STUDY PERFORMANCE COLLECTOR OF WATER ON HYDROPANEL DEVICE

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Mohamad Shahmizan Bin Mohamad

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MOHAMAD SHAHMIZAN BIN MOHAMAD

A thesis submitted
in fulfillment of the requirements for the degree of
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DEDICATION

To my beloved parents who are always supporting me,

Mohamad Bin Ismail

Dayang Sadiah Binti Awang Zain

And

To my supervisor

Dr Muhammad Zulkarnain

To my families and my dearest friends,

Who provided me with a loving, encouraging, caring and supportive ambience.

"There's always going to be another mountain, I'm always going and want to make it move.

There's always going to be an uphill battle, sometimes I have to lose.

Ain't about how fast I get there, ain't about what's waiting on the other side.

IT'S THE CLIMB."- Miley Cyrus, The Climb.

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ABSTRACT

Clean water is critical to human health, economic prosperity, and environmental sustainability. However, metropolitan regions confront considerable hurdles in ensuring clean water supplies owing to variables such as population increase, industry, pollution, and climate change. This research focuses on exploring the different types of regions or countries which have different seasons of water that Hydro Panels produce and evaluating their performance. By assessing the quality and efficiency of the water under various conditions, we aim to understand the effectiveness of Hydro Panel technology for sustainable water generation. In addition, it is reported to produce clean water by hydro panel device. Distilled water process can produce clean water for a common process for purifying liquids, can be successfully applied for separating water from atmospheric vapor. This approach works on the idea of phase transition, which converts water vapor into liquid water by condensation. The examination focused on the quality of water generated by the Hydro Panel and discovered that it constantly supplied drinkable water that met safety criteria. Performance metrics analysis revealed that the Hydro Panel was efficient in a variety of environmental situations while maintaining optimal water production. The research sought to investigate the nature and purity of water generated by Hydro Panels, with an emphasis on their kind and performance. The study found that the water created by Hydro Panels has properties similar to filtered water, such as reduced quantity of minerals and high cleanliness levels. Furthermore, performance evaluation revealed constant production rates and dependability, demonstrating the effectiveness of Hydro Panels in providing a sustainable water supply. Comparative tests with typical water sources demonstrated Hydro Panel water's better purity and environmental effect. Furthermore, talks focused on the consequences of using Hydro Panels in areas with water shortage, highlighting its capacity to reduce water stress while encouraging sustainability. This study investigates the water quality and efficacy of Hydro Panels, including the sort of water produced and how effectively they function. The findings emphasise the necessity of understanding the characteristics of water and increasing panel performance in order to maximise the efficacy and sustainability of Hydro Panel technology.

ABSTRAK

Air bersih adalah penting untuk kesihatan manusia, kemakmuran ekonomi, dan kelestarian alam sekitar. Walau bagaimanapun, wilayah metropolitan menghadapi banyak halangan dalam memastikan bekalan air bersih disebabkan pembolehubah seperti pertambahan penduduk, industri, pencemaran dan perubahan iklim. Penyelidikan ini memberi tumpuan kepada meneroka pelbagai jenis wilayah atau negara yang berbeza musim air yang dihasilkan oleh Panel Hidro dan menilai prestasinya. Dengan menilai kualiti dan kecekapan air dalam pelbagai keadaan, kami berhasrat untuk memahami keberkesanan teknologi Panel Hidro untuk penjanaan air yang mampan. Di samping itu, ia dilaporkan menghasilkan air bersih melalui peranti panel hidro. Proses air suling boleh menghasilkan air bersih untuk proses biasa untuk menulenkan cecair, boleh berjaya digunakan untuk mengasingkan air daripada wap atmosfera. Pendekatan ini berfungsi pada idea peralihan fasa, yang menukarkan wap air kepada air cecair melalui pemeluwapan. Pemeriksaan tertumpu kepada kualiti air yang dijana oleh Panel Hidro dan mendapati ia sentiasa membekalkan air boleh diminum yang memenuhi kriteria keselamatan. Analisis metrik prestasi mendedahkan bahawa Panel Hidro adalah cekap dalam pelbagai situasi persekitaran sambil mengekalkan pengeluaran air yang optimum. Penyelidikan ini bertujuan untuk menyiasat sifat dan ketulenan air yang dihasilkan oleh Panel Hidro, dengan penekanan pada jenis dan prestasinya. Kajian mendapati bahawa air yang dicipta oleh Panel Hidro mempunyai sifat yang serupa dengan air yang ditapis, seperti kuantiti mineral yang berkurangan dan tahap kebersihan yang tinggi. Tambahan pula, penilaian prestasi mendedahkan kadar pengeluaran dan kebolehpercayaan yang berterusan, menunjukkan keberkesanan Panel Hidro dalam menyediakan bekalan air yang mampan. Ujian perbandingan dengan sumber air biasa menunjukkan ketulenan air Panel Hidro dan kesan alam sekitar yang lebih baik. Tambahan pula, perbincangan tertumpu kepada akibat penggunaan Panel Hidro di kawasan yang mengalami kekurangan air, menonjolkan keupayaannya untuk mengurangkan tekanan air sambil menggalakkan kelestarian. Kajian ini menyiasat kualiti air dan keberkesanan Panel Hidro, termasuk jenis air yang dihasilkan dan keberkesanannya berfungsi. Penemuan ini menekankan keperluan memahami ciri-ciri air dan meningkatkan prestasi panel untuk memaksimumkan keberkesanan dan kemampanan teknologi Panel Hidro.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS AND ABBREVIATIONS

mL	-	Milliliter
°C	-	Celsius
°F	-	Fahrenheit

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

Water scarcity poses a significant challenge globally, impacting communities' access to clean and reliable water sources. To address this pressing issue, innovative technologies like hydro panel devices have emerged, offering a promising solution by extracting moisture from the air to produce drinkable water. These devices have gained attention for their potential to provide sustainable water sources, especially in areas facing water shortages. (Aliehyaie, 2023)

Figure 1.1 Example Hydro Panel Process Flow (sunconengineers, 2022)

The effectiveness of hydro panel devices in collecting water is crucial in various regions facing water scarcity. In dry areas like the Middle East and the Sahara, these devices are vital due to the limited availability of traditional water sources. Remote and rural communities in places like sub-Saharan Africa and rural India can benefit from these devices for decentralized water supply. (Manju and Sagar, 2017)

Coastal areas such as those in California and the Mediterranean can reduce their dependence on costly desalination processes by using hydro panels. Urban centers experiencing water shortages, including Cape Town and São Paulo, can integrate hydro panels to improve water security. Additionally, regions prone to natural disasters and isolated islands can rely on hydro panels to provide a steady source of drinking water when traditional systems fail. Understanding these different contexts is key to leveraging hydro panel technology to combat global water scarcity effectively. (Noorollahi, 2018)

Understanding when hydro panel devices perform best involves considering various time-related factors. These devices are most useful during dry seasons when traditional water sources run low and can be vital during extended droughts worsened by climate change, like those experienced in places such as California and Australia. They also play a crucial role in post-disaster scenarios, providing immediate access to clean water in areas where infrastructure has been damaged, such as islands in the Caribbean and the Pacific. Hydro panels work most efficiently during cooler, more humid parts of the day, underscoring the importance of timing their use. Moreover, their deployment aligns with global sustainability goals, such as ensuring universal access to clean water by 2030. As these devices become more advanced and affordable, their adoption is likely to increase, offering a more effective solution to water scarcity over time. (Balseca, 2023)

However, while the concept of hydro panel technology sounds promising, it's essential to thoroughly understand how well these devices work in real-world conditions. This study focuses on investigating how efficiently hydro panel devices collect water and how reliable they are under different environmental circumstances. We'll be looking at factors like humidity levels, temperature changes, and where the panels are installed to get a clear picture of their performance. Our goal is to shed light on the practical aspects of hydro panel technology and its potential to address water scarcity challenges. By studying these devices closely, we hope to provide valuable insights that can guide decision-making processes regarding their implementation in water management strategies. Ultimately, we aim to contribute to the broader conversation about sustainable water solutions and improve access to clean water for communities worldwide. (Shemer, 2023)

1.2 Problem Statement

Regarding lack of information on characteristics of scarcity performance of research cause failed demand in market there's a critical need to thoroughly assess how well they collect water under different environmental conditions. This uncover needs to figure out reliable ways to measure the amount and quality of water they produce, considering factors like humidity levels, temperature changes, and where they're used.

We also need to reveal to the standardized testing methods, understanding how different environments affect their performance, making them work more efficiently through better design, and ensuring they can keep working well overtime. By addressing these problems, we can really understand how effective hydro panel devices are and make sure they're a viable solution for generating water sustainably.

1.3 Research Objective

This research aims to thoroughly understand how well hydro panel devices collect water in different environments. Specifically, the objectives are as follows.

a) To investigate the type of water on Hydro Panel.

b) To analyze the performance type of water on Hydro Panel.

1.4 Scope of Research

The scope of this research are as follows:

- The dimensions of SOURCE Hydro Panel are 2.4m Long X 1.2m Wide X 1.13m Height.
- Each SOURCE Hydro Panel weighs 340 lbs. or 154.221 Kg in dry weight.
- This research using 24 hours observation for get different type of water within climate change in Malaysia.
- The are research on Kuching, Sarawak with Latitude from Melaka is 2.18959 to Kuching 1.55000 and 11m to 8m Altitude from Melaka to Kuching, Sarawak.
- Record each data 4 hours per day and water temperature in range 20-25 (^{0}C).

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Water is the most vital fluid on Earth, essential for human life and industrial processes. Despite this, only 1% of water is used for domestic and industrial purposes. Rapid population growth, industrial pollution, and climate change have reduced precipitation, creating a critical water shortage. As a result, seawater desalination has become crucial to address water scarcity for both household and industrial use. Studies indicate that 40% of the global population lives in remote areas, with WHO estimating that about 900 million people lack access to clean drinking water, and approximately 2.6 billion lack proper sanitation facilities. (Harby, 2020)

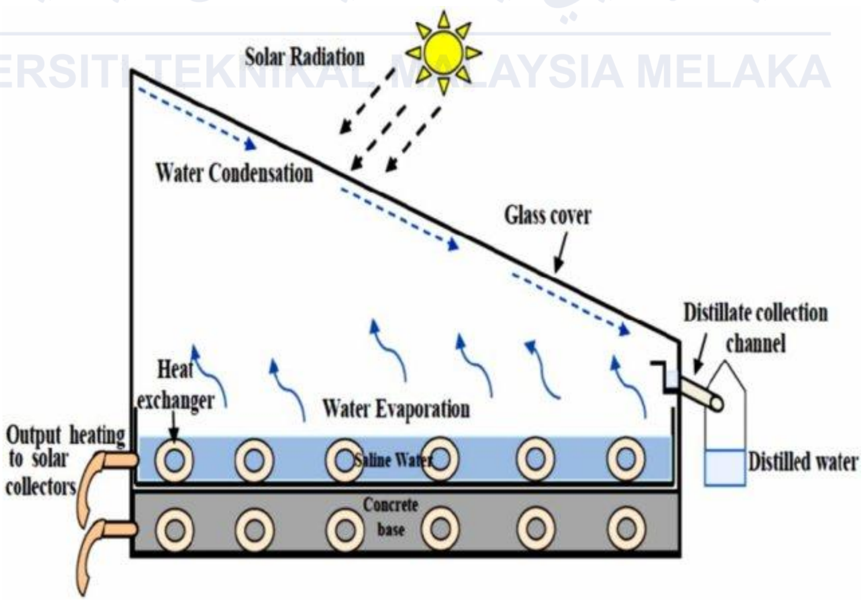


Figure 2.1 Schematic of solar distillation system.

The subsequent sections will delve into the intricacies of water collector performance, exploring factors like material characteristics, environmental conditions, engineering design parameters, and integration with water purification systems. Furthermore, we will assess the environmental and sustainability ramifications of decentralized water production using hydro panel devices, alongside the technological innovations propelling progress in this domain. This literature review endeavors to contribute to a deeper comprehension of hydro panel technology and its potential to mitigate global water challenges. By elucidating the mechanisms and factors shaping water collector performance, we aim to catalyze ongoing innovation and adoption of sustainable water harvesting solutions across diverse geographical contexts. (Irfeey, 2023)

2.2 Material Selection and Surface Coating

Venturing deeper into the realm of material selection and surface coatings for hydro panel water collectors reveals a multifaceted landscape where innovation meets necessity. In the ongoing pursuit of sustainable water solutions, the significance of precisely tailored materials becomes increasingly evident. Analogous to the careful selection of armor for a medieval knight, each material component must offer optimal protection while allowing for flexibility and agility. Similarly, hydro panel water collectors necessitate materials that excel in water absorption yet facilitate efficient water release a delicate equilibrium akin to finding the ideal sponge for a specific cleaning task. Throughout this exploration, we traverse the domains of bio-inspired surfaces, adaptable materials, and composite architectures, each offering potential advancements in water collection efficiency and adaptability. This journey not only sheds light on the evolving science of hydro panel technology but also underscores its pivotal role in tackling global water challenges. (Musa, 2023)

2.2.1 Beyond the basics of Material Selection for Hydro panel.

Exploring materials for hydro panels goes beyond simple selection, akin to seeking the ideal sponge for car washing it must absorb water effectively (hygroscopicity) yet release it easily (wettability). Researchers pursue innovative materials inspired by nature, like spider silk, renowned for its water collection ability from dew. They're also developing adaptable materials, capable of adjusting water absorption depending on environmental conditions; imagine a material more absorbent in dry climates. Additionally, composite materials are being investigated, blending different materials for optimal performance, such as a highly absorbent substance within a water-repellent matrix, promising significant enhancements in moisture capture and droplet retention. (Brenes, 2023)

2.2.2 Surface Coating Strategies for Enhance Performance

Surface coating methods can be likened to special treatments applied to enhance the performance of a car sponge. For instance, superhydrophobic coatings cause water to bead up and roll off easily, reducing water loss through evaporation, a critical aspect for efficient water collection in hydro panels. Another beneficial coating is anti-fouling, which prevents the buildup of dirt, algae, and bacteria that could obstruct the collector and hinder its effectiveness. Imagine a sponge that repels dust and grime, that's the principle behind it. Additionally, self-cleaning coatings represent a promising development, allowing rain or wind to wash away dirt and debris, minimizing the need for manual cleaning, much like a self-cleaning car. (Akram Entezari, 2023)

2.2.3 Challenges and considerations for Sustainable Development

Material selection and surface coatings always involve trade-offs, much like finding the right balance of features in a car. For example, desiring a highly absorbent sponge may lead to increased weight. Similarly, achieving optimal properties for hydro panels, such as hygroscopicity and wettability, simultaneously can be challenging. Material selection often requires prioritization based on the specific environmental conditions of the hydro panel's location. Furthermore, ensuring that coatings maintain their effectiveness over time, especially in harsh weather conditions, is essential. Lastly, considering the environmental impact of both materials and coatings is crucial to avoid unintended consequences. Researchers are continuously seeking ways to minimize the environmental footprint and ensure the long-term sustainability of hydro panel technology. (Sauer, 2024)

2.3 Exploring the Efficacy of Hydro panel in Diverse Environments.

Water scarcity is a critical issue around the world, especially in places where water sources are limited or unreliable. Hydro panels, which extract water from the air, offer a promising solution to this problem. This study, titled "Study of Performance Collector of Water on Hydro panel Device," aims to explore how effective hydro panels are in different environments. We focus on how different climates and weather conditions impact hydro panel performance. This includes studying areas with varying humidity levels, from dry deserts to more humid regions, as well as considering how altitude and terrain affect water collection. The study also compares how well hydro panels work in urban versus rural settings. Urban areas might have air quality issues that could affect the water collected, while rural areas with cleaner air might show different results. We also look at remote locations with limited access to clean water to see how hydro panels can make a practical difference. (Barquero, 2023).

2.3.1 Studied Geographical Location.

Ilam province, spanning an area of 2013 km2, constitutes approximately 1.2% of Iran's total landmass. Situated to the west of the Zagros Mountain Range, it lies between 32◦ and 0.3 min to 34◦ and 02 min of northern latitude, and 45◦ and 24 min to 48◦ and 10 min of eastern longitude from the Greenwich meridian in the western region of Iran. It shares borders with Khuzestan Province to the south, Lorestan Province to the east, and Kermanshah Province to the north. The climate of Ilam province is characterized by hot, desert-like conditions, particularly in the Mehran and Dehloran areas in the southern part. Average yearly temperatures range from 18 to 26 ◦C. With an annual sunlight duration of approximately 3000–3400 hours, the province holds significant potential for solar energy generation. Additionally, radiation maps indicate an average radiation level of 4.5–5.2 kWh/m2 per day across the province. (Noorollahi, 2018)

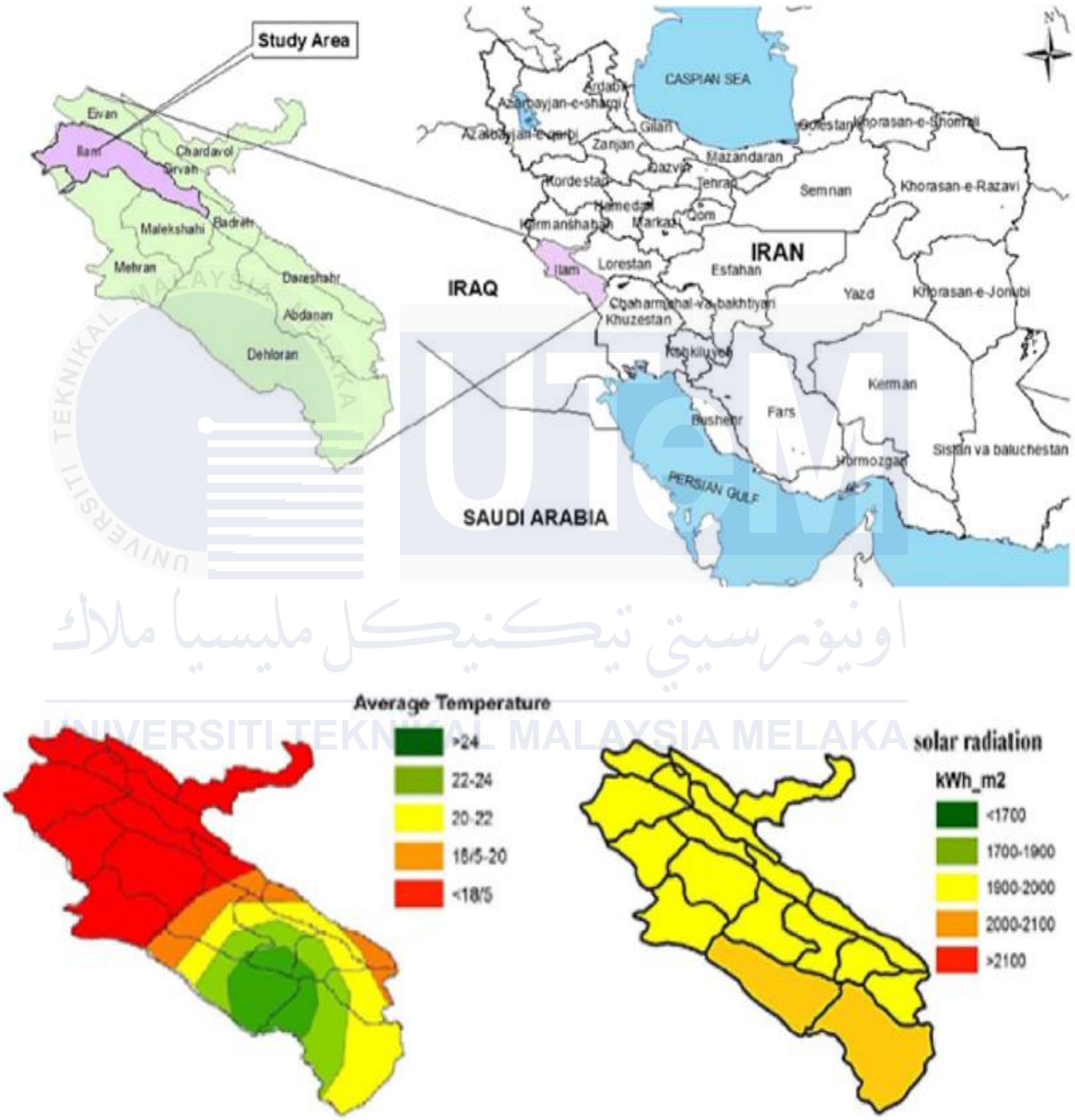


Figure 2.2 Location of the study region (Noorollahi, 2018)

2.3.1.1 Experimental Setup Locations

The researchers aren't just testing hydro panels in any random location. They've created a two-pronged approach to understand their effectiveness. The first involves meticulously controlled environments, like laboratories or research facilities. Imagine a high-tech room where temperature, humidity, and even airflow can be precisely dialed in. Here, researchers can isolate variables and truly understand the fundamental science behind how hydro panels extract water. It's like putting the technology under a microscope, observing its every move and reaction in a perfectly controlled setting. However, science thrives not just in isolation, but also in the real world. That's where field studies come in. Researchers take the hydro panels out of the lab and into the homes, farms, and communities that could benefit from them most. This real-world testing is crucial for understanding how well hydro panels integrate into people's lives and if they can truly be a sustainable solution for water needs. By combining these controlled and field studies, researchers get a holistic picture of how well hydro panels work, both in theory and in practice. (McCarthy, 2020)

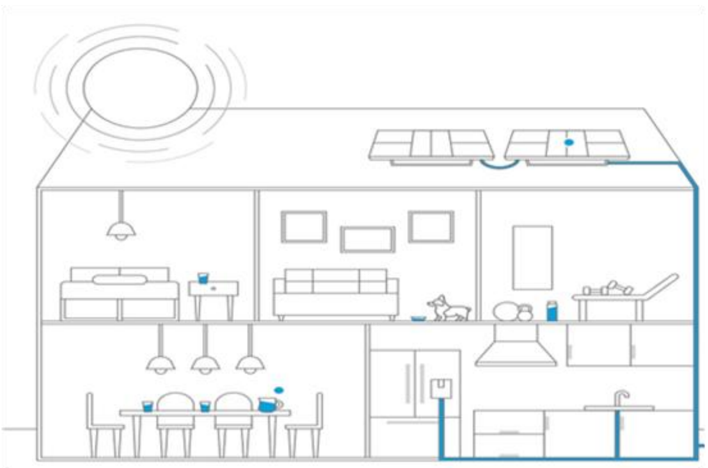


Figure 2.3 Example of a household using Hydro Panel (Clos, 2022)

2.3.2 Comparison Sites

Comparison sites for hydro panel studies are strategically chosen based on varying humidity levels and different geographic regions to comprehensively evaluate the technology's performance. By examining how hydro panels operate in areas with different humidity, researchers can gather valuable insights into the devices' efficiency under diverse atmospheric conditions. For instance, hydro panels might be tested in dry deserts where humidity is extremely low, which poses a significant challenge for water extraction. Conversely, they could be evaluated in coastal areas where humidity is consistently high, providing an ideal environment for maximum water collection. Moreover, studies often extend to mountainous regions, where the weather patterns are complex, and altitude can significantly influence atmospheric moisture levels and temperature fluctuations. (Droog, 2021)

These regions present unique challenges and opportunities for hydro panel performance, offering a more comprehensive understanding of their capabilities. By comparing data from these diverse locations, researchers can determine how well hydro panels adapt and function across different climates and terrains. This thorough comparison across various parts of the world not only helps in assessing the hydro panel's global applicability but also in identifying potential improvements and optimizations needed for different environments. Ultimately, such extensive research ensures that hydro panel technology can be effectively deployed in a wide range of settings, addressing water scarcity issues in both arid and humid regions, as well as in varied geographic landscapes like deserts, coastal areas, and mountainous regions.

Figure 2.4: An array of source's hydro panel in Dubai.

Figure 2.5: Two source hydro panel in front of a home in the Lee Chee Chapter of the Navajo Nation, near page, Arizona.

Figure 2.6: A man getting water from a source hydro panel in Allensworth, California

2.4 Environmental Impact

As fresh water becomes increasingly scarce, innovative solutions are essential for ensuring a sustainable supply. One promising technology is the hydro panel, which collects water from the atmosphere using solar energy. These devices function by extracting moisture from the air, offering a decentralized and eco-friendly water source. To ensure their benefits outweigh any ecological costs, it is important to assess the environmental impact of hydro panels.

This study focuses on evaluating the environmental effects of water collection via hydro panel devices. Key performance indicators such as energy use, water production, and material sustainability will be analyzed to determine the ecological footprint of hydro panels. Additionally, the study will explore the potential of hydro panels to reduce reliance on conventional water sources, decrease waste, and alleviate environmental pressures related to water extraction and distribution.

By thoroughly examining these aspects, this research aims to provide valuable insights into the sustainability of hydro panels. Highlighting both their benefits and potential drawbacks, this study seeks to inform stakeholders, policymakers, and the scientific community about the effectiveness of hydro panels in addressing water scarcity while maintaining environmental health. (Peeters, 2020)

2.4.1 Energy efficiency

$$\sum_{\text{Volume of Water}} = (\text{Length X Width X Heigh})$$

The environmental effect of hydro panel devices is directly related to their energy efficiency. Liu et al. (2019) highlighted the need of optimizing solar energy use to reduce the environmental impact of these devices. Efficient data collectors that maximize condensation rates while requiring little energy input are critical for long-term operation.

Then, there's the environmental side of things. Even though hydro panels use renewable energy and make clean water, making them and the materials they use can still have an impact on the environment. Researchers have investigated this and found ways to make the manufacturing process more eco-friendly to reduce things like carbon emissions and waste.

Now, let's talk about the cool tech stuff. Some hydro panel systems are getting smarter. They can sense things like temperature and sunlight and adjust how they work to get the most water while using the least energy. Scientists have even used fancy computer programs to help predict the best settings for these systems, making them even more efficient. So, making hydro panel systems work better isn't just about the weather. It's also about improving the technology and being mindful of the environment. By doing this, we can keep making progress in tackling water scarcity while being kinder to the planet. (Brenes, 2023b)

2.4.2 Resource Utilization

The materials used to manufacture water collectors have an influence on hydro panel environmental imprint. Smith et al. (2021) reported that using reusable and eco-friendly materials might greatly minimize environmental effects. Furthermore, advances in material science that result in longer lasting and more effective water collectors help to improve the general environmental sustainability of hydro panel systems.

a) **Hydro panel Devices:** A sufficient number of hydro panels to cover various environmental conditions while maintaining statistically meaningful findings.

b) **Monitoring Equipment:** Sensors that monitor humidity, temperature, sun radiation, and water yield. Data recorders and energy meters are used for continuous data collecting.

c) **Financial Resources:** Budget allocation for procuring equipment, setting up and operating hydro panels, and supporting labour expenses.

d) **Human Resources:** An interdisciplinary team comprised of climate scientists, engineers, data analysts, and field workers.

e) **Logistical Support:** Transport for site visits, installation and maintenance tools, and safe data storage facilities.

2.5 Policy and Regulations Framework

Policy and regulations for hydro panel devices cover various aspects to make sure the role of policy and legislation in promoting the deployment and usage of hydro panel devices. This involves researching current frameworks, identifying gaps, and suggesting policies to promote hydro panel innovation, acceptance, and long-term operation. (Hespanhol and Prost, 1994) Here's breakdown of key aspects:

- Supporting Policy Frameworks

A thorough policy framework for hydro panel devices should encompass regulatory standards to ensure water quality and safety, along with required performance certifications. Environmental regulations must mandate impact assessments and set energy efficiency benchmarks. Financial incentives, such as subsidies and grants for research and development, will encourage adoption and innovation. Simplifying permitting processes and incorporating hydro panels into public infrastructure projects will ease deployment. Educating the public through awareness campaigns and training programs is crucial for proper use and maintenance. International cooperation on standardizing regulations and sharing knowledge will boost global adoption. Systems for continuous performance monitoring and regular data reporting should be established to guide policy refinements. This framework aims to promote the widespread use of hydro panel devices to sustainably address water scarcity. (Godin, n.d.)

- Regulation Frameworks

To guarantee that hydro panels are a safe and sustainable solution to water scarcity, a complete framework is required. This involves establishing stringent water quality standards, demanding certification from independent laboratories, and completing environmental impact studies for large-scale facilities. Regulations would govern correct installation, permitting, monitoring, and maintenance, while consumer safeguards such as clear labelling and guarantees would protect purchasers. Incentives for research and development would encourage innovation and reduce prices, while public education campaigns would improve knowledge of the advantages and ethical use of hydro panel technology. This comprehensive strategy prioritizes safety, sustainability, and customer well-being, while guaranteeing that hydro panels successfully handle water scarcity issues. (Organization, 2008)

2.6 Future Directions

Future research on hydro panel devices should aim to improve water collection efficiency by exploring new materials and better designs, while also finding ways to reduce energy use through renewable sources. Adapting these devices to work in different climates and studying their long-term durability and reliability are also important. Enhancing water quality with advanced filtration and purification systems and conducting economic studies to make these devices more affordable will highlight their financial benefits. Research should also investigate how hydro panels can be integrated with existing water systems to boost overall water security. Additionally, understanding how climate change impacts their performance, assessing how people accept and use the technology, and examining supportive policies will help promote widespread use and sustainable operation of hydro panels. (Inbar, 2020)

2.7 Summary

Our human daily life has always been fragile where we could not survive without water for less than 3 days, our body slowly shuts down and notifies our brain to find clean water to dehydrate to stay alive. Researchers have proven that through time we will always look for a new resource to create new and better technologies and a safer environment. Based on Barquero, a study shows that hydro panels can generate water in different types of environments which rain, hot weather, cloudy etc. This technology can collect water and safe to drink to conduct any activities in our human life. By looking at the challenges on the literature review, it is mentioned that desiring a highly absorbent sponge may lead to increased weight. Similarly, achieving optimal properties for hydro panels, such as hygroscopicity and wettability, simultaneously can be challenging. Moreover, we can see our researchers has located the area where water is hard to manage and collect by using filtered water from the sea water supply the authorities, location as mentioned is mostly in the middle east where the area itself are dessert and most likely hard to find rain.

Therefore, hydro panels were first introduced in this area due to its lack of water supply. It began a new modern technology to create clean water for human needs and not long introduced globally worldwide. The method chosen to test this technology based on literature reviews are dew forming method which is a process distilled water from an actual are prototype of hydro panels where the panel Photovoltaic technology is located at Kuching, Sarawak as mentioned in research scope. Regarding the distillation process to collect clean water, the more air or vapor water is heated at the surface the faster the process of collecting water can be generated. In addition, when the sun is at peak hour the process of dew forming, basically warm air heats the surface the water droplet cold itself from the fan by the Photovoltaic technology. As for conclusion, the performance of having a hydro panel device will help human to collect clean water and ensure that the new generation gets the idea of this innovation of renewable energy and sustainable technologies to avoid any climate change or other type of impact towards mother nature. (Barquero, 2023)

CHAPTER 3

METHODOLOGY

3.1 Introduction

This study describes the approach we used to evaluate the quality of the hydro panel device collects water from the air. Hydro panels use solar energy and special materials to capture and condense moisture from the atmosphere, offering a sustainable solution to water shortages. The method chosen as a process for collecting water is distilled water process were founded in previous literature reviews, the technique guarantees exceptional purity, rendering distilled water ideal for numerous applications, including medical use, laboratory experiments, and even drinking. (Baquero,2023)

Our goal in this study is to measure how effective and reliable these panels are in different environments. We conducted experiments and gathered data to see how much water the panels can produce, how much energy they use, and how consistently they operate. By analyzing these aspects, we hope to understand how practical and scalable hydro panel technology can be.

To ensure our results are accurate and can be replicated, we performed both controlled field trials in various climates. The following sections will explain how we set up our experiments, the tools, and measurements we used, and how we analyzed the data. This detailed approach aims to provide clear insights into the performance of hydro panels and their potential for broader use in sustainable water collection.

This study is all about how we tested these cool hydro panels that suck water from the air. They're a hopeful fix for water shortages because they use sunlight and fancy materials to grab moisture from the atmosphere. We picked a method called the distilled water process, which some smart folks like Barquero already said is top-notch for getting super clean water. This kind of water is handy for loads of stuff, like medicine, labs, and even drinking.

3.2 Research Flowchart

The overall activity in this study is shown in Figure 3.1 PSM Research Flowchart where it covers the whole research from beginning to end to complete this research. Each description can be found in the table of contents where every subtopic from beginning to end of this research about study performance collector of water on hydro panel device

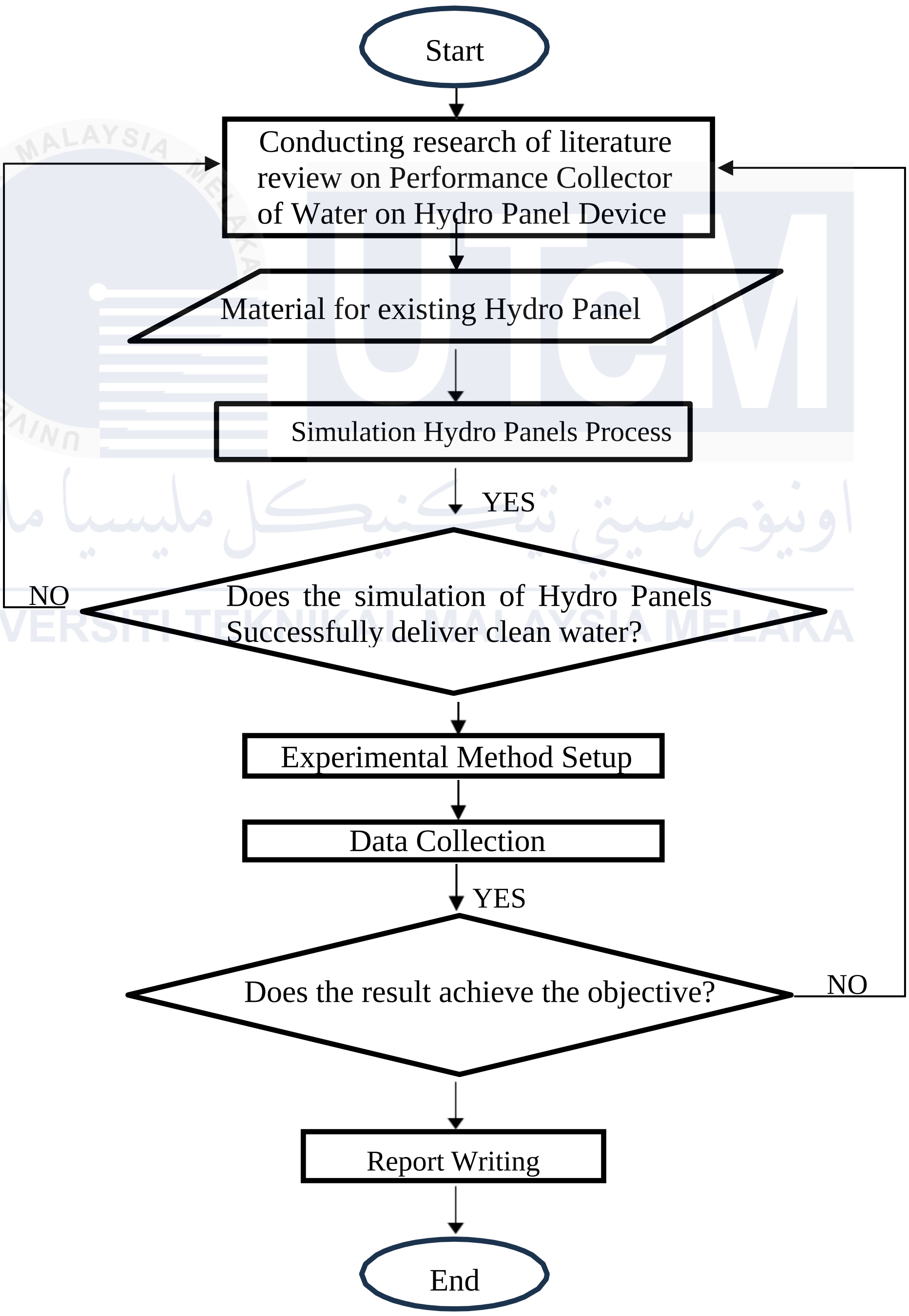


Figure 3.1 PSM Research Flowchart

3.3 PSM 1 Gantt Chart

PSM 1 Gantt Chart as shown in Figure 3.2 are very important to record the time consuming to produce this research through the whole time by looking and deciding the topic and writing the method for this research to prove the research of performance collector of water on hydro panel device from time to time.

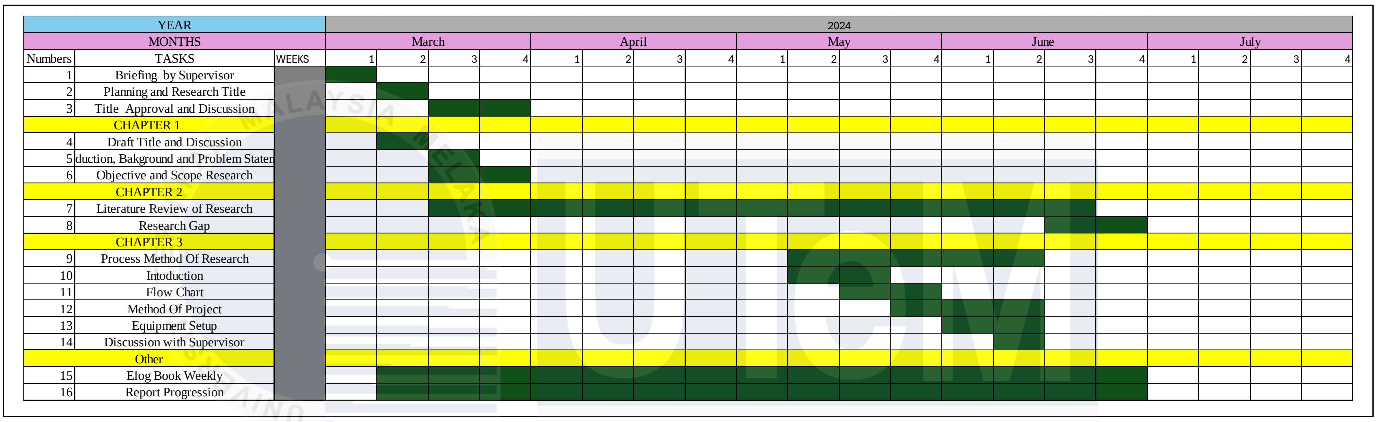
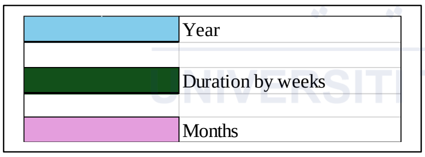


Figure 3.2 PSM 1 Gantt Chart



3.4 Proposed Methodology

Figure 3.3 is the method proposed in this an experiment to collect data by starting from the sun until can produce output or clean water throughout this experiment.

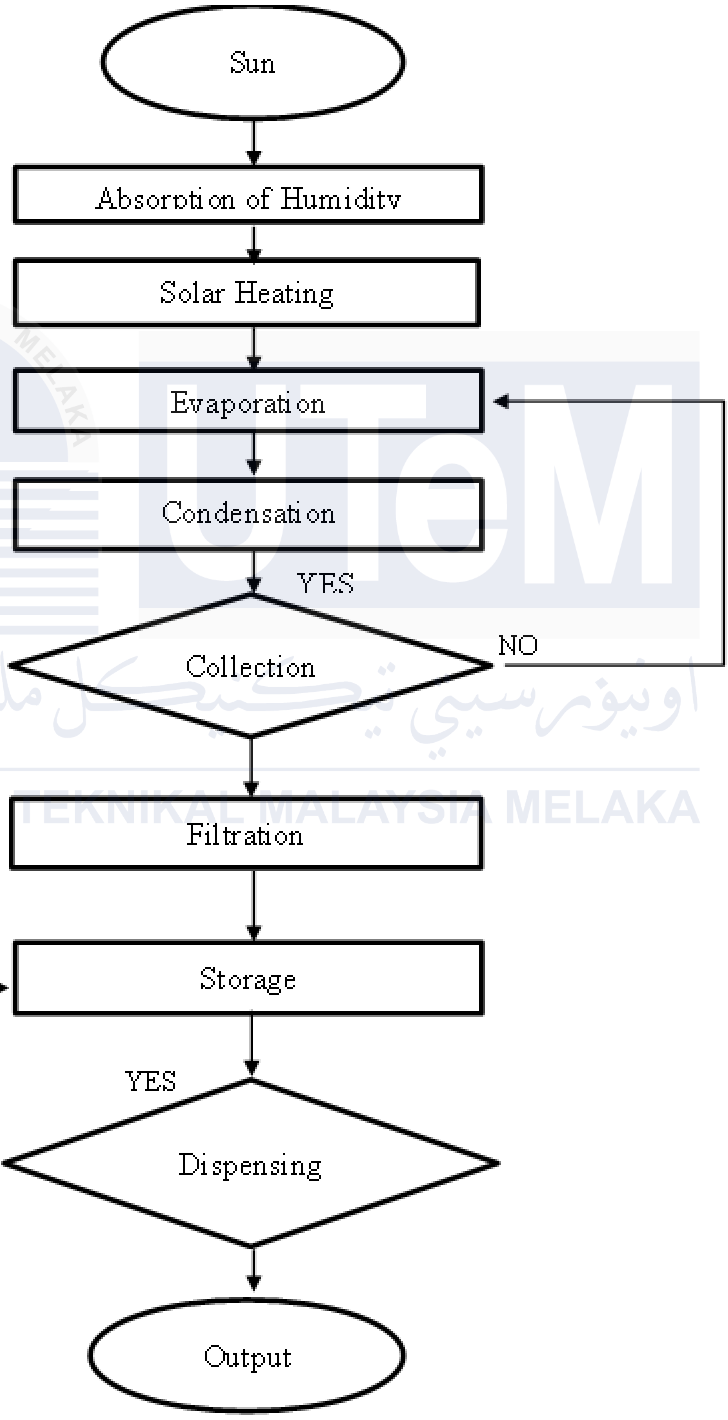


Figure 3.3 Methodology Flowchart

3.4.1 Equipment Requirements

Material setup is important to understand this method. For a hydro panel component setup, each component and materials have a role purposed to cover the whole system to work and produce the output from the distillation process, here are some of the components shown below:

Solar collectors as mentioned in Figure 3.4 Solar collector by Source Manufacturer essential for harvesting solar energy and facilitating the water production process. The solar collector, usually a photovoltaic (PV) or thermal solar panel, collects sunlight and turns it into useful energy. The addition of solar collectors ensures the hydro panel’s energy independence and increases its environmental friendliness.

Figure 3.4 Solar Collector by Source Manufacturer

Desiccant materials shown in Figure 3.5 Desiccant Material is a vital method for removing moisture from the air. Desiccants are hygroscopic chemicals with a high attraction for water molecules. The desiccant absorbs water vapor from the air, effectively drying it. To release the absorbed water, the desiccant is heated using solar energy gathered by solar panels installed into the system. This heating process evaporates the water from the desiccant substance, converting it into water vapor.

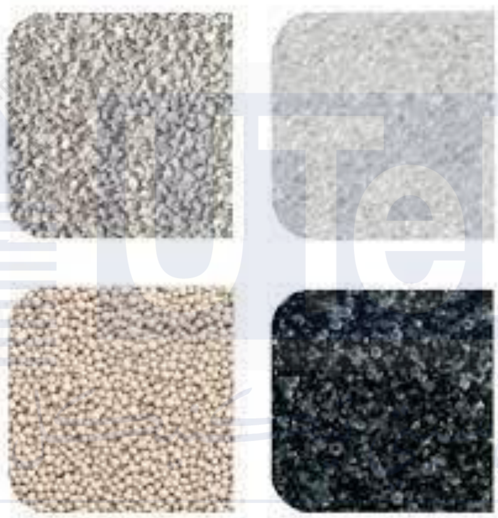


Figure 3.5 Desiccant Material

After drawing air into the panel and absorbing moisture with hygroscopic materials (desiccants), the air is heated with solar energy. Figure 3.6 Condensation Chamber is an example of a heating process that causes the absorbed moisture to evaporate, converting it to water vapor. The heated, humid air is then sent into the condensation chamber, which is normally cooled using a heat exchanger. The heat exchanger cools the warm air, usually with ambient air or a cooling fluid. As the air cools, water vapor condenses on the chamber's cool surfaces to form liquid droplets. These droplets combine and are collected in a reservoir.

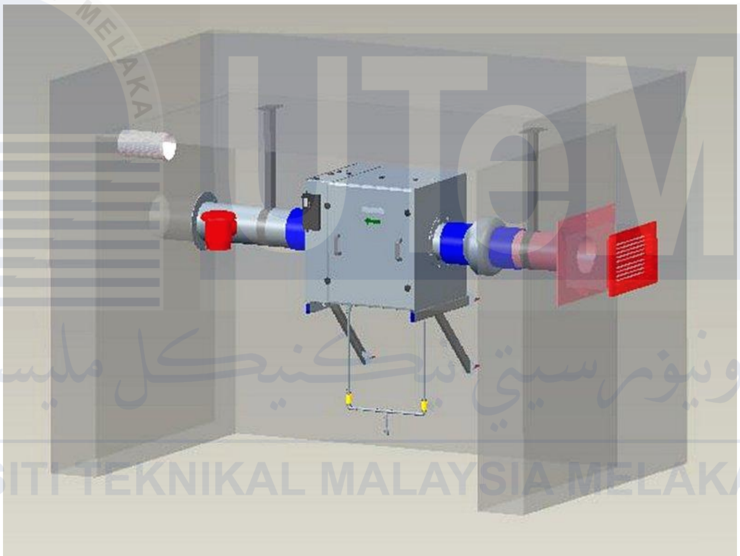


Figure 3.6 Condensation Chambers

Figure 3.7 Heat Exchanger transferred heat from humid air to a colder medium, usually ambient air or cooling fluid. As the humid air goes through the heat exchanger, it comes into touch with the cooler surfaces, lowering the air's temperature. As the temperature drops, the water vapor condenses into liquid water on the cold surfaces of the heat exchanger.

Figure 3.7 Heat Exchangers

Figure 3.8 Hydro Panel Collector integrates a variety of sensors and automated technologies to monitor and control the entire water production process. They ensure that the system runs optimally by continuously measuring environmental characteristics such as temperature, humidity, and sunshine intensity. The controllers optimize the operation of fans, pumps, and heating elements to maximize water extraction and energy efficiency.

Figure 3.8 Hydro Panel Controller

Figure 3.9 Filtration System comprises of numerous stages to remove various pollutants and contaminants from the collected water. Activated carbon has a porous structure that effectively absorbs contaminants. These filtration processes work together to create clean, potable water from the atmospheric moisture recovered by the hydro panel, resulting in a dependable and sustainable water source for a variety of applications.

Figure 3.9 Filtration System

Figure 3.10 Sensors and Monitoring continuously monitor ambient parameters such as temperature, humidity levels, and sun radiation. The sensors and monitoring systems help to ensure water purity. This ensures characteristics like water purity, conductivity, and pH to guarantee that the water produced is safe and fulfills quality standards.

Figure 3.10 Sensor and Monitoring

Stainless Steel Panel Tank as mentioned in Figure 3.11 is extremely durable and corrosion-resistant, making it an excellent material for containing and storing water. The flat surface of stainless steel also inhibits the growth of bacteria and other germs, ensuring the integrity of the stored water. Furthermore, stainless steel tanks are simple to clean and maintain, lowering the danger of contamination while assuring consistent water quality over time.

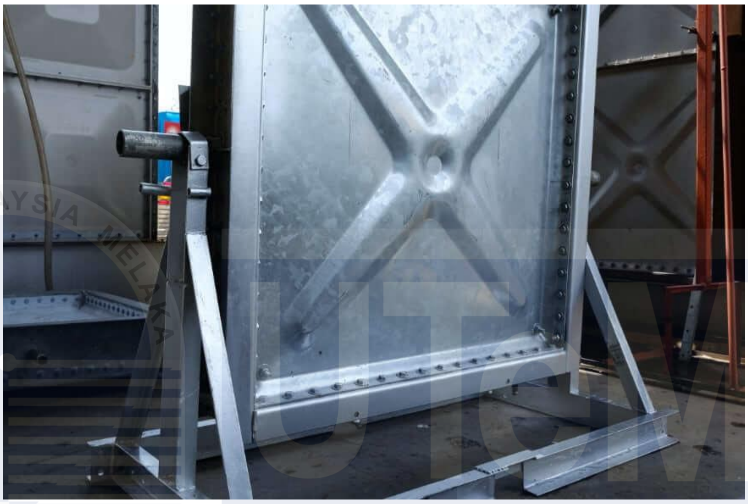


Figure 3.11 Stainless Steel Panels Tank

3.5 Method of making water from vapor

Distillation, a common process for purifying liquids, can be successfully applied for separating water from atmospheric vapor. This approach works on the idea of phase transition, which converts water vapor into liquid water by condensation. The process normally involves boiling the air to transform water to vapor, and then lowering it to condense the vapor back to liquid form, yielding distilled water.

3.5.1 Material Needed

a) Tap Water

b) Distillation apparatus (distillation flask, condenser, collection flask)

c) Heat source (Bunsen burner, hot plate)

d) Heat – resistant gloves.

e) Ice or cold water (for condenser)

f) Thermometer

g) Distilled water storage container

3.5.2 Experiment Setup

1) Setup the Distillation Apparatus

Assemble the distillation equipment per the manufacturer's instructions. Typically, the distillation flask is attached to the condenser, which is subsequently connected to the collecting flask.

2) Fill the Distillation Flask

Throw water from the tap onto the distillation flask. Fill it to 80% full, allowing some space for heating and expansion.

3) **Start Heating Process**

Set the distillation flask over a source of heat, like a Bunsen burner or a hot plate. Start boiling the water slowly.

4) **Boiling and Vaporization Process**

When the water in it is heated up, it will begin to boil. Water vapor will rise and pass through the condenser.

5) **Condensation Process**

At the condensation system, the water vapor will be exposed to a lower temperature. Thus, causing it to condense and return to a liquid state.

6) **Water Collecting Process**

The condensation water will trickle through the condensation system into the container of the collection flask. The fluid in question is now water that was distilled.

7) **Temperature Monitoring Process**

Monitor the temp. of the water that is in the distilling flask. It should steadily climb till you reach the boiling stage of water (100°C).

8) **Cooling Process**

If required, cool the cooling system to ensure proper condensation. This may be accomplished by cycling chilled ice or warm water around the condenser.

9) **Water Distilled Collecting Process**

Allow the distillation to continue until have collected sufficient water to distil in the flask.

10) **Shutdown Process**

Once have assembled the necessary quantity of distilled water, shut off the heat and let the equipment cool down.

11) Transfer and Storage Distilled Water Process

Gently transfer the water that was distilled from the collecting flask to a fresh, clean container for storage. To prevent contamination, ensure that the container is firmly sealed**.**

12) Apparatus Cleaning Process

Take apart the distillation apparatus and thoroughly clean it per the manufacturer's instructions. Discard any residual waters within the distillation flask.

13) Safety Precautions Process

When working with heated equipment, always wear heat-resistant gloves. To prevent burns or mishaps, use caution when near a heat source.

Following these methods should result in high-quality distilled water suited for a variety of uses, including laboratory investigations, medical operations, and home consumption.

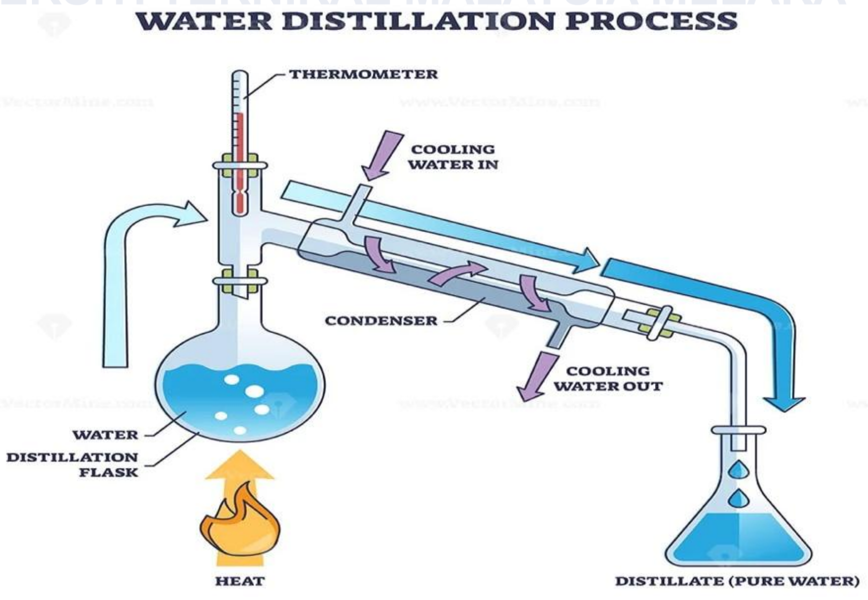


Figure 3.12 Water Distillation Process

3.6 Hydro Panel Setup

To install a hydro panel system, complete the following procedure.

a) To set up the hydro panel framework, first choose an ideal position that receives plenty of sunshine and has sufficient ventilation.

b) Secure the hydro panels to a solid structure or place them on the roof, ensuring they are properly angled to maximize solar exposure.

c) Connect the water intake and exit pipes to the hydro panels, making all connections waterproof to prevent leaks.

d) Install a control device and sensors around the hydro panels to track efficiency and automated water flow as necessary.

e) Verify that the electrical connections between the hydro panels and the battery storage system are adequately insulated and secure.

f) Test the complete arrangement by flowing water through it and monitoring the output to check that the hydro panels are working properly.

g) Conduct frequent maintenance inspections on the hydro panels, pipelines, and electrical connections to maintain long-term efficiency and dependability.

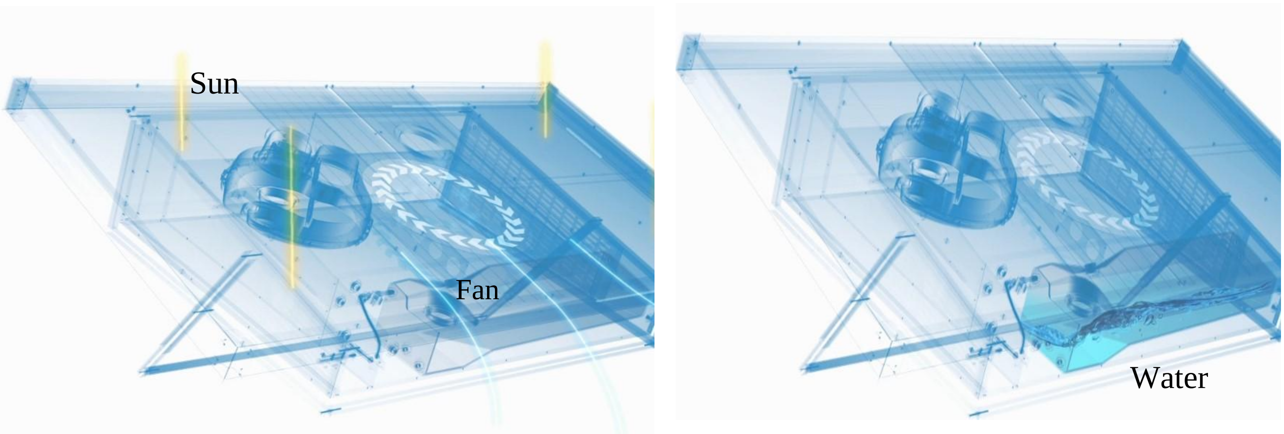


Figure 3.13 Hydro Panel Setup

3.7 Water Data Collection

a) Data Collection based on hours per day.

I. Record each data 4 hours per day by using the Thermometer in 100ml.

II. Compare the water temperature (°C) in 100ml with 2 different weather conditions in 4 hours per day.

III. Provide figures for the water temperature (°C) in 2 different weather conditions in 4 hours per day.

IV. Plot the temperature and time data in graph.

V. Create a bar Chart for water temperature (°C) in 100ml within 2 different weather conditions in 4 hours per day.

b) Water Collecting Data

Table 3.1 show time and temperature(°C) to get results by using a Thermometer as a tool for measuring temperature.

Table 3.1 Time and Temperature(°C)

Time	**Temperature(°C)**	**Volume(mL)**
7 a.m. - 10 a. m.	20-25(°C)	100mL
1 p.m. - 4 p.m.	20-25(°C)	100mL
5 p.m. - 8 p.m.	20-25(°C)	100mL
9. p.m. - 12 a.m.	20-25(°C)	100mL

3.8 Classification of Hydro Panel System.

Table 3.2 shows the type of equipment, model, qualified from certified company and a minimum of quantity unit for Hydro Panel device.

Table 3.2 Classification of Hydro Panel System

Equipment	Model	Qualified	Quantity
Hydro Panel	G2021211000	System Tested and Certified by NFS International against NSF P343 Health and Sanitation Requirement for atmospheric Water Generators	2

3.9 Develop Maintenance Activities Standards

Maintenance of hydro panels is critical to their efficient operation and long-term efficacy. The article describes standardized maintenance practices tailored exclusively for hydro panels. These standards are intended to improve efficiency, lengthen longevity, and increase sustainability in energy generation. We aim to improve efficiency, reduce downtime, and reduce the dangers related to hydro panel installation by establishing defined processes. These standards, which were developed through cooperation and experience, establish a new standard for renewable energy maintenance excellence.

Hydro panels, also known as atmospheric water generators (AWGs), must be maintained to continue operating properly and provide clean drinking water on a consistent basis. Here's an explanation of the main aspects of maintaining hydro panels:

1. **Regulator Inspection**

- Visual Inspection: Inspect the hydro panels on a regular basis for signs of damage, wear, and leaks. Examine the components, including solar collectors, condensation chambers, filters, and storage tanks, for cleanliness and proper operation.

2. **Cleaning**

- Cleaning the Solar Collectors: Keep the solar collectors clear of dust, grime, and debris to guarantee optimal sunlight absorption. Clean them on a regular basis with a gentle brush or cloth and mild detergent, if necessary.
- Cleaning the Condensation Chamber: Remove any collected dirt or residue from the condensation chamber to ensure proper condensation. Using a moist cloth or sponge, gently wipe the inner surfaces.
- Cleaning filters: To avoid blockage and maintain ideal water quality, clean or replace filters such sediment filters and activated carbon filters on a regular basis. Follow the

manufacturer's recommended filter maintenance intervals.

3. **System Calibration**

- Calibration of Sensors: Periodically calibrate sensors and monitoring equipment to ensure accurate measurement of environmental conditions (e.g., temperature, humidity) and system performance (e.g., water production rates, water quality).
- Adjustment of Settings: Review and adjust system settings as needed based on changes in environmental conditions or water demand. This may include adjusting fan speeds, temperature settings, or water production rates.

4. **Water Quality Management**

- Adjustment of Settings: Review and adjust system settings as needed based on changes in environmental conditions or water demand. This may include adjusting fan speeds, temperature settings, or water production rates.
- Water Quality Testing: Test the produced water on a regular basis to ensure that it fulfills safety and regulatory criteria. Conduct tests to determine pH, total dissolved solids (TDS), and microbiological contamination.
- Flushing the System: Use clean water to flush out any accumulated silt or contaminants and preserve water quality.

5. **Component Replacement**

- Adjustment of Settings: Review and adjust system settings as needed based on changes in environmental conditions or water demand. This may include adjusting fan speeds, temperature settings, or water production rates.
- Filter Replacement: Replace filters as recommended by the manufacturer, or when they become clogged or inefficient.
- Desiccant Replacement: If the desiccant material becomes saturated or loses

effectiveness, replace it with fresh material to ensure proper moisture absorption.

6. **Record – Keeping**

- Maintain Thorough Records of All Maintenance Activities: List all dates associated with inspections, cleanings, component replacements, and any problems that arise. This makes troubleshooting easier in the event that issues emerge and helps monitor the system's performance over time.

Hydro panel owners may guarantee their systems run smoothly, provide clean drinking water, and last longer by adhering to these maintenance procedures. Frequent maintenance enhances the advantages of using atmospheric water generating technology by ensuring reliability, preventing problems, and ensuring efficiency.

3.10 Summary

The methodology for assessing the performance of a water-collecting hydro panel device includes many important phases to ensure accurate and reliable data collection. First, the hydro panel gadget is placed in a controlled outdoor location where it will be exposed to natural weather conditions. To maximize water collection efficiency, the site is chosen using parameters such as solar exposure, average humidity, and low shadowing. Sensors are installed to monitor various characteristics such as temperature, humidity, sun radiation, and wind speed. The hydro panel is outfitted with a water collection system that includes storage tanks and monitoring instruments for determining the volume of water collected throughout time periods.

As for conclusion, data is collected continuously over a set time, usually many months, to account for seasonal fluctuations. The performance of the hydro panel is evaluated by evaluating the obtained data using statistical methods. Key performance metrics are the amount of water collected each day, the efficiency of water collection in relation to environmental circumstances, and the device's performance constancy over time. The hydro panel’s efficiency and efficacy are evaluated by comparing it to theoretical models and benchmarks from similar devices. Furthermore, a Hydro Panel Technology could meet a target average daily drinking water requirement standard of 5 liters per day per person. (Lord,2021) To conclude, maintenance operations and operational concerns are documented to provide insight into the practical elements of installing such devices in real-world contexts.

CHAPTER 4

PRELIMINARY RESULTS

4.1 Introduction

In this chapter, our goal is to achieve collect water in 4 hours can collected in 250ml of produced by hydro panel device. On the other hand, the aims of this chapter also want to be proved based on our observations of the water collecting process by Hydro Panel system, it is relevant for the community to produce clean water by this process. Regarding the matter, the characteristics of the performance tests show that these panels consistently produce water and are drinkable, indicating the effectiveness at providing a sustainable water source. According to (Lord,2021), Mapping thermodynamic constraints is important for establishing maximum global expectations for Hydro Panel Technology output and assessing the opportunity for improvement between current device performance and basic physical limits.

Hence, compared to traditional water sources, Hydro Panel water stood out for its purity and positive environmental impact as a renewable source in water collecting. Hydro Panel successfully can separate water from atmospheric vapor. Data collection of quality water by Hydro Panel plotted in graph form are between time and quantity of water constantly supply in millimeters (ml). On the other hand, emphasizing the necessity of undergoing toward water temperature (°C) and weather conditions (°F) also are plotted in graph form meanwhile for weather conditions plots in bar chart. These findings focus on specific country mainly in Borneo Island Kuching, Sarawak which allocated in the East South of Malaysia who are typically rich of their rainforest relative humidity and its moisture.

4.2 Results and Discussion

The experiment gathered data on the water collection performance of a hydro panel device located in Kuching, Sarawak. Water temperature was measured with a thermometer, while the collected water was stored in a plastic bottle in volume 250ml. Table 4.1 Data Recoded Early Morning presents the first result.

Table 4.1 Data Recorded in Early Morning

Time	**Temperature(°C)**	**Volume(mL)**
7 a.m.	30.0°C	250ml
8 a.m.	30.2°C	250ml
9 a.m.	31.0°C	250ml
10.00 a.m.	31.8°C	250ml

The results indicate that from 7 a.m. to 10 a.m., the volume of water collected by the hydro panel remained constant at 250 ml, regardless of the rising temperature. Starting at 30°C at 7 a.m., The temperature increased incrementally by approximately 0.2–0.8°C each hour, reaching 31.8°C by 10 a.m. However, this gradual temperature change did not seem to impact the volume of water collected. This pattern suggests that the hydro panel maintained a stable collection rate within the temperature range observed, implying that slight temperature fluctuations may not significantly influence the device's water collection performance over this time span.

Table 4.2 Data Recorded in the Afternoon shows from 1:00 p.m. to 4:00 p.m., there was a gradual decrease in temperature, starting at 33.1°C and slowly dropping to 32.2°C by the end of the recorded period. Despite this slight cooling trend, the volume of collected water remained constant at 250 ml each hour. This stability in water collection, unaffected by the minor changes in temperature, may suggest that the process or equipment collecting the water is not highly sensitive to small temperature variations within this range. It could also imply that factors other than temperature, such as humidity or airflow, play a more critical role in determining the volume collected. This data may help in understanding the conditions under which consistent water collection can be achieved, highlighting the resilience of the collection method against minor temperature fluctuations.

Table 4.2 Data Recorded in Afternoon

Time	**Temperature(°C)**	**Volume(mL)**
1.00 p.m.	33.1°C	250ml
2.00 p.m.	32.8°C	250ml
3.00 p.m.	32.4°C	250ml
4.00 p.m.	32.2°C	250ml

Table 4.3 Data Recorded in Evening starts at 5:00 p.m., the temperature was recorded at 31.8°C with 250 ml of water collected. By 6:00 p.m., the temperature had dropped slightly to 31.4°C, though the water volume stayed the same. At 7:00 p.m., the temperature continued to cool down to 30.0°C, with the volume still at 250 ml. By 8:00 p.m., the temperature reached 29.6°C, but the amount of water collected remained steady at 250 ml throughout the evening.

Table 4.3 Data Recorded in Evening

Time	**Temperature(°C)**	**Volume(mL)**
5.00 p.m.	31.8°C	250ml
6.00 p.m.	31.4°C	250ml
7.00 p.m.	30.0°C	250ml
8.00 p.m.	29.6°C	250ml

Table 4.4 Data Recorded in Night observations recorded from 9:00 p.m. to 12:00 a.m. reveal a clear trend of decreasing temperature, reflecting the system's thermal dynamics. The initial temperature was 29.5°C at 9:00 p.m., indicating a warm environment. Over the next few hours, the temperature gradually dropped, measuring 29.2°C at 10:00 p.m., 29.0°C at 11:00 p.m., and reaching 28.9°C by midnight. Throughout this entire period, the volume remained steady at 250 mL, showing that the system maintained its stability despite the temperature changes. This data provides valuable insights into how the system behaves under varying thermal conditions, which could be useful for further analysis.

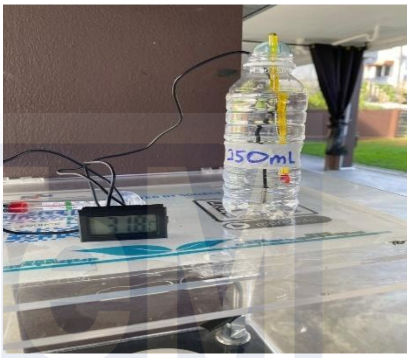
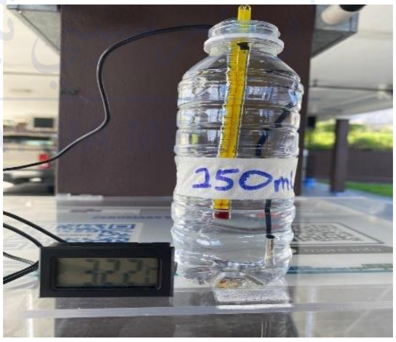
Table 4.4 Data Recorded in Night

Time	**Temperature(°C)**	**Volume(mL)**
9.00 p.m.	29.5°C	250ml
10.00 p.m.	29.2°C	250ml
11.00 p.m.	29.0°C	250ml
12.00 a.m.	28.9°C	250ml

4.3 Average Data Recorded

Table 4.5 shows the evidence of data recorded for average data in 4 hours collected in early morning, in afternoon, in evening time and in the nighttime by using Thermometer as a tool to measure water temperature and plastic bottle to save the water collected.

Table 4.5 The evidence of data recorded for average data in 4 hours collected.

1) Early average data recorded from 7.00a.m to 10.00a.m.	
2) In afternoon time the average data recorded from 1.00p.m to 4.00p.m.	
3) From 5.00p.m to 8.00p.m is the 4 hours average data collected.	

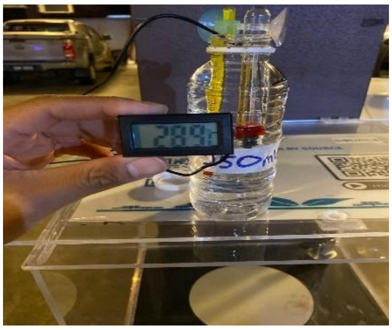
4) End of average data recorded from 9.00p.m to 12.00a.m.	

Table 4.6 Average Data Recorded 4 hours per day shows that the average temperature from 7 a.m. to 10 a.m. was 31.8°C, with a consistent volume of 250 ml. In the afternoon, between 1 p.m. and 4 p.m., the temperature rose slightly to 32.2°C, while the volume remained the same. Later, from 5 p.m. to 8 p.m., there was a noticeable drop in temperature to an average of 29.6°C, again keeping the volume at 250 ml. Finally, from 9 p.m. to 12 a.m., the temperature decreased further to 28.9°C, with the volume unchanged throughout all the time periods. Overall, this data highlights a clear trend of falling temperatures as the day goes on, while the volume stays consistent.

Table 4.6 Average Data Recorded 4 hours per day

Time	**Temperature(°C)**	**Volume(mL)**
7 a.m. – 10 a. m.	31.8°C	250ml
1 p.m. - 4 p.m.	32.2°C	250ml
5 p.m. - 8 p.m.	29.6°C	250ml
9 p.m. - 12 a.m.	28.9°C	250ml

The Figure 4.1 graph which is provides a comprehensive overview of Temperature (°C) and Time data recorded at throughout the day, which can be particularly insightful for understanding environmental conditions and their effects on water behaviour. Although the specific location of the measurements is at Kuching Sarawak, one can infer that they were taken in a controlled environment, such as an outdoor setting suitable for monitoring temperature fluctuations. This type of environment is crucial for obtaining accurate data, as external factors can significantly influence the reading

The data Figure 4.1 is organized into four distinct time intervals, showcasing the temperature changes throughout the day. From 7 a.m. to 10 a.m., the recorded temperature was 31.8°C. During the afternoon, from 1 p.m. to 4 p.m., the temperature peaked at 32.2°C, marking the warmest period of the day. Following this peak, the temperature began to decline, dropping to 29.6°C between 5 p.m. and 8 p.m. Finally, from 9 p.m. to midnight, the temperature further decreased to 28.9°C. These readings illustrate a typical pattern of daily temperature fluctuations, with warmer temperatures observed during the peak sunlight hours and cooler temperatures at night.

Understanding these temperature dynamics is essential, especially in the context of the research focused on the hydro panel device. The primary goal of collecting this data is likely to explore how temperature variations influence water collection efficiency and overall device performance. By analysing how water behaves at different temperatures, researchers can gain valuable insights that may lead to improvements in the design and functionality of the hydro panel.

To collect this data, a thermometer would have been used to accurately measure the air temperature, while a graduated cylinder ensured precise measurements of water volume. Each volume measurement was consistently set at 250 ml, allowing for straightforward comparisons across the different time periods. This consistency in measurement is critical, as it provides a reliable dataset for analysis.

Moreover, the methodology employed for this data collection may involve controlling external factors, such as placing the measurement tools in similar conditions to minimize variations that could skew the results. By maintaining such control, researchers can be more confident in the accuracy and relevance of their findings. Ultimately, this data not only sheds light on the relationship between temperature and water behaviour but also contributes to a broader understanding of environmental influences on hydro panel performance, which is crucial for optimizing water collection strategies in various applications.

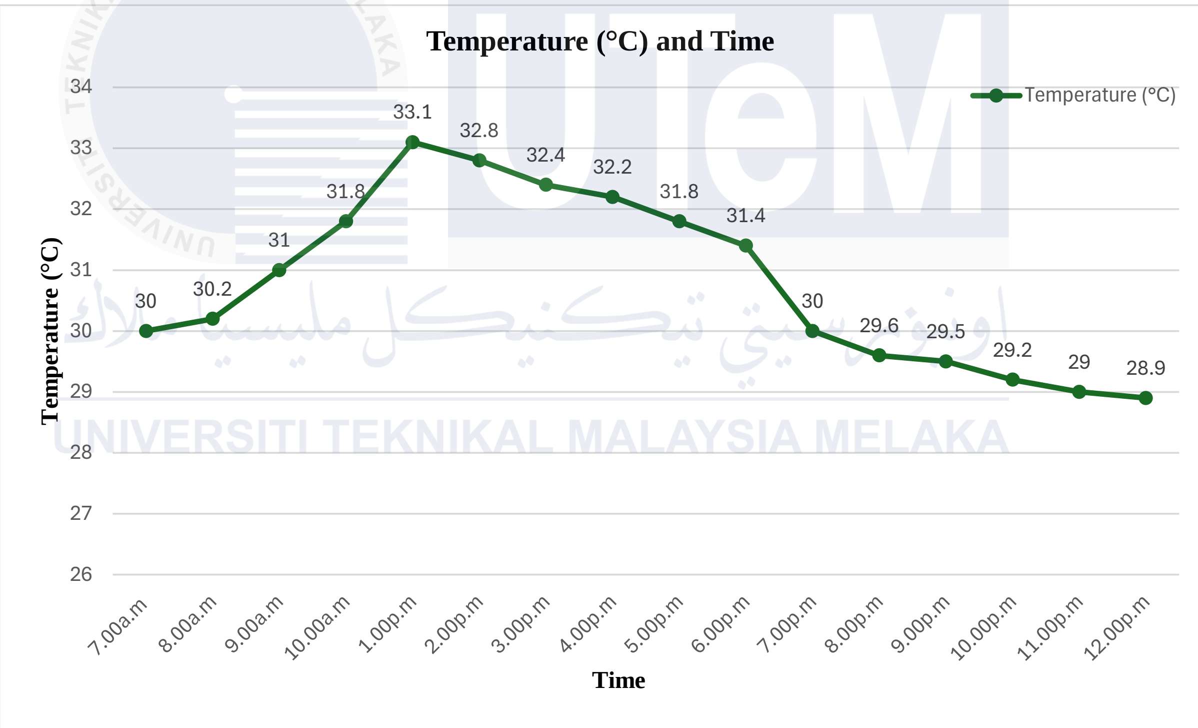


Figure 4.1 Graph Temperature(°C) and Time by used Hydro Panel Device

4.8 Performance Metrics

As depicted in Figure 4.2, The Hydro Panel unit is a carefully designed device featuring considerable dimensions of 8 feet in length, 4 feet in width, and 8.5 inches in height. This design not only maximizes space efficiency but also enables effective water collection, with the panel capable of holding a total of 30 liters of water at once. Under ideal environmental conditions specifically a stable temperature of 30°C and a relative humidity level around 70% this innovative hydro panel demonstrates impressive efficiency, collecting between 4 to 10 liters of water daily. Throughout a comprehensive 30-day testing period, the hydro panel maintained consistent performance, showcasing its reliability in various climate conditions, highlighted by a maximum collection of 15 liters on particularly humid days. This exceptional performance translates into a significant output, allowing for the filling of approximately 180 standard-sized water bottles on the day with the highest humidity, thus emphasizing the potential of this technology to serve as a sustainable water source in situations where traditional water supply methods may be less effective (Tanavade ,2021)

Figure 4.2 Hydro Panel Device

4.9 Average Data Comparison

Table 4.7 and Table 4.8 experiment result shows the average data comparison with household using Hydro panel device and household Origin water supply (without using Hydro Panel device) in every 4-hour collected.

Table 4.7 Average Data Recorded from Hydro Panel Device

Time	Temperature(°C)	Volume(mL)
7 a.m. – 10 a. m.	31.8°C	250ml
1 p.m. - 4 p.m.	32.2°C	250ml
5 p.m. - 8 p.m.	29.6°C	250ml
9 p.m. - 12 a.m.	28.9°C	250ml

Table 4.8 Average Data Recoded from Origin Water supply

Time	Temperature(°C)	Volume(mL)
7 a.m. – 10 a. m.	31.1°C	250ml
1 p.m. - 4 p.m.	32.1°C	250ml
5 p.m. - 8 p.m.	31.4°C	250ml
9 p.m. - 12 a.m.	30.7°C	250ml

This data provides a comparison between the temperatures and water volumes recorded from a hydro panel and an origin water supply across four different times of the day which is in the morning (7 a.m. – 10 a.m.), early afternoon (1 p.m. – 4 p.m.), evening (5 p.m. – 8 p.m.), and night (9 p.m. – 12 a.m.).

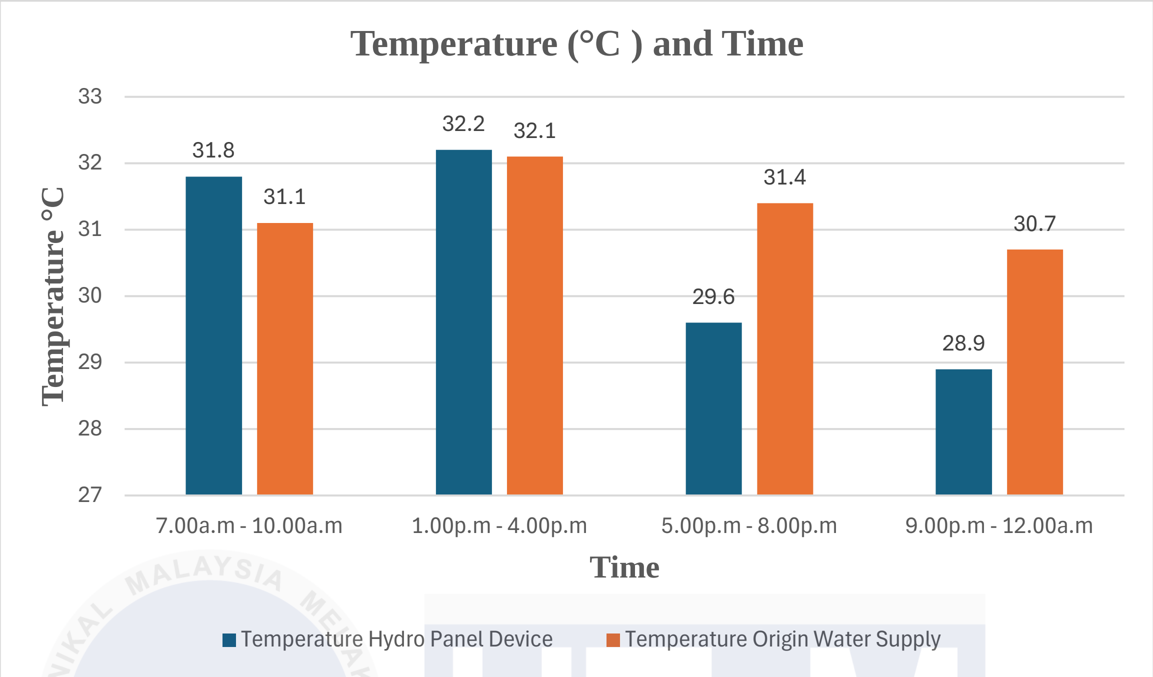


Figure 4.3 Graph Comparison Temperature(°C) and Time for Hydro Panel Device and Origin Water

For the hydro panel, temperatures varied slightly throughout the day starting at 31.8°C in the morning, peaking at 32.2°C in the afternoon, dropping to 29.6°C in the evening, and ending at 28.9°C by night. Interestingly, despite these temperature changes, the water volume stayed consistent at 250 ml each time. In contrast, the original water supply also produced a steady 250 ml of water at each interval, but with slightly different temperatures. 31.1°C in the morning, 32.1°C in the afternoon, 31.4°C in the evening, and 30.7°C at night.

This comparison shows that both the hydro panel and the original water supply maintained a stable water output of 250 ml across varying temperatures, demonstrating reliability. However, the hydro panel's temperatures fluctuated a bit more during the evening and night compared to the original supply. This slight difference might be influenced by the hydro panel's materials or surrounding environmental factors, which could affect how it absorbs or retains heat. Overall, the data suggests that the hydro panel is effective at consistently collecting water, like the original supply, even with minor temperature changes throughout the day.

4.10 Phenomena Comparison

In Malaysia, the performance of hydro panels benefits from the country's tropical climate, which is marked by high humidity (75–90%) and warm temperatures (26–32°C) year-round. The abundant rainfall, averaging around 2500 mm annually, creates a moisture rich environment that supports water vapor production, making it ideal for hydro panels. This is especially advantageous for rural areas where access to clean water is limited. However, there are some challenges to consider, such as the potential reduction in solar panel efficiency during the long rainy seasons and the risk of contamination from industrial pollution in certain areas. Despite these challenges, the overall climate in Malaysia is well-suited for the use of hydro panels. (Foley, 2019)

Meanwhile in the UAE, the performance of hydro panels is largely affected by the local climate. The humidity levels are relatively low, ranging from 20% to 60%, which can limit the amount of water the panels can produce. The extreme heat, especially during the summer when temperatures can reach as high as 50°C, can also put a strain on the system. Additionally, the UAE experiences very little rainfall, with only about 100 mm annually, highlighting the need for alternative methods of water generation. On the plus side, the consistent availability of solar energy in the region boosts the efficiency of the hydro panels, making them a valuable solution for remote desert areas that lack access to traditional water sources. (Chowdhury, 2016)

Table 4.9 show of comparison of factor between in Malaysia and UAE. In Malaysia, the climate is ideal for hydro panels. The high humidity (often between 75% and 90%) and warm temperatures (26–32°C) create perfect conditions for these panels to capture water from the air. With abundant rainfall throughout the year, there's plenty of moisture in the air for the panels to extract. While there are natural water sources in Malaysia, hydro panels can still be useful, especially in rural areas where access to clean water might be limited. Plus, the moderate climate means maintenance is relatively easy, and solar energy combined with grid power ensures a steady energy supply for the panels.

In the UAE, the situation is a bit different. The climate is much drier, with humidity levels ranging from 20% to 60%, meaning the panels have less moisture to work with. The extreme heat (up to 50°C in summer) can also stress the system, making it harder for the panels to function efficiently over time. Despite these challenges, the UAE's severe water scarcity makes alternative water sources like hydro panels crucial, especially in remote desert areas. Solar energy is abundant, so power for the panels is reliable, but the yield of water will be lower due to the dry conditions. However, the high cost of maintaining the system in such an extreme climate could be a concern.

In conclusion, Malaysia's high humidity and favorable weather conditions make hydro panels an effective and cost-efficient option, while in the UAE, despite the lower efficiency, the need for water makes these panels an important solution, especially in areas with limited access to fresh water.

Table 4.9 Comparison of factor between in Malaysia and UAE

Factor	Malaysia	UAE
Humidity	High (optimal for AWG)	Low to moderate (lower yield)
Temperature (°C)	Warm, Steady	Extremely hot (Potential stress)
Water Demand	Moderate, many natural sources	High, scarce natural sources
Energy Source	Reliable solar + grid backup	Solar- powered preferred
Yield	High	Moderate to low
Economic Feasibility	Cheaper maintenance due to milder conditions	Expensive maintenance due to harsh climate

4.7 Summary

The data is presented in a straightforward manner, with clear temperature readings and consistent water volumes of 250 ml measured at four different times throughout the day. This precise reporting enhances the accuracy of the findings and effectively highlights the temperature changes over time.

The analysis is conducted without bias, as both water sources are evaluated under the same conditions. The fact that both the hydro panel and the original water supply deliver a consistent output suggests that the hydro panel is reliable, even with variations in temperature.

Although the data is firsthand and original, referencing studies on hydro panel performance and environmental influences could provide additional context. These citations would help to frame the findings within the larger body of research on water collection technologies.

Chapter 5

Conclusion and Recommendations

5.1 Conclusion

In summary, this study assessed the water collection performance of hydro panel devices, focusing on two key objectives is Identifying the types of water collected and analyzing the impact of these types on overall performance. Findings showed that hydro panels are effective at capturing atmospheric moisture to generate potable water under varying environmental conditions. Different water types, such as condensed atmospheric moisture and water with trace air pollutants, were observed, providing valuable insights into the hydro panel's adaptability across different climates and air quality conditions.

The performance analysis highlighted that water yield and quality are influenced by factors like humidity, temperature and environment. These environmental variables not only affect the volume of water produced but also their mineral content and purity, emphasizing the importance of installing hydro panels in areas with favorable conditions for consistent water production. This reinforces the hydro panel's potential as a reliable water source, especially in regions with limited clean water access.

Moreover, the study suggested potential improvements to enhance hydro panel efficiency and durability, such as adding filtration systems and using more resilient materials. These modifications could increase water purity and extend the device's usefulness in harsher climates. Future research could explore the cost-effectiveness and sustainability of hydro panels, facilitating their broader use in remote and resource-constrained areas, and contributing to sustainable solutions for water resource management.

5.2 Recommendations

Based on the study's findings, several recommendations are suggested to improve the effectiveness and broader applicability of hydro panel devices for water collection. First, it is beneficial to place hydro panels in locations with high humidity and low pollution levels to maximize both water yield and quality. Integrating advanced filtration systems is recommended to enhance water purity, making it safer for drinking. Additionally, using materials that can withstand different climate conditions would extend the device's durability, especially in areas with extreme weather. Consistent maintenance and monitoring of environmental conditions are also important to ensure the panels operate efficiently.

In addition, equipping hydro panels with adaptive design features that respond to real-time environmental changes, such as temperature and humidity fluctuations, could further enhance water collection efficiency. Future studies should examine the cost-effectiveness of hydro panels in comparison with other water collection and purification methods, which could encourage their adoption in areas with limited resources. Incorporating renewable energy, like solar power, would make hydro panels more self-reliant and reduce operational costs, supporting sustainable water collection practices. Expanding hydro panel use in remote and arid areas could help alleviate water shortages in regions with scarce water resources.

Moreover, developing educational programs for end-users on the proper maintenance of hydro panels can help improve device lifespan and ensure safe water usage. Finally, collaborating with local governments and community groups could aid in deploying hydro panels in underserved areas, providing essential clean water access. These recommendations are intended to enhance the sustainability and practical use of hydro panels as a reliable water source across various environmental conditions.

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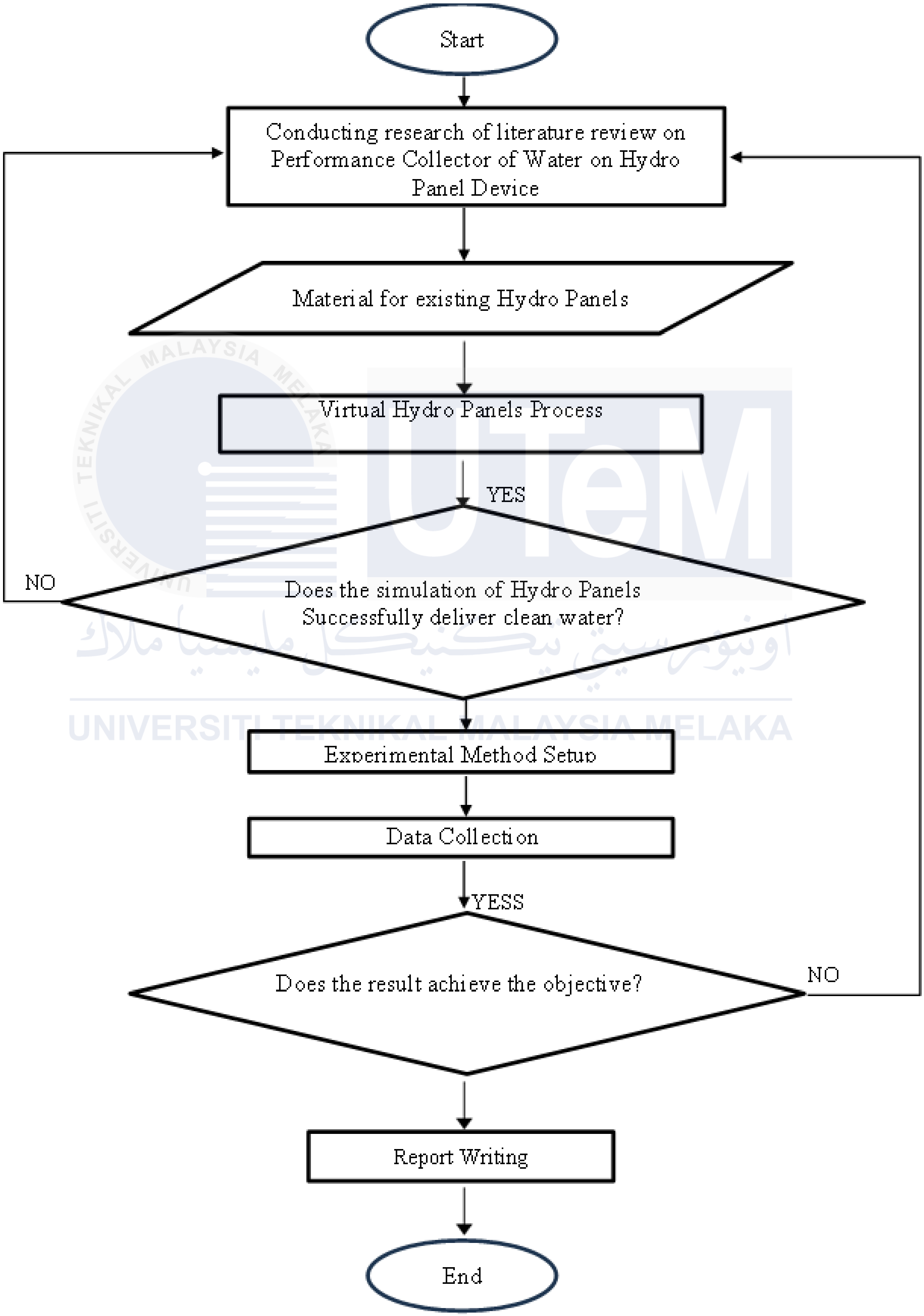
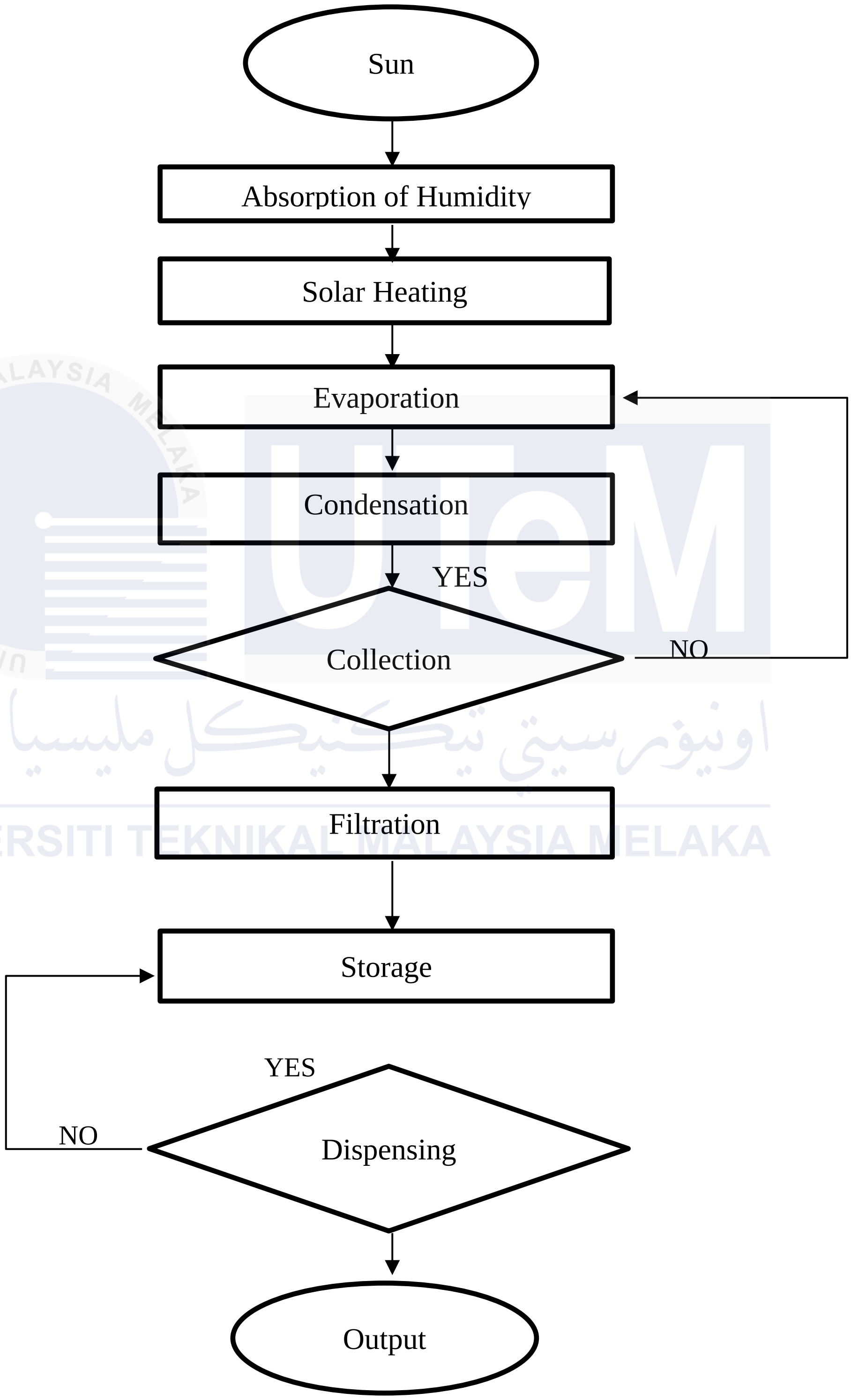
APPENDICES

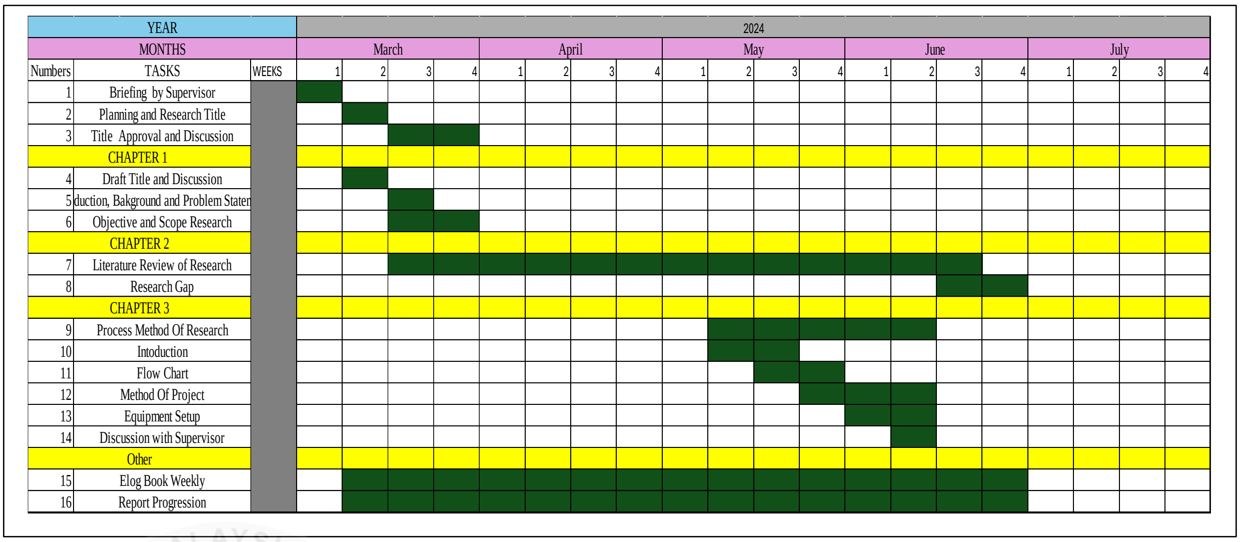
APPENDIX A PSM Research Flowchart



APPENDIX B Methodology Flowchart



APPENDIX C PSM 1 Gantt Chart



PSM 2 Gantt Chart