve at this connection point and is a good idea if the reservoir is larger than one days' worth of water. The piping can use a timer system and then it must be implemented to supply water through the filter.

In order to increase stress, unique size pipes should be used to save you from the fertilizer clogging. This technique gradually decreases the size of the strains used, e.g. starting with a (2 ft line at the bottom of the tank, then decreases the size every 1-four ft so that it can be 1 ft, 6 inches, 3 inches, 1 inch, 1⁄2 inch) in the emitter by decreasing to 1/8 in at the irrigation line.

2.2.3 Timer Regulator and Water Filter

There are many battery-powered timer models that can be set up and run for a whole season. These timers manage the frequency of emitting water into the strains of the drip. Later than the timer switches, a clear out should be mounted in the water line. It avoids clogging and advancing fertilization gadget from the smaller strains.

There are many timer fashions powered by batteries that can be set and run in a single season. This timer regulates the rate in the irrigation line of water released. The filter should be put in the front or earlier water line than the timer valve. It avoids blockage of thin lines and increases the fertilizer.

2.2.4 Valves and Drip irrigation lines

The closing valve must be positioned between the reservoir tank pipe and the irrigation pipe in front of the timer valve. The drip line is any common line that can be bought from any gardening and hardware store.

2.2.5 Design Concept of Gravitational Tank

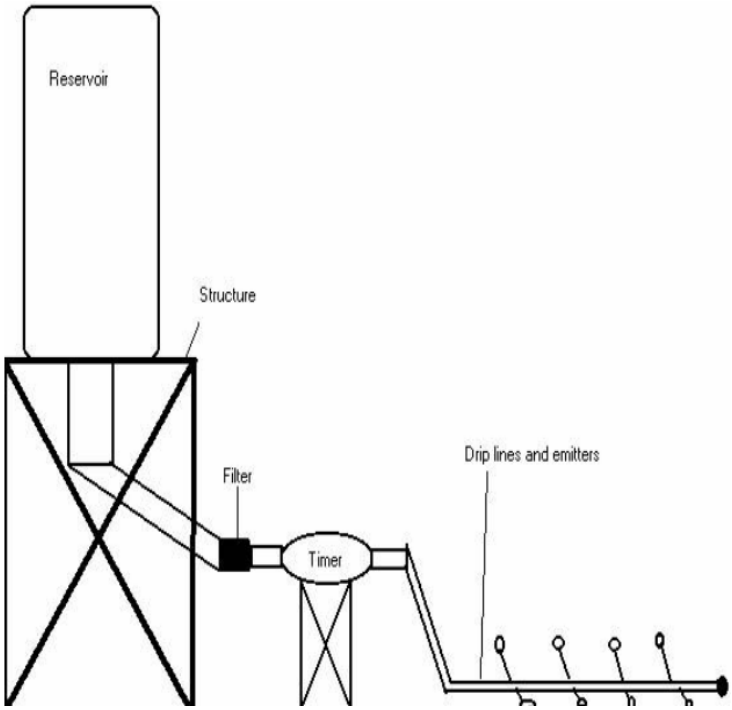

Figure 2.2: The illustration concept design that want to be optimize

The dam must be as wide as critical because the larger it is, the less possible it will be to fill and assist. Together with cement, properly braced steel or timber, the structure should be very stable. The piping is PVC and can be reduced to any size and different joints are available to make it easy to make any form or edition to length. In any yard, the filter can be provided and must be flushed many times to avoid clogging. In these tests, the vehicle-timer can also be sold in a special hardware shop that could provide a cheaper or friendlier item. The reservoir should be as large as necessary. The smaller the easier the filling and support. The structure should be very stable like concrete, wood and well braced metal .The

pipes are PVC material, and can be cut to any size, and various connections are possible so that all shapes or adaptations to size can be easily performed. Filters can be purchased in any garden and need to be watered many times to avoid clogging. Automatic timers can also be purchased in specialized hardware stores in this survey, which can provide a cheaper or better premium product. In contrast to the droplet traces, the size is widespread and safe for modification.

2.2.6 Emitters

Drip irrigation emitters use different special strategies at the opening to reduce the cost of gliding. Flow loading figures for a wide range of emitters no longer fall below 10 psi, as shown in Figure 2.3, because they are meant to be used with better stress structures with a regulator that maintains a normal force. Flag emitter is the NC, or no compensating, what uses the cutting-edge prototype of the sponsor. This emitter type has the potential for cleaning to be disassembled. For drip irrigation systems, clogged emitters are higher standard that do not use a clear out due to low stress. A laboratory test happened within the Experimental Hall of the China Agricultural University that tested emitter clogging based on shape of emitter. From this test it ends up concluded that turbulent waft emitters, such as the flag emitters, are the most successful at stopping clogging.

Pressure compensating (PC) emitters provide steady wave charge for a specific range of operating pressures to account for slight elevation changes in the device's output. The drift price is very similar at ultra-low pressures through non-pressure compensating emitters and higher complex PC emitters. Such PC emitters usually have a pressure range of 10-40 psi or 30-50 psi, but do not maintain a steady stream below the minimum load. The operating pressures of a gravity-fed irrigation gadget with restricted head strain are just too distant to presume float power under the PC emitters running distance.

In 2010 a study was carried out at the Farmington Agriculture Science Center (ASCF) to determine which emitters might be appropriate for use in low-strain structures. The test evaluates the consistency of various emitter models in low-stress drip systems and indicates the relationship between flow rate and consistency. The test showed that NC emitters are able to deliver water at low pressures uniformly.

Figure 2.3: Example of Various Drip Emitters.

(China Watering Plastic Dripper Irrigation Emitters 2010)

2.2.7 Irrigation

Irrigation is the soil's artificial water technology because of crop production. To complement the rainfall, irrigation water is used. The amount and timing of rainfall in many regions of the world are no longer ok to meet the moisture needs of plants and therefore irrigation is necessary to meet the desires of food and fibre designed to allow farming in arid and semi-arid regions to minimize drought. The growing demand for crop production is triggering the rapid expansion of irrigation throughout the arena for the growing population.

Drip or drip irrigation is one of the state-of - the-art irrigation methods that is becoming increasingly popular in areas where water scarcity and salt problems are present. This allows for the consistent and gradual application of water to the plant so that practically all of the water is concentrated within the root zone. Common losses, deep percolation, erosion, and evaporation of ground water are reduced in drip irrigation. Drip irrigation is categorized within the discipline according to its placement: surface drip machine–water is applied immediately on the soil floor; sub-surface drip irrigation system–water is perforated under the soil surface. In this method, irrigation water is provided by the use of small diameter