

STUDY OF WATER QUALITY FOR RAIN
WATER HARVESTING SYSTEMS ON ROOF
MATERIAL

ABDUL MU'IZ BIN EMBONG

B. ENG(HONS.) CIVIL ENGINEERING

UNIVERSITI MALAYSIA PAHANG



SUPERVISOR'S DECLARATION

“I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Civil Engineering”

(Supervisor's Signature)

Full Name : HASMANIE BINTI. ABDUL HALIM

Position : LECTURER

Date : 15 JUNE 2017



STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

(Student's Signature)

Full Name : ABDUL MU'IZ BIN EMBONG

ID Number : AA13224

Date : 15 JUNE 2017

STUDY OF WATER QUALITY FOR RAIN WATER HARVESTING SYSTEMS ON
ROOF MATERIAL

ABDUL MU'IZ BIN EMBONG

Thesis submitted in fulfillment of the requirements
for the award of the
Bachelor Degree in Civil Engineering

Faculty of Civil Engineering and Earth Resources

UNIVERSITI MALAYSIA PAHANG

JUNE 2017

ACKNOWLEDGEMENTS

Alhamdulillah. Thanks to Allah SWT, the most gracious and most merciful, whom with Him willing giving me strength to complete this Final Year Project. Special thanks to my beloved family, my parents, my brothers and sisters because of their courage and support during the period of completing the thesis. Support and motivates keep me motivated and alive to complete and produce a high quality of thesis.

To my supervisor, Madam Hasmanie binti Abdul Halim, special thanks for all the guidance, motivation and supports, thanks for the time spend with me, idea and courage. The supervision and support that she gave truly help the progression and smoothness of the project. With her presents, teaching and guidance, my final year project gone recognize by university.

In addition, I would like to express my gratitude to my panel, Dr. Mir Sujaul Islam, Dr. Edriyana binti Abdul Aziz and Madam Suryati binti Sulaiman to their valuable suggestions and comments on my work as to improve my research outcomes and meet the objectives of this study. Apart from that, I would like to thank all the lecturers whom have taught me in every semester. They have indeed helped me to reinforce my basic knowledge and theories in this field.

Finally, I would like to express my appreciation to my best colleague mate, Advein a/l Ami, Hasan bin Raja Aznn and all my final year project teammates as they are always shared with me their knowledge in completing the study. Thanks for being with me through my ups and downs. Thanks for the support, courage and assist me on writing and so on.

Once again, thanks to all of you.

TABLE OF CONTENT

DECLARATION	
TITLE PAGE	
ACKNOWLEDGEMENTS	ii
ABSTRAK	iii
ABSTRACT	iv
TABLE OF CONTENT	v
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF SYMBOLS	xi
LIST OF ABBREVIATIONS	xii
CHAPTER 1 INTRODUCTION	1
1.1 Background of the Study	1
1.2 Problem Statement	2
1.3 Objectives of the Study	2
1.4 Scope of the Study	2
CHAPTER 2 LITERATURE REVIEW	3
2.1 Introduction	3
2.2 Rainwater Harvesting	3
2.2.1 Problems in Rainwater Harvesting System	4
2.3 Water Quality Standards	5
2.3.1 World Health Organization (WHO) Drinking Standards	5

2.3.2	European Union (EU's) Drinking Water Standards	6
2.4	Water Quality Parameters	6
2.4.1	pH	6
2.4.2	Conductivity	7
2.4.3	Turbidity	7
2.4.4	Total Suspended Solids	8
2.4.5	Nitrate/Nitrites	9
2.5	Water Treatment	9
2.5.1	Sand Gravel Filter	10
2.5.2	Charcoal Filter (Activated Carbon)	10
2.5.3	UV Filtration	11
2.5.4	Reverse Osmosis	11
CHAPTER 3 METHODOLOGY		13
3.1	Introduction	13
3.2	Location of the Study	13
3.3	Sampling Procedure	15
3.3.1	Sample Preservation	15
3.3.2	Sample Labelling	16
3.4	Analytical Method	16
3.4.1	pH	16
3.4.2	Total Suspended Solid (TSS)	17
3.4.3	Nitrates/Nitrites	19
3.4.4	Escherichia Coli (E-Coli)	19
3.4.5	Conductivity	21

CHAPTER 4 RESULTS AND DISCUSSION	23
4.1 Introduction	23
4.2 Water Quality	23
4.2.1 Temperature	23
4.2.2 pH	25
4.2.3 Turbidity	26
4.2.4 Conductivity	27
4.2.5 Total Suspended Solids (TSS)	28
4.2.6 Nitrates	30
4.2.7 Nitrites	31
4.2.8 E-Coli	32
4.2.9 Total Coliform	33
CHAPTER 5 CONCLUSION AND RECOMMENDATION	35
5.1 Conclusion	35
5.2 Recommendation	36
REFERENCES	37
APPENDIX A	39
APPENDIX B	44

LIST OF TABLES

Table 3.1	Sample Preservation Technique	16
Table 3.2	Result interpretation of pH	17
Table 3.3	Result interpretation of E-Coli	20

LIST OF FIGURES

Figure 2.1	Contaminants at rooftop gutter system	4
Figure 2.2	pH Instrument	6
Figure 2.3	Turbidimeter	8
Figure 2.4	Hach DR5000	9
Figure 2.5	Sand Gravel Filter	10
Figure 2.6	Charcoal Filter (Activated Carbon)	11
Figure 2.7	Reverse Osmosis Machine	12
Figure 3.1	Concrete Flat Roof (KK2 Residential Area) – Point 1	14
Figure 3.2	Metal Deck Roof (KK2 Residential Area) – Point 2	14
Figure 3.3	Clay Roof (KK2 Residential Area) – Point 3	15
Figure 3.4	Proper Sample Labelling	16
Figure 3.5	Total Suspended Solids sample after dried in oven	18
Figure 3.6	Weighing process of TSS sample after dried in room temperature	18
Figure 3.7	Nitrate and Nitrite reagent	19
Figure 3.8	E-Coli test reagent	20
Figure 3.9	Colilert nutrient indicator become fluoresces after 24hours	21
Figure 3.10	Instrument to measure Conductivity	22
Figure 4.1	Location of catchments area	23
Figure 4.2	Temperature value for different types of roof	24
Figure 4.3	Average of Temperature value for different types of roof	24
Figure 4.4	pH value for different types of roof	25
Figure 4.5	Average of pH value for different types of roof	26
Figure 4.6	Turbidity value for different types of roof	27
Figure 4.7	Average of Turbidity value for different types of roof	27
Figure 4.8	Conductivity value for different types of roof	28
Figure 4.9	Average of Conductivity value for different types of roof	28
Figure 4.10	Total suspended solids value for different types of roof	29
Figure 4.11	Average of Total suspended solids value for different types of roof	29
Figure 4.12	Nitrates value for different types of roof	30
Figure 4.13	Average of Nitrates value for different types of roof	31
Figure 4.14	Nitrites value for different types of roof	31
Figure 4.15	Average of Nitrites value for different types of roof	32
Figure 4.16	E-Coli value for different types of roof	33

Figure 4.17	Average of E-Coli value for different types of roof	33
Figure 4.18	Total coliform value for different types of roof	34
Figure 4.19	Average of Total coliform value for different types of roof	34

LIST OF SYMBOLS

NTU	Nephelometric Turbidity Unit
mg/l	milligram/litre
MPN/100ml	Most Probable Number/100milliliter
cfu/100ml	Colony Forming Unit/100milliliter
μ S	microsiemens

LIST OF ABBREVIATIONS

TSS	Total Suspended Solids
TC	Total Coliform
WSP	Water and Sanitation Program
RWH	Rain Water Harvesting
WQI	Water Quality Index
WHO	World Health Organization
EU	European Union
UV	UltraViolet Ray
R.O	Reverse Osmosis
KK2	Kolej Kediaman 2
GAC	Granular Activated Carbon