

THE EFFECT OF ULTRA-VIOLET  
GERMICIDAL TO THE REMOVAL OF  
PATHOGENS IN RAINWATER HARVESTER

AZYAN BINTI ROZLAN

B. ENG (HONS.) CIVIL ENGINEERING

UNIVERSITI MALAYSIA PAHANG



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I/We\* hereby declare that I/We\* have checked this thesis/project\* and in my/our\* opinion, this thesis/project\* is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

---

(Supervisor's Signature)

Full Name : DR. HJ MOHD. YUHYI B. HJ MOHD. TADZA

Position : SENIOR LECTURER

Date : 12 JUNE 2018



## **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.

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(Student's Signature)

Full Name : AZYAN BINTI ROZLAN

ID Number : AA14210

Date : 12 JUNE 2018

THE EFFECT OF ULTRA-VIOLET GERMICIDAL IRRADIATION TO THE  
REMOVAL OF PATHOGENS IN RAINWATER HARVESTER

AZYAN BINTI ROZLAN

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## **ABSTRAK**

Kekurangan air merupakan masalah utama di banyak negara sedang membangun. Malaysia mempunyai hujan tinggi sehingga ini menjadi sumber yang mungkin untuk kegunaan domestik. Dalam kajian ini, iradiasi cahaya Ultraviolet digunakan untuk membasmi air hujan dalam sampel air yang dikumpulkan dari tangki penuai air hujan di Gambang, Pahang. Kemudian, ia tertakluk kepada analisis untuk kehadiran patogen bakteria yang terpilih dan patogen berpotensi kebimbangan kesihatan untuk *Escherichia coli* dan Total Coliform. Patogen ini didapati lazim dalam sampel air hujan dengan *E. coli* sebagai patogen berpotensi yang paling lazim dalam kedua-dua jenis sampel. Sampel terdedah kepada cahaya UV selama 5 minit, 10 minit, 15 minit dan 30 minit. Parameter kualiti air untuk pH, Warna, Kekeruhan, Pepejal Pepejal Keseluruhan, Pepejal Tergantian dan Kekerapan yang digunakan. Sampel air tangki juga diuji untuk bakteria fecal (*Escherichia coli*, total coliform dan potensi patogen lain) menggunakan kaedah berasaskan budaya. Hasilnya kemudian dibandingkan dengan standard air minum Kementerian Kesihatan. Antara sampel yang terdedah kepada cahaya UV, semua parameter mematuhi piawaian kecuali untuk nilai Total Coliform yang melebihi set standard maksimum. Berdasarkan kajian ini, sinar UV dapat membasmi air dengan bantuan kaedah penyahsenaan yang lain.

## ABSTRACT

Water scarcity is a major problem in many developing countries. Malaysia has high precipitation thus this becomes the possible source for domestic use. In this study, ultra violet germicidal was used to disinfect rainwater in water samples collected from rainwater harvester tank in Gambang, Pahang. Then, it subjected to analysis for the presence of selected bacterial pathogens and potential pathogen of health concern for such *Escherichia coli* and *Total Coliforms*. This pathogen were found to be prevalent in rainwater samples with *E. coli* being the most prevalent potential pathogen in both types of samples. Samples were exposed to UV light for 5 minutes, 10 minutes, 15 minutes and 30 minutes. Water quality parameter for such pH, Colour, Turbidity, Total Dissolved Solid, Total Suspended Solid and Hardness was used. Tank water samples were also tested for fecal bacteria (*Escherichia coli*, *total coliforms* and other potential pathogens) using culture-based methods. The results then being compared with Ministry of Health drinking water standards. Among the sample that was exposed to UV light, all the parameters comply with the standards excepts for the value of *Total Coliforms* which exceed the maximum standard set. Based on this study, UV light is able to disinfect water with the help of other disinfection method.

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## **LIST OF ABBREVIATIONS**

RWH	Rainwater Harvester
MOH	Ministry of Health
UV	Ultraviolet
NA	Nutrient Agar
PDA	Potato-Dextrose Agar

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

Water scarcity is becoming the largest problem in the world today. Sustainable economic growth requires a reliable supply of water for energy, agriculture, and a growing population. Water is necessary and normally used in agriculture, sanitation or even as a drinking water (Helmreich and Horn, 2010; Li et al., 2010; Abdulla and Al-Shareef, 2009). Due to industrial growth, freshwater resources have been increasingly polluted and depleted globally.

Due to this issue, rain water harvesting and its quality are the focal points of several ongoing researches. In this context, the practice of rainwater harvesting (RWH) is becoming important as successful examples show in Queensland, Australia and Zambia. Rural Zambia is a region that had limited access to safe water and sanitation structures led to the lack of safe water to the majority of city dwellers were lack of financial resources to increase the water supply system and rural to urban migration. Rainwater implementation was believed to able to solve water scarcity problem. In Ireland, by utilising these water systems in order to avoid paying a large water bill. Reducing the use of publicly-supplied water through Rainwater Harvester treatment systems has cut down the cost of providing a centralised water supply by the Irish government (Li et al., 2010). Recent studies have highlighted the significant economic, social and environmental benefits of harvesting rainwater as an alternative water resource.

Rainwater before is supplied for domestic uses has to be disinfected first before being supplied for domestic uses since water might contain active pathogens in it. The most common disinfection method for drinking water is Chlorination method, but in this study

focused more on Ultraviolet disinfection method. Due to the increased information on the production of hazardous oxidation by-products during chlorination and Ozonation, UV irradiation gained more attention where low pressure UV light that exposed on water produces almost no by-products (Hijnen et al., 2005). UV-GI is a technique of exposing water to ultraviolet light with several wavelength. Ministry of Health Malaysia were standardised a guidelines to ensure the quality of drinking water.

## **1.2 Problem Statement**

The safety of this water source is of concern as contamination of domestic rainwater systems has been linked to a number of instances of human infection. Good quality water must free from disease causing organisms, harmful chemical substances and radioactive material. It should also be aesthetically appealing and free from objectionable colour or odour. Several types of microbiological contaminants have been found in harvested rainwater and lead to the existence of harmful pathogens. This microbial pathogens may originate in fecal contamination by birds, mammals and reptiles that have access to catchment areas or water storage tanks (Sazaklia, 2007). The consumption of untreated rainwater has been linked to bacterial diarrhoeas associated with *Salmonella* and *Campylobacter*, bacterial pneumonia due to *Legionella*, *botulism* due to *Clostridium*, tissue helminths, and protozoal diarrhoeas from *Giardia* and *Cryptosporidium* (Lye, 2014). According to the study done in Southeast Queensland, Australia, pathogens such as *Escherichia coli* (*E. Coli*), *Enterococcus spp.*, *Aeromonas hydrophila*, *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Legionella pneumophila* were detected in one or more tank water samples (Ahmed et al., 2013). This links to disease outbreaks to consumer.

## **1.3 Objectives**

1. To indicate the water quality parameter of rainwater from RWH
2. To study about microbiological activities of pathogens in rainwater
3. To propose disinfection method of rainwater.

#### **1.4 Scope of study**

The scope of this study is to investigate water quality parameters of rainwater from Rainwater Harvester. Also, to identify the microbiological contain of sample after being exposed to Ultra-violet light. Laboratory investigation was conducted environmental laboratory in Universiti Malaysia Pahang (UMP). This study are focusing more on the applicability of UV light in the removal of pathogens in rainwater.



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