UNIVERSITI TEKNIKAL MALAYSIA MELAKA

FLOW ANALYSIS OF CABINET FERTIGATION SYSTEM USING CFD

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

by

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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 (REFRIGERATION AND AIR CONDITIONING) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Hari demi hari terdapat kekurangan air. Terdapat kemarau seperti keadaan selepas jurang setiap tahun tertentu di negara ini. Penggunaan air yang begitu cekap menjadi perlu. Juga, pengayaan kimia yang digunakan dalam jumlah berlebihan adalah berbahaya bagi kesihatan tanah, jadi keperluan penggunaan baja yang optimum. Sebab-sebab ini membawa kepada graviti pengairan dan aplikasi baja di fertigasi. Teknik pengairan moden mempunyai kecekapan yang tinggi untuk membekalkan air ke tumbuhan daripada kaedah konvensional. Fertigasi adalah mengenai aplikasi pengairan + baja. Oleh itu, baja larut air digunakan sebagai baja dalam kes ini. Dalam bidang pertanian terdapat banyak vitamin tanah yang perlu diberikan kepada tanaman. Ini kerja selesai dengan memasukkan mereka ke lateral titisan sekarang.

Dengan perkembangan pendek dalam pengkomputeran selari dan pembangunan kod komersial, CFD telah berkembang menjadi alat penting dalam pembangunan mekanisme terkini. Bersama dengan eksperimen, CFD juga membolehkan pengurangan masa yang besar dari susunan utama melalui prototaip ke produk lengkap. Kemungkinan pereka untuk mensimulasikan dan melihat aliran cecair simulasi sebelumnya dalam paip atau yang direka. Hasil simulasi memberikan terperinci tentang kontur bidang aliran bendalir dalam paip dan ramalan prestasi. Tujuan kajian ini adalah untuk mensimulasikan pengairan air dalam paip untuk kabinet kabin. dan bandingkan pola aliran konfigurasi paip yang berbeza menggunakan simulasi. Di samping itu untuk mencadangkan perpipaan aliran air dalam sistem, satu kriteria utama berlaku dalam analisis ini

ABSTRACT

Day by day there is deficiency of water. There are the droughts like conditions after gap of every certain year in the country. So efficient use of the water is becoming necessary. Also, the chemical enrichers used in the excess amount are harmful for the health of the soil, so need of the optimum use of the fertilizers. These causes lead to the gravitational of the irrigation and the fertilizer application in the fertigation. The modern irrigation techniques have high efficiency on supplying the water to plants than the conventional method. Fertigation is about irrigation and fertilizer application. Hence, water soluble fertilizers are used as fertilizers in this case. Within the agriculture there are lot many soil vitamins need to be furnished to the crops. This of work is finished through insertion of them into the present drip laterals.

With the short progress in parallel computing and development of the commercial codes, CFD has grown to be a key tool in development of latest mechanism. Along with the experiment, CFD also allows for massive reduction of time from the primary layout thru the prototype to the complete product. The designer possibility to simulate and have look at previous simulated fluid flow in the pipe or being designed. The simulation results provide detailed of the flow field contours of the fluid in pipe and the performance predictions.

The purpose of this research is to simulate of the water irrigation in pipe for cabinet fertigation. and compare the flow pattern of different piping configuration using simulation. Beside that to propose the new piping of water flow in system one of main criteria takes place in this analysis.

DEDICATION

Every challenging work needs self-efforts as well as guidance of elders, especially those who very close to our heart.

My humble effort I dedicate to my sweet and lovely

Family members

Whose affection, encouragement and prayers of day and night make me able to get such success and honour.

Project supervisor, Encik Mohd Arizam Bin Abdul Wahap

Along with all hardworking and respected

Lecturers and friends

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Special thank also to my panel who also as my examiner, Muhammad Nur Bin Othman for his guidance and helps in improvement of project in terms of ideas related to project and suggestion regarding the system.

I also thank to myself that always give supports by finishing this this research. I want thank me for believing in me do all this work. I want thank me for having no days off for the simulation results. I want thank me for never quit and right or wrong. Last but not least, I would like to thank me for just me, me and me!

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CHAPTER 1

INTRODUCTION

1.1 Overview

The overall goal for this chapter is to introduce the approaches of this project. Firstly, the general idea has been discussed and followed by the problem statement of this project has been identified. Next, the aim of the project has been explained clearly and the extent for implementation of this project has been stated. Meanwhile, this chapter has been also discussed the overall thesis structure of this project.

1.2 Background

Day by day there is deficiency of water. There are the droughts like conditions after gap of every certain year in the country. So efficient use of the water is becoming necessary. Also, the chemical enrichers used in the excess amount are harmful for the health of the soil, so need of the optimum use of the fertilizers. These causes lead to the gravitational of the irrigation and the fertilizer application in the fertigation. The modern irrigation techniques have high efficiency on supplying the water to plants than the conventional method. Fertigation is about irrigation + fertilizer application. Hence, water soluble fertilizers are used as fertilizers in this case. Within the agriculture there are lot many soil vitamins need to be furnished to the crops. This of work is finished through insertion of them into the present drip laterals.

A free surface will not exist in the pipe itself, and the Froude number, which is important to open channel flows, will accordingly have no significance. The Reynolds

number will be the significant dimensionless parameter, but its importance will also diminish at high Reynolds numbers as the flow becomes independent of viscous effects. Flow in a circular pipe is certainly the most usual closed fluid flow. Its miles encountered in veins and arteries in a body, in a town of water system, in a farmer irrigation machine, within the piping systems supplying fluids. For a sufficiently low Reynolds numbers (Re < 2000 in a pipe) a laminar flow results, and at sufficiently high Reynolds number a turbulent flow occurs.

The open channel flow and the pipe flow is in essential mechanism that drives the flow. When at the open channel flow, gravity by self is the driving pressure such that the water flows down a hill like in streams and rivers. Moreover, for the pipe flow maybe essential (the pipe need no longer be horizontal), but the primary using force is in all likelihood to be a strain gradient along the pipe. The gravity method is simplest and best irrigation system. Because the irrigation system running at atmospheric pressure where the water flows in open channels. The fertilizer tank is above the level of the channel so that the fertilizers solution easily can drips into irrigation channel. Once the fertilizer mixed, the velocity of the irrigation stream should be excessive sufficient.

With the short progress in parallel computing and development of the commercial codes, CFD has grown to be a key tool in development of latest mechanism. Along with the experiment, CFD also allows for massive reduction of time from the primary layout thru the prototype to the complete product. The designer possibility to simulate and have look at previous simulated fluid flow in the pipe or being designed. The simulation results provide detailed of the flow field contours of the fluid in pipe and the performance predictions.

1.3 Problem Statement

Today more than half of the world's population lives in city area; in 2050, there are almost everybody on the earth will stay in urbanized metropolitan areas. Until 2050, the number of individuals living in urban ranges is anticipated to rise to more than six billion, 90% of them in creating nations (UN, 2013). This uncommon blast and development of mega-cities around the world may demonstrate unsustainable and environmentally sad. Besides, in today's busy society, people pay more attention and spend more time to their job than to their own health. Thus, most of the people nowadays because of their busy, they solve their three meals a day casually outside. In fact, outside food can bring the convenience, but more is unhealthy. Besides, many gardeners have put chemical fertilizers on their crops to avoid damage from pest insects. Therefore, most of the vegetables we buy are filled with chemical substances. According those phenomenon's, one of the solutions in used for increasing agricultural production without land planting and without chemical substances is carrying urban farming by self.

This Indoor Farming is a concept for growing a vegetable garden in the houses, without help from sun or rain. It is a fastidiously designed, self-growing cultivate that revolutionizes how new nourishment is developed. This self-growing cultivate makes a difference all plants flourish, naturally making beyond any doubt they have the right sums of water, light, oxygen, and supplements. This Indoor Farming is designed in a cabinet and just leaves it alone by self. This concept also can save the water by literally and people still can enjoy a higher quality of life.

In this project, the improvement for the indoor farming focus to supplemental water for irrigation, lights, cost and a smart cabinet garden with different system,

design, and features. For this surely, water is important for plants to help them to carry out growth process. There was some modification on the structure of pipe and the placement of the water tank. Some of the pipes were bending so that there is difficult to water reach the plant pot. It is because of the water breaks at the bending point and its take time for water reach at every plant pot. It happens by the principal of differential pressure or pressure difference because of mass flow rate and speed or velocity changes. The go with the flow being a turbulent is characterised through unsteady eddying motions which can be in regular motion with respect to each different. Because when the sectional area of the pipe decrease the velocity of fluid will increase with pressure .in keeping the laws governing fluid dynamics, the velocity of the fluid should increase when it passes the narrow path. In these cases where fluid behaviour is a major factor in design, an understanding of fluid mechanics. The analysis of how fluids behave in response to forces exerted. While testing a virtual prototype utilizing computational fluid dynamics, engineers can analyse: the turbulence in fluid as it flows, forces exerted on water by gravitational.

1.4 Objectives

i. To simulate of the water irrigation in pipe for cabinet fertigation.
ii. To compare the flow pattern of different piping configuration using simulation.
iii. To propose the new piping of water flow in system.

1.5 Scope of project

This project is focusing on;

i. Closed fertigation system.

ii. Simulate the flow from existing product and data.

iii. The detail drawing of structure of pipe by using Solid works and the analysis developed in Fluent Ansys.

1.6 Thesis structure

This progress report contains of five chapters. This section is to explain about the overview of the thesis going to be done. The first chapter discusses about the project background, problem statement, objective of project, and scope of project.

The second chapter emphasizes more on the theory and the literature review. In this chapter, there are a lot of journal, book, thesis, public source and internet source were read and come out with good conceptualization. Other than that, it is also about the theory on software and the validation. In chapter 3, there is the flowchart of overall progress and the flowchart of the development of structure of pipe flow for the cabinet fertigation and its simulation. In this chapter, the parameters for simulation also were stated.

Chapter 4 is the results and discussion of this project. In this chapter, all the analysis result has been discussed in this chapter. Those analysis results include result of simulation and the graph comparison that happens within the parameters. Generally, chapter 4 is the way how a student analysed the data obtain from the project, so it is importance for the student or people who are going to read.

Lastly, in chapter 5, conclusions and recommendations where be cover in this chapter, all the sustainability, commercialization and future work will be stated in it and the achievement of the objective also will be mentioned to prove the progress is successful or not.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

This chapter will discuss on the background of the Indoor plant growing system, irrigation system and about water flow system through pipe by a gravitational flow system. Furthermore, this chapter also study on the clogging issue that happen in irrigation system. As for the design method, some of the required information that need to consider making sure that the amount of water that received by every single plant is same with different level of pressure. Hence some information obtained from journals that have been done by other researches previously.

2.2 Background of indoor plant growing system

The worldwide projections appear that up to 2040 agrarian arrive can as it were be raised by only another 2% (Banerjee and Adenaeuer 2014). Due to population escalating up day by day meanwhile diminishing farm land in the world, producing enough food deliver has come to be one of the critical worldwide issues. By 2050, the world population will be increase to at least nine billion, at the same time; food demand will speed up at a far faster rate than population growth (Dorling n.d.).Nowadays one of the issues that people concerned about is water and it also insufficient resource. From this it require decreasing the terrible ecological impacts of fertigation, specifically with appreciate to greenhouse gasoline emissions, soil degradation and the safety of already dwindling water resources and biodiversity arises. Subsequently, must attempt to