

DESIGN AND DEVELOPMENT OF ACCUMULATOR FOR  
DOMESTIC WATER SYSTEM

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**BORANG PENGESAHAN STATUS TESIS\***

JUDUL: DESIGN AND DEVELOPMENT OF ACCUMULATOR FOR DOMESTIC WATER SYSTEM

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**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DESIGN AND DEVELOPMENT OF  
ACCUMULATOR FOR DOMESTIC WATER  
SYSTEM**

Thesis submitted in accordance with the partial requirements of the  
Universiti Teknikal Malaysia Melaka for the  
Bachelor of Manufacturing Engineering (Design Manufacturing)

By

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April 2008

## DECLARATION

I hereby, declared this thesis entitled “Design and Development of Accumulator for Domestic Water System” is the results of my own research except as cited in references.

Signature : \_\_\_\_\_  
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## **APPROVAL**

This PSM submitted to the senate of UTeM and has been as partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Design Manufacturing). The members of the supervisory committee are as follow:

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## **ABSTRACT**

It is common that domestic water user experience low pressure of water supply. However, some of the user facing high pressure, which can cause another problems. This high pressure can cause leaking problem especially on fitting and valve due to shock pulsation or water hammer. This project is to study effect of this scenario in the system, design and also develop an accumulator for the domestic water system. This project present a study case of the problem facing by domestic water user, identify cause of the problem, and develop accumulator unit and analysis the effectiveness of accumulator application in the problem rectification. In this project, the inner mechanism of the accumulator have a aluminum shaft with thread that can be adjusted the spring length using the lower aluminum spring holder, aluminum piston with two buna o-ring that will act as seal and also a 302 stainless steel spring which act as the external mechanical force to absorb shock pulsation or water hammer, this spring type accumulator is similar in operation to the gas charged accumulator, except that the springs is used to provide the compressive force. The outer feature of the accumulator has a UPVC type bodies, mild steel accumulator holder that is fasten by nut and an upper aluminum spring holder as the block to compress the spring when water hammer occur.. In programming simulation and drawing, COSMOS FloXpress software will be use to see the how the water flow inside the accumulator system.

## **DEDICATION**

This project is dedicate to UTeM, my Main Supervisor, Mr. Mohd Shahir Bin Kasim, my family and everyone that help me directly or indirectly in the making of this project until its successfully finish.

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# TABLE OF CONTENTS

Abstract.....	I
Dedication.....	II
Acknowledgement.....	III
Table of Contents.....	IV
List of Chart.....	VII
List of Sketching.....	VIII
List of Figure.....	IX
List of Table.....	X
List of Symbol.....	XI
List of Picture.....	XII
List of Tree Structure.....	XIII
List of Drawing.....	XIV
<b>CHAPTER 1: INTRODUCTION.....</b>	<b>1</b>
1.1 Background.....	1
1.2 Problem Statement.....	3
1.3 Objective.....	3
1.4 Scope and Key Assumption.....	3
1.5 Definition of Terms.....	4
1.6 Organization.....	5
<b>CHAPTER 2: LITERATURE REVIEW.....</b>	<b>7</b>
2.1 Domestic water.....	7
2.1.1 Gravity Tank.....	9
2.1.2 Pressurized Tank.....	10
2.2 Pipe Leaking.....	11
2.3 Water Hammer.....	13
2.4 Accumulator.....	15

<b>CHAPTER 3: METHODOLOGY.....</b>	<b>19</b>
3.1 PSM I.....	19
3.1.1 Research Stage.....	19
3.1.2 Design Stage.....	20
3.1.2.1 Concept Design Stage.....	21
3.1.2.2 Concept Design Matrix.....	26
3.1.2.3 SOLIDWORKS Drawing.....	27
3.2 PSM II.....	29
3.2.1 Machining Procedure.....	31
3.2.2 Assemble Procedure.....	35
3.2.3 Testing Procedure.....	38
<b>CHAPTER 4: RESULT.....</b>	<b>40</b>
4.1 Spring Calculation.....	40
4.2 Product Specification and Operating Principle.....	45
4.3 Simulation Observation.....	46
4.4 COSMOS FloXpress.....	49
4.5 Cost.....	51
<b>CHAPTER 5: DISCUSSION.....</b>	<b>52</b>
<b>CHAPTER 6: SUMMARY AND CONCLUSION.....</b>	<b>54</b>
<b>CHAPTER 7: SUGGESTION.....</b>	<b>56</b>
<b>REFERENCES.....</b>	<b>57</b>

## **APPENDIX**

A. ASTM – Schedule 40 – PVC Pipe

- B. General Properties of Steel
- C. Common Spring Materials and Properties
- D. Aluminum Properties
- E. 2D Drawing (Front View)
- F. 2D Drawing (Right View)
- G. 2D Drawing (Top View)
- H. 2D Drawing (Isometric View)
- I. 2D Drawing (Inner Mechanism View)

## **LIST OF CHART**

Chart 1: Water Use by Source	8
Chart 2: Groundwater Utilization by Sector	8
Chart 3: Manual Simulation Graph	47

## **LIST OF SKETCHING**

Sketching 1: Balloon Mechanism with 2 Side Holding	22
Sketching 2: Spring Mechanism with 2 Side Holding & Spring Mechanism with 1 Center Holding	23
Sketching 3: Spring Mechanism with Adjustable Center Holding (Design 1)	24
Sketching 4: Spring Mechanism with Adjustable Center Holding (Design 2)	25

## **LIST OF FIGURES**

Figure 1: Domestic Water Supply System with Gravity Tank	9
Figure 2: Domestic Water Supply System with Pressurized Tank	10
Figure 3: Simulation of Pressure Contour Cause by Water Hammer When Valve Were Close Suddenly	14
Figure 4: Cross-sectional Views and Symbols for Hydraulic Accumulator	17
Figure 5: Spring Type Fluid Accumulator	17
Figure 6: Length Deflection after Force Applied	40
Figure 7: Key Parameter in spring	43
Figure 8: COSMOS FloXpress Showing the Water Movement	49

## **LIST OF TABLE**

Table 1: Concept Design Matrix	26
Table 2: Machining Procedure	31
Table 3: Result from Manual Simulation	47
Table 4: Inlet	50
Table 5: Outlet	50
Table 6: Result	50
Table 7: Costing List	51

## **LIST OF SYMBOL**

Symbol 1: Concept Design Matrix Symbol Definition	26
Symbol 2: Hydraulic Symbol Definition	28



## LIST OF PICTURE

Picture 1: Left Corner Demolition	11
Picture 2: House Mold Can Be the Result of Pipe Leaking	11
Picture 3: Pipe Leaking Damage Surrounding Especially Wood	12
Picture 4: Repairing the Leak	12
Picture 5: Shaft, Upper Cylinder Holder, Upper Spring Holder and Spring Assemble	35
Picture 6: Lower Spring Holder Assemble	35
Picture 7: Ring and Accumulator Cap Assemble	36
Picture 8: Upper Cylinder Holder Assemble	36
Picture 9: P.T.F.E. Thread Seal Tape	36
Picture 10: Piston and Bolt Assemble	37
Picture 11: O-Ring Assemble	37
Picture 12: Accumulator Body Assemble	37
Picture 13: U-Shape Assemble	38
Picture 14: Testing Procedure	38
Picture 15: Stainless Steel Spring	40
Picture 16: Develop Accumulator	45
Picture 17: Manual Simulation	46

## **LIST OF TREE STRUCTURE**

Tree Structure 1: Research Stage	20
Tree Structure 2: Design Stage	21
Tree Structure 3: PSM II Stages	30

## **LIST OF DRAWING**

Drawing 1: Inner Mechanism of Accumulator	27
Drawing 2: Accumulator	27
Drawing 3: Accumulator Simulation Kits	28

# CHAPTER 1

## Introduction

### 1.1. Background

It is common that domestic water user experience low pressure of water supply. However, some of the user facing high pressure, which can cause another problems. Water pressure is created by water forcing its way through the distribution system to tap. Gravity is the most effective way to bring water to home. Water storage tank (reservoir) usually located higher than the homes it is designed to serve so that water can flow by gravity. But not all can be supplied by gravity flow, some areas will require plumbing. Normally, the reservoir is filled at night when water use is lowest. The full tanks are then able to supply higher demand for water in the daytime. The water pressure at particular home will depends on the elevation of home and proximity to the reservoir. The closer the home are to the elevation of the reservoir, the lower the pressure will be. Similarly, the lower the home is in relation to the reservoir, the higher the water pressure is supply.

According to IRWD standard (Irvine Ranch Water District), domestic water supply are between 50 until 100 psi but most household appliances are designed to work with water pressure between 15 psi until 120 psi. Most of household appliances can cause water hammer or shock pulsation when a water flow turn off suddenly, example a dishwasher, a clothes washer, a toilet or even closing a hand faucet. Shutting off the flow suddenly sends a pressure or shock wave down the water line through the water shocking the pipes and creating the 'hammer' noise. According to Nor & Maz Enterprize, water hammer waves in typical water pipes can exert tremendous instantaneous pressures, sometimes reaching over 160 psi. According to

Santrali Sdn Bhd, the pipe that installed in household usually using PVC or ABS pipe with diameter of 40mm, from the ASTM schedule, the mention pipe can work at maximum working pressure of 160 psi for the selected size. In other words, the water hammer pressure is extending the work pressure the can be handle by the pipe, so over time, water hammer can damage pipes, valves and eventually weaken pipe joints and can cause pipe leaking which cause serious damage and high cost repairing.

A newly design of accumulator for domestic water which can help domestic water user to prevent water hammer and shock pulsation which also reduce percentage of pipe leaking to occurs. The inner mechanism of the accumulator have a aluminum shaft with thread that can be adjusted the spring length using the lower aluminum spring holder, aluminum piston with two buna o-ring that will act as seal and also a 302 stainless steel spring which act as the external mechanical force to absorb shock pulsation or water hammer, this spring type accumulator is similar in operation to the gas charged accumulator, except that the springs is used to provide the compressive force. The outer feature of the accumulator has a UPVC type bodies, mild steel accumulator holder that is fasten by nut and an upper aluminum spring holder as the block to compress the spring when water hammer occur.

According to [Hooke's law](#) the magnitude of the force exerted by a spring is linearly proportional to its extension. Therefore as the spring compresses, the force it exerts on the fluid is increased. This accumulator can reduce shock effects in piping resulting from inertia or external mechanical forces , maintain system pressure by compensating for pressure loss due to leakage, it's compensates for such pressure changes by delivering or receiving a small amount of water.

## **1.2. Problem Statement**

Water hammer is a phenomena where its occurred when the flow been stop suddenly, this phenomena is usually occur from application of household appliances that use water as a medium to work, this phenomena cannot be prevent manually. Water hammer phenomena can weaken pipe joint and one of the factors that can cause pipe leaking if it's not prevented, repairing a pipe leaking need a lot of money and not only can damage the surrounding but its also dangerous that can cause lost life. Present accumulator device is not appropriate to be used in the domestic water system because of each capacity which is much higher than the pressure flow of domestic water system and different application.

## **1.3. Objective**

- 1) Study on problem facing by domestic water user.
- 2) Identify cause of problem.
- 3) Design an accumulator for domestic water system and develop 1 unit of the designed accumulator.
- 4) Understanding on concept and function of the accumulator.
- 5) See the phenomena effectiveness of accumulator application in problem rectification.

## **1.4. Scope and Key Assumption**

1. Design accumulator for domestic water
2. Fabricate accumulator
3. Implement design
4. Rectification design

## 1.5. Definition of Terms

### 1. Accumulator

An accumulator is an [energy storage](#) device. It is a [pressure](#) storage reservoir in which a non-compressible [hydraulic fluid](#) is held under pressure by an external source. That external source can be a [spring](#), a raised [weight](#), or a compressed [gas](#).

### 2. Hydraulic

Involving, moved by, or operated by a fluid, especially water, under pressure.

### 3. Spring

An elastic device, such as a coil of wire that regains its original shape after being compressed or extended.

### 4. Domestic water system

Domestic water supply or system (DWS) is a comprehensive term for the potable water supply systems in residential, commercial, institutional, and industrial buildings.

### 5. High pressure

High pressure it is meant pressures above the range of domestic water pressure, above 100 psi.

## 6. Water hammer

A banging noise heard in a water pipe following an abrupt alteration of the flow with resultant pressure surges, sometimes reaching above 160 psi.

## 7. Shock pulsation

Liquid's motive force is generated by reciprocating or peristaltic positive displacement pumps. It is most commonly caused by the acceleration and deceleration of the pumped fluid. This uncontrolled energy appears as pressure spikes. Vibration is the visible example of pulsation and is the culprit that usually leads the way to component failure.

### **1.6. Organization**

Before starting on designing and developing an accumulator, the first step is data collecting and research for better understanding on the project. This was done by using resource from internet, book, journal, questionnaire, literature review, and presents study cases that relevance to the project. This report consists on understanding of domestic water system, how a water hammer occurs and how it can cause pipe leaking, function of an accumulator and how an accumulator can help preventing pipe leaking. All this data and research will be put at Introduction chapter and Literature Review chapter. Where Introduction chapter is for understanding what this project is all about and the Literature Review is more on the related data, technical data of pipe, question and answer and resources that have been collected so that reader has more understanding on the important scope in this project.

For the Methodology chapter, it will consist of concept design stage, Solidwork drawing of selected design and testing kits, technical data of the chosen material, list of material, list of costing and procedure on machining or developing the accumulator. In the result chapter, it will consist of the analysis from Cosmos