"INDUSTRIAL TRAINING REPORT"

Name: Muhammad Amirul Bin Rasidi

Program: Diploma in Chemical Engineering

ID: 2018691716

LI Duration: 16 Weeks

Supervisor: Encik Mohd Yusof Bin Ismail

Company Address: No 29, 1st & 2nd Floor, Jalan S2B17,
Biz Ave S2 70300 Seremban, Malaysia.

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CHAPTER 1

INTRODUCTION TO INDUSTRIAL TRAINING

1.0 Introduction

Industrial training is a mandatory course for all Diploma students of Faculty of Chemical Engineering. It is a requirement to fulfill the course in order to complete the course as well as graduate from university. It is an important component in engineering curriculum. Theories learnt in all the core and non-core courses will have to be applied into the real working environment in chemical industries. Prior to the actual training in industries students are trained to make job applications before stepping into the real working environment.

The training refers to work experience that is relevant to professional development prior to graduation. For Chemical Engineering students, 16-weeks period and 7 credit hours were allocated for training at the chosen location by the students themselves. No restriction is imposed on them whether they want to work in government agencies or private organizations.

For the semester, the trainee Muhammad Amirul Bin Rasidi (2018691716) has started working in Hexagon Synergy (M) Sdn. Bhd. (740886-A) starting from 22nd of March 2021 until 16th July 2021.

1.1 Objectives of Industrial Training

The objectives of this industrial training are as below:

- To fulfil the requirement for the students to graduate for the students to graduate from this course.
- Apply theories learnt in classroom in working environment.
- Improve students' confidence after graduation.
- Improve both soft and hard skills
- Improve communication and management skills.

CHAPTER 2

ABOUT COMPANY

2.0 Introduction

This section will include a brief overview of the business (Hexagon Synergy Sdn. Bhd.) This segment will detail the company's logo, company's history, organization structure, vision, and purpose as well as the services and awards it has earned.

2.1 Company Logo

HEXAGON SYNERGY

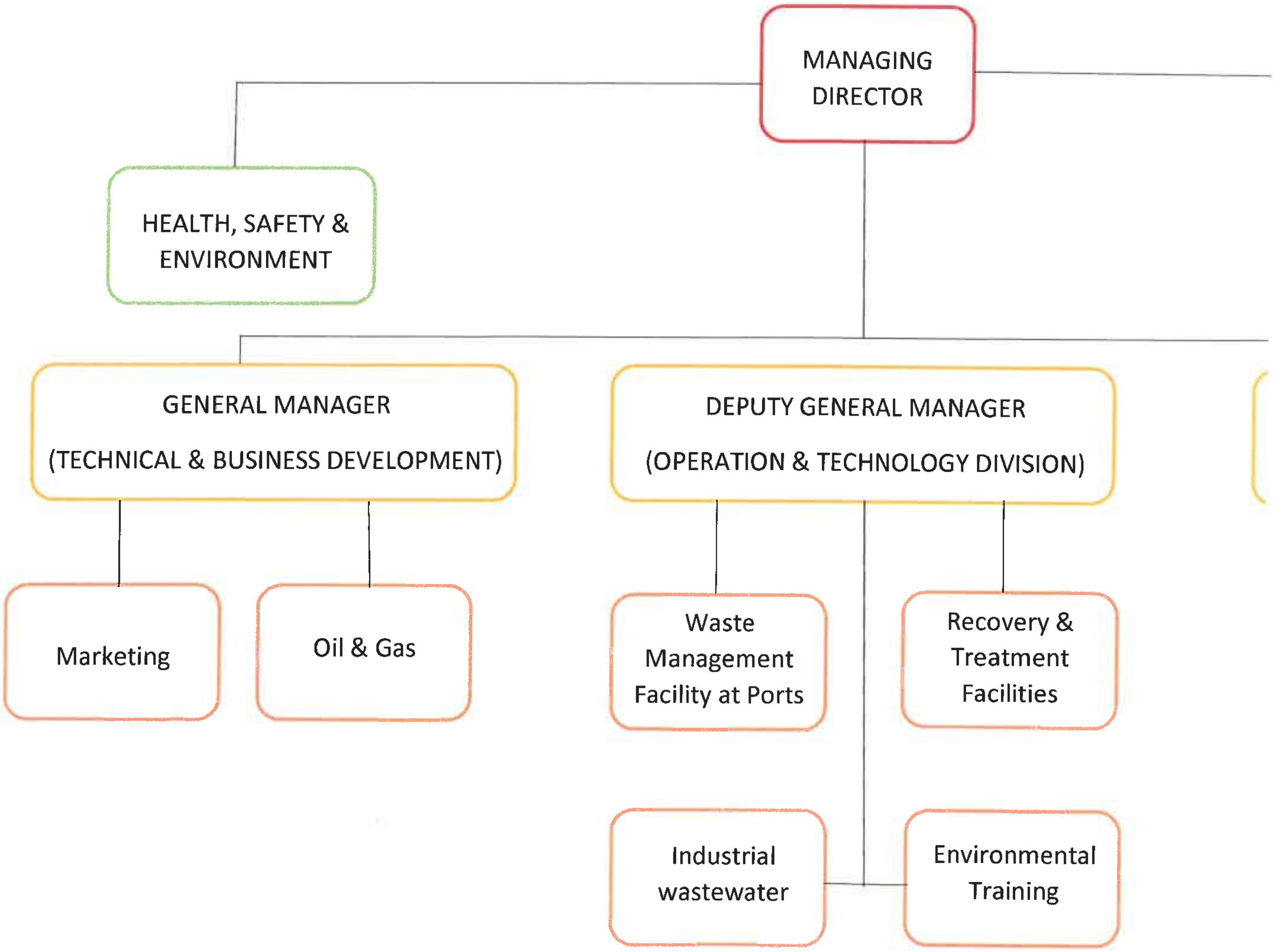
2.2 Company Background

Hexagon Synergy ("Hexagon") is a multidisciplinary group of specialists with decades of expertise. Hexagon Synergy team were involved in the establishment of an integrated hazardous waste facility in Malaysia in 1997 and a medical waste treatment facility in 1996. Following this, it has extended its capabilities to design, develop, operate, and sustain our oil and gas recovery facilities, allowing them to become a market leader in waste management. Furthermore, it has worked alongside medical waste treatment facilities, incineration plants, sewage treatment plants, oily sludge recovery facilities, and port waste reception facilities to provide engineering services.

Hexagon Synergy has become one of the most trusted service providers in the engineering and environmental industries as a result of these invaluable first-hand experiences. Hexagon Synergy recognises ample opportunities to unlock potential and deliver maximum value from waste produced by waste producers through its inventions. Hexagon Synergy has invented new technologies and successfully commercialised them for the industries. because of an experienced R&D team and cutting-edge technology capitalizing by capitalising on the technology technological advancement and market demand, Hexagon Synergy committed to serving to support the environmental needs with the best, sustainable, and cost effective most cost-effective solution.

Hexagon Synergy are committed to supporting the environmental needs by providing the best, sustainable and most cost-effective solutions by capitalising on technological advancement and market demand.

2.3 Organization Chart



2.6 Awards & Recognitions

- ✓ Letter of recognition from the President of Ashgal. The findings were incorporated in Qatar national strategic plan for management of industrial liquid waste.
- ✓ Appointed as technology provider to Government Link Companies in the waste minimization project.
- ✓ Won silver award for technology provider.
- ✓ The 1st and only onsite CPI and Oily Sludge Recovery Facility that has provided significant saving to Petronas Refinery Facility.
- ✓ Appointed as Scheduled Waste contractor to manage waste within Pengerang Integrated Complex.
- ✓ TERAJU-Identified as high potential Bumiputera company in waste business.
- ✓ Successfully design, construct, and operate the 1st Port Reception Facilities in Malaysia.

CHAPTER 3

MINI PROJECT

3.0 Introduction

Palm Oil Mill Effluent, abbreviated as POME, is a byproduct of the palm oil milling process. The Palm Oil milling plant produces highly toxic effluent known as POME, which is frequently disposed of in disposal ponds, resulting in the leaching of toxins that can harm groundwater and soil, as well as the release of methane gas into the environment. POME is an oily effluent with high Bio Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) that is formed by palm oil processing mills and contains a variety of suspended constituents. This liquid waste, along with wastes from sterilizer condensate and cooling water, is referred to as POME. Because of the dangers that POME poses to the aquatic system, all companies in charge of treating it must have their own laboratory to conduct additional research and experiments to ensure that the POME can be discharged safely into the drainage. In Northport (M) Sdn. Bhd, to meet the requirements of the client which is Alam Flora Environmental Services (AFES), Hexagon Synergy (M) Sdn Bhd led by Encik Rasydan have agreed to set up a mini laboratory on the site in front of the Port Reception Facilities. It will build inside a small blue cabin. The mini laboratory will consist of several equipment needed for the POME treatment such as electronic balance, stirrer, and pH meter.

3.1 Objectives

- Laboratory Set-Up
  - I. To ensure that all the POME receive from clients will well-treated
  - II. To obtain the specific data of chemicals used for the POME treatment before proceeding for the plant scale treatment.
  - III. To ensure that the expenses used for treatment are economically for the company and its client

- Palm Oil Mill Effluent (POME) Treatment
  - I. To study the coagulant-flocculent and purification properties of wastewater treatment agents towards POME.

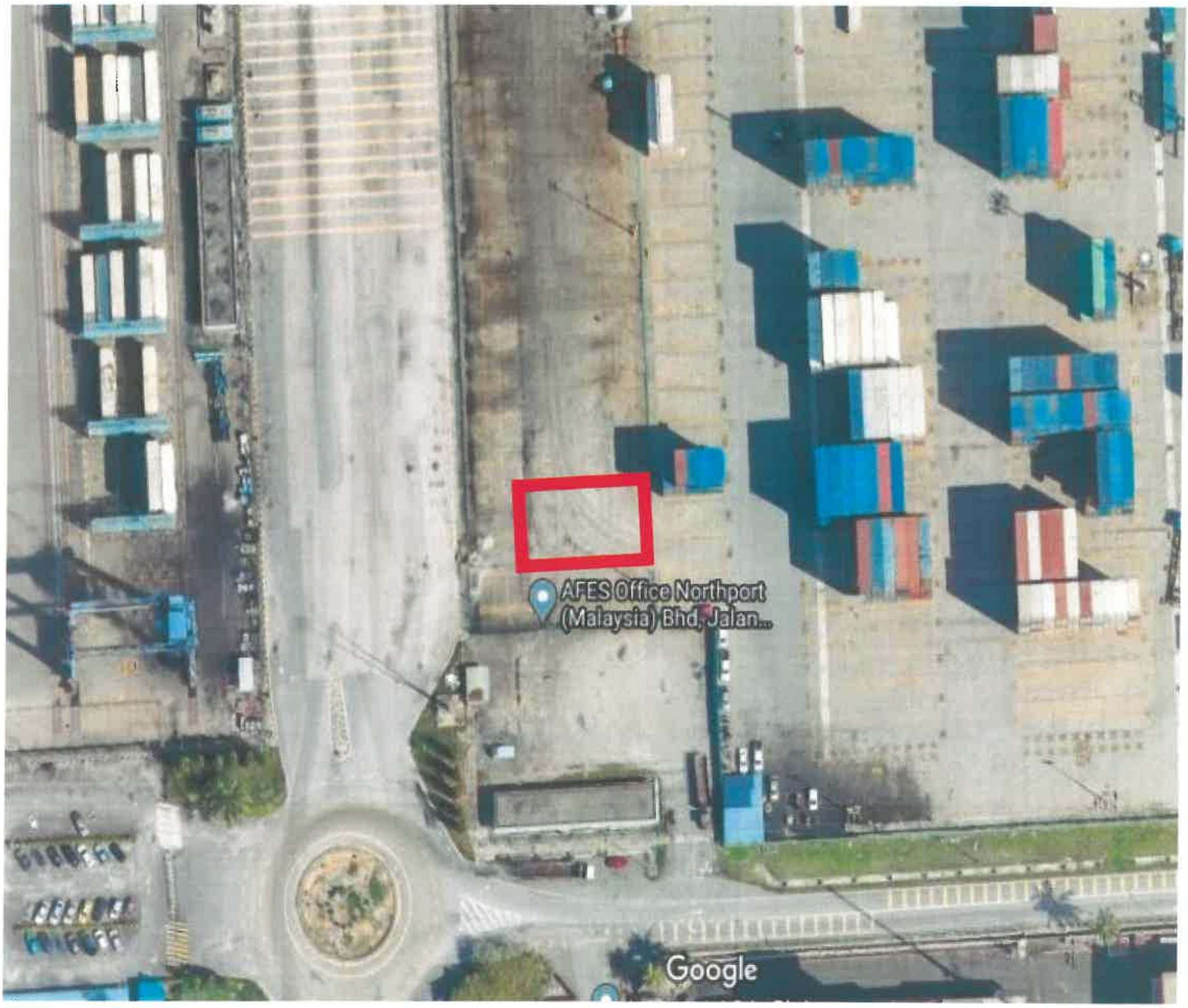
II. To study the effect of pH towards the activity of wastewater treatment agents towards POME.

III. To study the effect of amount of wastewater reagents towards POME.

IV. To obtain the best and economic way to treat POME.

3.2 Location

NORTHPORT


AFES Office Northport
(Malaysia) Bhd, Jalan...
Google

2.4 Vision & Mission

Vision

- Bring inspiration and innovation to a sustainable world.

Mission

- To provide economical and effective solutions for greener and sustainable environment.

2.5 Provided Services.

Hexagon Synergy's incorporation is a strategic move toward the country's unique waste management systems. From design, fabrication, installation, operation, and maintenance, the organization has developed to become the industry's top counsel. Hexagon Synergy offers cutting-edge services guided by a team of experts and specialists with extensive experience in the following areas:

- Scheduled Waste Management
- Solid Waste Management
- Industrial Wastewater Management
- Clinical Waste Management
- Hazardous Waste Management
- Oil Recovery & Alternative Fuel
- Port Reception Facility

3.3 Project Summary (Laboratory Set-Up)

In a team of two, we were given a blue empty office cabin with several equipment, apparatus, chemicals, and furniture that were brought from HQ in Seremban to Port Klang as an on-site laboratory. We were given task to plan and arrange the provided items according to our preference. We arranged chemicals at the corners to avoid interruption and for safety. Equipment was placed on a high strength table near to a main sockets and apparatus on an isolated area. The laboratory is equipped with a ventilator and our working space is located near a window for better lighting.

3.3.1 Inventory List

- **Chemicals**

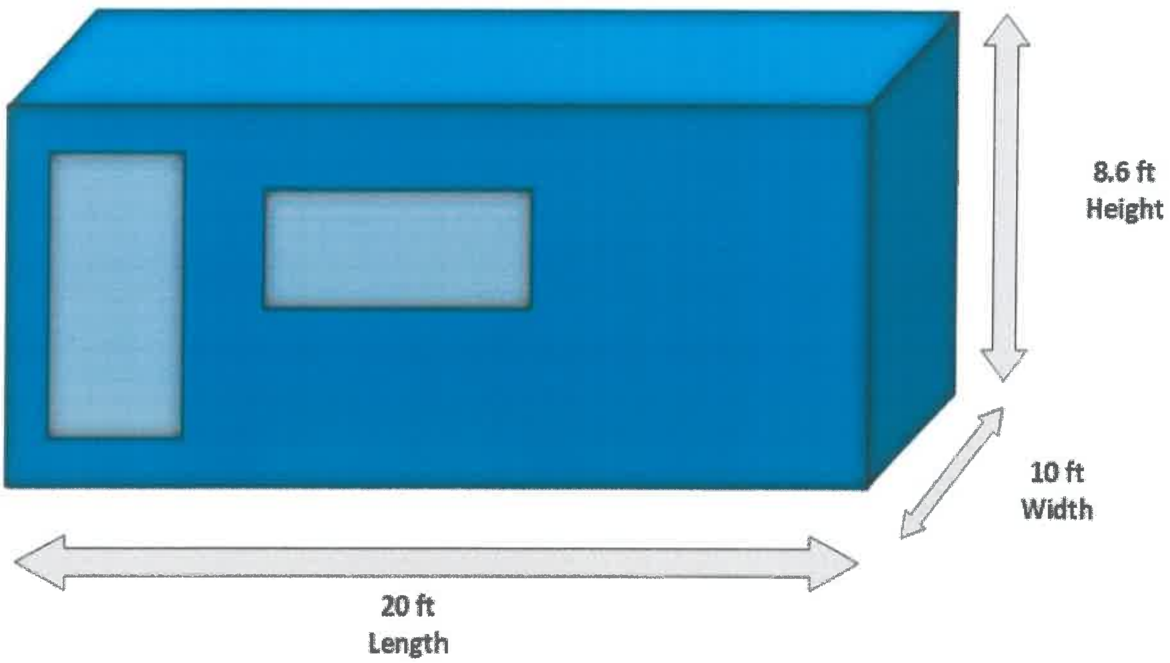
1. POME
2. 7.0 pH buffer
3. NaOH pellets
4. H2SO410%
5. Bio-DFA
6. Activated charcoal.
7. Polymer PAC
8. Ferric chloride
9. Ferric sulphate
10. Ferrous sulphate
11. Hydrogen peroxide

- **Apparatus**
    1. Beakers 250mL, 500mL, 1000mL
    2. Measuring cylinder
    3. Filter funnels
    4. Filter papers
    5. Stirrers
    6. Test tubes/boiling tubes
    7. Test tubes/boiling tubes rack
    8. Spatulas
    9. Pipette 1mL, 10mL, 25mL

- **Equipment**
    1. pH meter
    2. Magnetic stirrer
    3. Weight balance
    4. Heater
    5. Refrigerator

3.3.2 Laboratory Dimensions

MINI LABORATORY USING (20 x 10 x 8.6)ft CABIN



3.3.3 Appendices

Blue Cabin as On-Site Laboratory

Inside On-Site Laboratory

3.4 Palm Oil Mill Effluent (POME) Sample Treatment

Two to three bottles of sample were taken to the lab for further analysis. There are two types of POME sample which are a clean POME and raw POME from Tank 1 and Tank 4 respectively. Both POME has similar content however differences are determined by their BOD and COD value. Clean POME is obtained from final batch of POME ponds at Palm oil mill factories that has loss most of its solid through continuous sedimentation and anaerobic treatment. This POME has low BOD and COD content and usually requires minor final treatment before being discharged to the environment. However, raw POME was obtained from the first pond after palm oil milling processes. It has a very high BOD and COD level which contributed to its dark brown colour and requires major treatment before it is safe to be release to the environment. POME treatment procedures in laboratory scale offer limited resources hence a proper set-up with sufficient knowledge on sample and chemical parameters is important.

Throughout the internship, I was introduced with a common method of wastewater treatment namely physicochemical treatment. This method of treatment considers of chemicals and physical factor into one continuous treatment. Continuous treatment involves coagulation-flocculation and Fenton- oxidation method. Coagulation-flocculation step primarily use chemical such as Bio-DFA, alum and ferric chloride that is important to improve the separation of species during sedimentation and filtration by inducing chemical reaction and eliminating the negative charges causes particles to repel though coagulation and slow stirring after coagulation causes flocs formation. Meanwhile Fenton oxidation uses hydrogen peroxide to generate hydroxyl radical that will degrade toxic and non-biodegradable substances for more COD and colour reduction.

I conducted coagulation-flocculation method using two chemicals to identify the suitability of coagulant according to POME intensity. Fenton-oxidation was also conducted using two types of ferum salt as catalyst to investigate the rate of activity.

3.4.1 POME treatment procedures

a. Coagulation-Flocculation (Bio-Dfa as coagulant)

200mL of sample was prepared in 500mL beaker complete with a magnetic stirrer. Initial pH of sample was obtained. An amount of Bio-DFA with activated carbon was added and mixture allowed to react for 1 hour. After 1 hour, reacted mixture allowed to settle for 3-4 hours before filtration.

(Using ferric chloride as coagulant)

200mL of sample was prepared in 500mL beaker complete with a magnetic stirrer. Initial pH was recorded and tuned to pH 5. An amount of ferric chloride was added, and the mixture allowed to react for 30 minutes. Throughout the process, the pH of sample must be maintained at 5 using NaOH or H2SO4 throughout the reaction process. Fast stirring for 3 minutes and slow stirring for remaining 27 minutes. After 30 minutes, pH of sample rises to 9 and allowed to settle overnight before filtration.

b. Fenton oxidation/Fenton-like oxidation

300mL sample was prepared in 500mL beaker complete with magnetic stirrer. Initial pH was recorded and tuned to pH 3.5. A small amount of ferric sulphate/ferrous sulphate was added and allowed to react for 15 minutes. Later an amount of hydrogen peroxide was added few drops at a time every 5 minutes and allow reaction to proceed overnight. pH of sample must be maintained at 3.5 throughout the reaction process. Upon completion, pH of sample rises to 9 and a very small amount of polymer was added. Another 15 minutes of slow stirring is required. Sample allowed to settle down before filtration.

3.4.2 Results

i. **Coagulation-Flocculation using bio-dfa**

Sample	Ratio of sample: Bio-DFA: activated carbon
1	200:1:1
2	200:2:1
3	200:3:1
4	200:4:1

5	200:5:1
6	200:6:1
7	200:7:1
8	200:8:1
9	200:9:1
10	200:10:1

ii. **Fenton-like oxidation using ferric sulphate.**

Sample	Ratio of sample: ferric sulphate: hydrogen peroxide
1	400:1:15
2	400:1:20
3	400:1:25

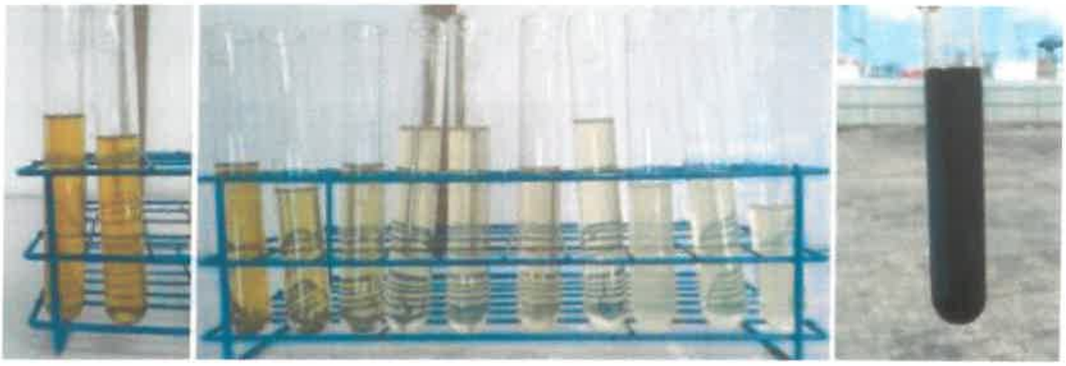
iii. Continuous treatment

***Coagulation-flocculation** – ferric chloride*

***Fenton oxidation** – ferrous sulphate & hydrogen peroxide*

Sample	Ratio of sample: ferric chloride: ferrous sulphate: hydrogen peroxide
1	600:20:1:20
2	600:40:1:20
3	600:60:1:20
4	600:80:1:20

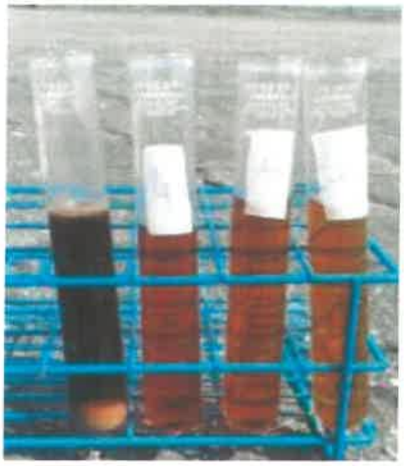
Observation of coagulation using various amount of bio-dfa in clean POME exhibit significant colour reduction as the amount of bio-dfa increases. However, no colour reduction was observed in raw POME. Usage of bio-dfa on raw POME exhibit very mild difference in colour however some suspended solids were successfully removed. After the sample allow to settle down for some time, the water turns sticky which indicates the viscosity of sample increase as settlement time increase. This is unfavourable during wastewater treatment because high turbidity wastewater indicates high total suspended solids. Bio-dfa is a mineral based coagulant that works efficiently in light to medium contamination of wastewater hence treatment of POME with high BOD and COD value is inconvenient.



***Left image**: colour of clean POME (left) and filtered clean POME (right)*
***Middle image**: Ten different amount of bio-dfa in clean POME.*
***Right image**: Filtrated raw POME with bio-dfa as coagulant.*

Coagulation-flocculation treatment was done using ferric chloride to replace bio-dfa for treatment of raw POME. This method plays a lot with pH to ensure the chemical able to function perfectly in its optimum pH range.

Fenton oxidation was done with ferric sulphate and ferrous sulphate. Ferric sulphate as catalyst is called Fenton-like oxidation meanwhile ferrous sulphate as catalyst is the genuine Fenton oxidation. Ferric sulphate was used to investigate its potential in Fenton-like oxidation of raw POME. An estimation of Fe to H2O2ratiowas obtained from a journal, *Fenton degradation of Lignin wastewater.*[2], due to lignin presence in POME. Three ratios of Fe to H2O2 tested were 1: 15, 1: 20 and 1: 25. From observation, high amount to hydrogen peroxide exhibit higher degree of discoloration however high amount of hydrogen peroxide is unlikely used in Fenton oxidation at industrial scale due to cost ineffective. Reaction time for Fenton oxidation step is also an important parameter for successful degradation of POME toxic and non-biodegradable substances hence all samples were left overnight to allow maximum degradation to occur.



Fenton-like degradation with various Fe: H_2O_2 ratio [from left: *raw POME, 1: 15, 1: 20, 1: 25]*

With thorough discussion, we have decided to bring forward ferrous sulphate as the catalyst for Fenton degradation instead of ferric sulphate due to its higher strength to generate oxidizing agents that facilitate Colour degradation in small amount.

Treatment proceeds with continuous treatment of coagulation-flocculation followed by Fenton oxidation using ferric chloride as coagulant and ferrous sulphate as catalyst for Fenton oxidation. The amount of ferric chloride during coagulation was manipulated to determine the optimum volume yet cost effective. Amount of sample to ferric chloride maxed at ratio 600: 80 exhibit acceptable ability to reduce the BOD and COD level of raw POME. Higher amount of ferric chloride exhibits greater removal of suspended solids and reduction of COD and BOD value however too much chemical used is not acceptable in industrial scale. The amount of ferrous sulphate and hydrogen peroxide is capped at ratio 1: 20 for 300mL of all POME sample.

***Left to right**: raw POME, coagulation with 10mL, 2mL, 30mL and 40 mL Ferric Chloride.*

Of course, there's Hexagon Synergy (M) Sdn Bhd to consider. Thank you for having me here and for giving me some insight into what it is like to work in industry. Certainly, the knowledge I got from this hands-on training will aid me in becoming a better engineer in the future.

4.2 Suggestions

My own recommendation for the company is that they create a proper guideline or module for a practical student that outlines what they must do or prepare throughout their training at the company. Any simple project, such as a research or development project, project management, or process monitoring that focuses solely on one field of activities/programs, should suffice. This will assist the student in being more organized and focused when accomplishing the activity at hand. These types of projects allow students to delve much deeper into an area rather than just learning the surface.

Next, as for the faculty of Chemical Engineering UiTM Johor Kampus Pasir Gudang, in my opinion, the faculty must prepare a guideline for the industrial training course. This is because there were still some of my batchmate does not have a clue about what to do to complete this course such as report's content, presentation rubrics. We do not have a proper meeting regarding rubric problem. Some of us still referring our senior guideline. I am sure this covid pandemic itself have given many problems not to the student but also to the lecturers that why students keep got information in the last minutes. Hopefully in the future, the students and faculty could cooperate to face this pandemic.

4.3 Appendices

i) Wash water & Oil Collections

CHAPTER 4

CONCLUSION, SUGGESTIONS & APPENDICES

4.0 Introduction

I have been watching and recording on vital details to finish my coursework during my time as a practical trainee here at Hexagon Synergy (M) Sdn. Bhd. In this chapter, I will share my own thoughts and recommendations on this course, which may be used to improve the way this course is conducted in the future.

4.1 Conclusion

Overall, the 17 weeks I spent in the engineering/R&D department and working with engineers was a once-in-a-lifetime opportunity for me. It is eye-opening to see how the real industry operates, and having exposure to both office and field work, as well as dealing with a diverse group of individuals, has taught me a plethora of soft and hard skills that I would not have gained in a classroom.

Aside from that, I learned concepts that are not difficult to learn in a classroom when I became too interested in receiving oil and wash water from cargo ships. During the desludging of oil and wash water, I saw a variety of vessels and equipment. It has piqued my curiosity in becoming a better engineer in the future.

I was also exposed to the real-life Industrial Effluent Treatment System (IETS) plant size because of this practical training. I learned a lot about the facility, including the piping system and the processes of each piece of equipment.

Finally, I'd want to express my gratitude to the Faculty of Chemical Engineering at UiTM Johor Kampus Pasir Gudang for providing me with the opportunity to take this course, CHE 353, Industrial Training. Thank you especially to the program coordinator, Sir Mohd Haikal bin Mustafa, and Ms. Noor Hidayu Binti Abdul Rani, for assisting me in obtaining a placement and completing this course.


VLK
EAGLE ASIA

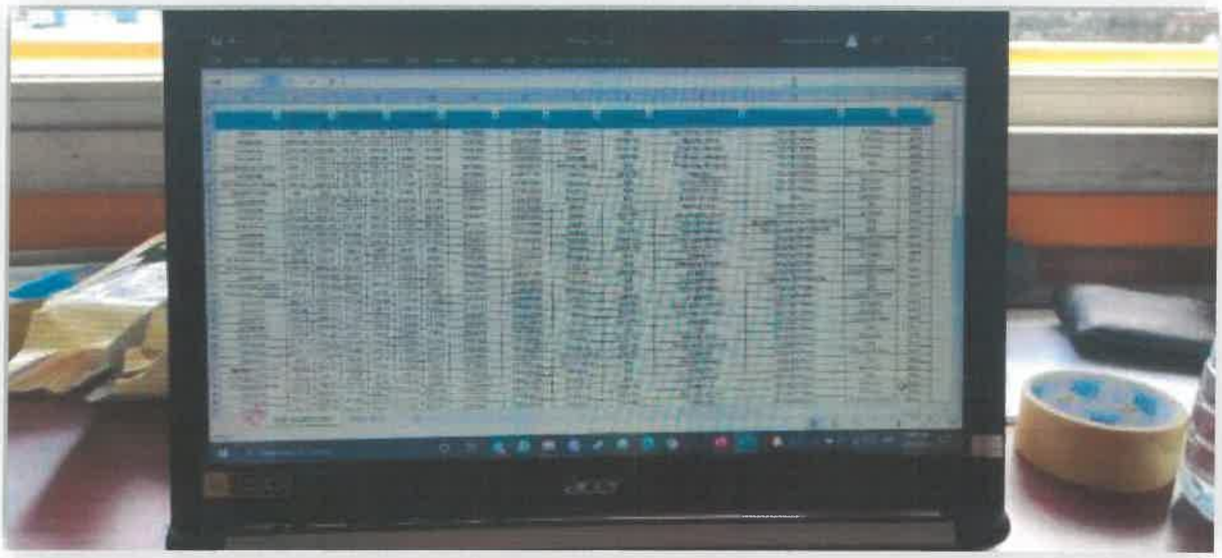

KELUAR
EXIT

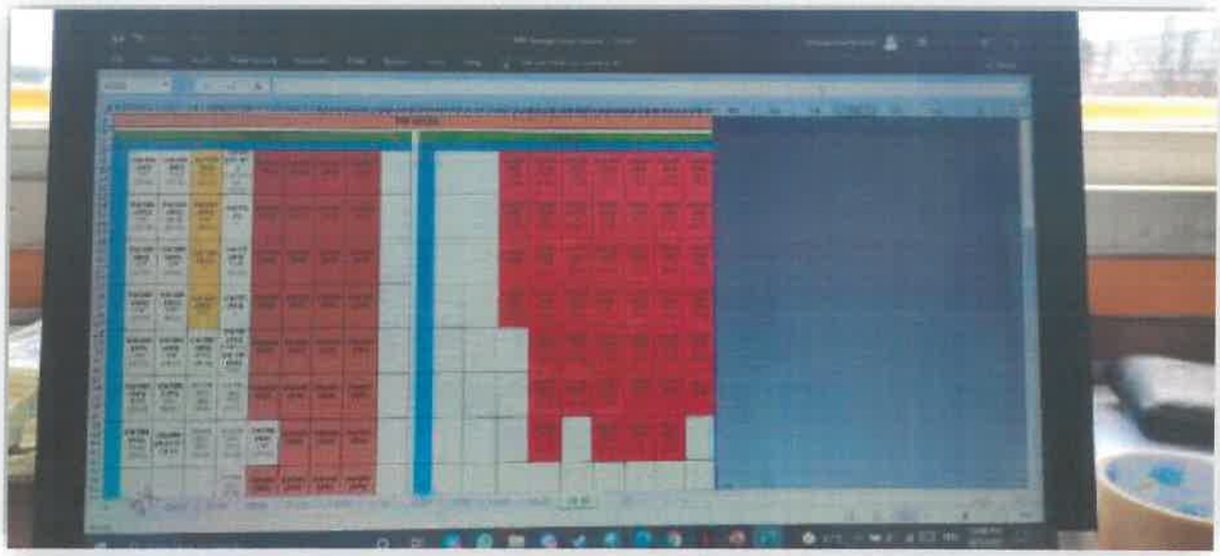
ii) Scheduled Wastes Management

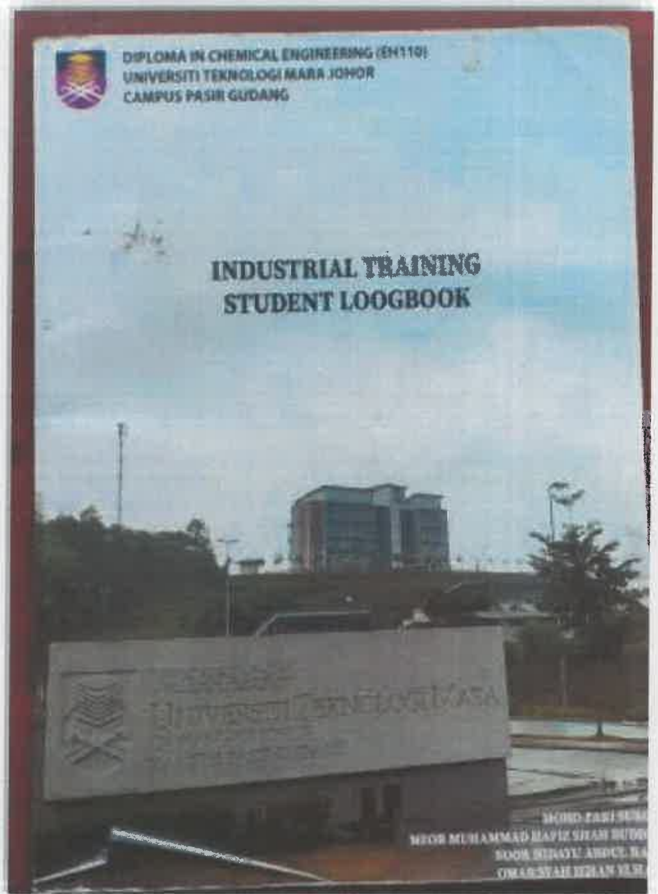

KALMAR

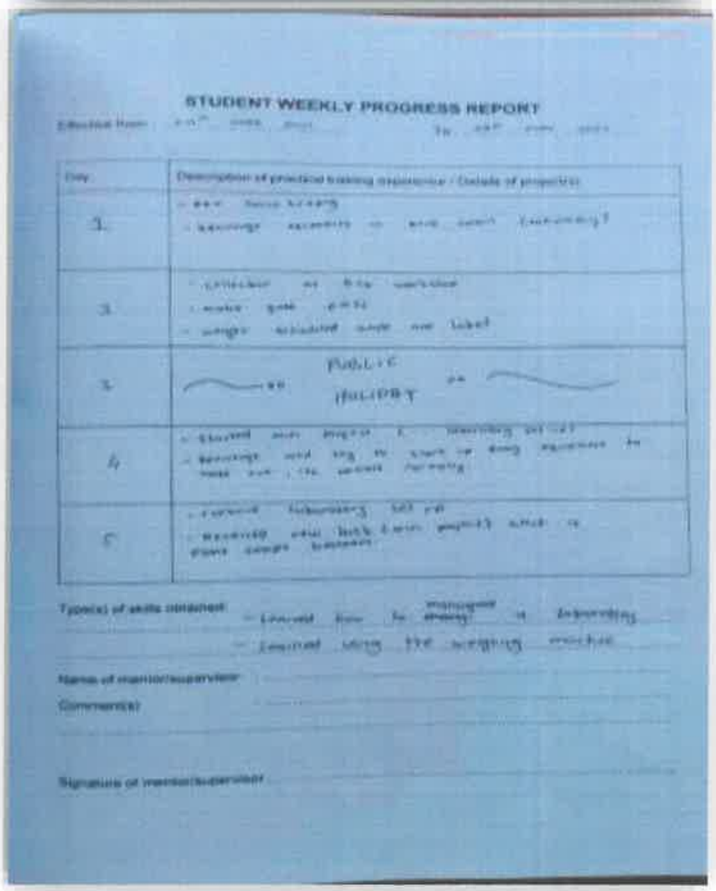
iii) Mini Project

iv) Daily Activities








STUDENT WEEKLY PROGRESS REPORT

Day	Description of practical training experience / Details of project(s)
1	[illegible]
2	[illegible]
3	PUBLIC HOLIDAY
4	[illegible]
5	[illegible]

Type(s) of skills obtained: [illegible]

Name of mentor/supervisor:

Comment(s):

Signature of mentor/supervisor: