Cawangan Johor
Kampus Pasir Gudang

INDUSTRIAL TRAINING REPORT

NAME	:	NOOR SYAZUA FITRI BINTI MOHD ROZY
PROGRAMME	:	FACULTY OF CHEMICAL ENGINEERING
STUDENT ID	:	2018256542
INTERNSHIP DURATION	:	21st MARCH 2021- 15th JULY 2021
SUPERVISOR	:	MRS FARHANA BINTI IBRAHIM
COMPANY ADDRESS	:	VANCE BIOENERGY SDN. BHD. PLO 228, JALAN NIBONG 5, KAWASAN PERINDUSTRIAN TANJUNG LANGSAT, PASIR GUDANG
VISITING LECTURER	:	MRS. NOR AIN BINTI ABU SAMAH

ACKNOWLEDGEMENT

The internship opportunity that I had after completion of 17 weeks with Vance Bioenergy Sdn. Bhd. was a great chance for learning and professional development. Therefore, I consider myself as a very lucky individual that able to gain knowledge and the opportunity to be a part of it. I am also grateful for having a chance to meet and interact with so many wonderful people and professionals that led me along this internship period.

Bearing in mind previous, I am using this opportunity to express my sincere gratitude to the organization, Vance Bioenergy Sdn. Bhd. and to Mrs. Farhana Binti Ibrahim, Quality Control and Lab Manager of this company for their kindness and for giving me the opportunity to do my internship. I was assigned to the Quality Control department and many new experiences and new knowledge were gained throughout the training period.

I express my deepest thanks to all the senior chemists and junior chemists who despite being extraordinarily busy with their duties, took time out to guide and keep me on the correct path. Giving me full guidance that allows me to carry out my project at their esteemed organization and extending during the training.

I would also like to express my gratitude to all the lab technicians for giving me advice, guidance, and sharing of knowledge at all possible moments to complete my tasks and responsibilities successfully in these 17 weeks. It is my radiant sentiment to place on my best regards to them for their careful and precious guidance which extremely valuable for my study both theoretically and practically.

Finally, I would like to thank my internship coordinator, Miss Noor Hidayu Binti Abdul Rani and Sir Mohd Haikal Bin Mustafa, University of Technology MARA (UiTM) for the opportunity created for the undergraduate to gain experience and solve the real-world problems related to our field of study. I will strive to use gained skills and knowledge in the best possible way in the future.

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CHAPTER 1

INTRODUCTION TO INDUSTRIAL TRAINING CHE353

Industrial training is an important component of the engineering curriculum. The industrial training will expose the student to professional skills and gain experience in industrial engineering practices. Theories learned in all core and non-core courses will have to be applied to the real working environment in chemical industries. In preparing the students for the real working environment as engineers, prior to actual training in the industry helps to produce engineering graduates with technical and soft skills competency. I was given the opportunity to do my industrial training at Vance Bioenergy Sdn. Bhd. for 17 weeks starting from 22nd March 2021 until 15th July 2021.

The objectives of industrial training include:

i. To develop skills in the application of theory to practical work situations.
ii. To expose students to real work environment experience gain knowledge in writing reports in technical works or projects.
iii. To build good communication skills with a group of workers and learn to learn proper behavior of corporate life in the industrial sector.
iv. To enhance the ability to improve student creativity skills, sense of responsibility, and good work habits.
v. To develop students with good moral values such as have a higher level of integrity, ethics, and accountability in practicing engineering.

CHAPTER 2

BACKGROUND OF INDUSTRY

2.1 Company Profile

Vance Bioenergy Sdn. Bhd. is one of the companies under Vance Group Limited. There are three companies under the Vance Group limited which are include Vance Bioenergy in Malaysia, Vance Nutraceuticals in Indonesia, and Vance Chemicals in Singapore. The Vance Group of Companies is a diversified and financially strong business group whereby headquarters are located in Singapore.

Vance Bioenergy Sdn. Bhd is a leading ISO 9001 certified producer of fatty acid methyl ester, biodiesel (Vance Biodiesel), pharmaceutical-grade refined glycerine (Vance Refined Glycerine), vitamin E, cocoamidopropyl betaine (CAPB), and cocodiethanolamide (CDE) for use in many industries. The production plants are located at the Pasir Gudang Industrial Estate of Johor, Malaysia. Vance Bioenergy has two sites located in Pasir Gudang which are Keluli site at Kawasan Perindustrian Pasir Gudang and the other one is at Nibong site located at Kawasan Perindustrian Tanjung Langsat. The products at Vance Bioenergy Keluli are focused on the production of palm methyl ester, refined glycerine, and vitamin E. Meanwhile, the products at Vance Bioenergy Nibong are focused on the production of used cooking oil (UCO) methyl ester, cocoamidopropyl betaine (CAPB), and cocodiethanolamide (CDE).

Due to the plants that are located at the Pasir Gudang Industrial Estate of Johor, making its benefits from both its access to fresh palm oil and its significant storage and berthing facilities. This is because they can get fresh palm oil from the oil palm refineries in Pasir Gudang with approximately 7 million metric tons of palm oil refining capacity and due to its close to Johor Port, making it easier to access significant storage and berthing facilities. Due to these benefits, Vance Bioenergy can ship its products efficiently around the world at competitive prices.

There are two methyl ester plants and two single-standing glycerine refineries at Vance Bioenergy. Those methyl ester plants total about 150,000 metric tons of annual production capacity. Meanwhile, those single glycerine refineries are the largest in Asia that can produce 40,000 metric tons of pharmaceutical-grade refined glycerine per annum. Other than that, Vance Bioenergy also has storage tanks that have a total capacity of 25,000 metric tons and are equipped with nitrogen blanketing. In the production line, cleanroom class drumming and warehouse are fully integrated to ensure adherence to the highest quality and hygiene standards.

Their continuously on-site laboratory houses have the latest testing equipment to check the quality of the products and are also staffed by a full and good team of chemists, laboratory managers, and laboratory technicians that ensure to maintain their firm quality assurance standards. Furthermore, Vance Bioenergy also engages in Research and Development (R&D) and ongoing efforts to enhance the quality of the products, expand the product line improve the production processes. Other than that, the logistics team at Vance Bioenergy is also a lead to ensure all the products are accurate and timely delivered to the customers. They are also experienced in managing the entire spectrum of packaging and shipping solutions of the problems.

Other than having production specialists with immense experience that have more than a century's worth of work experience in the vegetable oil industry and oleochemical, Vance Bioenergy also has the technology and expertise to produce a high quality of products that meet or exceed customers' expectations. Benefits from it, Vance Bioenergy enable to maintain a good production process and good products.

Vance Bioenergy is a socially and environmentally responsible company and has been a full member of the Roundtable on Sustainable Palm Oil (RSPO) since 2006 and a founding member of the Malaysian Biodiesel Association. Lastly, Vance Bioenergy is one of the subsidiaries of Vance Group Ltd, a diversified and financially strong business group that the headquartered are placed at Singapore.

2.2 Accreditation and Certification

Vance Bioenergy Sdnn. Bhd. are awarded by the following accreditations such as:

i. **GMP according to Recommended International Code of Practice General Principles of Food Hygiene** CAC/RCP 1-1969 (Lloyd's Register LRQA) - Refined Glycerine & Palm TFR
ii. **HACCP based Food Safety System** (Lloyd's Register LRQA) - Refined Glycerine & Palm TFR
iii. **Food Safety System Certification 22000** (including ISO22000 and ISO22002-1) (Lloyd's Register LRQA) - Refined Glycerine & Palm TFR
iv. **ISO 9001:2015** (Lloyd's Register LRQA) – Palm Methyl Esther, Refined Glycerine & Palm TFR

2.3 Vision and Mission

i. Vision

"To ensure a healthy environment for current and future generation."

ii. Mission

"Our philosophy is to do our best to fulfill our customer's needs and constantly improve our products and services."

2.4 Quality Policy

i. Providing quality Biodiesel, Refined Glycerine and Palm Tocotrienol Rich Fraction (Palm TRF) products to customers.
ii. Achieving excellence through training and guidance of our employees, and thus providing them with growth opportunities.
iii. Having a joint commitment for continuous quality improvement with our suppliers
iv. Deploy a risk-based thinking approach to act as a proactive and preventive measure to be ahead of risk and challenges may arise

2.5 Company Corporate Logo

Figure 1 Vance Bioenergy's Logo

2.6 Main products and services

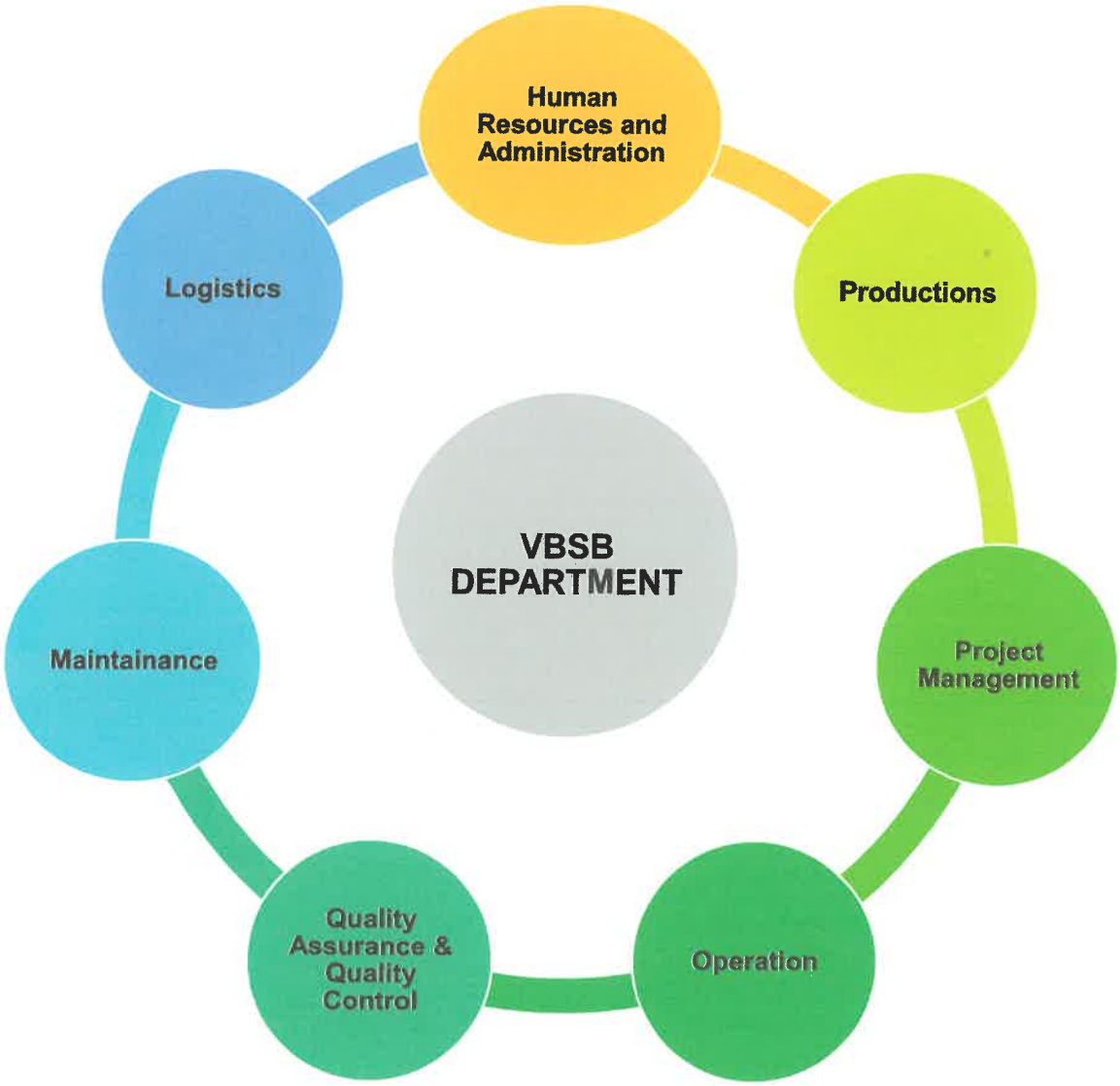
Vance Bioenergy Sdn. Bhd. is a Malaysian company that produces oleo chemical-based products. It produces fatty acid methyl ester, pharmaceutical-grade refined glycerine (Vance Refined Glycerine), Vitamin E, biodiesel (Vance Biodiesel), cocodiethanolamide (CDE), and coco amido-propyl betaine (CAPB) for use in many industries. These items are used throughout the country and being exported all over the world. These products are used throughout the country and being exported all over the world. All these products have their specific characteristics and intended use. All the products produced in the company are responsible to be checked by the quality control department to make sure the standards and specifications of each product reach the standards. All these products have their specific characteristics and intended use.

Table 1 Vance Bioenergy products and its intended use

Product	Intended use/ Characteristics
Fatty acid methyl ester, biodiesel (Vance Biodiesel)	• Biodiesel is often used as an additive to petroleum diesel fuel due to it has superior lubricity and significantly reduces engine wear. • Biodegradable and non-toxic as biodiesel can break down to 4 to 5 times faster than mineral diesel. • Biodiesel is non-flammable with flash point of 150°C.
Pharmaceutical-grade refined glycerine (Vance Refined Glycerine)	• 99.7% of purify refined glycerine is ideal for use in high-end applications such as food and beverages, pharmaceuticals, personal care, cosmetics, and others. • Refined Glycerine from VBSB had exceed internationally recognized standards.
Vitamin E	• Clear Reddish Amber liquid ingredients in personal care, cosmetic, dietary supplement which has role in neurological function.
Cocodiethanolamide (CDE)	• Viscous is biodegradable, non-ionic surfant that has good weting, decontamination and dispersing properties that used in various cleaning liquid products. • Can improve foaming ability and stable the foam produced when used together with primary surfactants.
Cocoamidopropyl Betaine (CAPB)	• CAPB is a mild amphoteric secondary surfactant. • It is used as viscosity builder, thickening agent, foam booster, humectant, and antistatic agent in surfactant formulations. • Commonly used in personal care and cosmetic products, household, and industrial and institutional cleaners.

2.7 Department in Vance Bioenergy Sdn. Bhd.

Table 2 Department in VBSB



CHAPTER 3

PROCESS FLOW OF PRODUCT

3.1 Palm Methyl Ester and Refined Glycerine

The process to produce biodiesel from oil, methanol, and catalyst is a simple chemical process. They will occur a transesterification process that will convert the triglycerides to fatty acids methyl esters (FAME) and glycerine. Then continued with the separation process that will separate fatty methyl esters (FAME) and glycerine by using citric acid. Once separated, the biodiesel goes through a clean-up or purification process to remove excess alcohol, residual catalyst, and soaps. Meanwhile, the glycerine is occurred further distilled to obtain refined glycerine which is 99% concentration and colorless. The figure below shows the process flow diagram of refined glycerine production and the description.

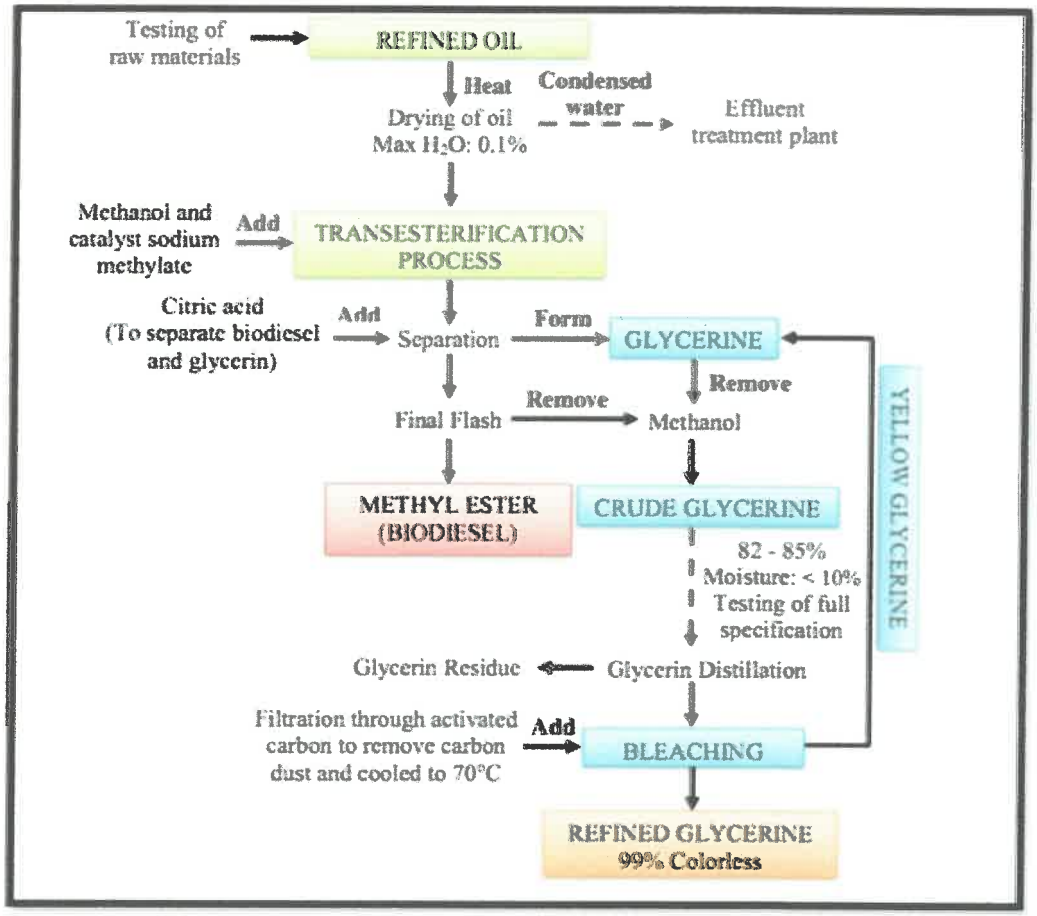


Figure 2 Process flow diagram and description of palm methyl ester refined glycerine production

3.2 Vitamin E

The production process of Vitamin E is using Palm Fatty Acid Distillate (PFAD) as the raw material. For the early stage, the Palm Fatty Acid Distillate (PFAD) is processed through the short plant distillation to produce T1T3 at the concentration of 20-45%. Then, the cooling process is conducted bypassed through the cooling water solution to crystalize the T1T3 by using methanol as an additional catalyst. This is continued by the evaporation process to evaporate the methanol. At the final stage, the concentration of T1T3 should be between 30% to 60%. The methanol content is required to be less than 100ppm. The figure below shows the process flow diagram of vitamin E production and the description.

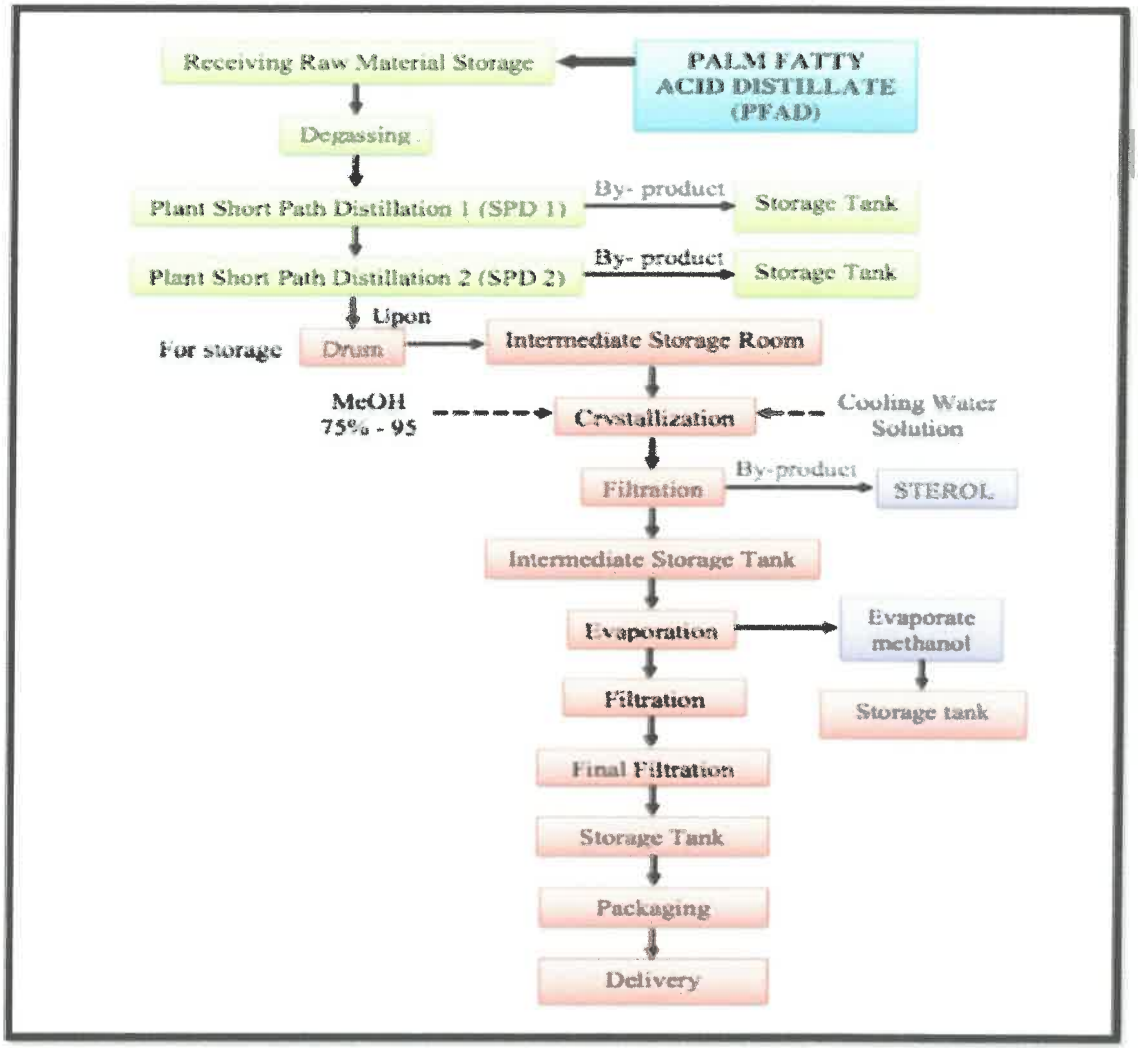


Figure 3 Process flow diagram and description of vitamin E production

3.3 Cododiethanolamine (CDE)

The process to produce CDE only involves a batch process at which the process only occurs in a single vessel. A specific amount of raw material which is triglyceride and dethanolamide is added and pumped into the vessel. Then, are stirred to homogenize it. At the same time, the mixture is heated. Sodium methylate is used as the catalyst and is added when the temperature of the mixture reaches 60°C to 65°C. The reaction is continued until the temperature up to 90°C and the temperature is maintained for 3 hours The reaction is stopped and the CDE is ready for the drumming process once the product already reaches the specifications needed.

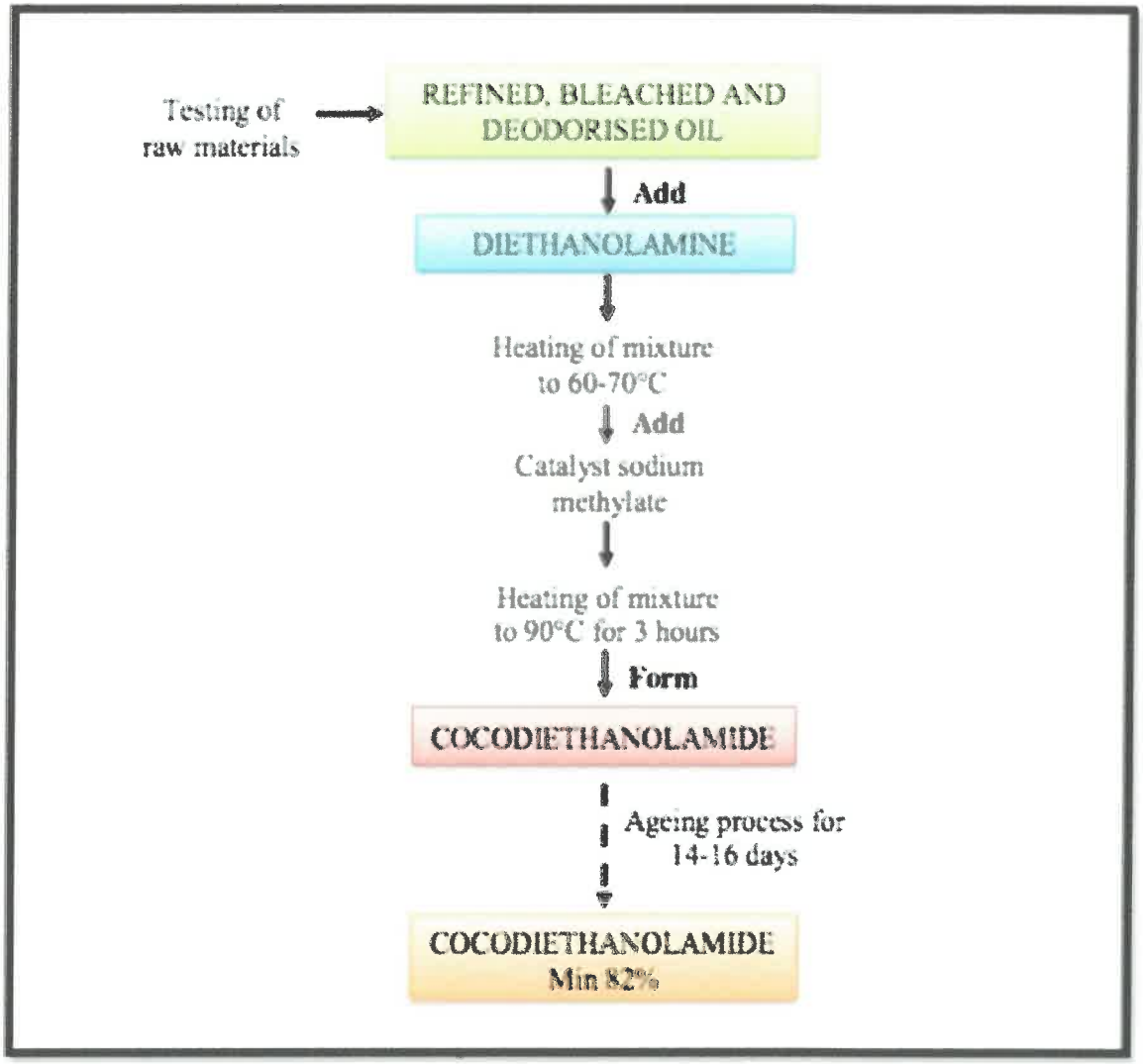


Figure 4 Process flow diagram and description of Cododiethanolamine (CDE) production

CHAPTER 4

QUALITY CONTROL DEPARTMENT

Quality control department at Vance Bioenergy Sdn. Bhd. is coordinated by Mr. Khairul Anuar Bin Abd Samad which is the Senior Manager of the company. This department also comprises a lab and quality control manager, senior chemists, junior chemists, and also lab technicians.

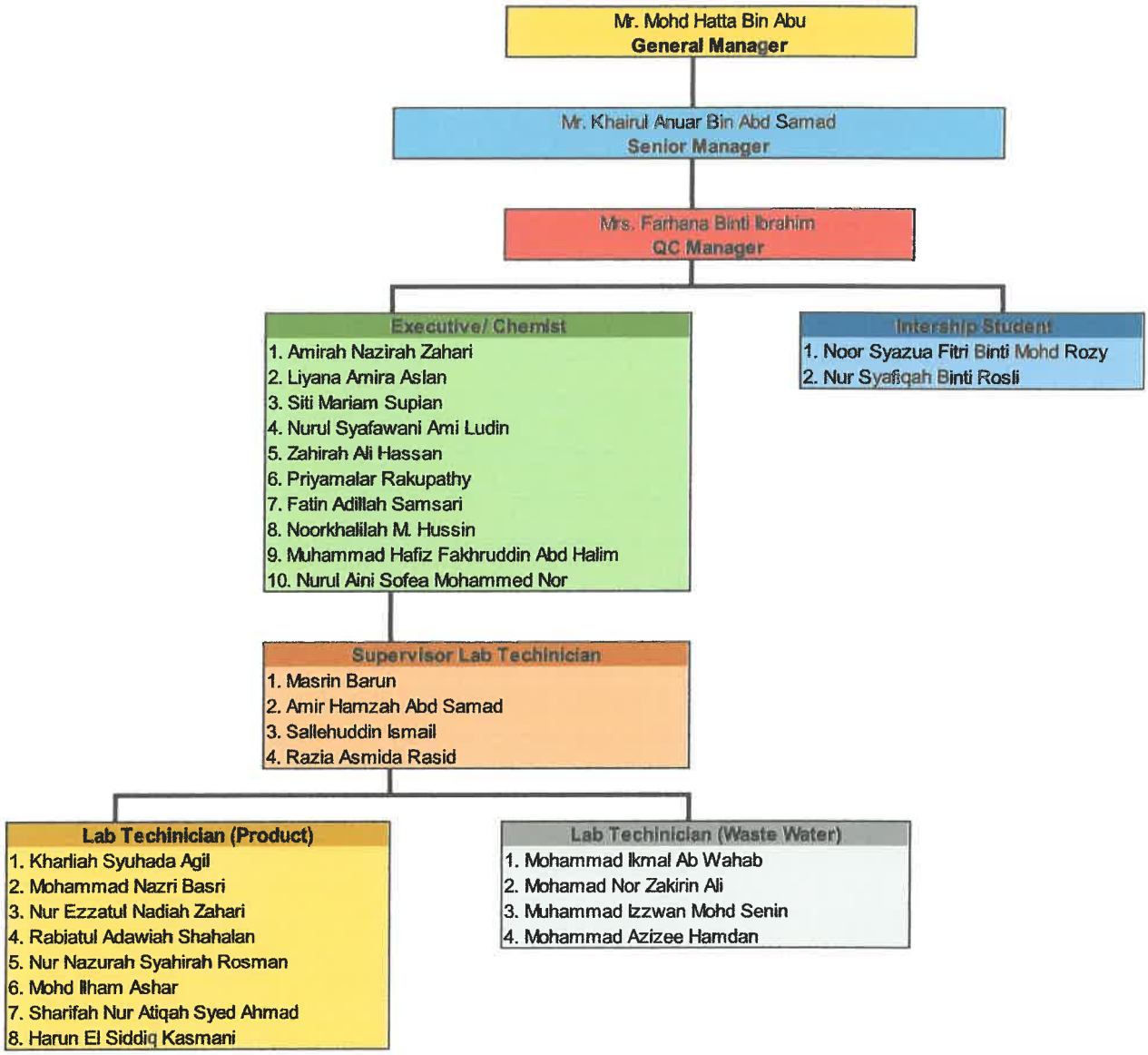
All the products produced in the company are responsible to be checked by the quality control department to make sure the standards and specifications of each product reach the standards. The quality control department is also responsible to ensure the quality of the products from the production is maintained all the time. It is included in monitoring the quality of raw material, plant in-process samples, and the final products which are intended for delivery and export.

The quality control department is also in charge of the wastewater treatment in the plant. They will make sure the wastewater treatment already removed the contaminants and reach the specifications so that it can be returned to the water cycle.

Strategies and conceptualizing to enhance and maintain the quality of products is also the responsibility of the department. This is important to enhance the quality of the products and to ensure the quality of the products meet the specifications and need of the customers.

This department is also engaged with other departments in achieving the vision and the mission of the company. They connect with the production department, logistics department, and quality assurance department to achieve their goal. Working in this department helps me to gain more knowledge and experience in the quality control department.

The figure below shows the organization chart of the quality control department lead by Mr. Mohd Hatta Bin Abu, general manager of Vance Bioenergy Sdn Bhd, assisted by Mr. Khairul Anuar Bin Abd Samad, senior manager.


Mr. Mohd Hatta Bin Abu
General Manager
Mr. Khairul Anuar Bin Abd Samad
Senior Manager
Mrs. Farhana Binti Ibrahim
QC Manager
Executive/ Chemist
1. Amirah Nazirah Zahari
2. Liyana Amira Aslan
3. Siti Mariam Supian
4. Nurul Syafawani Ami Ludin
5. Zahirah Ali Hassan
6. Priyamalar Rakupathy
7. Fatin Adillah Samsari
8. Noorkhalilah M. Hussin
9. Muhammad Hafiz Fakhruddin Abd Halim
10. Nurul Aini Sofea Mohammed Nor
Intership Student
1. Noor Syazua Fitri Binti Mohd Rozy
2. Nur Syafiqah Binti Rosli
Supervisor Lab Techinician
1. Masrin Barun
2. Amir Hamzah Abd Samad
3. Sallehuddin Ismail
4. Razia Asmida Rasid
Lab Techinician (Product)
1. Kharliah Syuhada Agil
2. Mohammad Nazri Basri
3. Nur Ezzatul Nadiah Zahari
4. Rabiatul Adawiah Shahalan
5. Nur Nazurah Syahirah Rosman
6. Mohd Ilham Ashar
7. Sharifah Nur Atiqah Syed Ahmad
8. Harun El Siddiq Kasmani
Lab Techinician (Waste Water)
1. Mohammad Ikmal Ab Wahab
2. Mohamad Nor Zakirin Ali
3. Muhammad Izzwan Mohd Senin
4. Mohammad Azizee Hamdan

CHAPTER 5

JOB SCOPES

5.1 Task Description

During the internship period, I was assigned to the quality control and laboratory department at Vance Bioenergy, Keluli at Kawasan Perindustrian Pasir Gudang. I have been required to assist chemists and lab technicians. I was under the supervision of Mrs. Farhana Binti Ibrahim, manager of quality control and laboratory, and I was assisted by two chemists, Miss Liyana Amira Binti Aslan and Miss Nurul Syafawani Binti Ami Ludin. My job scopes during industrial training are such as testing and monitoring the quality of plant in-process samples, and the final products which are intended for delivery and export. Other than that, I am required to do the documentation.

5.1.1 Testing of raw materials

Crude or processed material can be converted by the manufacture, processing, or combination into a new and useful product. As Vance Bioenergy Sdn. Bhd. is an oleo-chemical company making its main raw material are from refined, bleached, and deodourised palm oil. Other constituents of palm oil are palm olein, palm kernel olein, and palm kernel stearin that are also being used. Caustic soda, hydrochloric acid, sodium methylate, and methanol are also used as their raw materials in this company. Crude glycerine from the production of palm methyl ester also is considered a raw material as it is used in the production of refined glycerine.

It is compulsory to analyze all the raw material as the quality of the products start from the raw materials. It is also important to make sure the raw materials reached the specification before sending it to the production process to start the process. In Vance Bioenergy there are many modern instruments and procedures are used to analyze the raw material. The different specification and analysis used that can be referred from the Table 3.

TYPE OF SAMPLE	METHOD OF TEST	SPECIFICATIONS	EQUIPMENTS/METHOD
Sodium Methylate	• Moisture Content	• 0.2% Max	• Karl Fischer Volumetric
	• Total Alkality	• 29-31%	• Titration
	• NaOH Content	• 0.50% Max	• Calculation
	• Methanol Content	• 69.00-70.00	• Calculation
	• $NaOCH_3$ Content	• 28.9- 30.00	• Calculation
Methanol	• Moisture Content	• 0.1% Max	• Karl Fischer Volumetric
Hydrochloric Acid (HCL)	• Concentration	• 33.0% Min	• Titration
Caustic Soda	• Concentration	• 49-50%	• Titration
RBD Palm Oil	• Iodine Value	• 50-55	• Titration
	• Color	• 3.0 R / 3.0 Y	• Lovibond Tintometer Model F
	• Moisture Content	• 0.10% Max	• Oven Method
	• Free Fatty Acid	• 0.10% Max	• Titration
Crude Glycerine (CG)	• Chloride Content	• 10ppm Max	• Titration
	• Glycerine Content	• 80% Min	• Calculation / Titration
	• Water Content	• 15% Max	• Karl Fischer Volumetric
	• Fatty Acid and Ester	• 3.0 Max	• Titration
	• Methanol Content	• 0.50% Max	• GC Headspace
	• pH test	• 1.0 -14.0	• pH Meter
	• Appearance/ Solubility	• Clear	• Visual

5.1.2 Testing of in-process samples

In-process samples are the sample that is being obtained from the plants which are still undergoing the process to become a product. These in-process samples generally mean sample at any point in the production cycle before a final inspection and placement in finished products. All the samples from different points during the process are taken to be checked to make sure the quality of the products is maintained and to assure the process is under control up to the point of final products. In-process sampling is valuable because collecting data throughout manufacturing runs will allow to monitor and ensure the process is operating desirably and it will help to determine either the products are ready to be discharged or not. The different specification and analysis used that can be referred from the Table 4.

TYPE OF SAMPLE	METHOD OF TEST	SPECIFICATIONS	EQUIPMENTS/METHOD
Palm Methyl Ester (PME)	• Moisture Content	• 500ppm Max	• Karl Fischer Volumetric
	• Acid Value	• 0.5mg KOH/g Max	• Titration
	• Methanol	• 0.2% Max	• GC Headspace
	• Density at 15°C	• 860-900 mg/kg	• Hydrometer
	• Flash point	• 120°C	• Automated Flash Point Test
	• Soap Test	• Final Product: Nil	• Titration
	• Conversion	• Monoglyceride: 0.7% Max • Diglyceride: 0.2% Max • Triglyceride: 0.2% Max • Free Glycerol: 0.02% Max	• Gas Chromatography
Vitamin E	• Free Fatty Acid	• 10% Max	• Titration

	• T1T3 (Tocopherol & Tocotrienol)	• 50% Min	• HPLC
Refined Glycerine (RG)	• Black Particle	• Rating 1-2	• Filtration & Visual
	• pH Test	• 6-7.5 pH	• pH Meter
	• Fatty Acid and Ester	• 1.0 Max	• Titration
	• Color Test	• 10 APHA Max	• Lovibond PFX 195 Tintometer
	• Chloride Content	• 10ppm Max	• Autotitrator
	• Glycerine Content	• 99.7% Min	• Calculation/ Titration
	• Moisture Content	• 0.3% Max	• Karl Fisher Instrumentation
	• Heat Stability	• 150 APHA Max	• Lab heating mantle • Lovibond PFX 195 Tintometer
	• Related Compound	• 0.1% for individual impurities • 1.0% for total impurities	• Gas Chromatography
	• H_2SO_4	• 20 APHA Max	• Heating bath • Lovibond PFX 195 Tintometer
	• Maltol test	• Appearance	• Mixing
	• KOH test	• Appearance	• Mixing

	• Odor rating	• Odorless	• Observation
	• Taste	• Sweet Warm Taste	• Observation

5.1.3 Testing of final products

Final products are the finishing product of the process and are intended for shipping and delivery throughout Malaysia and all over the world. It is compulsory to check the final products to make sure the products reach the specification and requirements given by the customers to produce a good quality of products that are being produced by the company. Testing final products typically involve testing a product against a specific standard or regulation in a certified laboratory. Whereas the product inspection often involves checking a random sample of an order for compliance with the buyer's requirement and specification. The different specification and analysis used that can be referred from the Table 5.

TYPE OF SAMPLE	METHOD OF TEST	SPECIFICATIONS	EQUIPMENTS/METHOD
Palm Methyl Ester (PME)	• Moisture Content	• 500ppm Max	• Karl Fischer Volumetric
	• Density at 15°C	• 860-900 mg/kg	• Hydrometer
	• Flash point	• 120°C	• Automated Flash Point Test
Vitamin E	• Free Fatty Acid	• 10% Max	• Titration
	• T1T3 (Tocopherol & Tocotrienol)	• 50% Min	• HPLC
Refined Glycerin (RG)	• Black Particle	• Rating 1-2	• Filtration & Visual
	• pH Test	• 6-7.5 pH	• pH Meter
	• Fatty Acid and Ester	• 1.0 Max	• Titration
	• Color Test	• 10 APHA Max	• Lovibond PFX 195 Tintometer
	• Chloride Content	• 10ppm Max	• Autotitrator
	• Glycerine Content	• 99.7% Min	• Calculation/ Titration
	• Moisture Content	• 0.3% Max	• Karl Fisher Instrumentation

	• Heat Stability	• 150 APHA Max	• Lab heating mantle • Lovibond PFX 195 Tintometer
	• Related Compound	• 0.1% for individual impurities • 1.0% for total impurities	• Gas Chromatography
	• H_2SO_4	• 20 APHA Max	• Heating bath • Lovibond PFX 195 Tintometer
	• Maltol test	• Appearance	• Mixing
	• KOH test	• Appearance	• Mixing
	• Odor rating	• Odorless	• Observation
	• Taste	• Sweet Warm Taste	• Observation

5.1 Documentation

Documentation is another important aspect other than testing and analyzing products. The documentation defines a system of information and control the risks inherent misinterpretation and error in oral communication can be minimized. Many documents are prepared for each of the products in the company and need to be updated to make sure the products produce is managed well from the production stage up to the selling of the products to the customers. Some of the data collected along the process will be transferred into the Microsoft Excel file to easier the production to define the specifications and procedures for all materials and products is under control. The data helps to increase the traceability of the products when a problem arises regarding the quality of the products.

CHAPTER 6

MINI PROJECT

I was assigned to do research regarding refined glycerine. Vance Bioenergy is one of the largest producers of refined glycerine in Asia. The production capacity of this company is about 40,000 metric tons of glycerine per annum. Other than being one of the largest producers of refined glycerine in Asia, Vance Bioenergy is also a buyer and a trader of refined glycerine. Refined glycerine is a viscous, colorless, and sweet-tasting liquid. It is derived purely and natural from vegetable oils.

The title of the report is "Report Product: Vance Refined Glycerine 99.7%". During the tasks given, I am required to do some research regarding refined glycerine, the objective of each test is to check each parameter of the specifications regarding the products, and will the parameters affects the refined glycerine when it exceeds the specifications. Other than that, the packaging used for the products and applications of refined glycerine was also mentioned and discussed in the report.

The reports are also being checked by the chemist, Miss Liyana Amira Binti Askan, and are verified by Mrs. Farhana Binti Ibrahim, Quality Control and Lab Manager. The full report can refer to Appendices A.

(Refer Appendices A)

7.2 Recommendations

These seventeen weeks of internship program really helped me to gain useful knowledge about all the products and each of the processes involved. However, the company should have a proper module for practical students so that the students are well organized and know exactly what they need to do especially when the students should work from home. This proper module will help the students to gain knowledge and be able to organize themselves even though there are working from home. This will help the students to gain experience to give the experience to work with less monitor but still be able to give a good outcome to the company. Other than that, it would be a blessing if the students are able to do the internship related to their courses. For example, I was assigned under the Quality Control department. During that particular time, I am not able to implement what I already learned during my diploma. But the advantages are that I can gain so much experience during the internship periods and having fun learning new knowledge.

APPENDICES A

Cawangan Johor
Kampus Pasir Gudang

PRODUCT REPORT
(REFINED GLYCERINE)

NAME

NOOR SYAZUA FITRI BINTI MOHD ROZY

STUDENT ID

2018256542

COMPANY ADDRESS

VANCE BIOENERGY SDN. BHD.
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81700, PASIR GUDANG, JOHOR.

1. INTRODUCTION

Vance Bioenergy Sdn. Bhd. is one of the companies under Vance Group Limited. There are three companies under the Vance Group limited which are include Vance Bioenergy in Malaysia, Vance Nutraceuticals, and Vance Chemicals in Singapore. The Vance Group of Companies is a diversified and financially strong business group whereby headquarters is in Singapore.

Vance Bioenergy Sdn. Bhd is a leading ISO 9001 certified producer of fatty acid methyl ester, biodiesel (Vance Biodiesel), pharmaceutical-grade refined glycerine (Vance Refined Glycerine), vitamin E, cocoamidopropyl betaine (CAPB), and cocodiethanolamide (CDE) for use in many industries. The production plants are located at the Pasir Gudang Industrial Estate of Johor, Malaysia. Vance Bioenergy has two sites located in Pasir Gudang which are Keluli site at Kawasan Perindustrian Pasir Gudang and the other one is at Nibong site located at Kawasan Perindustrian Tanjung Langsat. The products at Vance Bioenergy Keluli are focused on the production of palm methyl ester, refined glycerine, and vitamin E. Meanwhile, the products at Vance Bioenergy Nibong are focused on the production of used cooking oil (UCO) methyl ester, cocoamidopropyl betaine (CAPB), and cocodiethanolamide (CDE)[1].

These products are used throughout the country and being exported all over the world. All these products have their specific characteristics and intended use. All the products produced in the company are responsible to be checked by the quality control department to make sure the standards and specifications of each product reach the standards.

2. PRODUCT (VANCE REFINED GLYCERINE 99.7% MIN)

Vance Bioenergy is one of the largest producers of refined glycerine in Asia. The production capacity of this company is about 40,000 metric tons of glycerine per annum. Other than being one of the largest producers of refined glycerine in Asia, Vance Bioenergy also a buyer and a trader of refined glycerine. Refined glycerine is a viscous, colorless, and sweet-tasting liquid. It is derived purely and natural from vegetable oils (Refer Figure 1).

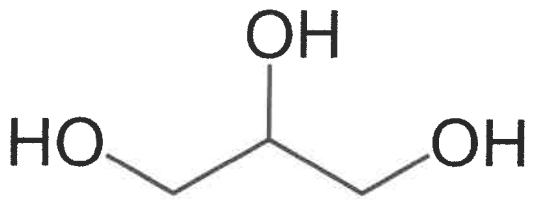
Vance's pharmaceutical and food-grade refined glycerine is ideal for use in high-end applications where uncompromised quality is needed, such as applications in beverages, pharmaceuticals, food, and cosmetics.

Figure 1 Refined Glycerine.

2.1 INTRODUCTION

Glycerine, which is also known as glycerin and glycerol is the term most often applied to commercial products, which usually contains a small percentage of water. Glycerine refers to the chemical compound and content in a formulation, specifically to the trihydric alcohol with a molecular of $C_3H_5(OH)_3$. Its IUPAC name is Propanol-1,2,3-triol[2]. It is odorless, colorless, very viscous, has a sweet taste, and hygroscopic. Glycerine easily dissolves in water because of its three hydroxyl groups. It combines with three fatty acids to form what is called triglyceride. This is the main constituent

of oils and fats which are naturally found in animals and plants. Figure 2 shows the molecular structure of glycerine.



A Swedish chemist K.W Scheele has fortuitously found glycerine in 1779 while heating a mixture of lead monoxide and olive oil. He then called it the sweet principle of fat. In 1783, Scheele published a description method of his methods of preparation to produce glycerine in *Transactions of the Royal Academy of Sweden*. Scheele's method was commercially used for some years to produce glycerine. Later around 1811, a French investigator of oils and fats, M. E. Chevreul immense potential of glycerine and named Scheele's method as the "sweet principle of fat". This sweet principle of fat glycerine from the Greek word glykys which means sweet. Thirteen years later in 1826, another French investigator, announced the empirical formula of glycerine as $C_3H_8O_3$. Then in 1883 Berthelot and Lucea established a new and accepted structural formula of glycerine which is $C_3H_5(OH)_3$ [3].

3 PROCESS

The process to produce biodiesel from oil, methanol, and catalyst is a simple chemical process. They will occur a transesterification process that will convert the triglycerides to fatty acids methyl esters (FAME) and glycerine. Then continued with the separation process that will separate fatty methyl esters (FAME) and glycerine by using citric acid. Once separated, the biodiesel goes through a clean-up or purification process to remove excess alcohol, residual catalyst, and soaps. Meanwhile, the glycerine is occurred further distilled to obtain refined glycerine which is 99% concentration and colorless. The figure below shows the process flow diagram of refined glycerine production and the description.

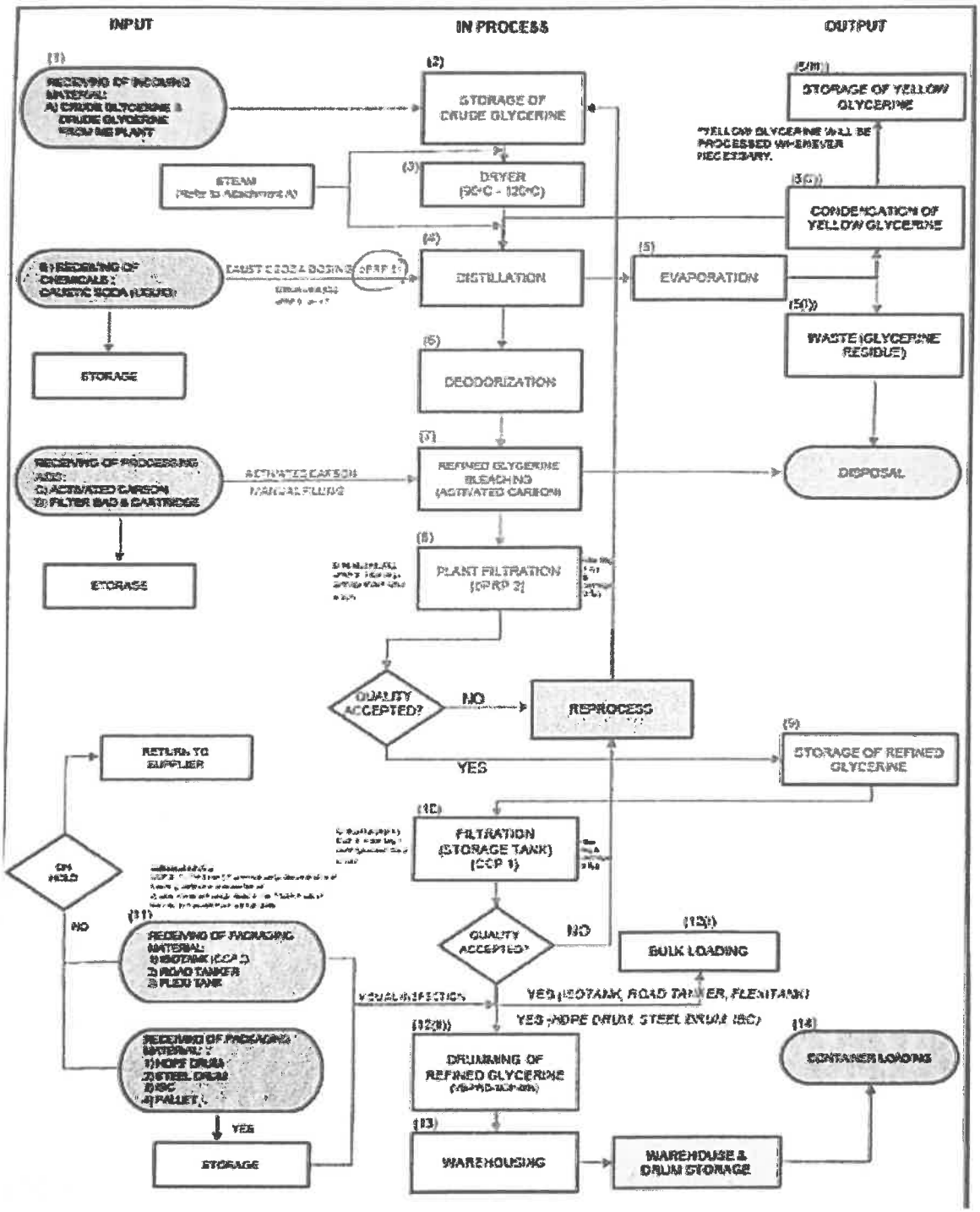


Figure 3 Process flow diagram and description of refined glycerine production

4 QUALITY CONTROL SPECIFICATION

All the products produced in the company are responsible to be checked by the quality control department to make sure the standards and specifications of each product reach the standards. The quality control department is also responsible to ensure the quality of the products from the production is maintained all the time. It is included in monitoring the quality of raw material, plant in-process samples, and the final products which are intended for delivery and export.

4.1 Testing plant in-process sample

In-process samples are the sample that is being obtained from the plants which are still undergoing the process to become a product. These in-process samples generally mean sample at any point in the production cycle before a final inspection and placement in finished products[4]. All the samples from different points during the process are taken to be checked to make sure the quality of the products is maintained and to assure the process is under control up to the point of final products. In-process sampling is valuable because collecting data throughout manufacturing runs will allow to monitor and ensure the process is operating desirably and it will help to determine either the products are ready to be discharged or not.

Black particle, pH test, fatty acid and ester, color test, chloride content, glycerine content, moisture content, heat stability, related compounds, H_2SO_4 test, KOH test, maltol test, odor rating, and taste are the parameter to analysis for the in-process samples.

4.1.1 Black particle

Black particle is a carbon black which is a virtually pure elemental carbon in the form of colloidal particles which are produced by incomplete combustion, or it can be from thermal decompositions of gaseous or liquid hydrocarbons under controlled conditions[5]. It is important to monitor the black particle in the refined glycerine to determine the remaining activated carbon in the refined glycerine either exceeds the specifications or under the specifications.

Activated carbons refer to a wide range of carbonized materials of high surface area and a high degree of porosity [6]. Degree of porosity is the percentage of void space in a rock which is defined as the ratio of the volume of voids or pore space divided by the total volume [7]. These activated carbons can be used either in granular forms, in fixed-bed adsorbers or filter, or dosed as a powder in a batch-type process.

As known, major applications of refined glycerine involve in food, cosmetics, pharmaceutical industry users, to minimize the number of impurities and to purify the glycerine is vital to make sure products meet the required industry standards. Physical adsorption is the main way in which activated carbon filters out a given substance. As liquid or air comes into contact with activated carbon, intermolecular forces draw molecules into the millions of pores and pockets on the surface of activated carbon. Refer figure 4 for schematic structure of an activated carbon. These activated carbons are used when purifying glycerine to remove both color and odor, leaving the refined glycerine water-white and colorless [8].

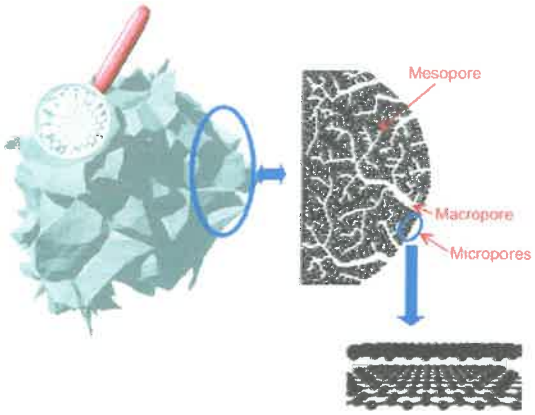


Figure 4 Schematic structure of an activated carbon

To determine the black particle in refined glycerine are by glycerine sample is diluted in distilled water with a ratio of 1:1. Then the solution is being filtered with glass fiber filter paper GC-50 with a pore size of 0.5um because the mean particle diameter of activated carbon is around 1um to 45um making it a suitable size to filter these activated carbons. This black particle test for in-process samples was only being tested for glycerine from sampling point 743. The approved specification for glycerine plant filtration is from rating 1-2. Refer Figure 6.

Figure 5 Vacuum set for filtration

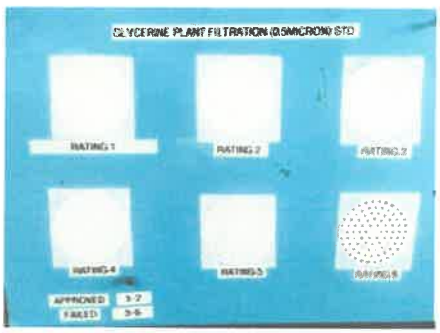


Figure 6 Glycerin plant filtration rating

4.1.2 pH test

A pH is a unit of measures that describes the degree of alkalinity or acidity of a solution in terms of its hydrogen ion activity [9]. The term pH is derived from "p" the mathematical symbol for negative logarithm while the "H" is the chemical symbol for Hydrogen.

The pH value of a substance is direct to the hydroxyl ion (OH^-) and hydrogen ion (H^+). If the H^+ concentration is greater than OH^- which shows the pH value is less than 7, the material is acidic. Meanwhile, if the OH^- concentration is greater than H^+ which shown the pH value is greater than 7, the material is basic. If the value of H^+ and OH^- is the same, the material is neutral with a pH value of 7 [10]. The pH value was measured on a scale from 0 to 14. Refer figure 7 for the pH scale.

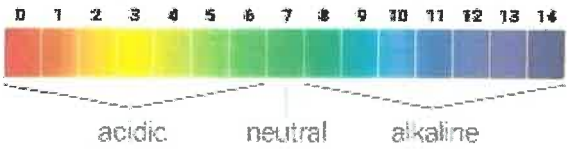


Figure 7 The pH scale value

To determine the pH value for refined glycerine by using a digital pH meter is to measure the hydrogen-ion activity in the refined glycerine either acidity or alkalinity (Refer Figure 8). This pH meter consists of a voltmeter that attached to a pH-responsive electrode and a reference electrode which are unvarying electrode. When these two electrodes are immersed in a solution, they act as a battery and the pH-responsive electrodes will develop an electric potential charge that is directly related to the hydrogen-ion activity in the solution. Then the voltmeter will measure the potential difference between the pH-responsive electrode and a reference electrode [11].

This pH test for in-process samples was only being tested for glycerine from sampling point 743. The approved specification for glycerine plant pH value is from pH 6 to pH 7.5.

Figure 8 Digital pH meter

4.1.3 Fatty Acid and Ester

Fatty acid and ester are a type of ester that comes from the combination of alcohol and fatty acid. When this alcohol component is glycerine, the fatty acid esters produced are often triglycerides, diglycerides, or monoglycerides. The characteristics of esters of fatty acids are colorless, although degraded samples are sometimes can appear to be even brown or yellow [12].

As known, Vance Bioenergy produced biodiesel by the process of transesterification at which glycerine is the main byproduct produce from the process. Transesterification is a chemical reaction used for the conversion of triglycerides which are fats containing in oils into usable biodiesel. Carryover of some of these fatty acids and ester from the process of transesterification will enter the process of production of refined glycerine.

Free fatty acids are not soluble in glycerine and are separated at the top of the mixture which can be removed and recycled. These fatty acids can be esterified and

thus can be used as a biodiesel feedstock in the input stream of transesterification reaction. By further distillation, the purify of this glycerine then can be increased from 99.5 to 99.7 %. [13].

By conducting the fatty acid and ester test, we can monitor the amount of fatty acid and ester that enter the glycerine process either it exceeds the specifications or under the specifications. To determine the fatty acid and ester in refined glycerine are by a test portion is dissolved in freshly boiled distilled water and sodium hydroxide, NaOH before titrated with hydrochloric acid, HCl until excess. Refer figure below for chemical equations during titration.

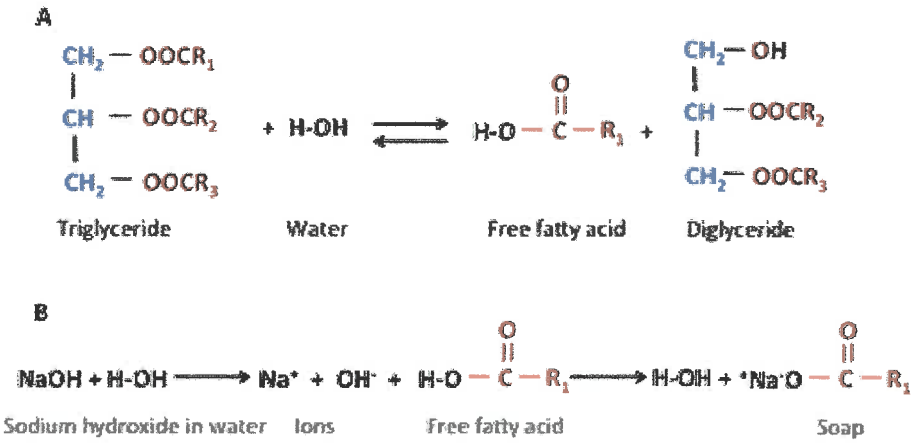


Figure 9 Chemical Equation for titration reaction

This fatty acid and ester test for in-process samples was being tested for all sampling points at 701, 710, 743, 746, 725, and 728. The acceptance criteria for fatty acid and ester are not more than 1 ml of 0.5N sodium hydroxide, NaOH is consumed by using calculation:

Fatty Acid and Ester (ml 0.5N HCL/50g): Titration blank, V_0 - Titration sample, V_1

4.1.4 Color Test (APHA)

The color for refined glycerine is a clear and almost colorless product for uses that requiring glycerine of high purify[14]. The APHA color test is the American Public Health Association (APHA) color test using gradient values of yellowness. This system is used to evaluate the purify of the products and to detect any traces of organic substances or other unwanted impurities [15].

The color for refined glycerine was determined by Lovibond PFX 195 Tintometer, which is a color determines instrument with quartz color cells 50.0mm provided. Tintometer is an apparatus for determining the concentration of a solution of a colored substance by comparing the intensity of its color with that of a standard solution or with standard color slides [13]. The Lovibond PFX 195 Tintometer works by automatically measures the color of transparent samples according to the one-dimensional color scale that have been adopted as industry standards. The calorimeter is a field of determination of a colored compound concentration in a solution [14].

This color test (APHA) for in-process samples is being tested for sampling points at 710, 725, and 743. The approved specification for glycerine plant color is 10 APHA maximum.

Figure 10 Lovibond PFX 195 Tintometer

Figure 12 Chloride Autotitrator

4.1.6 Glycerine Content

The glycerine content in an aqueous solution is "not less than 95%" as defined and still contains water but must retain only small amounts of other organic or inorganic impurities[18]. Also, state by the U.S Pharmacopeia-National Formulary (USP-NF) that the amount of any individual impurity in glycerine must not exceed 0.1% and 1.0% for all the total impurities. Glycerine with a glycerine content from 95% to 99.5% was considered pure while the impurities are water and trace levels of polyglycerol [19].

This glycerine content test for in-process samples is being tested for all sampling points except sampling point at 728. The approved specification for glycerine content is 99.7% minimum to maintain a good quality of glycerine. This glycerine content can be determined from the moisture content by using calculation:

Glycerine Content (%) = 100% – Moisture Content (%)

4.1.7 Moisture Content

Moisture content can be thought of as the amount of water in a substance or material in a relatively small quantity[20]. Excessive or deficient moisture content of a substance can adversely impact the physical properties of a material.

To determine the moisture content of refined glycerine are by a test portion is tested via KF Titrino 787 which is a water analysis by Karl Fisher Instrumentation Method adapted from ISO2097:1972. The principle of Karl Fisher titration is based on the oxidation sulfur dioxide and iodine to form hydrogen iodine and sulfur trioxide. When all the water is consumed, it reaches an endpoint.

$$I_2 + SO_2 + H_2O \rightarrow 2HI + SO_3$$

There are two methods used to perform the Karl Fisher titration test which is Volumetric Karl Fisher and Coulometric Karl Fisher. The main difference between the two is that the volumetric method, the titrant is added directly to the sample by a burette. Conversely, with the coulometric method, the titrant generated electrochemically in the titration cell. The coulometric method measures water levels much lower than the volumetric method [21].

The KF titrino 787 is used Volumetric Karl Fisher at which by this method, the moisture determination is based on the amount, volume, or reagent used to convert the water. Glycerine is more suitable to use volumetric as the range of the sample size of the application is 0.1% to 100%. In the KF titrino 787 is one components reagent which the titrant contains iodine, sulfur dioxide, buffer and methanol or ethanol. The working medium contains only the methanol or ethanol. The samples are dissolved in methanol,

and then the iodine is added to KF reagent before the titration begins [22]. Here, the endpoint is detected potentiometrically.

This moisture content test for in-process samples of refined glycerine is being tested for all sampling points except sampling point at 728. The approved specification for moisture content is 0.3% maximum that referring to the instrument for the moisture content results.

Figure 14 KF Titrino 787

4.1.8 Heat Stability

Heat stability is the property of a molecule to retain its structure intact in high ambient temperature and the ability of a fluid to resist breaking down under heat stress [23]. Heat stability testing aims at collecting reaction rate data to assess whether a specified quantity of product can be used in a way such that runaway reactions are avoided. This is compulsory when considering processing, long-term storage, or shipping of a material [24].

This heat stability is used to test the thermal stability of refined glycerine over time. This is because pure glycerine is not vulnerable to oxidation by atmosphere under ordinary conditions. The glycerine will break down on heating into acrolein. Due to

these breaking down which causes the color change of the glycerine to yellow liquid with a disagreeable odor [25].

The heat stability for refined glycerine is determined by a test portion of refined glycerine that was heated in mild steel digital heating mantle up to 250°C and set the timer for 30 minutes after the settling time of heating mantle reach 250°C. After heated, the test portion is then being cooled, then the color for the test portion is being determined by Lovibond PFX 195 Tintometer, which is a color determines instrument with quartz color cells 50.0mm provided.

This heat stability for in-process samples was being tested only for sampling points at 743. The approved specification for heat stability is 150 APHA maximum.

Figure 15 Lovibond PFX 195 Tintometer

4.1.9 Related Compound

Related compounds are composed of all process-related substances that are related to the main compound of interest. This can include degradants that may be formed in the products [26]. State by the U.S Pharmacopeia-National Formulary (USP-NF) that the amount of any individual impurity in glycerine must not exceed 0.1% and 1.0% for all the total for impurities [19]. Any component of a refined glycerine that is not the chemical entity defined as the refined glycerine is classified as impurities.

To determine the related compound of refined glycerine are by a test portion has been distilled then is inserted into the gas chromatography vial. A gas chromatograph A (GC-A) is an analytical instrument that is used to measure the content of various in the sample (Refer figure 16) [27]. The principle of this gas chromatograph is by the distilled sample solution is injected into the instruments enters a gas stream which transports the sample into the separation tube known as column. Nitrogen or helium is used as the so-called carrier gases that are needed for the transfer of the injected sample to the separation column [28].

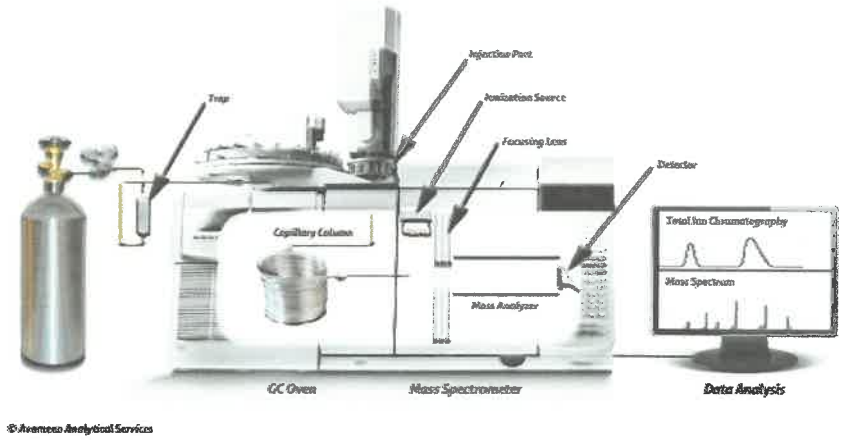


Figure 16 Gas chromatograph A (GC-A)

The various components in the samples are then separated inside the column. This column is filled with the stationary phase, or its walls are covered with a liquid adsorbent. This column is done for selective absorbance and retention of the sample components. The column is enclosed by a column oven which is responsible for maintaining a constant temperature during isothermal operation. The maximum rate of temperature is 30 to 40°C per minute [29]. Then the detector will detect the quantity of the components that exit the column. A common example of the detector is flame

ionization detector, thermal conductivity detector (TCD), and electron capture detector (ECD) [30]. Then data system will calculate and display the parameters.

This related compound test is done by the refined glycerine is being distilled and shake for homogenization. The sample is put into the gas chromatography vial (Refer figure 17). Then the GC vial is run using GC-A. Then the data of related compound, resulted from the process can be obtained by edit the chromatogram of related compounds.

Figure 17 Gas chromatography vial

This related compound test for in-process samples was being tested only for sampling points at 743. The approved specification for the related compound is less than 0.1% for individual impurities while less than 1.0% for total impurities in glycerin content that can be obtained from the related compound report from the chromatogram.

4.1.10 $\underline{H_2SO_4}$

Sulfuric acid (H_2SO_4) is a strong mineral acid which is soluble in water at all concentration. It was once known as the oil of vitriol [31]. This sulfuric acid test is an acid stability test. Sulfuric acid (H_2SO_4) is used as dehydrating agent. This is because in glycerine, sulfuric acid will remove all water molecule to give unsaturated aldehyde

called acrolein. This test is distinctive for glycerine whether it is free or combined with fatty acids[32].

The sulfuric acid test is conducted by a small quantity of sulfuric acid is added in a test portion of refined glycerine. The solution is then being stirred about 4 minutes and was heated in the heating bath until reaches 100°C then being stand for 14 minutes and 30 seconds. After heated, the test portion is then being cooled, then the color for the test portion is being determined by Lovibond PFX 195 Tintometer.

This sulfuric acid test for in-process samples was being tested only for sampling points at 743. The approved specification for the sulfuric acid test is 20 APHA maximum.

4.1.11 KOH test

Potassium hydroxide is also known as *lye* an organic compound with the chemical formula of KOH. This potassium hydroxide is also commonly referred to as caustic potash in several forms including powder, flakes, and pellets[33].

This KOH act as a reagent used for detection and determination of aldehydes and ketones. The KOH test is conducted by mixing refined glycerine sample with distilled water. Then, KOH is added into the same beaker and the appearance of the sample is observed.

This KOH test for in-process samples was being tested only for sampling points at 743. The approved specification for potassium hydroxide is by the appearance of the sample are clear. While if the color of the sample is pinkish or unclear is rejected.

4.1.12 Maltol test

Maltol is a naturally occurring organic compound that is used primarily as a flavor enhanced with a white crystalline powder that is soluble in hot water, chloroform, and other polar solvents [34] (Refer figure 18). Maltol test is used to test the presence of iron in the refined glycerine. We can observe the presence of the iron in the refined glycerine is because maltol will turn red in the presence of iron [35]. This is because maltol when reacts with Iron (Fe^{3+}) will form a red or orange chelates color of solution depending on the pH or concentrations of the component such as glycerine.

This maltol test for in-process samples was being tested only for sampling points at 743. This maltol test for in-process samples was being tested only for sampling points at 743.The approved specification for maltol is by observation.

Figure 18 Maltol

4.1.13 Odor rating

Refined glycerine is odorless because some of the odor-causing impurities have been removed because of refining. The approved specification for odor rating is by observation of the odor rating which is odorless.

4.1.14 Taste

Refined glycerine has a sweet taste with a syrup-like consistency. Being sweet-tasting, refined glycerine is widely used as a sweetener in food. The approved specification for taste is by observation of the taste which is a sweet warm taste.

TYPE OF SAMPLE	PARAMETERS	SPECIFICATIONS	EQUIPMENTS
Refined Glycerin (RG)	• Black Particle	• Rating 1-2	• Filtration & Visual
	• pH Test	• 6-7.5	• Digital pH meter
	• Fatty Acid and Ester	• 1.0 Max	• Titration
	• Color Test	• 10 APHA Max	• Lovibond PFX 195 Tintometer
	• Chloride Content	• 10ppm Max	• Autotitrator
	• Glycerine Content	• 99.7% Min	• Calculation / Titration
	• Moisture Content	• 0.3% Max	• Karl Fisher Instrumentation
	• Heat Stability	• 150 APHA Max	• Lab heating mantle • Lovibond PFX 195 Tintometer
	• Related Compound	• 0.1% for individual impurities • 1.0% for total impurities	• Gas Chromatography
	• H_2SO_4	• 20 APHA Max	• Heating bath

			• Lovibond PFX 195 Tintometer
	• KOH test	• Appearance	• Mixing
	• Maltol test	• Appearance	• Mixing
	• Odor rating	• Odorless	• Observation
	• Taste	• Sweet Warm Taste	• Observation

4.2 Testing Final Products

Final products are the finishing product of the process and intended for shipping and delivery throughout Malaysia and all over the world. It is compulsory to check the final products to make sure the products reach the specification and requirement given by the customers to produce a good quality of products that are being produce by the company. Testing final products typically involves testing a product against a specific standard or regulation in a certified laboratory. Whereas the product inspection often involves checking a random sample of an order for compliance with buyer's requirement and specification.

The parameter to analysis the final products is same as the in-process products which are black particle, pH test, fatty acid and ester, color test, chloride content, glycerine content, moisture content, heat stability, related compounds, H_2SO_4 test, KOH test, maltol test, odor rating, and taste. These are parameter to analysis for the final process samples. Table 2 shows the list of final product analysis and their specifications.

Refer previous section (4.1.1 to 4.1.13) for details information regarding parameter.

	• KOH test	• Appearance	• Mixing
	• Maltol test	• Appearance	• Mixing
	• Odor rating	• Odorless	• Observation
	• Taste	• Sweet Warm Taste	• Observation

5 PACKAGING

Packaging of a product is important to keep the product safe during shipment between the manufacturing facility to the customer. It is necessary to analyze the packaging characteristics and a suitable packaging for a product to retain a good quality of products and to reduce the environmental effect of the products before received by the customers. Vance refined glycerine in Vance Bioenergy is available in metal drums, IBC totes, flexibags, ISO Tanks and HDPE drums.

Bulk of refined glycerine should be stored in stainless steel for FDA approved lined tanks. FDA is stand for The Food and Drug Administration that is responsible safety regulation of most types of foods, drugs, vaccines, blood products, medical devices, cosmetics, etc. The refined glycerine should be stored at ambient to slightly heated conditions to enable handling. Excessive heat to the product could result in product degradation[36]. Refined glycerine is stable if kept near ambient temperatures. Refined glycerine stored in vented tanks may increase in water over time due to the hygroscopic nature of glycerine. A hygroscopic substance is one that readily attracts water from its surroundings, through either by absorption or adsorption[37]. The shelf life of glycerine is 24 months when stored below 38°C in a closed container.

Figure 17 Metal Drums

Figure 18 IBC totes

Figure 19 Flexibag

Figure 20 ISO Tanks

Figure 21 HDPE drums

6.2 Pharmaceuticals

Glycerine is used in the manufacturing of drugs in a small amount, and it is used to provide lubrication, smoothness, and as a humectant that will help to improve moisture-retaining ability.

Because glycerine is naturally sweet, it is also used to make medicines such as cough syrups and lozenges more palatable. This is the reason cough syrup is quite thick and has a sweet taste. The food and drug administration classifies glycerine as "generally recognized as safe (GRAS)" when being used in pharmaceutical products as the quantity of glycerine found in it is low [39].

6.3 Medicine

Because of hygroscopic, glycerine is used in IV fluids to reduce excessive intracranial pressure caused by cerebral edema. Cerebral edema happens when there is an excess accumulation of fluid in the intracellular spaces of the brain. It does this by drawing out excess fluid from the body tissue and bloodstream, which it can do by being extremely hygroscopic. It then dehydrates the tissues by preventing the kidneys from reabsorbing the water. This reduces the volume of blood which ultimately reduces intracranial pressure [40].

6.4 Personal Care

In personal care products, glycerine is the most used ingredient in personal care which validates its usefulness even more. Glycerine is commonly used as an emollient that helps to retain the moisture on the skin and functions as a humectant. As glycerine is a humectant, it is used to hydrate the outermost layer of skin that leaving the skin soft

and supple, helps to improve skin barrier function, provides protection against skin irritants, and even helps to speed up wound-healing processes.

The characteristics of glycerine that are humectant, is the key ingredient that is used to produce beauty products meant to moisturize such as lotions, hand soaps, conditioner, and shampoos. In hair care products, glycerine can keep the hair from over drying and spitting and is used in shampoos that treat dandruff and itchy scalp.

For lotions and skincare products, the use of glycerine is to attract and chemically hold onto moisture. These are the characteristics of glycerine as a humectant that pulls moisture to the surface of the skin from the air and deeper layers of the skin, leaving the complexion looking dewy. Other than that, it is also commonly used in the manufacturing of toothpaste, creams, mouthwash, hair and skin care products, soap, etc. [41]

6.5 Others

There are many other applications for refined glycerine. There are uses in small in volume and is highly versatile. It is also used in industrial applications such as tobacco, surface coating resins, paper and printing, lubricants, textiles, and anti-freeze.

7 CONCLUSION

It is compulsory to check the quality of the products to make sure the products reach the specification and requirement given by the customers. By setting up a specification for these products it will help to retain a good quality of products that are being produce by the company. It also serves as a guideline for product teams to follow throughout the development process and a good product specification provides clarity, which streamlines development and to keep the production teams on track while producing the products. The characteristics of Vance's pharmaceutical and food-grade refined glycerine, making it ideal for use in high-end applications. It is important to make sure that the quality of the products follow the specifications.

In these reports, only a few applications of glycerine are mentioned here but there are about 2000. Many more applications are being evolved because the availability of surplus crude glycerine made possible by biodiesel manufacturing and nontoxic nature of this glycerine. The wide application of glycerine is because due to combination of factors like chemical and physical properties such as viscosity, high boiling point, nontoxic, hygroscopic, etc. The compatibility of glycerine has made it a chemical of choice in many applications.

6605 words

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APPENDICES B

Figure 1 Room Sample VBSB, Keluli

Figure 2 Front view at VBSB, Keluli

Figure 3 VBSB, Nibong

Figure 4 VBSB, Keluli

Figure 5 VBSB, Keluli

Figure 6 VBSB, Keluli

Figure 7 VBSB, Keluli

Figure 8 VBSB, Keluli