UNIVERSITI TEKNIKAL MALAYSIA MELAKA

EVALUATION OF ELECTRICAL CONDUCTIVITY(EC) FOR FERTILZER SOLUTION OF VENTURI FERTILIZER SYSTEM (VFS) USING DESIGN OF EXPERIMENT(DOT) ANALYSIS FOR AGRICULTURE FERTIGATION

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

by

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2019

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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SESI PENGAJIAN: **2019/20 Semester 2**

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Sukacita dimaklumkan bahawa Laporan PSM yang tersebut di atas bertajuk ***"* Evaluation Of Electrical Conductivity(Ec) For Fertilzer Solution Of Venturi Fertilizer System (Vfs) Using Design Of Experiment(Dot) Analysis For Agriculture Fertigation*"*** mohon dikelaskan sebagai *SULIT / TERHAD untuk tempoh LIMA (5) tahun dari tarikh surat ini.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Mechanical and Manufacturing Automotive with Honours. The member of the supervisory is as follow:

………………………………

(Ts. Mohd Ruzi Bin Harun)

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I hereby, declared this report entitled “PSM Title” is the results of my own research except as cited in references.

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DEDICATION

Special thanks to:

My beloved parents

Siblings

Friends

Thank you to my supervisor:

Ts. Mohd Ruzi Bin Harun

For all the spirituals and moral support that had been given to me all the time.

ACKNOWLEDGEMENT

I would like to thank first and foremost, I would like to take an immense pleasure in thanking my supervisor, Ts. Mohd. Ruzi Bin Harun for his invaluable advice, guidance and his enormous patience throughout the development of the research. Although, I would like to express my deepest appreciation to Faculty of Technology Manufaturing (FTKMP) in UTeM for providing this subject which is project undergraduate. This project has given me the opportunity to gain a deeper knowledge regarding to the topic I have chosen about fertigation system. Without this subject, I would not have known that I have the capabilities to finish this project as the project undergraduate has always been known as the hardest project in university. Besides that, I would like to express my thankful to our lecturer En. Khairul Azri B. Azlan and En. Mohamed Saiful Firdaus B. Hussin who pointed out the mistake I made during the presentation. Without them, my mistaken would not be realised and most probably will cause to serious consequences. In addition, I would like to take this opportunity to convey my gratitude to other all my lecturers and course mates who always ready to help me whenever I faced difficulties in doing the project and willing to share the information to me. Last but not least, I would like to express my appreciation to my family and friends who have given their hand along the way. Their spiritual supports and loves have always given me the strength to finish the project. Once again, thousand words could not fully express my thanks to them, but their kindness have graved in my heart all the time.

ABSTRAK

Tujuan utama penyelidikan adalah untuk memeriksa dalam beberapa masalah system sistem yang digunakan untuk zaman sekarang. Daripada pemerhatian kajian, terdapat cara yang mudah dan murah untuk sistem fertigasi. Kajian ini dijalankan untuk menunjukkan data input (EC) yang diperlukan untuk mencapai output (EC) 2.5 µs/cm dalam jarak minimum 20 lubang. Data minimum ini kemudian boleh dijangka untuk top-up input yang seterusnya dengan tujuan untuk tidak menyalurkan kandungan baja terlalu lebih atau kurang kerana ia menetukan kesihatan pertumbuhan pokok untuk cukup nutrien. Selepas itu, kandungan baja 2.5 µs/cm ini pula diuji untuk mencapai jarak dalam 20 sehinggalah 100 lubang kerana untuk melihat berapa banyak kehilangan baja apabila menggunkan 'venturi injector'. Dalam pada itu, untuk menunjukkan berapa hasil tanaman yang boleh dikeluarkan tanpa menggunkan tenaga buruh dalam perancangan menggunakan 'water timer tools'. Produk ini boleh diset kan masa mengikut jadual yang ditetapkan dimana ia membuka injap untuk air masuk dan menyedut baja hingga ia disalurkan ke pokok. Beberapa komponen digunakan dalam keseluruhan sistem direka untuk kos yang rendah tetapi dalam bentuk sistem fertigasi yang kompleks dan dipastikan berfungsi dengan efisien untuk mendapatkan hasil data yang tepat dan bernas.

ABSTRACT

The main purpose of the research is to examine in some depth the problem occurrences fertigation system that use for nowdays. From what we observed there are easy and cost less money transforming. Function of this experiment is to shows the expectation result in input (EC) that needed to reach the output (EC) electrical conductivity of 2.5 μs/cm for the minimum range of 20 holes of micro pipes. This minimum result then can be assume on the next top-up input of the fertilizer in reason for do not want to overdose or undersupply the content of the fertilizer that leads unbalance or unhealthy growth of plant. After that, the content of fertilizer output were tested from 20 to 100 holes to test how much loss was recorded when using venturi injector. This is because when more holes were stamped the suction, the speed of venturi injector increases due to many micro pipe flow out of the water output. Other than that, is to show the outcome in produce more yields crop in such an efficient way and less effort in planning to connect the irrigation system with water timer tools. This product can set the time according to the schedule where it open the valve to allow water flow in for the fertilizer content reaches the plant. Several component that has use in the whole system was design for less cost but in such complex fertigation system and must work efficiently to assure precise result outcome.

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GLOSSARY

Cation-Exchange Capacity (CEC) – Capacity of soil to exchange cations (positively charged ions). High clay or organic matter content soils have a higher CEC than low organic matter or sandy soils.

Wetting Diameter – Area of which emmiters drip the water from irrigation line.

Denitrification – Conversion and loss of nitrate nitrogen to atmosphere in various gas forms, due to lack of oxygen when soil becomes saturated with water.

dS/m – Unit of measurement for electrical conductivity of soil in deciSiemens per meter.

µs/cm – Unit of measurement for electrical conductivity of soil in microSiemens per meter

EC Method – Standard accepted laboratory method for soil EC testing using a saturated paste extract (does not need to be adjusted for soil texture).

EC1:1 Method – Soil EC testing method described in this document using a 1:1 soil-water mixture that must be adjusted for soil texture.

Nitrification – Conversion of ammonium compounds in organic material, or fertilizer into nitrites and nitrates by soil bacteria, making nitrogen available to plants.

Nitrogen Oxides – Family of nitrogen gases that can be generated by human activities and released to atmosphere. Losses of nitrogen gases from soils increase 10 to 100 fold through nitrification, under dry soil conditions; or through denitrification, under saturated soil conditions. Soil losses of nitrogen oxide gases also increase, when EC values are above 1 to 2 dS/m.

Respiration – Release of carbon dioxide (CO2) from soil due to soil biological activity (i.e., microorganisms and roots) and decomposition.

Saline/Sodic Soil – Saline soils have a high content of soluble salts that negatively affect soil processes, productivity and overall soil health. As sodium (Na+) predominates, saline soils can become *sodic*. Sodic soils present particular challenges because they tend to have poor structure, preventing water infiltration and drainage.

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CHAPTER 1

INTRODUCTION

1.1 Research background

The efficient use of water and recycle of waste water are most economic and often major sources of extra water and at the same time the most important is to controlling water pollution. The drip irrigation is a well efficient micro-irrigation. It applies the water throughly to the root zone according by the crop needs. Further with the addition of the drip irrigation to control the water applications matching the temporal variations of plant or crop water needs is possible. The whole efficiency of drip irrigation system is about 80 - 95 per cent compared with that of 30 - 40 per cent in the situation of surface irrigation. Because of high efficiency, drip irrigation methods are replacing conventional irrigation methods especially in water scarce areas. By developing drip irrigation technique has made possible to irrigate almost all growing crops soils, even on rolling hills and steep slopes.

The proper drip irrigation delivers right volume of water from all emitting devices assumed in proper set conditions. But it is really difficult to bring reach as flow from emitting device affected by variability in water pressure through distribution irrigaton lines, which eventually affects the wetting diameter in irrigation line. Constant water distribution by any irrigation system is necessary to increase the crop/plant yield and to improve the quality of farmers produce. The constant water supplying is also necessary for efficient use of available irrigation water with the right timing schedule on irrigation.

Although drip irrigation has high potential for irrigation efficiencies, poor design, management and maintenance to leads low efficiencies, non-uniform discharge throughout the irrigated field. To overcome this lack of uniformity, field irrigation which leads to waste gate of water, nutrients, energy and also ensure that proper water application efficiency needs technical evaluation of the system.

Venturi injector is largely used in fertigation system thanks to its obvious advantages such as cheap system, simple design, and robust system, suitable for water pressure operation, and needless of external energy for operation. Venturi injector is one of the basic types of injector that suitable in drip irrigation system.

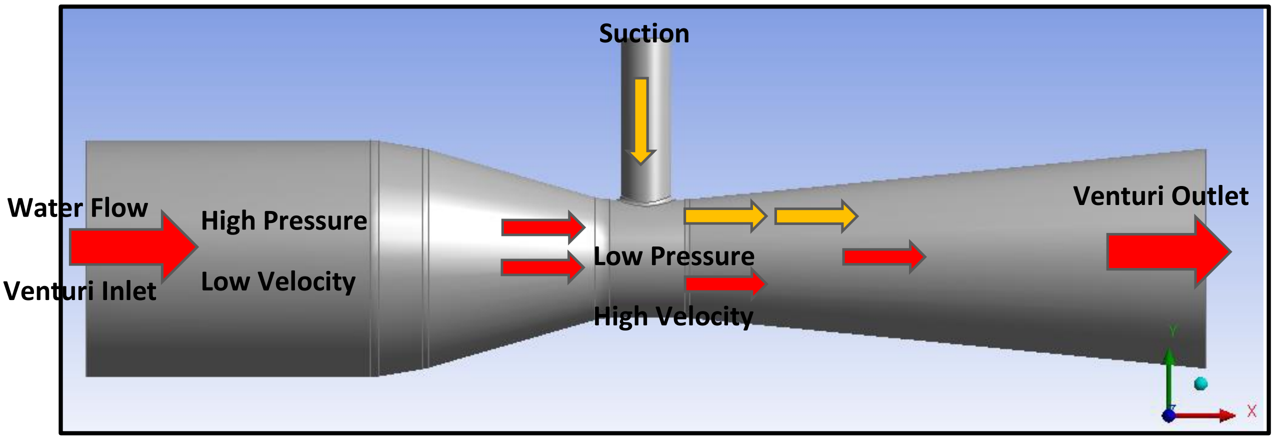

Figure 1.1: Venturi Tube Principal (Burman, R. and L.O. Pochop, (2004)

For better understanding, the venturi tube principal are presented as in Figure 1.1. A venturi tube create a constriction within a pipe that builds backpressure upstream and effects a negative pressure downstream of the constriction. The action process of a fluid through a constriction, causing a pressure drop and increase in velocity is designated by the venturi effect. During operation as the fluid continuing flow in at certain pressure, the flow inside the venturi changes thus give the impact on the venturi wall. The pressure on the wall are then was studied and the geometry are improved.

In this research, the area of related about is on the wall surfaces along the venturi. As mentioned earlier, upon operation as the fluid continuing pump in at certain pressure, the flow inside the venturi changes thus the impact on the venturi wall changes. Then, in order to ensure the venturi tube is operating within the required condition, the boundary condition of the pressurized fluid must be maintain by controlling certain parameters and material.

However these parameters are subject to become different if the initial condition changes. To being clearly, optimization geometry of the venturi is required to avoid vibration occurs on the surface which may contributes to failure again. In order to identify pressure distribution along the venturi wall, five different velocity and pressure inlet are observed and the geometry of the venturi was optimize using Design of Operation (DoE), which is Standard Second Order for Response Surface and Screening for Optimization. Our goal is then is to study the pressure distribution as it is affected by flow velocity and to demonstrate the influence of venturi size before and after optimization process.

Progressively, the requirements in agriculture are increasing for higher productivity of crops cause by the increasing human population. In the agricultural field, for proper growth of the crop, it is necessary to provide it require nutrients & this nutrients are made available by the fertilizers. The liquid fertilization is appropriate fit for plant growth & its productivity. So the aim is to maintain constant pressure of flow for each & every crop or plant. In the agricultural field, for proper growth of the crop or plants, it is necessary to provide it require nutrients & this nutrients are made available by the fertilizers. This purpose liquid fertilizer must be provided in adequate amount. The application of fertilizer by using irrigation systems is describe as fertigation. Using fertigation, fertilizer can be directed towards the plant deep to the root zone with irrigation . A liquid fertilizer solution is syringed into the irrigation water at the proper rate. When introduce fertilizer into a properly designed micro-irrigation system the fertilizer will be transfer to the plant root by the irrigation water.

Drip fertigation has become an attractive method of fertigation in modern intensive agriculture due to its higher water and fertilizer application afficiency and ease to use of it in all weather conditions. Considering all above features for plants and importance of water, drip irrigation research work entitled, "Study evaluation of electrical conductivity (EC) of fertilizer solution of ventury fertilizer system (VFS)" was carried out with the following specific objectives at the Universiti Teknikal Malaysia Melaka

1.2 Research objectives

Research objectives are as follows:

i. To determine the optimize irrigation and quality of fertigation for using venturi injector irrigation system.

ii. To find out the plant electrical conductivity requirement under different irrigation level based on plant growth and optimize suitable EC level for the plant to grow healthy.

iii. To estimate the water and fertilizer appliction under venturi drip fertigation system in small area or greenhouse.

iv. To investigate the interaction effect of concept design irrigation and fertigation level based on growth of plants/crop

v. To verify the pressure distribution affected in irrigation system by selection model of venturi before and after optimization of the experiment.

1.3 Problem statement

People in the fertigation industry often exposed to expensive venturi tube operation for agriculture systems. The construction of nowdays fertigation and its resulting backpressure can substantly reduce flow and burden the pump adding with other problem with unnecessary load increasing energy costs and shortening its serviceable life. When this happen, the problem occurs from pump and others leads the pressure drop. Thus, sufficient amount of pressure through a venturi must be enough to create a pressure (vacuum) as measured relative to atmospheric pressure.

Venturi tube usage often experience problems such as head losses, cavitation phenomena and sometimes cannot inject fertilizer solution. This leads, replacing the venturi involved a high cost and not a suitable method. These issues could be solved by using the right choice and the accurate design favor in order to make sure the good stability of the system.

Not a well designed gravitational venturi fertigation system might leads to increasing of more labor usage and energy. Therefore, the venturi fertigation system (VFS) of the current geometry and parameter was optimize and the flow and pressure distribution along the drip pipe irrigation was analyse before and after optimization was investigated.