Water Retention in Urban Environment and Mosquito Breeding Problems

By

Mohd Ihsan Adli Muhmed

Dissertation submitted in partial fulfilment of
the requirements for the
Bachelor of Engineering (Hons)
(Civil Engineering)

JUNE 2005

Universiti Teknologi PETRONAS
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

Water Retention in Urban Environment and Mosquito Breeding Problems

By

Mohd Ihsan Adli Muhmed

A project dissertation submitted to the
Civil Engineering Programme
Universiti Teknologi PETRONAS
in partial fulfilment of the requirements for the
BACHELOR OF ENGINEERING (Hons)
(CIVIL ENGINEERING)

Approved by,

(Associate Professor Dr. Nasiman)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

June 2005

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgments, and that the original work contained herein have not been undertaken or done by unspecified sources or persons

MOHD IHSAN ADLI MUHMED

ABSTRACT

It has been more than a hundred years since the very first dengue cases in Malaysia is being reported. Over the last three decades, the dengue epidemic has been increasing terrifically. Nowadays, dengue is one of the major public health problems in our country. More than 80% of the cases are reported in urban area as compare to the rest for rural area.

As the dengue cases is increasing inline with more urbanization done in our Malaysia, we can simply state that there's something wrong with the urbanization. Usually the dengue cases is said to be closely related with the human faults and lack of their concern to the surroundings cleanliness and therefore, they are eventually providing the *Aedes* mosquito breeding environment which is the particular mosquito acting as the vector of dengue virus transmission to human.

This project focuses on the contribution of the engineering structures that can retain water which potentially contribute to the *Aedes* breeding environment. The study is concerning three common engineering structures which are the septic tank, box for water distribution chamber and box for fire hydrant maintenance.

The government has done lots of campaign and control measures to overcome the dengue problems. However, as the controlling measures increase, the dengue cases have also increase and this simply indicates that the current measures taken is not going to eliminate or at least control the dengue problems in our county. Hence, alternatives solutions are necessary and this project proposes the biological control of the *Aedes* mosquito to be promoted and applied nationwide.

ACKNOWLEDGEMENTS

Alhamdulillah, with my greatest gratitude to the Almighty Allah for his gracious blessings throughout this project was undertaken. Also I would like to express a deepest gratitude to my parents for their love and supports to me from the beginning of my life until now. To my supervisor, Assoc. Prof. Dr. Nasiman, thank you so much for the guidance and support throughout completing the projects. There were times when I feel down as his word of wisdom had really encouraged me to give more effort to the projects. I'm feeling lucky to have him as a supervisor that I am so highly motivated like him. I also want to thank to the personel from Lembaga Air Perak, Mr Shahidan and Mr Veeramohan, Perak Tengah Health Officer who help me to settle the obstacles that I had face in completing this project.

The compliment also should give to all Civil Engineering (CV) Laboratory technicians for giving me such an enormous of information and assistances in completing this project. In particular, they are Kak Nor and Mr Siva.

I would also like to express my sincere appreciation to my special friend, Noor Faradila Mad Dalan for all her contributions and supports towards the project.

I really hope that all the efforts had been given to me and also with the help of such nice people; the project will benefit the society.

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION 1
1.1 Background of Study 1
1.2 Problem Statement 2
1.3 Objectives. 2

CHAPTER 2: LITERATURE REVIEW 3
2.1 Dengue in Malaysia 3
2.12 Dengue Control Programme 6
2.2 Aedes Mosquito 10
2.2.1 Mosquito Life Cycle 11
2.2.2 Aedes Breeding Environment. . . . 16
2.3 Water retention structure in urban environment . . 17
2.3.1 Septic tank 17
2.3.2 Water distribution sluice valve box . . . 18
2.3.3 Fire hydrant sluice valve box 19

CHAPTER 3: METHODOLOGY 21
3.1 Procedure. 21
3.2 Tools/Equipment. 21
3.3 Scope of the Project 22
3.4 Fieldwork. 22
3.4.1 Septic tank 23
3.4.2 Water distribution sluice valve box . . . 26
3.4.3 Fire hydrant sluice valve box 27
3.5 Experiment 28
3.5.1 Water quality analysis. 29
3.5.2 Biological control 30

CHAPTER 4: RESULTS AND DISCUSSION 39

CHAPTER 5: SUMMARY AND RECOMMENDATION. . . . 43

CHAPTER 6: CONCLUSION 45

REFERENCES 46

LIST OF FIGURES

Figure 1: Mosquito life cycle
Figure 2: mosquito egg raft
Figure 3: mosquito larva
Figure 4: mosquito pupa
Figure 5: mosquito adult
Figure 6: Typical septic tank
Figure 7: Sluice Valve Box Drawing
Figure 8: Detail of typical connection to pillar hydrant
Figure 9: Detail of C.I Surface Box and Sluice Valve
Figure 10: septic tank
Figure 11: pump house of the septic tank
Figure 12: septic tank with open cover
Figure 13: *Aedes* mosquitoes stick on septic tank wall
Figure 14: LAP Sluice Chamber Box
Figure 15: typical fire hydrant
Figure 16: fire hydrant sluice valve hole
Figure 17: larvae and pupa beneath the water surface
Figure 18: *Aedes albopictus*
Figure 19: water bug
Figure 20: Bugs in the stock container
Figure 21: Two bugs attacking mosquito larvae
Figure 22: Acclimatization process
Figure 23: Suitability and Survivability test for the bugs
Figure 24: Bug's habitat water sample
Figure 25: Water sample from box of water distribution sluice chamber
Figure 26: Water sample from box of fire hydrant sluice valve
Figure 27: Water sample from septic tank

LIST OF CHARTS

Chart 1: Cases of clinically confirmed dengue reported in Malaysia 1973 - 2002

Chart 2: Dengue case fatality rate according to DF/DHF and DHF in Malaysia

Chart 3: Three decades of dengue cases in Malaysia (1973-2002)

Chart 4: Three decades of national campaign in Malaysia (1973-2002)

Chart 5: number of bugs in tested water samples in 30 days

LIST OF TABLES

Table 1: Ratio of DF and DHF reported cases, 1996-2001 (August)

Table 2: Dengue control in Manjung, Perak (2004)

Table 3: *Aedes* breeding by type of premises in 2000

Table 4: Water quality test

Table 5: Number of bugs in various water samples in 30 days

CHAPTER 1

INTRODUCTION

1.1 Background of Study

It has been sometime since anyone took a real critic at how dengue is being managed by the relevant authorities. In previous three decades, the dengue cases reported in Malaysia has been arising year by year and it comes to early of this year when this epidemic has been booming astonishingly. As the control measure has been taken by the Ministry of Health increasing throughout the years, it indicates that whatever control measure has been taken is not going to counter the dengue problem in Malaysia because even since the number of dengue cases have also rising.

Normally people's attitude will always be blamed for each dengue case happened. However it cannot be taken into account to much since that we cannot say current people's attitudes is worse as compare to people from previous decades or maybe people in area A which has more dengue cases reported is worse than people in area B with lesser dengue cases reported. People's attitude in this context is including their non-hygienic lifestyle where people don't manage their solid waste such as can, plastic, and bottle properly and also some of their activities including gardening and construction.

It will be so hard for the authority if they are just concentrating on educating people and continues with current control measures without looking at any other options because seemingly these will never solve the dengue problems in Malaysia.

1.2 Problem Statement

Provided that we can look at any problems in two views; one of it is area of control and secondly is area beyond control all problem can be solved. Usually people will always look at the area beyond their control and that's where people will blame other people for any harmful situation. As from engineering point of view, by looking at the area of control, urbanization of over the decades has been taken into account and has been suspected to contribute to this dengue problems catastrophic.

This project is mainly to identify whether the water retention structures in urban area are contributing to the *Aedes* mosquito breeding environment as they were identified as to become the vector for dengue fever. Plus this project will attempt to study the use of biological control of the mosquito as the new alternative to the current controlling measure by the Ministry of Health.

1.3 Objectives

The objectives of this project are summarized as follows:

1. To study dengue cases in Malaysia, *Aedes* mosquito and its breeding environment.
2. To identify the contribution of water retention structures in urban environment to *Aedes* mosquito environment.
3. To study biological control to encounter mosquito breeding problems and hence promoting the use of it nationwide.

CHAPTER 2

LITERATURE REVIEW

2.1 Dengue in Malaysia

Dengue fever (DF) in Malaysia was first reported in year of 1902. It has now becoming one of the major public health problems in our country, especially with the emergence of dengue haemorrhagic fever (DHF) in 1962 (Teng, 2001).

Dengue infection is predominant in urban areas where currently 61.8% of the country's population lives, as compared to only 34% in 1980. Rapid industrial and economic development over the last two decades has brought about massive infrastructure development and a very active construction sector for housing and commercial development, creating many man-made opportunities for *Aedes* mosquito breeding (Teng, 2001).

The number of clinically diagnosed DF and DHF reported cases has been steadily increasing from below 1000 cases a year in 1980s to over 5000 cases in 1991. There were outbreaks in 1974 and 1982, and a major outbreak in 1998 with 27381 cases reported (Teng, 2001). Again in this new century, the figure has jumped to as high as in the last outbreak approximately 33,000 in the year of 2002 (Veeramohan, 2004). Chart 1 below shows that the dengue is apparently out of control.

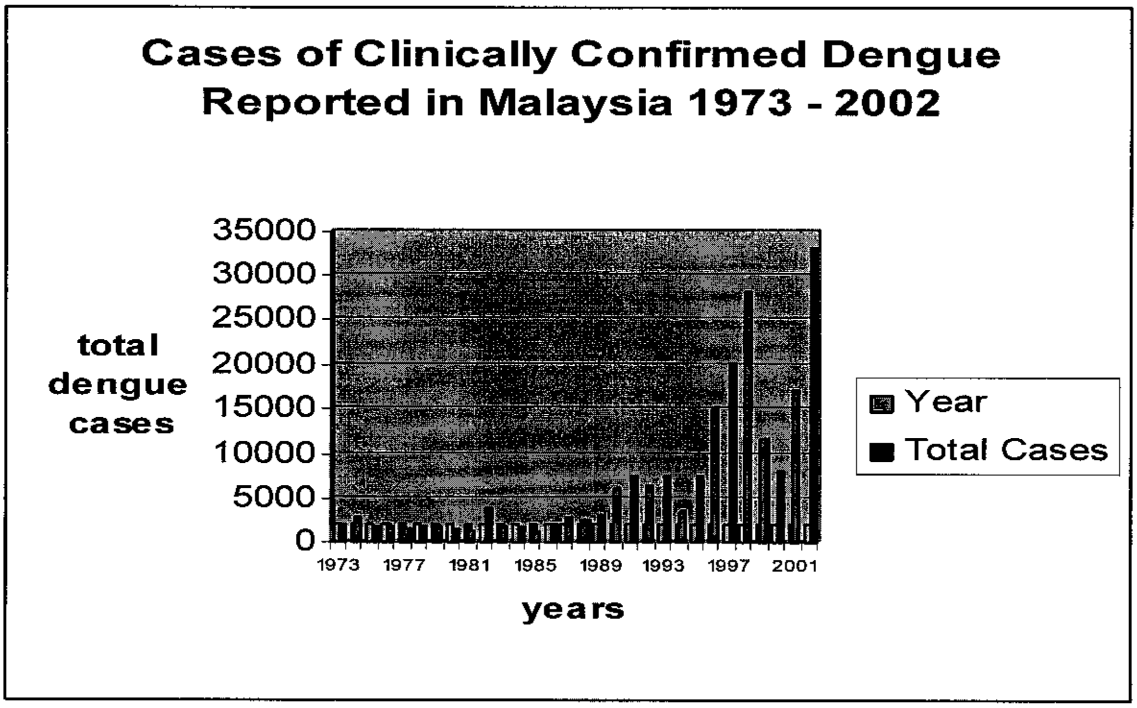

Chart 1: Cases of clinically confirmed dengue reported in Malaysia 1973 - 2002

Statistics: Vector HQ, MOH

DHF continues to present a major health problem in many areas of the world especially in South East Asia. The infection is caused by the dengue virus which has four serotypes (Den1, Den2, Den3 and Den4). Dengue virus is transmitted to human via mosquito bites (Tuksinvarachan, 2004). All confirmed vectors of dengue virus are in the genus *Aedes* and the most important is *Ae. Aegypti* (Linnaeus, 1762) and (Gubler, 1988). This mosquito thrives in association with humans, larvae of the species are developing in almost any water-filled container (Christophers, 1960). Another *Aedes* type that's spreading the virus is *Ae. Albopictus*. *Ae. Albopictus* is among the most important arbovirus vectors in the world, particularly for *Dengue Virus* (DV) (Fontenille, 2001).

Dengue fever was the predominant type with the DF/DHF ratio of 16-25:1 in the year ranges of 1996-2001 (Table 1), based on the notified clinically diagnosed cases (Teng, 2001).

Year	DF	DHF	DF:DHF ratio
1996	13723	532	25.8:1
1997	18642	787	23.7:1
1998	26240	1133	23.1:1
1999	9602	544	17.6:1
2000	6692	411	16.28:1
2001 (August)	9375	524	17.9:1

Table 1: Ratio of DF and DHF reported cases, 1996-2001 (August)

The case fatality rate (CFR) for DF and DHF is shown in Figure. The case-fatality for DHF was especially high but this was partly contributed by under-reporting of DHF where the initial notification as DF was not rectified when these cases subsequently were diagnosed as DHF (Teng 2001).

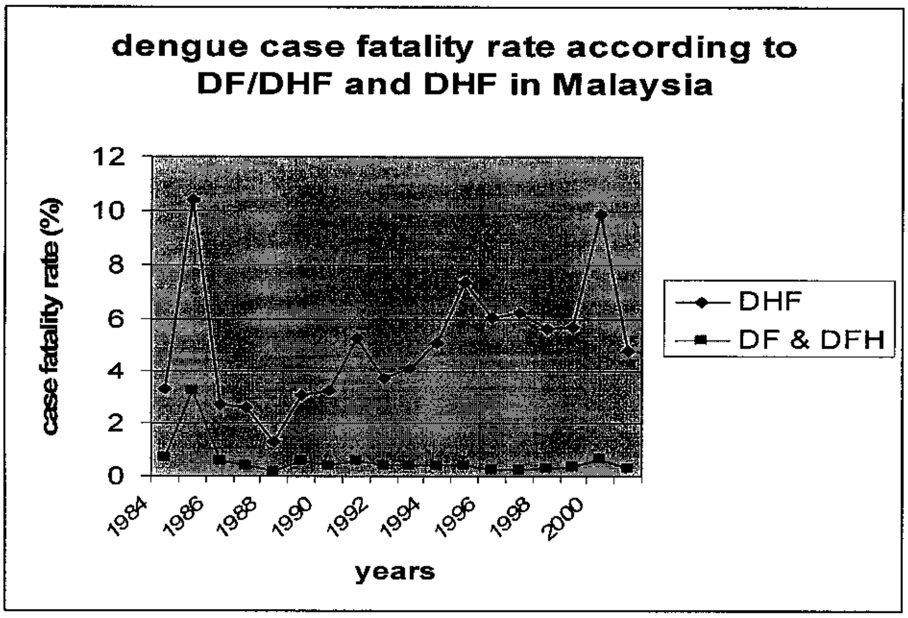

Chart 2: Dengue case fatality rate according to DF/DHF and DHF in Malaysia

2.12 Dengue Control Program

Dengue control forms part of the national Vector-Borne Disease Control Programme which encompasses malaria, dengue, Japanese enchapalitis, filarisis, typhus, yellow fever and other new emerging vector-borne diseases. The dengue control programme (Teng, 2001) comprises the following aspects:

- Disease surveillance and control.
- Vector surveillance and control.
- Public education.
- Inter agency collaboration and community participation.
- Quality assurance.
- Research and training.

Objective and targets of the dengue control programme.

The main objective of the programme is to reduce the morbidity and mortality caused by DF/DHF so that it will no longer pose a public health problem.

The targets set under the Eight Malaysian Plan (2001-2005) are as follows:

1) Not more than 50 cases of DF/100,000 population.
2) Not more than 2 cases of DHF/100,000 population.
3) Case-fatality rate of DF/DHF not more than 0.2%.
4) Case-fatality rate of DHF not more than 1.0 %.
5) Aedes Premise Index not more than 1%.

Strategies:

1) Epidemiological surveillance through prompt case notification within 24 hour of clinical diagnosis via phone, fax or email.
2) Enhancing laboratory diagnostic support through the use of rapid screening tests and confirmation by standard laboratory technique.
3) Improved clinical management through early case detection and quality assurance surveillance and audit.
4) Case control through rapid response aimed at case investigation and destruction of vector by chemical fogging.
5) Entomology surveillance through regular *Aedes* larval surveys.
6) Legislative control on *Aedes* breeding through premises inspection and destruction of breeding sources.
7) Public education through health education activities in the community and with community involvement.
8) Inter-agency collaborating targeting at high-risk areas and population groups such as schools, construction sites, solid-waste dumps, factories and government facilities.

However, by looking at the accumulative totals for three (3) decades in Chart 3, we can definitely conclude that something is seriously wrong in the administration and technical management of dengue in the country (Veeramohan 2004).

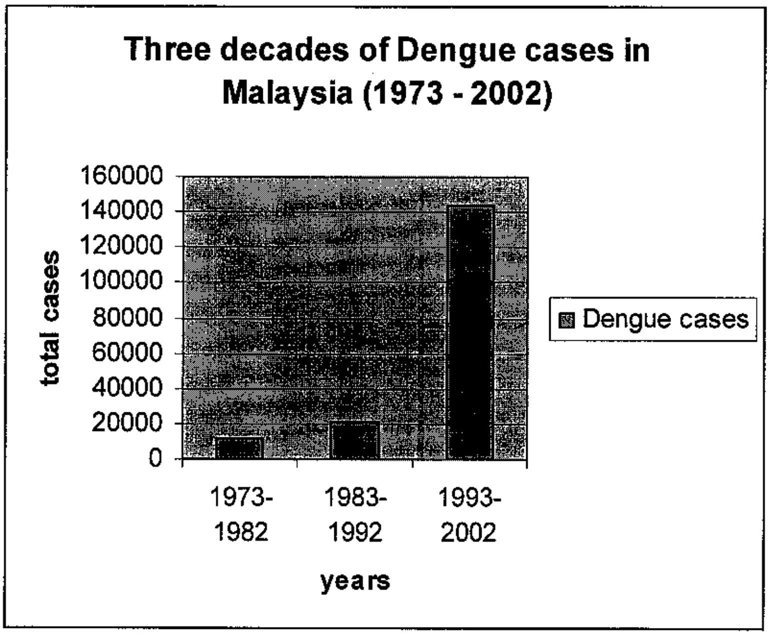

Chart 3: Three decades of dengue cases in Malaysia (1973-2002)

By looking at the objectives and targets of the Dengue Control Programme published by the Ministry of Health, we found that the statements do not compare favourably against the statistical outcomes of the dengue control programme as can be seen in the foregoing and following graph and chart. An analysis against national campaigns carried out before or after nationwide outbreaks of dengue in chart reveals solutions to problems faced by the Ministry of Health in the administration and technical management of dengue and its causative factors. It indicates that such cost-effective community based campaigns have been managed to interrupt transmission by eliminating or reduce the density of external breeding vectors (Veeramohan 2004).

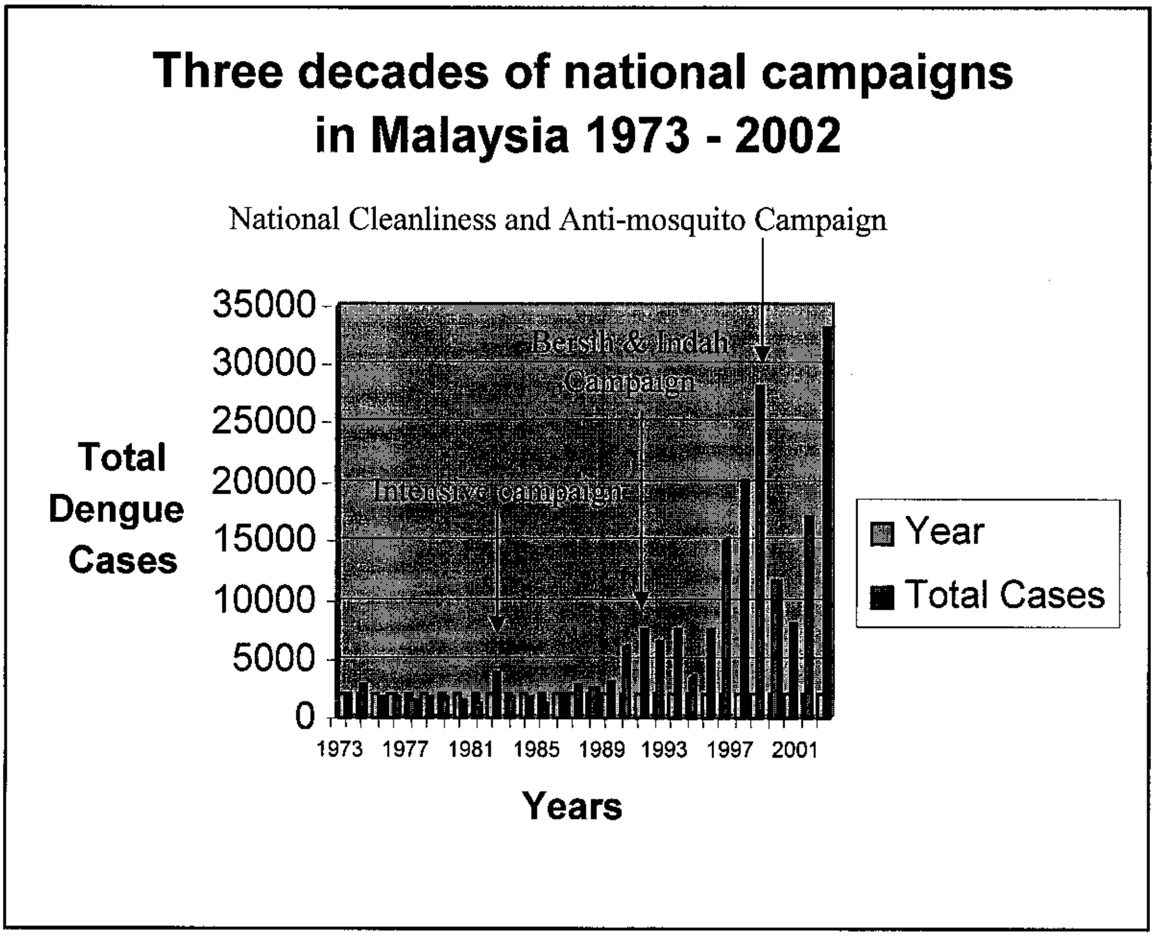

Chart 4: Three decades of national campaign in Malaysia (1973-2002)

The campaigns were external and did not involved intensive fogging or larviciding of residential sources of breeding which are visited by the Ministry of Health throughout the year. The Aedes and Breteau Indices for residential and commercial premises do not have any relevance when external breed rates are not surpressed to sustainable levels. The campaigns did not rely on enforcement of the Destruction of Disease Bearing Insects Acts 1975 which was amended in 2001. This was because the objectives and targets for dengue control are merely speculative based on reported cases of dengue (Veeramohan 2004).

Fogging and abate activities in which believed to control the *Aedes* breeding problem is so far founded ineffective as the dengue cases has also been arising. For instance, in Manjung, Perak the dengue control that has been done in last year is as follow:

Total premises inspected	49,778
Total premises fogged	341,875
Total premises Abated	7,346
Total notice	67
Total compound	175
Total fine (RM)	14,600
Total DF and DHF	750

Table 2: Dengue control in Manjung, Perak (2004)

An average of 62 cases per month has been recorded in such a medium size district like Manjung despite of a relatively high number of the total premises fogged throughout the year which is 341,875 in total.

2.2 Aedes Mosquito

Mosquito has tremendous impact on humans almost everywhere, either as significant sources of irritation or as vectors of serious disease. Dengue is the most common viral pathogen transmitted by mosquitoes. The virus, which consists of four serotypes, causes a spectrum of disease ranging from mild fever to fatal shock (Strickman, 1997).

Mainly there are two species of *Aedes* that identified to be the vector for dengue virus. *Aedes Aegypti*, the principal vector of DF/DHF, is mainly distributed in countries lying between January 10°C isotherm and July 10°C isotherm. *Aedes albopictus*, which ranks second only to aegypti as a vector of DF/DHF which was essentially a species of the Oriental and Indo-malayan region, has become established worldwide during the last 30 years (Knudsen, 1996).

Aedes Aegypti infects more than 100 million people in every year in more than 110 countries in the tropics. The regions of the Americas, Africa and South-East Asia are the most infected areas. Children are the most vulnerable to dengue infection and 95% of the dengue cases are those under 15 years of age (Wiesman, 2003).

Aedes albopictus which ranks second after *Ae. aegypti* in importance to man as a disease vector of dengue and DHF is an arbovirus vector which potentially places at risk 2.5 to 3 million people living in urban, suburban and more rural environments in more than 100 countries in the tropical and sub-tropical regions of the world. *Aedes albopictus* recieved its nick name, "tiger mosquito" in South-East Asia due to its vivid median silvery line extending from the head to the dorsum and its distinct tarsal bands. It is considered to be an aggressive and colourful mosquito, catching the fancy of biologists and the public alike. Along with *Ae. aegypti* it is one of the more 25 *Aedes (Stegomyia)* species found around the globe (Knudsen, 1996).

2.2.1 Mosquito Life Cycle

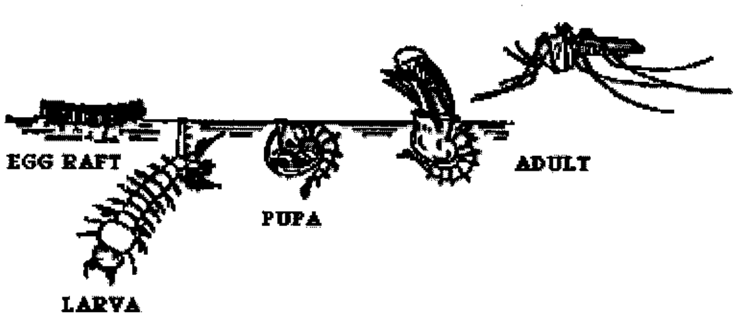

Figure 1: Mosquito life cycle

The mosquito goes through four separate and distinct stages of its life cycle: Egg, Larva, Pupa, and Adult. Each of these stages can be easily recognized by its special appearance.

Mosquito egg raft

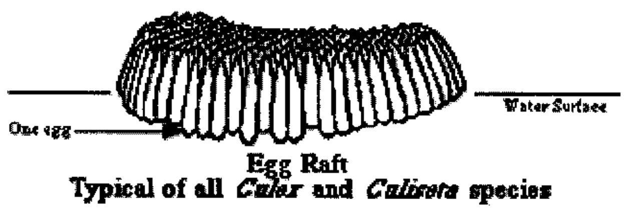

Figure 2: mosquito egg raft

Many mosquitoes lay their eggs on the surface of fresh or stagnant water. The water may be in tin cans, barrels, horse troughs, ornamental ponds, swimming pools, puddles, creeks, ditches, catch basins or marshy areas. Mosquitoes prefer water sheltered from the wind by grass and weeds.

Aedes mosquitoes lay their eggs singly, usually on damp soil. *Aedes* eggs are more resistant to drying out (some require complete drying out before the eggs will hatch) and hatch only when flooded with water (salt water high tides, irrigated pastures, treeholes flooded by rains, flooded stream bottoms).

Tiny mosquito larvae (1st instar) emerge from the eggs within 24 - 48 hours almost in unison (Floore, 2003).

Mosquito larva

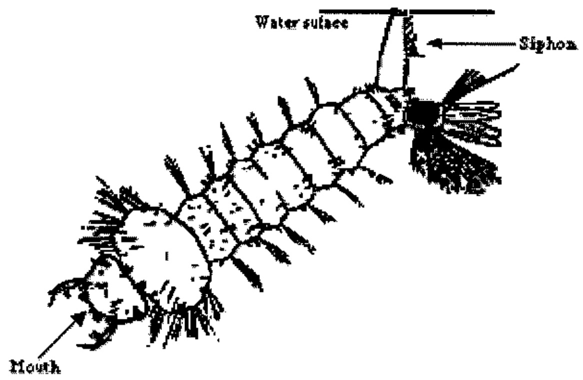

Figure 3: mosquito larva

Larvae shed (molt) their skins four times, growing larger after each molt. Most larvae have siphon tubes for breathing and hang upside down from the water surface. The larvae feed on microorganisms and organic matter in the water. During the fourth molt the larva changes into a pupa. Larvae usually live in water from 4 to 14 days.

Mosquito pupa

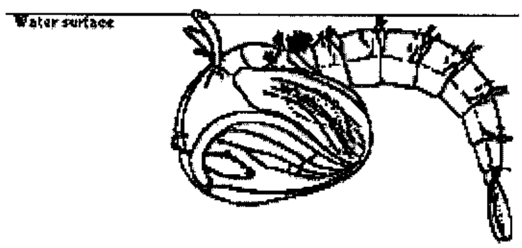

Figure 4: mosquito pupa

Mosquito pupae, commonly called "tumblers," live in water from 1 to 4 days, depending upon species and temperature.The pupa is lighter than water and therefore floats at the surface. It takes oxygen through two breathing tubes called "trumpets." The pupa does not eat, but it is not an inactive stage. When disturbed, it dives in a jerking, tumbling motion toward protection and then floats back to the surface.

The metamorphosis of the mosquito into an adult is completed within the pupal case. The adult mosquito splits the pupal case and emerges to the surface of the water where it rests until its body dries and hardens.

Mosquito adult

Figure 5: mosquito adult

Only female mosquitoes require a blood meal and bite animals - warm or cold blooded - and birds. Stimuli that influence biting (blood feeding) include a combination of carbon dioxide, temperature, moisture, smell, color and movement. Male mosquitoes do not bite, but feed on the nectar of flowers or other suitable sugar source. Acquiring a blood meal (protein) is essential for egg production, but mostly both male and female mosquitoes are nectar feeders.

Aedes mosquito is painful and persistent biter. They search for a blood meal early in the morning, at dusk (crepuscular feeders) and into the evening. Some are diurnal (daytime biters) especially on cloudy days and in shaded areas. They usually do not enter dwellings, and they prefer to bite mammals like humans. *Aedes* mosquito is strong flier and is known to fly many miles from their breeding sources (Floore, 2003).

2.2.2 Aedes breeding environment

Aedes larvae can develop in almost any water-filled container. There are two types of breeding sources for mosquitoes which are natural and artificial. Natural mosquito breeding sources include storm water ditches, non-fish bearing bodies of water, flood plains, and low areas in the topography that water will settle. Artificial mosquito breeding sources consists of anything that is man-made with the capacity to hold at least ¼" inch of water. This includes buckets, birdbaths, tarps, rimless tires, flower pot basins, and clogged gutters. Inverting or removing the source can eliminate artificial mosquito breeding sources (Floore, 2003).

Regular *Aedes* larval surveys and outbreak surveys provide the *Aedes* surveillance data in the country. The pattern of the *Aedes* breeding is indicated by data from surveys for the year 2000. Residential premises had the lowest percentage of breeding at less than 1% (Teng, 2001).

Type of premises	No. examined	*Aedes* breeding	
		No. positive	%
Factories	8,064	651	8.10
Abandoned housing project	828	56	6.80
Construction sites	6,335	398	6.30
Vacant land	5,789	212	3.70
Garbage dump sites	3439	110	3.20
Offices	3,,199	94	2.90
Schools	22,464	576	2.60
Houses/ Shops	1,916,604	11,187	0.60

Table 3: *Aedes* breeding by type of premises in 2000

2.3 Water Retention Structure in Urban Environment

2.3.1 Septic Tank

For an individual home or dwelling, the septic tank is usually a reinforced concrete or fiberglass tank with a capacity of 1900 to 5700 liter. The tank is usually a single-compartment tank as shown in Figure 6, or in some cases, a two-compartment tank. The two-compartment tank, which generally is used for extremely large tanks, has a second compartment in series with the first one to clarify the effluent before it goes to soil absorption system. As shown in the Figure 6, settleable solids accumulate at the tank bottom where decompositions take place under anaerobic conditions. Floatable solids (fats and greases) rise to the surface where limited microbiological decomposition results in the formation of a scum layer. Between the sludge at the bottom and the scum layer at the top, a partially clarified liquid remains. The partially clarified liquid exits the septic tank through an outlet located just below the scum layer and proceeds to the soil absorption system for further treatment (Reynolds, 1996).

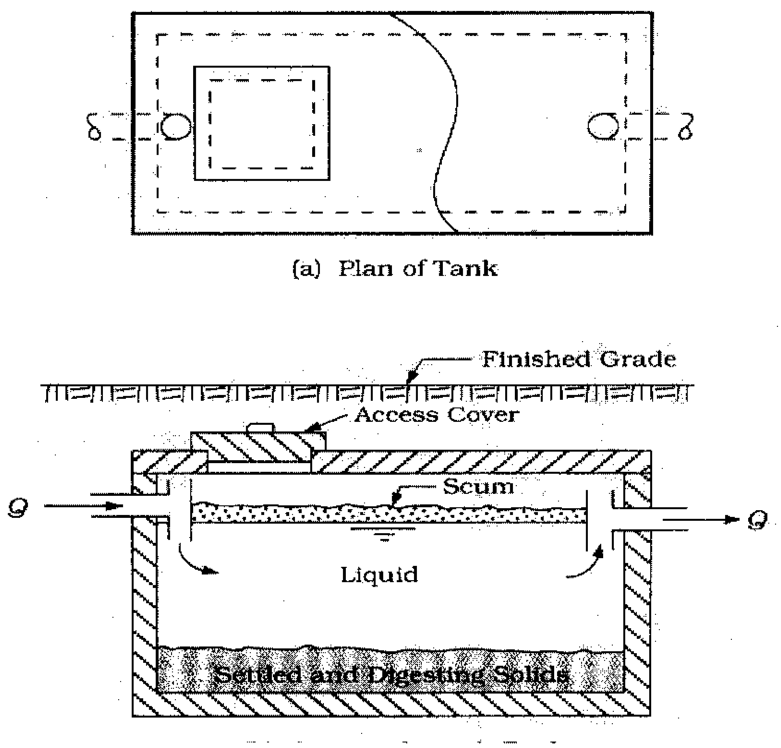

Figure 6: Typical septic tank

2.3.2 Water Distribution Sluice Valve Box

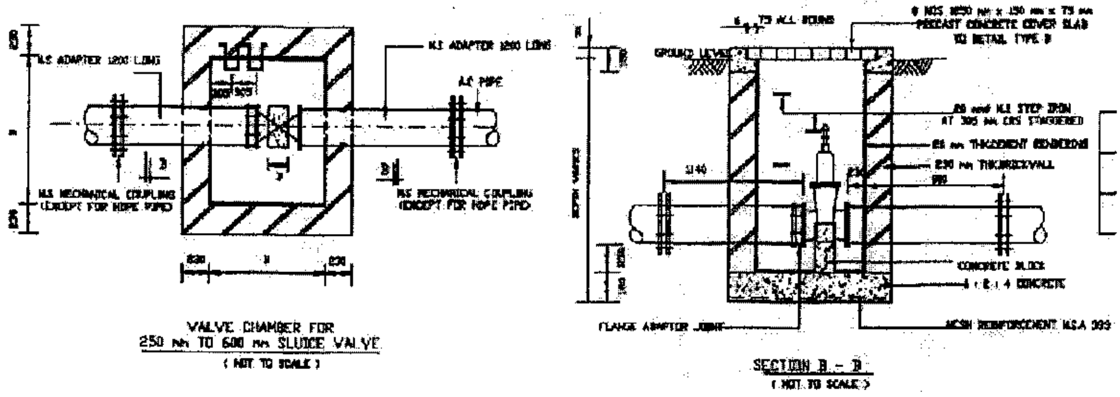

Figure 7: Sluice Valve Box Drawing

Figure 7 shows the typical box for water distribution sluice valve which are used by Lembaga Air Perak (LAP). The box is meant for protection of the sluice valve and to make the maintenance work easier. Normally the sluice valve comes along with air valves. Sluice valve is one of the stop valves which consists of a gate shut down into the pipeline. Valves maybe operated by hand or by actuator. Actuators generally are electric (but maybe hydraulic or pneumatic) and may be operated locally or by remote control. Meanwhile, the air valve is acting as a control valve. Air trapped in the pipeline will reduce the area of the flow, increasing the friction loss and hence reducing the flow capacity. Air trapped at a series of high points on a pipeline profile will have a cumulative effect and may seriously restrict flow. At this valve the air will be removed. An isolating valve (sluice valve, butterfly valve or stopcock) should be sited below each air valve, thus making it possible to remove the air valve for repairs without shutting down the main (Twort, 2000). The box for both valves however commonly retain water (normally rain water and sometimes water from the leaking valve connections) which is stagnant inside and cannot seep out or infiltrate to the ground.

2.3.3 Fire Hydrant Sluice Valve Box

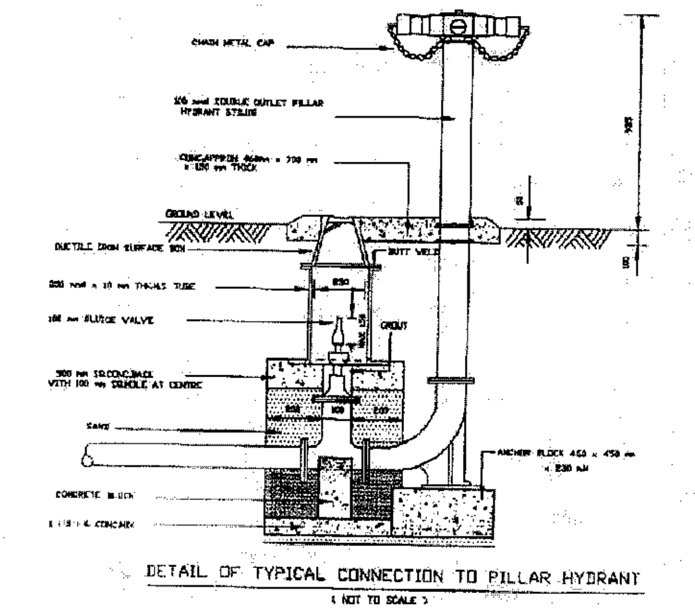

Figure 8: Detail of typical connection to pillar hydrant

Fire hydrant is one of the most important engineering structures in urban area. It is merely meant for the safety and to fight against the fire. Fire hydrants are located to provide complete protection to the area covered by the distribution system. Fire hydrant also have sluice valve and it is also protected with box and the water can possibly stagnant inside the box.

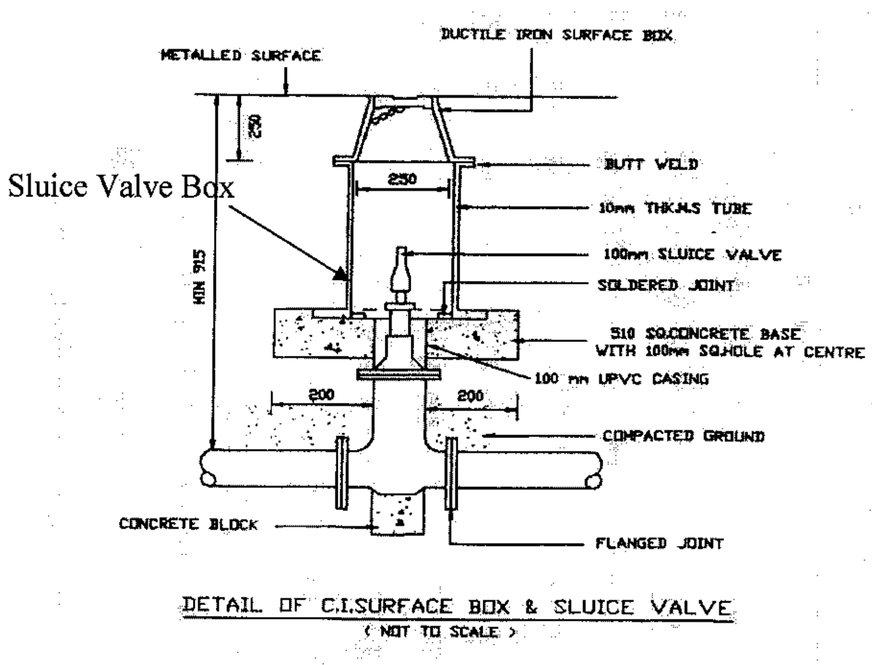

Figure 9: Detail of C.I Surface Box and Sluice Valve

CHAPTER 3

METHODOLOGY

3.1 Procedure

The project was carried out in three phases:-

- Literature review on mosquito breeding environment, dengue epidemic and the urban structure that retain water.
- Fieldwork: visit the urban structure that has potential as the mosquito breeding environments and sample collection.
- Experiment in the lab in order to promote ecological control in potential mosquito breeding environment.

3.2 Tools/Equipments

1. Volumetric flask of 500 ml
2. Beaker.
3. Pipette.
4. Hydrolab multitester.
5. Rotator.
6. Aluminum foil.

3.3 Scope of The Project

Promote biological control in engineering structures that have potential as mosquito (*Aedes*) breeding environment.

3.4 Fieldwork

This project has taken place in surrounding of UTP area and it goes as far as Batu Gajah and Parit area. Several visit has been done and from the observations, there were several engineering structure in the urban area that have been identified to retain water and have potential to become mosquito breeding environments which are:

1. Septic tank.
2. Water distribution sluice chamber box.
3. Fire hydrant sluice valve box.

Apart of the visit, water sample collection has also been done and it's then used to do the experiment in UTP lab.

3.4.1 Septic tank

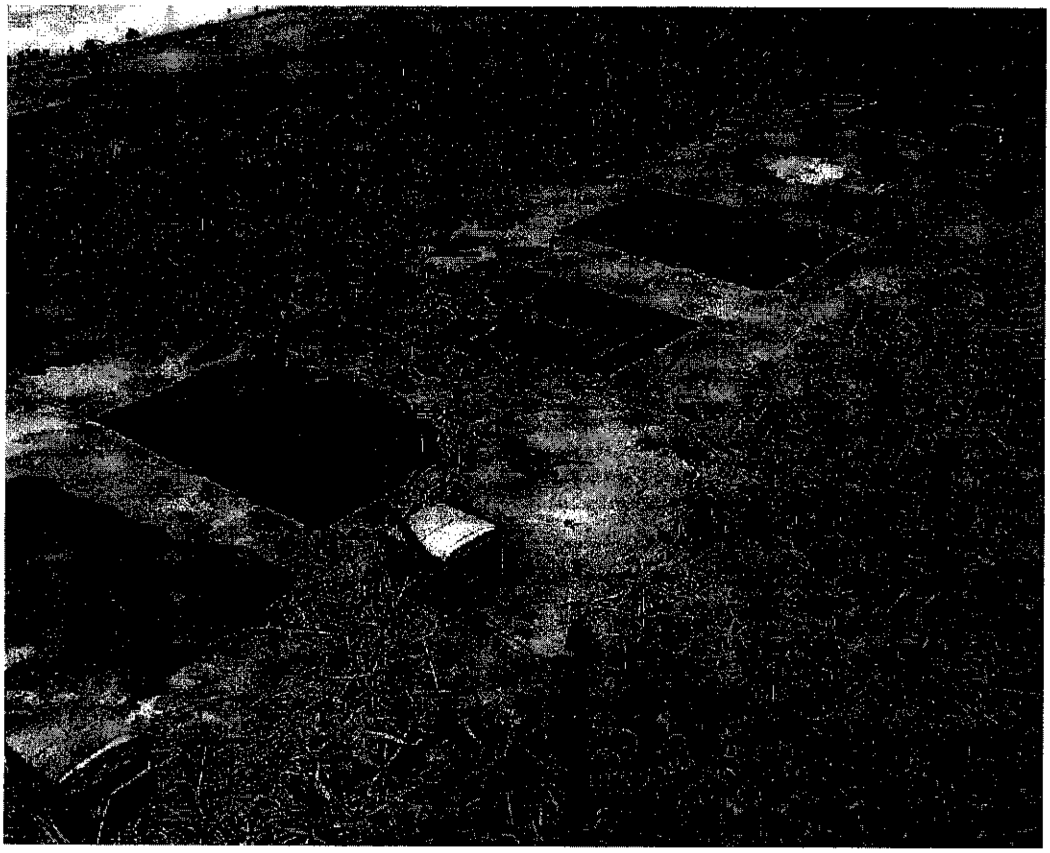

Figure 10: septic tank

Figure 10 shows the particular septic tank that has been investigated in a housing area in Batu Gajah town. This septic tank has three compartments which is used to treat the wastewater. The decomposing process applied is an anaerobic process since it has no aeration in the middle compartment. After the settling process and all other treatment process, the effluent is supposed to be discharged into the soil absorption system for further treatment. However the pump is not working as it is supposed to be and therefore it has contributed to the stagnation of the water.

Figure 11: pump house of the septic tank

Figure 11 also indicates the last compartment where the water sample was taken. It was so annoying because when the cover was opened, there were bundles of mosquito attacking and biting. Through the direct observation, it is clearly recognized that the mosquito type is *Ae. albopictus* and it has a single line on it's head. Plenty of the adult mosquitoes were staying still at the septic tank compartment wall.

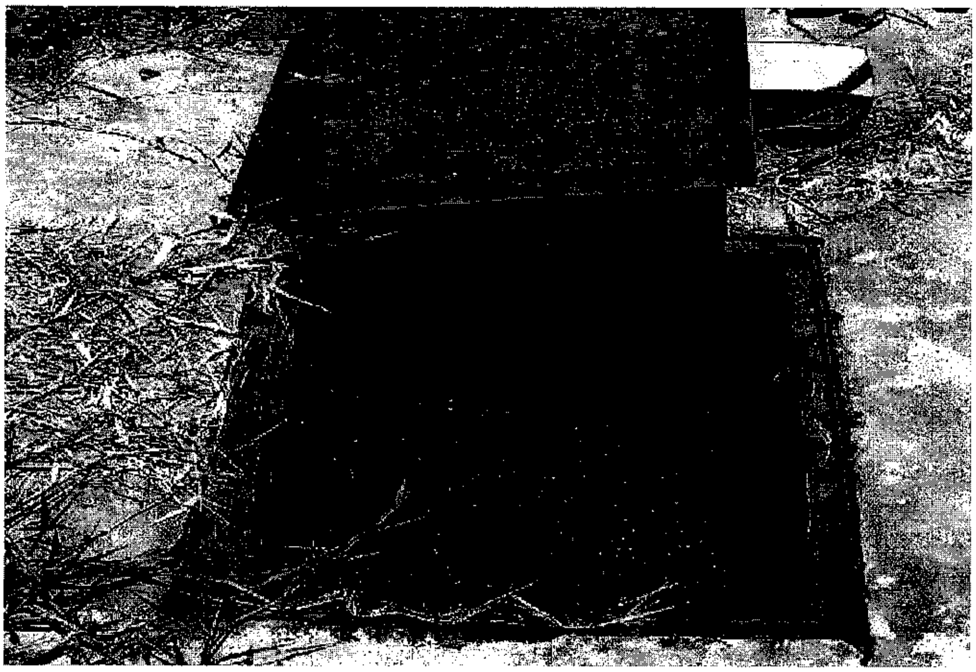

Figure 12: septic tank with open cover

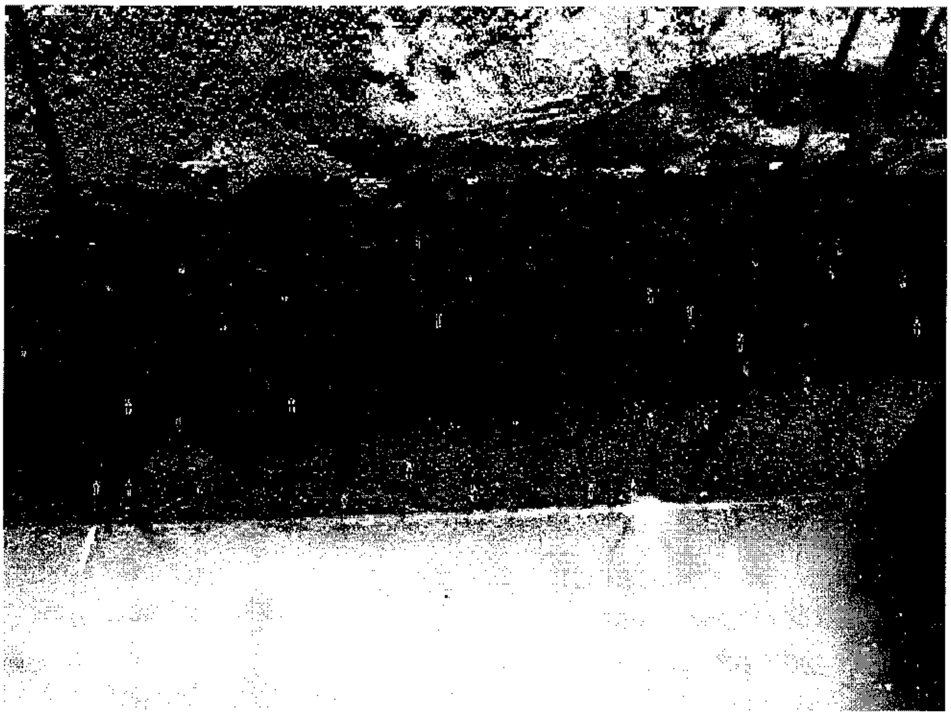

Figure 13: ***Aedes*** **mosquitoes stick on septic tank wall**

The water sample was then taken using the container by just taking it barely with free hand since the water level is apparently high. The sample was brought to the lab for experiment.

3.4.2 Water Distribution Sluice Chamber Box

The water distribution chamber box is located near to the UTP site and it has nothing there but access road to Entrance 3 of UTP. The box is the typical box as the other LAP's box for the sluice chamber and the water is taken by using a small pail which has a rope tighten at the handles and once the pail is full of water, it's pulled up to and the water sample is then brought to the lab.

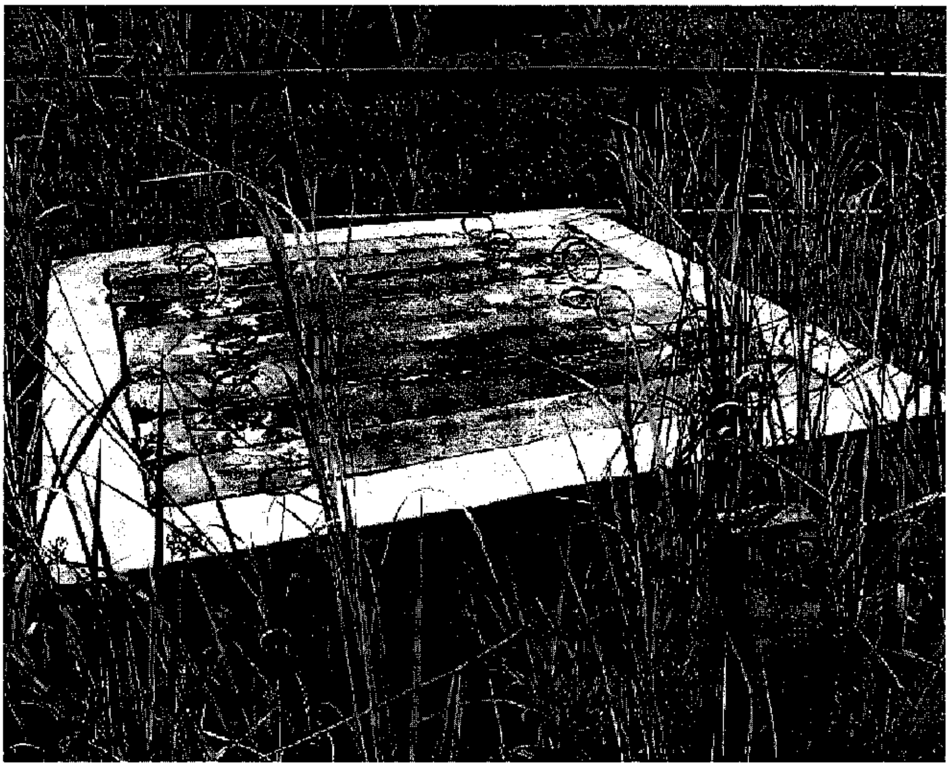

Figure 14: LAP Sluice Chamber Box

3.4.3 Fire Hydrant Sluice Valve Box

The site for this respective structure is also in Batu Gajah town. It's located besides the road and next to a house. The box of the fire hydrant sluice valve is provided with the metal cover and by putting in a stick inside, it was founded that the structure was retaining water. Mosquito larvae were founded in the water.

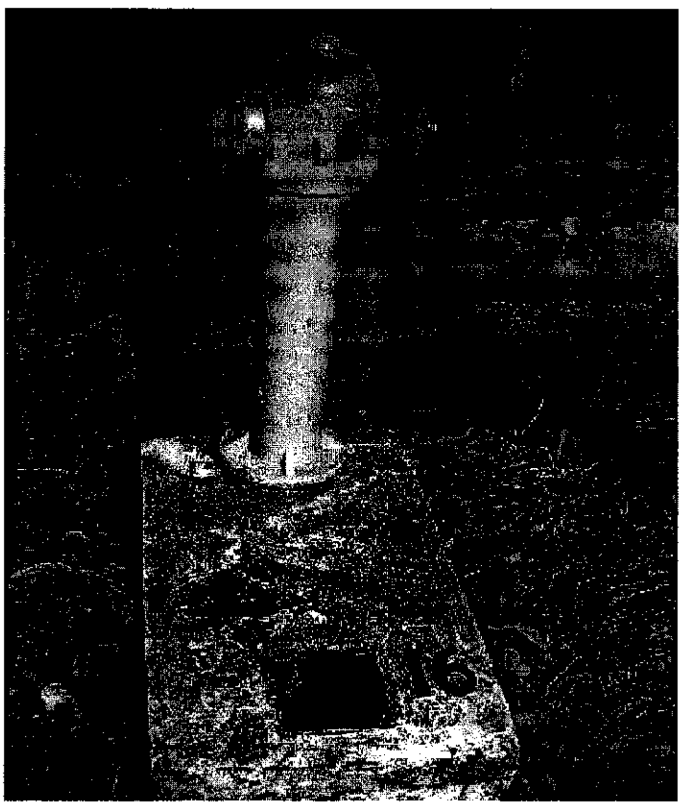

Figure 15: typical fire hydrant

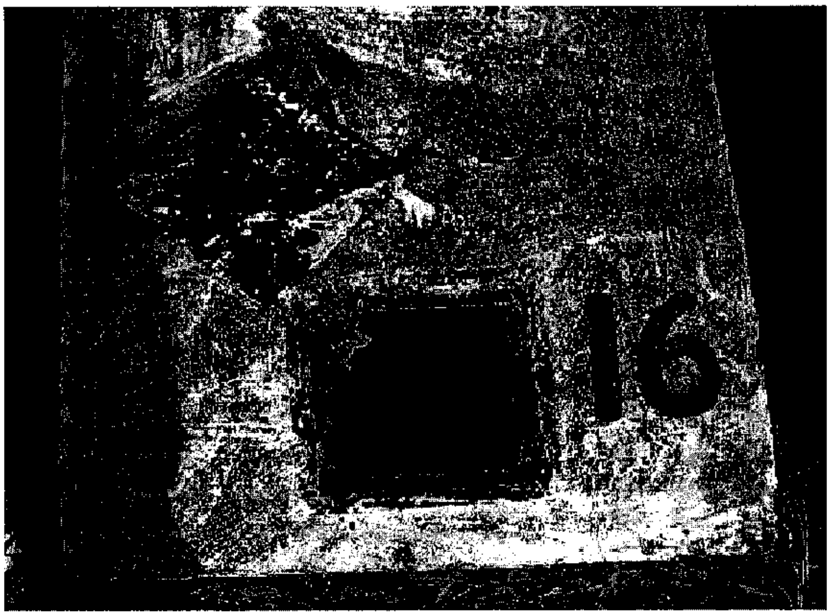

Figure 16: fire hydrant sluice valve hole

The water from the hole is then taken using a clean mineral water bottle and then transferred into the container to bring it back to the lab for experiment.

3.5 Experiment

The experiment has been carried out in Environmental Lab of Civil Engineering building of UTP. The experiment can be divided into two phases which are:

1. Water quality test.
2. Biological control test.

2.5.1 Water Quality Analysis

There are three measurement that has been taken into account which are pH, turbidity and COD. All experiments have been done in the Civil Engineering Environmental Lab. The experiment is using the Hydrolab multitester and rotator.

pH and turbidity test:

1. The electrode sensor is ensured to be in neutral condition by washing with distilled water.
2. Electrode was then immersed into the water for 2 or 3 minutes, and pH and turbidity reading was recorded.

Chemical Oxygen Demand (COD) Test:

1. 2ml of water sample was measured and poured into a test tube containing pottasium dichromate.
2. The test tube is the shaken properly. Heat was produced, indicating an exothermic process. This procedure is repeated by other group for other samples.
3. All the test tubes together with a blank as an indicator were then put into the rotator and left for 2 hours.
4. The readings are taken down and the average of those readings is calculated.

3.5.2 Biological control

Larvae, pupa and adult mosquito

Larvae and pupa is needed in order to test whether the biological control that is working. The sample which consists of not just the larvae and pupa, but also other solid particles such as plastic and rubbish was founded in an abandoned pail in Taman Maju, Seri Iskandar. It seems like the pail has been there for a while and it was filled with a relatively small quantity of water which believed to be rain water. It is then transferred into the container and later brought to the lab.

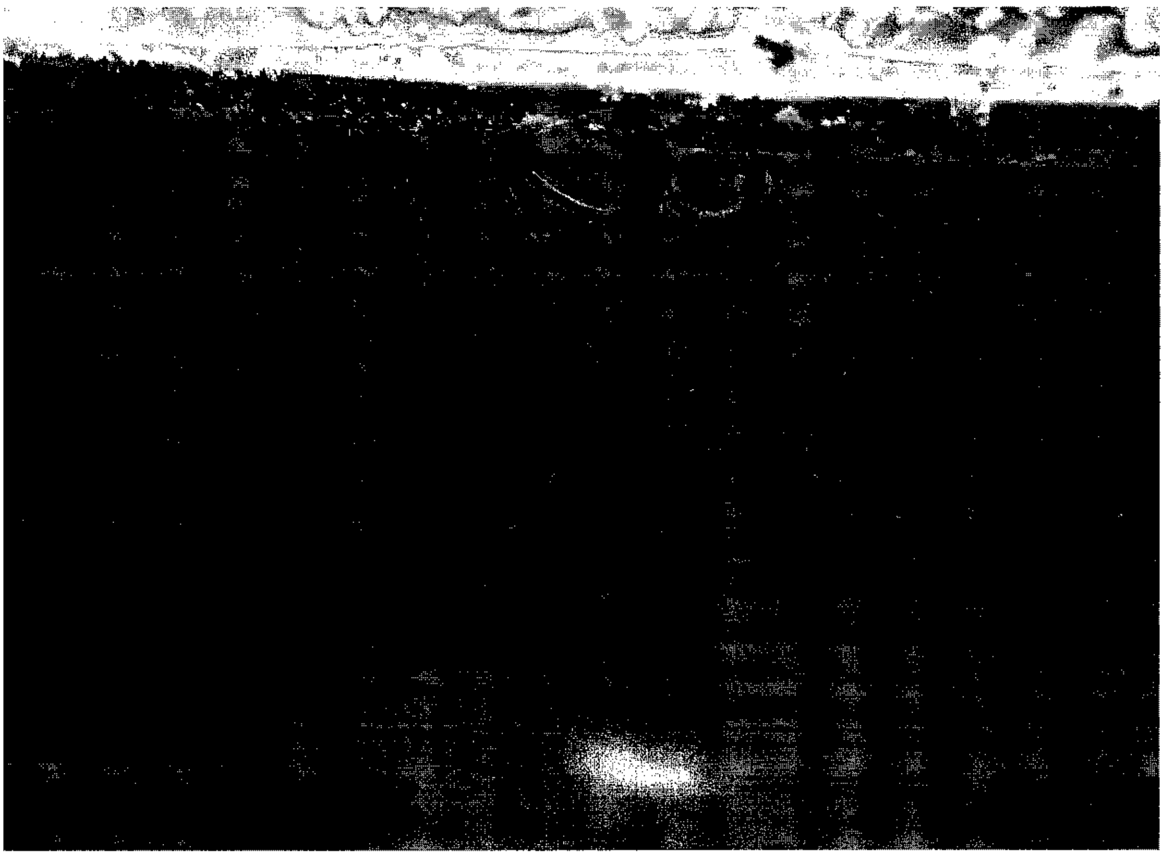

Figure 17: larvae and pupa beneath the water surface

as the larvae grows, it became pupa and finally it turned into adult mosquito. Figure 18 below is the example of adult mosquito from the sample. It was founded to be *Ae. albopictus* type from its identification. The mosquito body and legs have white stripes and the main colour of the body is black. On the mosquito's head, there's a single stripe which is an identification for *albopictus*. For the *aegypti* type, it has three stripes on its head instead of one stripe.

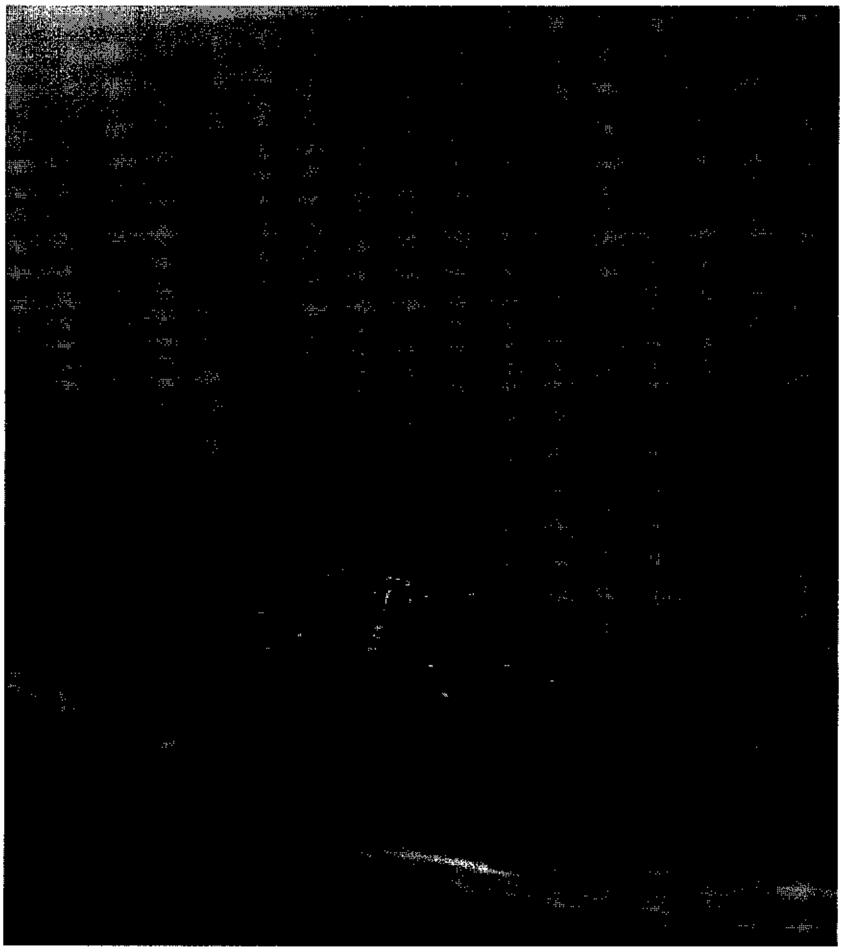

Figure 18: ***Aedes albopictus***

Larvae and pupa sample is stored in a safe place where it does not spread out to the lab. Since the mosquito larvae is observed to be aedes type of larvae, this safety and security measurement has been taken in order to avoid any problems that might occur as the adult mosquito can cause dengue if it bites human.

Bug as the larvae predator

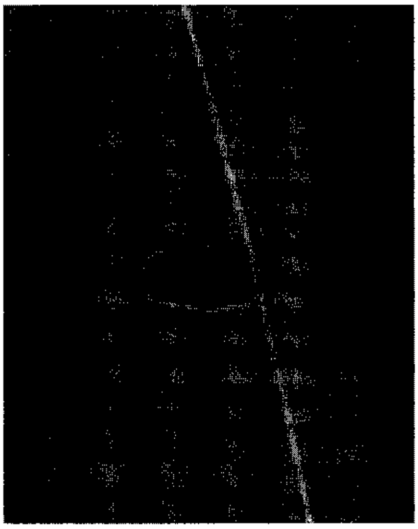

Figure 19: water bug

Intially, the bug has been braught to UTP from Johor by Dr. Nasiman as part of studies. He identified that this particular bug is the predator for mosquito larvae and it has been stored in a medium size storage tank in the laboratory. Since this water bug has no clear identification, it is simply called as bug.

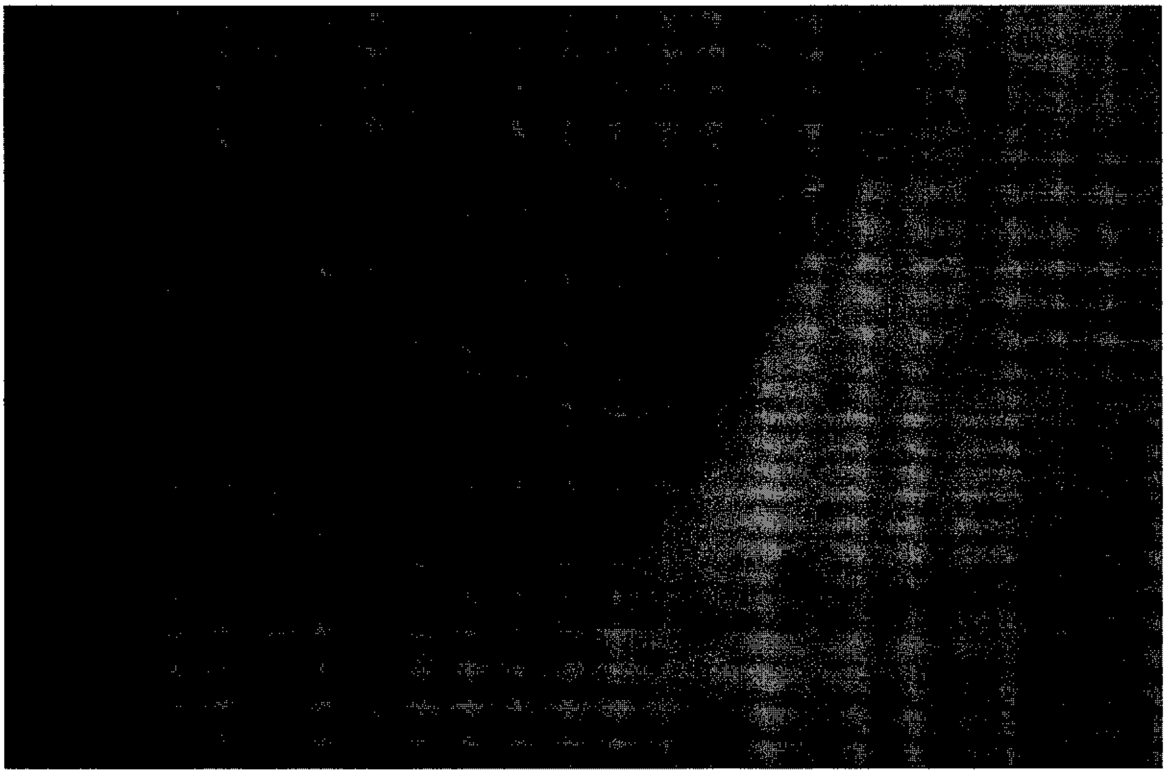

Figure 20: Bugs in the stock container

the size of adult bug is typically 1 to 2 mm in length. It has 6 legs and a pair of flipper and it swims upside-down the water container. The adult bug is black in colour meanwhile the young bug is brown in colour.

To test whether the bug can become the predator of mosquito larvae in order to control the mosquito breeding problems, both the larvae and pupa is then transfered by using pippete into the stock container and the bug reactions was observed.

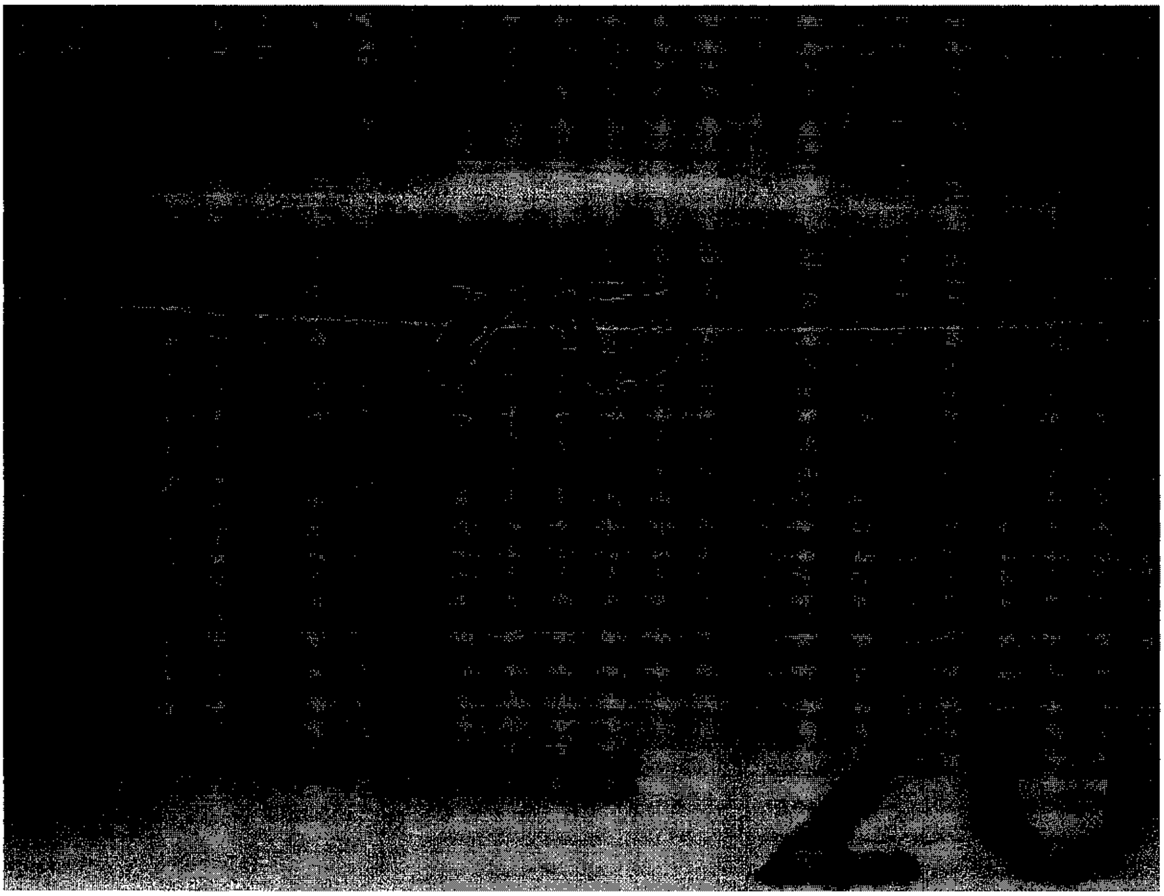

Figure 21: Two bugs attacking mosquito larvae

it is proven that the bug is the predator to the mosquito larvae and pupa. From the observation done, the bugs normally attack the larvae or pupa straight away as it enters the stock and as the bugs bite the larvae, it's brought upside and downside maybe in order to weaken the larvae and once the larvae is died, the bugs will eat the larvae but they will leave the larvae skin. It is observed that there is larvae skin floating after they have been attacked and eaten by the bugs.

Acclimatization of the bug

Figure 22: Acclimatization process

1. 5 bugs each has been transfered into the volumetric flasks for 8 sample.
2. The volumetric flasks are then kept for a week time.
3. The quantity of the bug in each flasks was counted and recorded after one week.

Suitability and survivability of bug in potential mosquito breeding environment.

This experiment was conducted to test wether the bug can adapt and survive and therefore control the mosquito breeding in the potential environment ecologically. The test is done after the acclamatization process.

Figure 23: Suitability and Survivability test for the bugs

For this project, three water samples was been taken which are from septic tank, fire hydrant sluice valve box and box for water distribution sluice chamber respectively. Two test specimens were prepared for each of the water sample plus another two specimen which was using the habitat water of the bug for control purpose.

The water was to changed with the water from the engineering structures. By using pipette, 50 ml of water inside the volumetric flasks was taken out and then it was replaced with 50 ml of water sample accordingly. For each time the water is changed, the bug quantity was calculated. Aluminium foil is used to wrap the volumetric flasks as to stimulate the conditions of all three engineering water retention structures.

Figures below show the test of suitibility and survivability of the bugs in the water retention that has been done. There are all eight sample of four different water sample sources.

Figure 24: Bug's habitat water sample

Figure 25: Water sample from box of water distribution sluice chamber

Figure 26: Water sample from box of fire hydrant sluice valve

Figure 27: Water sample from septic tank

CHAPTER 4

RESULTS AND DISCUSSION

Observations on the water sample indicated that there were mosquito larvae in two water sample; septic tank and fire hydrant sluice box. But there was no single larvae in water distribution sluice chamber box. Maybe this is because the place is new and relatively far from human as it is located near the bushes area. However, this structure has a big potential to become mosquito breeding environment as the water characteristic is almost similar with the other water samples where mosquito breeds. From experiment that has been done, two sets of results of water sample were obtained from the water quality test and the survivability of the bugs in the water sample.

Water quality test

water sample / operty	Abandoned container	Bug habitat	LAP sluice chamber box	Fire hydrant box	Septic tank
H	**7.164**	**7.489**	**7.267**	**6.366**	**7.657**
ırbidity (TU)	**18.7**	**2.41**	**1.31**	**1**	**6.21**
	18.6	**2.35**	**1.37**	**0.92**	**6.26**
	18.8	**2.40**	**1.25**	**1.13**	**6.30**
	Ave: 18.6	**2.39**	**1.31**	**1.02**	**6.27**
OD (ıg/l)	**401**	**79**	**25**	**16**	**96**
	401	**75**	**27**	**14**	**93**
	397	**77**	**23**	**12**	**94**
	Ave: 400	**77**	**25**	**14**	**94.3**

Table 4: Water quality test

From the water quality test which 5 water sample have been tested, the results obtained are as in above table.

There are three parameters were analyzed for water quality namely pH, turbidity and COD. pH of the water is a measure of its acidic, neutral or basic nature.

The pH is the logarithm of the reciprocal of the hydrogen ion concentration in moles per liter. For pure water at 24°C, the H+ ion and OH- ion concentrations are equal to 10-7 mole per liter; thus pure water has a pH of 7 and is neutral. Waters with a pH less than 7 are acidic, and waters with pH greater than 7 are basic. The pH values of natural waters range from 5 to 8.5 and are acceptable except from a corrosive standpoint.

Turbidity decreases the clarity of water and is due to fine suspended materials, which may range in size from colloidal to coarse dispersions. It is usually due to colloidal materials such as bacteria, silt, clay, algae, and organic debris. Turbidity interferes with the passage of light through a sample. It is measured by a nephelometric instrument, which measures the degree of reflected light or reduction of light transmitted through the sample as compared to a standard.

Chemical oxygen demand (COD) is representing the amount of oxygen required to oxidize chemically the organic and sometimes inorganic matter in a water or wastewater. The COD test does not measure the oxygen required to convert ammonia to nitrites and nitrites to nitrates; thus COD is frequently assumed to be equal to the ultimate first-stage biochemical oxygen demand (BOD) (Reynolds, 1996).

The result shows that the pH of all the waters is neutral water. Water in the abandoned container has the largest turbidity and COD which the averages are 18.6 and 400 mg/l respectively. This is maybe contributes by the decompositions of leaves in the container. The figures show that, the *Aedes* mosquito can even breed in the water with a relatively high turbidity and COD. Meanwhile, the lowest is water of fire hydrant box that has turbidity of 1.02 and COD of 14. Probably the figure is the lowest because the water is truly undisturbed by outside constituents and for the sample used in this experiment; it only has a small number of larvae living inside it.

Survivability of bugs in water sample

Before this test is carried on, the bug is first of all tested whether it would become the predator to the mosquito larvae and thus helps in controlling mosquito breeding problems. From the test, it has been proven that the bug is acting as the predator of the mosquito larvae. This test is conducted as to examine the suitability and the survivability of the bug in the potential mosquito breeding environment before this biological control is promoted to be applied as a mosquito control alternatives.

Sample \ Time (days)		1	3	6	10	13	16	21	23	27	30
Habitat water	1	13	13	14	15	17	18	16	15	14	15
	2	13	12	11	11	10	9	10	9	8	8
	Average	13	12	12	13	13	13	13	12	12	12
LAP sluice chamber box	3	15	13	11	8	7	5	4	4	3	3
	4	5	5	4	4	4	3	3	3	2	2
	Average	10	9	7	6	5	4	3	3	2	2
Fire hydrant sluice valve box	5	5	4	3	2	2	2	2	2	2	2
	6	5	3	-	-	-	-	-	-	-	-
	Average	5	3	1	1	1	1	1	1	1	1
Septic tank	7	5	4	5	5	4	5	5	4	4	3
	8	5	5	4	4	3	2	1	1	-	-
	Average	5	4	4	4	3	3	3	2	2	1

Table 5: Number of bugs in various water samples in 30 days

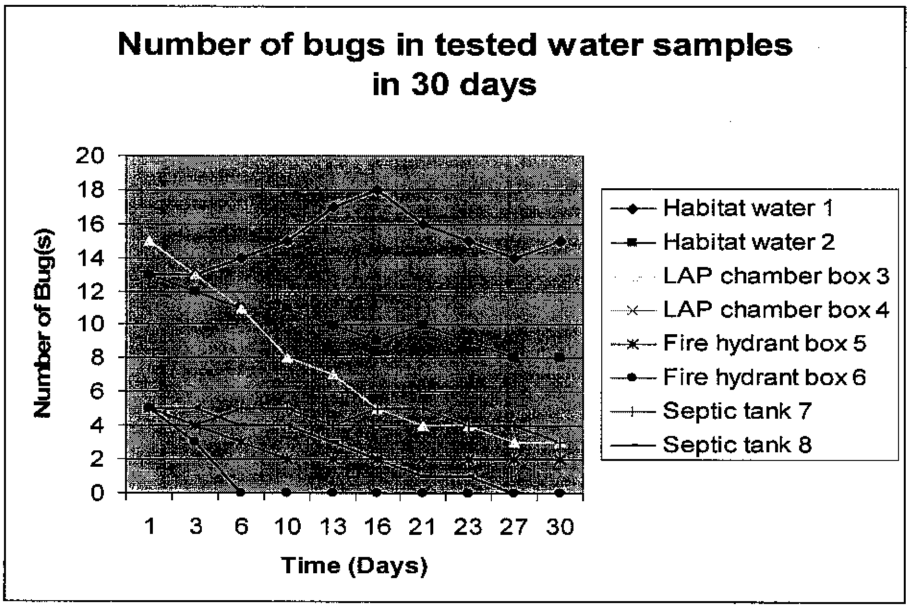

Chart 5: number of bugs in tested water samples in 30 days

From the graph and chart above, it can be simply concluded that the water bug which acting as the Aedes mosquito larvae can survive in the correspondence urban structures water sample. For the bug's habitat water which exposed to the direct lightning has the highest number of the bugs throughout the experiment. This is maybe because in the sample itself, there are algae that grow as it gets proper lightning and this have become food sources for the bug. Initially the bugs for sample 1 and 2 are fed with larvae as their additional foods. The number is however fluctuating because some bugs are breeding and some of it dies. For the rest of water sample which is wrapped with the aluminum foil in order to stimulate the real environment of the water sample has experienced large decrementing throughout the experiment. The most obvious example is water from LAP sluice chamber box which has the highest decrement. For sample 6 and 8 which are water from fire hydrant sluice valve box and septic tank water respectively, the bugs do not survive through the experiment life. Since all the samples are wrapped and have no direct lightning for the algae growth as the bug's food source in the absence of mosquito larvae has effect the bug's survivability.

CHAPTER 5

SUMMARY AND RECOMMENDATION

From this project, it has been identified that the dengue cases which is one of the major public health in our country, Malaysia in urban area is relatively high as compare to rural area with the ratio of 4 to 1 respectively. As due to the investigation done throughout the experiment, engineering structures as the septic tank, box for water distribution sluice chamber and fire hydrant sluice valve box in urban area have potential to be the *Aedes* mosquito breeding environment.

The number of dengue cases is increasing from year to year and so the control measurement taken by the local authority including the awareness campaign and chemical control by abating and fogging the sites using *Resigen* and *Aqua-resigen* shows that the current control measures is ineffective to handle the *Aedes* breeding problems which leads to the dengue epidemic.

Septic tank which is most of the times individually owned has become the biggest contributor to the mosquito of all other engineering structures studied. From this project, the pump that's used for discharging the treated wastewater is not functioning thus the water inside the septic tank is stagnant and eventually it has providing a great breeding environment for *Ae. albopictus* mosquito. As to ensure the proper flow of treated water, the pump has to be functioning or otherwise the drain for water discharge process shouldn't be too high and that the water will be discharged when it reaches certain level and overflow. Plus, the maintenance of scum and settled digesting solid should be done frequently to avoid the septic tank from clogging.

For the water distribution sluice chamber box and fire hydrant sluice valve box, it should have some kind of drainage that can infiltrate the retained water into the ground. The boxes should not contain water to make the maintenance work easier and thus will prevent from occurrence of faulty part of the system hence avoid any extra cost for repairing the damages.

As been proposed to use the biological control of mosquito larvae for the respective structures, it's experimentally proved that the bugs which acting as the mosquito predator can survive in the environment but it needs the lightning as to enrich the algae growth for the purpose of providing foods to the bugs as in the absence of light. The recommendation is to replace current solid cover with transparent type of cover to allow seeping through of the light.

CHAPTER 6

CONCLUSIONS

Dengue cases in Malaysia has been an issue for several decades since it's first reported in 1902. Over the last ten years, it has been tremendously increasing and brings worries to everyone. It has been recorded that more than 80% of the dengue cases are reported to happen in urban area. This can simply stated that there's something wrong with the urbanization and perhaps the communities too as refer to the increasing of dengue cases.

From this study, it has been identified that the three engineering structures have become the breeding environment for *Aedes* mosquito which is the vector for dengue. They are septic tank, box of chamber valve for water distribution and box for fire hydrant sluice valve.

Looking at the dengue control programme organized by the government, it is seen to be ineffective for the dengue cases keep arising. It indicates that the current control measures are not working that well and perhaps new approaches should be done as alternatives to solve the dengue problems. Current chemical control by fogging and abating is believed to kill or at least reduce not just the mosquito but their predators too. Therefore, the chemical control applied has disturbed the ecological system and the chain of food too. Mosquito such as *Aedes* is one of the insects that have short life-cycle but it can grow rapidly and with no predators such as fish and flies, it doesn't has ecological control hence creating big problems to the people surrounding it. It is therefore, an alternative control by biological approaches is necessary.

The bugs that been used in the experiment has proven to be the predator of mosquito larvae and pupa. The current design of the water structures need to have some modification in order to sustain the bugs' growth and that they will help in controlling the *Aedes* or mosquito in general and thus controlling the dengue cases in Malaysia.

REFERENCES

Veeramohan, Supramaniam (2004), "The Administration and Technical Management of Dengue in Malaysia (A Perspective of the Malaysian Association of Environmental Health)"

Teng, A. K. and Singh S. (2001), "Epidemiology and New Initiatives in the Prevention and Control of Dengue in Malaysia", *Dengue Bulletin – Vol 25, 2001.* 7-14p.

Strickman, D, Sithiprasasna R and Southard D (1997). "Bionomics of The Spider, *crossopriza lyoni* (Araneae, pholcidae), A Predator of Dengue Vectors in Thailand", *The Journal of Arachnology 25.* 194p.

Knudsen, A.B (1996). "Distribution of Vectors of Dengue Fever/Dengue Haemorrhagic Fever with special reference to *Aedes albopictus*, 1996". *Dengue Bulletin – Volume 20, 1996.* 5-7p.

Fontenille D. and Toto J. C.(2001). "Aedes (Stegomyia) albopictus (Skuse), a Potential New Dengue Vector in Southern Cameroon", *Emerging Infectious Diseases, Vol 7, No. 6, November-December 2001.* 1066p.

Reynolds T. D. and Richards P. A(1996), *Unit Operations and Processes in Environmental Engineering,* PWS Publishing Company. 102-110 and 734-735p.

Twort A.C., Ratnayaka D.D. and Brandt M.J.(2000), *Water Supply,* IWA Publishing. 596-606p.

Viessman W,Jr. and Hammer M.J(2004), *Water Supply and Pollution Control,* Pearson Prentice Hall, 145p.