

**DESIGN AN INNOVATIVE TEST TUBE WASHER FOR SCIENCE
LABORATORY**

FONG SHON FENG

**This Report is submitted in Partial Fulfilment of Requirements for the Award
of the Degree of Bachelor in Mechanical Engineering
(Design & Innovation)**

**Faculty of Mechanical Engineering
Universiti Teknikal Malaysia Melaka**

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SUPERVISOR DECLARATION

“I hereby declare that I have read this thesis and in my opinion this report is sufficient in terms of scope and quantity for the award of the degree of Bachelor of Mechanical Engineering (Design & Innovation)”

Signature :

Supervisor : DR. MOHD ASRI BIN YUSUFF

Date : JUNE 2015

DECLARATION

“I hereby declare that the work in this report entitle DESIGN AN INNOVATIVE TEST TUBE WASHER FOR SCIENCE LABORATORY is my own except for summaries and quotations which have been duly acknowledged”

Signature :

Author : FONG SHON FENG

Date : JUNE 2015

“Hard work dreams dedication success”

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ABSTRACT

The main purpose of this project is to design an innovative test tube washer for science laboratory that can reduce the uses of water by increasing the numbers of test tube per washing without compromise the cleaning quality and consume less time during test tube cleaning process. Test tube washer machine is one of the laboratory equipment used to help scientists clean up all the dirty test tubes. Basically, student at school do not use machine to wash the test tubes in laboratory. Mainly student wash up all the dirty test tube manually by using equipment such as test tube brush. This project primarily focus on design development of test tube washer machine within the good design characteristics such as light, lowest price, small size, simple to be operated by students at science laboratory of school and so on which are meet to customer requirements.

ABSTRAK

Tujuan utama projek ini adalah untuk mereka bentuk mesin basuh tabung uji yang inovatif untuk makmal sains yang boleh mengurangkan penggunaan air dengan meningkatkan bilangan tabung uji setiap kali proses membasuh tanpa menjejaskan kualiti pembersihan dan mengurangkan masa untuk menjalani proses pembersihan tabung uji. Mesin basuh tabung uji adalah salah satu peralatan makmal yang digunakan untuk membantu ahli sains membersihkan semua tabung uji yang kotor. Namun begitu, pelajar di sekolah tidak menggunakan mesin basuh tabung uji untuk mencuci tabung uji di makmal. Pelajar mencuci semua tabung uji yang kotor secara manual dengan menggunakan peralatan seperti brus tabung uji. Secara ringkas, projek ini memberi tumpuan utama kepada pembangunan reka bentuk mesin basuh tabung uji dengan ciri-ciri reka bentuk yang sesuai seperti ringan, harga yang rendah, saiz yang kecil, mudah untuk dikendalikan oleh pelajar di makmal sains sekolah dan sebagainya yang memenuhi keperluan pelanggan.

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CHAPTER I

INTRODUCTION

1.1 BACKGROUND

Test tube is importance equipment in laboratory to carry out experiment. Normally, test tube is used to hold various chemical liquids in science experiment. After test tube being used, test tube need to be cleaned to avoid interrupt result for next experiment. Test tube washer machine is one of the laboratory equipment used to help scientist clean up all the dirty test tube.

Basically, student at school do not use test tube washer machine to wash the test tube in laboratory. Mainly student wash up all the dirty test tube manually by using equipment such as test tube brush. Hence, the main idea of this project is to design an innovative test tube washer which suitable used by school's student to clean up test tubes after lab session. In order to realize the idea, research is carried out to accomplish the design's idea. Details of the progress schedule are shown in Gantt chart (Appendix A).

1.2 PROBLEM STATEMENT

Test tube is small glass containers that are used to hold various liquids in science experiment. As show in Figure 1.1, test tube need to be cleaned after being used to make sure nothing substance remain to avoid mixes with new substances in the next time test tube are used. Therefore, good cleaning process should also be attended by good examination of the glass surfaces for chips, cracks or scratch which will cause experiment failure.

During cleaning process of test tube at science laboratory of school, test tube needs to clean in running water one by one to wash away the remaining chemical substance inside test tube. When exchanging test tube to undergo further cleaning process, the pipe in sink still opened in running water which is wasted. This will consume a lot of water to perform the task.

On the other hands, basically student will separate to five or six groups to carry out experiment during lab session. Hence, few set of test tube used in whole class. After done the experiment, all the students clean up the test tube at the same times. Therefore, student need to spend so much time to wash the test tube since the amount of test tube used by whole class is usually large.



Figure1.1 Dirty test tubes
(Source: Biodiversity, 2010)

1.3 OBJECTIVE

Several objectives are aimed in order to achieve the project goals. Among the objectives are:

- i) To design a test tube washer that can reduce water used to wash test tube.
- ii) To design a test tube washer consume less time during test tube washing process.

1.4 SCOPE OF PROJECT

This project certain scopes that been identified based on the objectives of this project. The main scope of this project is optimize the uses of water by increasing the numbers of test tube per washing without compromise the cleaning quality and simple to be operated by student at science laboratory of school. Besides that, design and analysis test tube washer using CATIA engineering software also one of the scope of this project to achieve the objectives.

1.5 REPORT FRAMES

This project entitled “Design an Innovative Test Tube Washer for Science Laboratory” is divided into five chapters. Chapter I present the introduction for the general information of this project. This chapter includes the background of project, the project’s problem statements, objectives to achieve in this project, scopes of study, and report organization of this project.

Chapter II comprises literature review information which includes apparatus used to wash test tube and current test tube washer machine in market. Besides that, the study about washing system of dishwasher and spraying nozzle also carry out in this chapter since those are related with the washing system of test tube washing system.

Chapter III covers the methodology of this project. This chapter discuss the method used throughout the design development of test tube washer machine which consist sections that identify the customer needs through survey. Concept selection method and software use to produce design which is also described in this chapter.

Chapter IV present the conceptual design of test tube washer machine. This chapter show three new concept designs and explanation of each concept. Moreover, 3D modelling drawing by using CATIA software also include in this chapter. Other element include in this chapter are the design analysis using Finite Element Analysis software.

Chapter V is the last chapter in this report which discusses about the project. The conclusion and recommendation of the project also conclude in this chapter based on the objective and the relationship with problem statement presented in Chapter I.

CHAPTER II

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter discusses about the apparatus used to wash test tube. Besides that, the existing test tube washer machines in market also show in this chapter. Grabianowski (2014) state the purpose design dishwashers are interested in improving two key features of their products which are efficient cleaning and power consumers in operations which is likely same with the objectives of this project. Therefore, study of the system for dishwasher machine need to carry out in this chapter. Other than that, spraying nozzle system also investigates in this chapter since the washing system of test tube washer machine is related with spraying process.

2.2 STEP AND APPARATUS USED TO WASH TEST TUBE

Lukavics (2014) state that, there are few steps to wash test tube. First, clamp the test tube to the sink by using test tube holder as shown in Figure 2.1. Test tube holder is used to hold a single hot test tube to avoid user touched the hot test tube which provide safety to user.



Figure 2.1 Test tube holder
(Source: Lukavics, 2014)

Then, rinse the test tubes out with water, and scrub them out with a test tube brushes as show in Figure 2.2 to clean the test tube. After that, set the test tubes in the jar with cleaner such as soap or detergent.



Figure 2.2 Test tube brushes
(Source: Lukavics, 2014)

Next, wash the test tube in running water. Make the water overflow out of the test tube so that the remaining chemical contents are washed away. Lastly, rinse the test tube thoroughly with distilled water and allow to air dry in test tube racks as shown in Figure 2.3.



Figure 2.3 Test tube rack
(Source: Lukavics, 2014)

2.3 EXISTING PRODUCT IN MARKET

There are few designs of test tube washer current in market. Figure 2.4 and Figure 2.5 show two different designs of test tube washer.

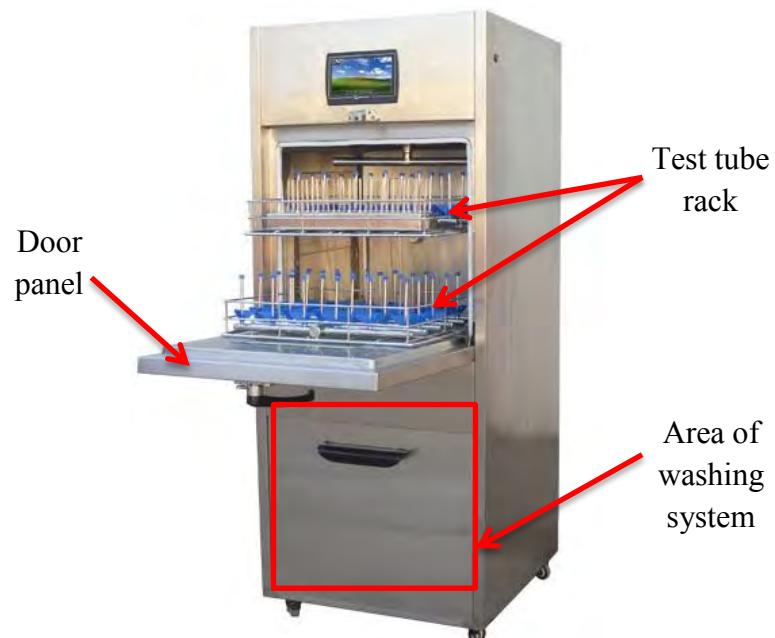


Figure 2.4 Standard test tubes washer machine
(Source: U-Therm, 2010)



Figure 2.5 Ultrasonic test tubes washer machine
(Source: DIY Trade, 2014)

Figure 2.6 and Figure 2.7 show the sample design of test tube rack used in test tube washer machine.

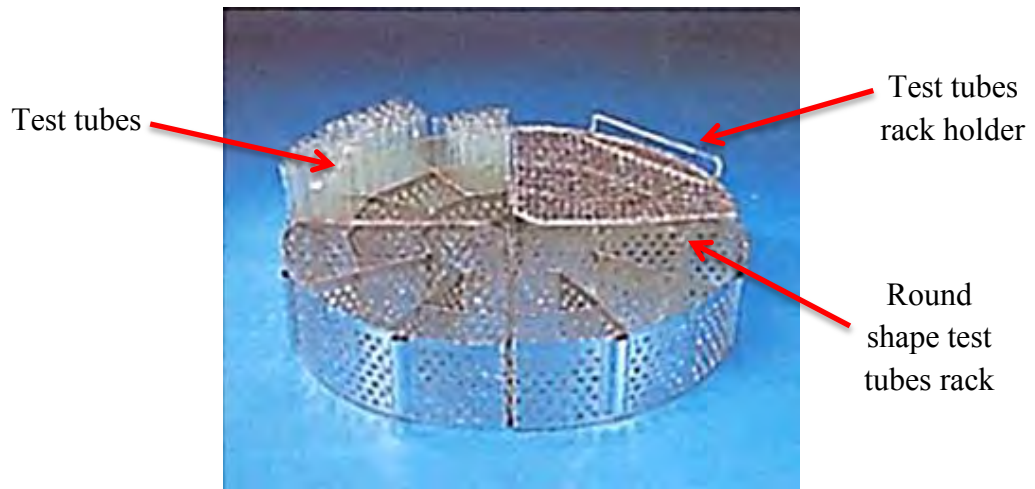


Figure 2.6 Simple test tubes rack
(Source: Yamato, 2012)

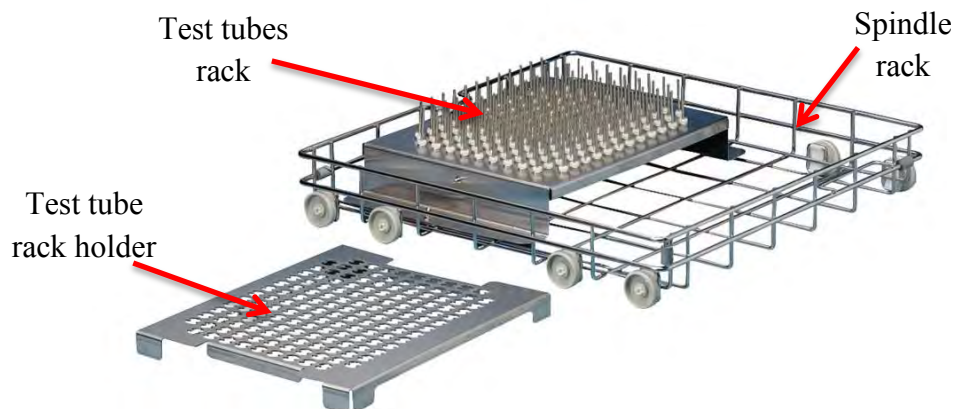


Figure 2.7 Test Tubes spindle rack
(Source: Grainger, 2014)

2.4 DISHWASHER MACHINE

Dishwasher machine operates on a simple principle of washing dishes that have been placed on racks inside the machine with multiple jets of water (Stamminger, 2003). Cleaning systems consist of a wash tower, sprayer arms, the power of the water pump, and so on. Figure 2.8 and Figure 2.9 show two different structure of washing system of dishwasher machine.

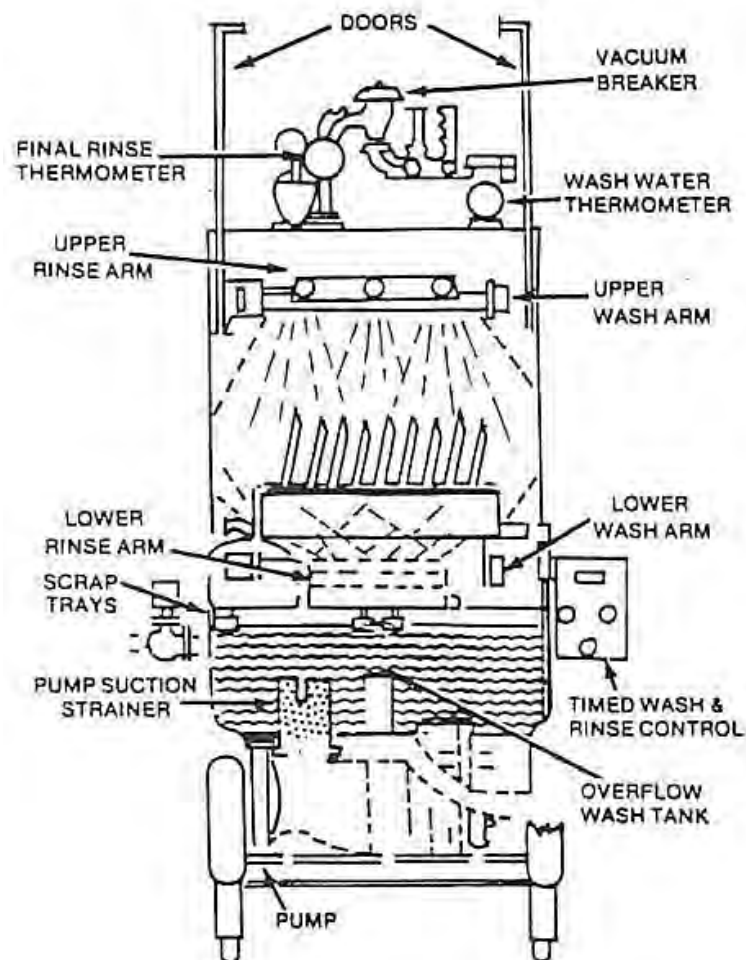


Figure 2.8 Stationary rack door type dishwasher machine

(Source: Stamminger, 2003)

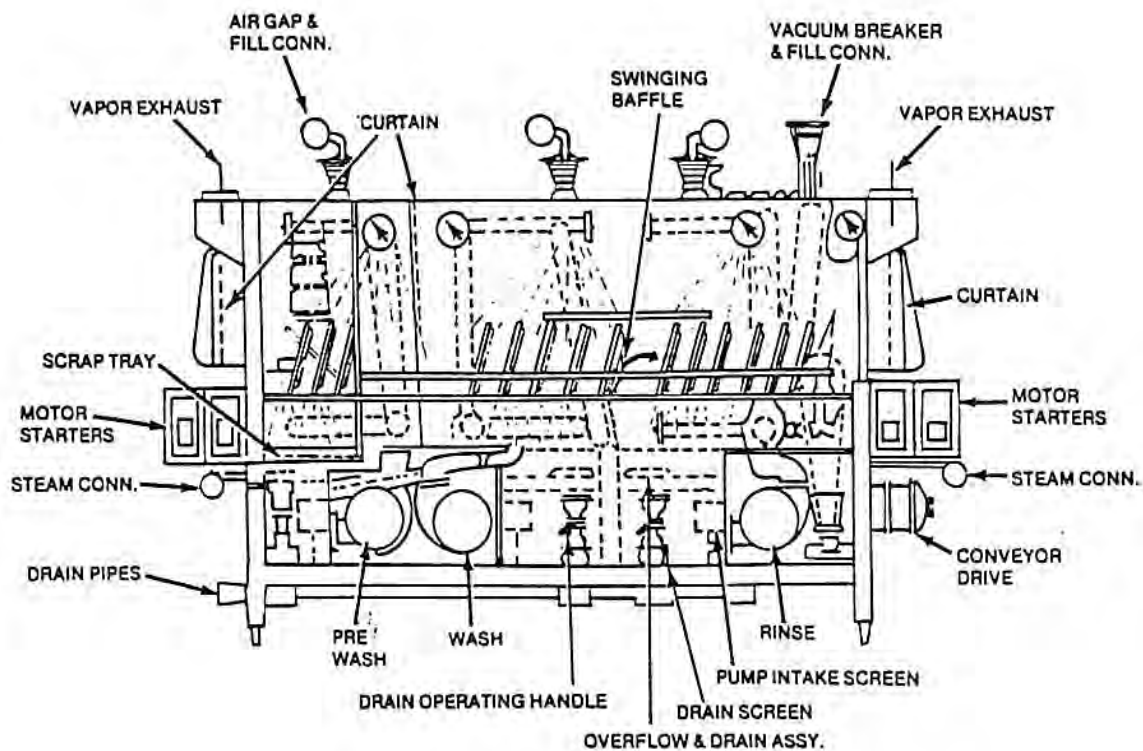


Figure 2.9 Multiple-tank rack conveyor type dishwasher machine

(Source: Stamminger, 2003)

2.4.1 Materials Used

AECinfo (2014) public the major components of a dishwasher are made of steel. The basic structure consists of a steel frame assembly and a steel door panel as shown in Figure 2.10. Besides that, the racks that hold the dishes are also made of steel. Sheets of stainless steel are purchased and fabricated in the required pieces and shapes where the door and the around cabinet for outside models are obtained as coiled sheet steel that has been prefinished in several standard colours.