INDUSTRIAL TRAINING FINAL REPORT

SESSION: 2022

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Firstly, I would like to thank to UNIGEL COMPOUNDS SDN BHD (UCSB) on giving me the opportunity to be a training in their company. UNIGEL COMPOUND SDN BHD has providing me such a fully equipped with advanced tools which allow me to gain essential engineering knowledge and broaden my view in engineering aspect.

I would like to thank and compliment my industrial training supervisor, Ms. Mok Chon Yee. She is exceedingly kind in person and keen enough to give any newbie his full attention including me. I would like to say thank to Mr Jamie Jeremy from lab department and Mr Radzi from production department for the knowledge that has been teach by them about the reality of working looks like. And thanks to my internship partner Nurul Darwisyah who always help me when I am in struggle to complete some tasks. Without them endless care and wit, I would not have made any clear progression and understand the purpose of being an intern at all. Most thanks for their support, feedbacks and all the worthwhile lessons.

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ABSTRACT

This industrial training report of Muhammad Afiq Syahmi Bin Samsol to undergo an industrial training for duration of 6 months which consist of 24 weeks before completing the Diploma courses. Starting industrial training on 20 February 2022 until 04 August 2022 at Unigel Compound Sdn Bhd which guided by Ms Mok Chon Yee.

The purpose of this program is to fulfil the course to complete the Diploma as well as graduate from the university. The training refers to work experience that is relevant to professional development prior to graduate. In first chapter this report is defining the term of industrial training and description on industrial training objectives. This part explains the details of objectives of industrial training report and industrial report. In second chapter of report is overview of the company and departments. In this part, explain about company history, company ownership, company working schedule and company product overview.

The next chapter describes the summary of the duties and various tasks in weekly of industrial training activities that conducted. In this chapter explain about overview of task and routine as an intern at UNIGEL.

The next chapter describe about details of experiences. This chapter deeply explain about task given by the company and project that company provide for research purpose. In this chapter also explain about problem encountered and approach of solving, professional and ethics at workplace and sustainable aspects. Last chapter was about conclusion and recommendations.

This training gives students a good experience in preparation for facing the real world of working environment. It eventually can improve and develop new skills for students for their future advantage.

Finally, trainee got opportunities to learn more about how work ethics works in working situation. Other than that, trainee also can learn independently on how to be a worker with strong heart and excellent when facing problem

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CHAPTER 1: INTRODUCTION OF INDUSTRIAL TRAINNING

1.1 Overview

Students in certain programs at all levels of higher education in Institutions of Higher Learning are required to complete Industrial Training (IT). Industrial training programs were introduced to strengthen the necessary competencies to increase the number of graduates qualified for employment. Industrial Training (IT) is the process of exposing students to engineering work in the real world and involving them in Chemical Engineering projects before they graduate. One of the requirements for the award of a diploma in chemical engineering is that the student MUST complete at least twenty-four (24) weeks with twelve (12) credits of industrial training within semester six (6) OR after passing all courses taken from semesters one through five.

The goal of Industrial Manship is to introduce UiTM students to industrial culture and the workplace while also improving student employability by enhancing their industrial skills. They will also attend several briefings that serve as training for the trainee. This internship will last for 24 weeks, beginning on February 20, 2022, and ending on August 4, 2022. The student must report to the company at the time and on the date specified during the Industrial Training briefing. One (1) Lecturer Evaluation will be given to the student during the internship period to evaluate their performance. Two (2) weeks after the internship ends, the logbook and finalized report must be submitted to the college both online and in hardcopy.

Courses in industrial training (IT) provide students with learning opportunities in the workplace so they can gain real-world experience and boost market trust. The industrial training aids in producing chemical engineering technician graduates with excellent technical skill and soft skill competency when it comes to preparing the students as engineering technicians. Since all core and elective theories can be applied in industrial training, it is expected that students will be able to approach problems and projects given to them by supervisors in original and creative ways. Additionally, the industrial training boosts students' self-confidence and enhances their teamwork and communication abilities. Students are also expected to practice engineering with a high degree of integrity, ethics, and accountability.

1.2 Objective Industrial Training

The main objective of Industrial Training (IT) is to give students learning opportunities in the world of work to receive practical experience in order to improve the reliability of the market. In preparing the students as an engineering technician graduates with excellent technical skill and soft skill competency. The other objectives are:

- Gaining essential knowledge of reality in working life
- Learning new skill and perfecting interpersonal skill
- Building network of contacts
- Mastering technical skills

1.3 Industrial Training Placement

1.3.1 Industrial Schedule

Normal Working Hours	8 hours
Day of working	5 days a week
Work in	8:30 am
Break Hour	**Monday – Thursday** • 8:30am to 12:30pm • 1:30pm to 5:40pm **Friday** • 8:30am to 12:30pm • 2:30pm to 5:40pm
Work Out	5:40pm

Table 1.1: Industrial Schedule

1.3.2 Company Supervisor Information

CHAPTER 2: COMPANY PROFILE

2.1 Company Background

Opcom Holding Berhad was founded as a private limited company in Malaysia in November 1994, with a focus on the production of fibre optic cables and related products. In December 2003, Opcom was listed on the MESDAQ market (ACE market) of Bursa Malaysia Securities Berhad.

Opcom Holding corporate structure:

- **Unigel Compounds Sdn Bhd** – Manufacturing and trading of cable filling and flooding compounds, and trading of industrial products.
- **Opcom Trading Sdn Bhd** – Dormant
- **Opcom Shared Services Sdn Bhd** – Provision of human resource management services.
- **Opcom Vision Sdn Bhd** - Project management services which include supply of cables, hardware and accessories, engineering consultation, information technology software and service management.
- **Opcom Lube & Solution Sdn Bhd** - Manufacturing lubrication oil and oil related products. Manufacturing Liquid solution for constructions and household uses.
- **Opcom VC Sdn Bhd** – Project management services which include supply of cables, hardware and accessories, engineering consultation, information technology software and service management.

OPCOM has benefited and enjoyed professional working relationship with our joint venture partner, Ericsson Network Technologies AB, Sweden, which provided a platform for continuous transfer of technology, management skills and experience as well as product know-how. At **OPCOM**, we pride ourselves in operating the country's only fully equipped laboratory, which conducts various cable tests on the cable products. Our production plant is MS ISO 9001: 2000 and MS ISO 14001: 2004 certified.

We at **OPCOM** are constant in our commitment to meet and exceed customers' expectation through high quality products, timely deliveries and excellent customer service

whilst maintaining a high level of environmental performance through best environmental practices.

Today, **OPCOM** has made a brand name on its own with a strong presence and position to becoming the leading manufacturer of fiber optic cables and cables related accessories in Malaysia.

2.2 Company History

2.2.1 UNIGEL COMPOUND SDN BHD

Unigel Compound Sdn Bhd is a subsidiary company that is owned by OPCOM Sdn Bhd. UNIGEL Compound Sdn Bhd is a global pioneer in thixotropic compounds for the cable, construction, and power industries.

Unigel Compound Sdn Bhd (UCSB) was incorporated in Malaysia on 14th August 1997 and commercial production commenced in April 2016. UNIGEL is a leading manufacturer and supplier of thixotropic gel for fibre optic cable industry. The company has evolved over the years into the world's top provider of cable compounds to the fibre optic cable sector.

UNIGEL manufacturing presence in the United Kingdom, United States and Malaysia. UNIGEL Compound export its portfolio of products to over 50 countries worldwide.

We at **UNIGEL** are constantly in commit to meet and exceed customer expectation through high quality product, timely deliveries and excellent customer service whilst maintaining a high level of environmental performance through practices.

UNIGEL has a policy of producing high quality products. Raw materials and finished products are subjected to a series of test before, during and after the manufacturing process to ensure the quality meet customer satisfaction.

2.3 Vision and Mission

Total Quality Management is a way of life at UNIGEL. We pledge to fully satisfy our customer requirement through a process of a continuous improvement. We recognize that Total Quality Management is not a short-term business objective. It is a long-term commitment aimed at continuously improving the way we work, to educate and train our people, providing a safe work environment, managing our business processes and supplier selection and retention. It is our global to position our organisation for market e

xpansion, thereby providing improved job security and quality of life for all.

Objective

Our quality objectives are customer centric to supply customers with high quality product, on time, and at the lowest cost as possible. We are committed to continuous improvement once an objective is achieved, it should be recognized and reset to stimulate further quality improvement. To reach our objectives, we will have to maintain a constant focus on quality with full dedication, commitment, and teamwork.

2.4 Organization Chart

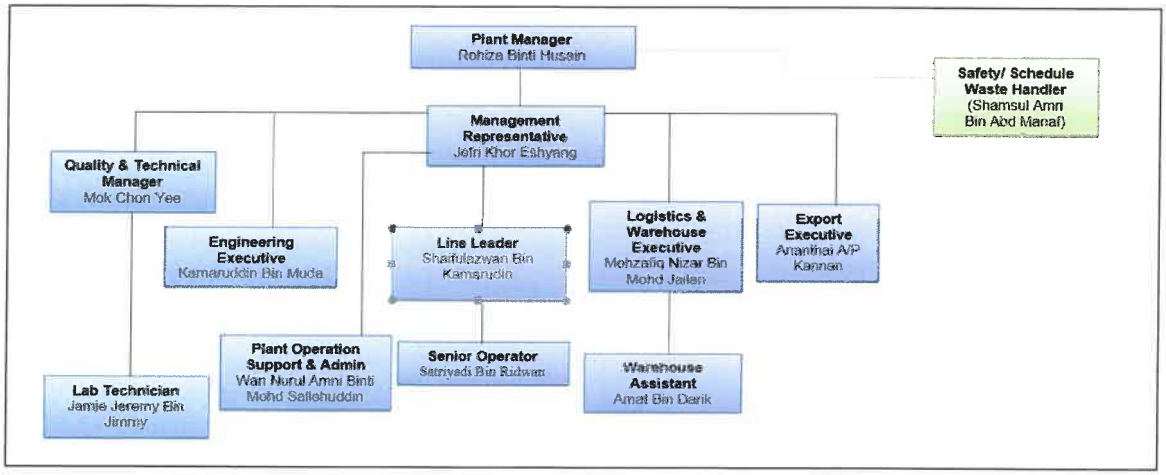

Figure 1 Organization Chart

2.5 Main Product/ Service Provide to the Client

2.5.1 Thixotropic Compounds

Thixotropic compounds or known as gel were used as a filing or flooding in fibre optic cables. The function of the gel is to avoid water penetration in the cable and to avoid an oxidation process from occurring in the cable. There are three major types of thixotropic compounds which are loose tube filling compounds, hydrogen absorbing gels for subsea & OPGW cables and filler compounds for twisted pair copper cables. For loose tube filling compounds, UNIGEL offers a wide range of filling compounds which have been developed with specific rheological characteristics to suit all tube designs, with working temperatures ranging from -60 to + 80 °C.

While hydrogen absorbing gels for subsea & OPGW cables, UNIGEL has a range of products available that are specified for cables facing a risk of hydrogen contamination in

stainless steel tubes and during the laser welding process. Last not but least is filler compounds for twisted pair copper cables. Low dielectric compounds suitable for cold filling into copper telephone cables up to 800 pairs.

2.5.2 Fibre Reinforced Plastic (FRP)

UNIGEL manufactures high quality of fibre reinforced plastic (FRP) that use as dielectric reinforming in most common optical fibre cable designs. With high quality of research for the formulations, it is design to be in the centre of fibre optic cables to produce a strong and cost-efficient cable reinforcement. The main function is to support the fibre optic cable which is enhancing the cable reinforcement during installation and reducing the tension on signal carried by the cable. It also provides excellent tensile strength performance while maintaining a high degree of stiffness and preventing cable from buckling over its entire service life.

CHAPTER 3: OVERVIEW OF TRAINNING

3.1 Introduction

During 24 weeks of the training, for lab, production for thixotropic gel and production for Fibre Reinforced Plastic has variety job and task each day. Lab department is a technical and quality department which will test all the product from UNIGEL its either within the standard quality or not and provide an instruction to the production department if the product is out of standard specifications. Lab department also will inspect the packaging of the product is in good condition or not because it also might affect the quality of the product. For production department for thixotropic gel, it's important for production department to made product that within the standard specifications to save the cost-efficiency and to save the time. Production department of thixotropic gel will start from prepare the raw material in term of weight and quantity. Then production department of thixotropic gel will start to process the raw material and follow the procedure of producing the thixotropic gel. Lastly, production department for Fibre Reinforced Plastic, it's also important for production of FRP to made products that within the specifications and follow the safety instruction to avoid any injuries. Production of FRP also will start the production from weight the raw material until packing the FRP in cable reel.

3.2 Summary of The Training Experienced Gained

Quality Control Department

As an intern, I expect to learn new engineering skills, gain knowledge, and gain experience working in a manufacturing company, particularly in the Quality Control department and Production department, where there is a wealth of knowledge and opportunities. The work experience I gained during this internship period has opened my eyes to the real working environment, and I am confident that it will be easier for me to adapt to and cope with real working life in the future.

Aside from that, the working experience allows me to not only gain new skills and knowledge in the Chemical Engineering field, but also to sharpen my critical and creative thinking in order to solve problems. As we all know, chemical engineers develop and design chemical manufacturing processes. It will be difficult to adapt and be successful in the industry if you do not understand the critical concept and have strong engineering skills.

During my working days, I also take the initiative to obtain as much useful information and tips from my mentor, Mr Jeremy and manager, Ms Mok Chon Yee and Mr Jefri Khor as possible based on their previous experience, as they are already senior in this industry. This internship period will be a valuable experience for me in the future because it includes knowledge gained,

skills gained, understanding job requirements, completing tasks on time, and applying theoretical knowledge to activities given.

Practical Skills Gained

i. Communication skills

Communication skills are the first skill that has the most impact on me during this internship. Any individual's acquired communication skills are in fact indispensable assets in building a great career, as modern jobs require a person to work in a group, share and digest ideas, solve problems, and so on. Even so, acclimating to unusual people and tasks is difficult.

Being passive, lonesome, or ashamed to ask questions or express ideas are not qualities of a perfect employee or future leader. It is an essential skill when working in a large company that requires dealing with a large number of people, and good communication also ensures that information is exchanged smoothly. As a result, communication skills entail not only talking but also learning to focus and digest the ideas of others, rather than simply listening when others are speaking. This enables me to improve my work efficiency in the company and. All staffs in every department at UNIGEL COMPOUNDS SDN BHD demonstrated excellent communication skills.

ii. Time Management

Managing time in an organized and systematic manner is very critical to ensure that a given task is completed within a given time. We are all aware that we cannot control the passage of time, but we can control how we spend the time we do have. As a student, I undoubtedly have procrastination habits, not only in completing assignments but also in dealing with personal matters. As a student, surely all of us have procrastination habits, not only in completing task but also in handling our own personal matters.

However, in working life, the case is completely different as the task given is almost always urgent, so it must be done on time. So, to avoid doing lousy job, I organized my schedule by allocating a certain time for a task so that I can complete the task given on time.

By developing the skills to manage time effectively, I could complete any task within the time given as I learn to prioritize things that are important and by acquiring this skill, it will bring a large improvement in my working life. It may be difficult at first, but I manage to come up with a schedule to be disciplined in doing my job. Moreover, I try to discipline myself to prioritize important tasks.

iii. Taking Initiatives

Taking the initiative is a skill that every intern should develop. The ability to do things without being told is described as initiative, a self-management skill. Individuals who demonstrate initiative demonstrate their ability to think for themselves and take appropriate action when deemed necessary. As an employee, I am expected to be knowledgeable and self-sufficient in my work. To deliver a good result, I must take the initiative to investigate everything on my own and gather information from reliable sources.

Furthermore, the initiatives can be in the form of work that can be completed, research on new knowledge, and the dissemination of ideas. I took a lot of initiative for my internship training to learn new knowledge and skills from others. Typically, my manager will guide me until she can no longer do so and assign me tasks; the rest, I will do on my own, based on my own initiative. What I usually do is solicit opinions and advice from my mentor, as well as conduct internet research. I was also able to learn not to be afraid to approach my mentor and manager in order to obtain the task. Those tasks instilled in me the need to be more self-reliant, creative, and resourceful in order to produce an excellent output and demonstrate good performance.

This has taught me to be proactive and self-sufficient in initiating my own solutions to ensure that the tasks assigned to me are completed smoothly and efficiently to deliver an excellent result. As a result, I am grateful for the opportunity to complete my training at UNIGEL COMPOUNDS SDN BHD in Quality Control department, where I learned a variety of important practises and skills that I believe will be of great assistance in the future.

3.2.1 Weekly Summary

Week	Activities
1	– Briefing about working policies by HR. – Briefing about manufacturing process that company carry out. – Briefing about project and task assigned during internship. – Perform quality test for gel such as viscosity test, cone penetration and perform Oxidation Induction Time. – Perform cleaning of cone mesh for future use.
2	– Start observation of project. – Briefing about environmental chamber for project. – Brief about oil transfer from tanker to storage tank. – Perform quality test for gel. – Perform quality check for base oil (viscosity test). – Brief about dripping test (for quality test).

	– Brief about drop point test (for quality test). – Perform dripping test. – Observation dripping test.
3	– Observation project. – Perform quality test on gel. – Perform gel cleaning procedure.
4	– Observation project. – Perform quality test on gel. – Perform gel cleaning procedure. – Perform leakage test for nitrogen gas.
5	– Observation project. – Perform quality test on gel. – Perform quality check on Intermediate Bulk Container.
6	– Observation project. – Perform quality test on gel. – Perform gel cleaning procedure. – Perform quality check for base oil (viscosity test).
7	– Been tested positive Covid-19.
8	– Observation project. – Perform quality test on gel. – Perform gel cleaning procedure. – Prepared oil separation test for OPGW gel. – Calibrate viscometer.
9	– Observation project. – Perform quality test on gel. – Perform gel cleaning procedure. – Perform oil separation test.
10	– Observation project. – Perform quality test on gel. – Perform gel cleaning procedure. – Perform oil separation test for 500NA gel. – Cleaning lab. – Make sure that all electricity is shutting down.

11	– Cuti Hari Raya
12	– Observation project. – Perform quality test on gel. – Change department to production department. – Briefing of work etiquette and safety in production department.
13	– Morning daily briefing to all department discussing on daily task. – Weekly production meeting discussing on division of duties for the week. – Assist production department on production.
14	– Morning daily briefing to all department discussing on daily task. – Weekly production meeting discussing on division of duties for the week. – Assist production department on production. –
15	– Morning daily briefing to all department discussing on daily task. – Weekly production meeting discussing on division of duties for the week. – Assist production department on production.
16	– Morning daily briefing to all department discussing on daily task. – Weekly production meeting discussing on division of duties for the week. – Assist production department on production. – Perform filter change at mixer.
17	– Morning daily briefing to all department discussing on daily task. – Weekly production meeting discussing on division of duties for the week. – Assist production department on production.
18	– Morning daily briefing to all department discussing on daily task. – Weekly production meeting discussing on division of duties for the week. – Assist production department on production. – Perform filter change at mixer.
19	– Morning daily briefing to all department discussing on daily task.

	– Weekly production meeting discussing on division of duties for the week. – Assist production department on production.
20	– Morning daily briefing to all department discussing on daily task. – Weekly production meeting discussing on division of duties for the week. – Working at FRP production for a week to expand knowledge about UNIGEL. – Assist FRP production on producing FRP finish goods.
21	– Morning daily briefing to all department discussing on daily task. – Weekly production meeting discussing on division of duties for the week. – Assist production department on production. – Perform filter change at mixer.
22	– Morning daily briefing to all department discussing on daily task. – Weekly production meeting discussing on division of duties for the week. – Assist production department on production. – Perform filter change at mixer. – Perform cleaning strainer at process tank.
23	– Morning daily briefing to all department discussing on daily task. – Weekly production meeting discussing on division of duties for the week. – Assist production department on production. – Perform cleaning IBC that can be reuse.
24	– Morning daily briefing to all department discussing on daily task. – Weekly production meeting discussing on division of duties for the week. – Assist production department on production. – Farewell party for all interns in company that will finish on august.

Table 2 Weekly Summary

CHAPTER 4: DETAILS OF EXPERIENCES (REPORT ON JOB/ TASK/ PROJECT)

4.1 Introduction

During 24 weeks of internship at UNIGEL, other than doing the quality check test such as viscosity test, cone penetration, oil separation and volatile loss test, compound flow test, drop point test, density test and oxidation induction time test I also have two project to complete for my internship projects.

The first project was UV Aging of 150N Base Oil with Combination of Antioxidant, Pour Point Depressant and UV Stabilizer. The purpose of the project was to observe the impact of yellowish pour point depressant when mix with base oil based on 400N AS01 formulation ratio.

Second project was ageing properties of Flame Retardant gel in UNIGEL Compounds SDN BHD. The purpose of the project was to inspect the ageing properties of fire-retardant gel.

4.2 Details of the training and experience gained

4.2.1 Duties in Lab Department

4.2.1.1 Viscosity Test

Figure 2 HAAKE Viscometer IQ - Rheometer

- Calibrate the viscometer at least once a day before starting any test on viscometer.
- Place the spirit level on the slab stand base plate and the level the slab stands by adjusting the three height adjustable feet.
- Switch on the rheometer and wit for it to initialize.

- Affix the appropriate measuring geometry
- Ensure that the gap setting tool is inserted in the back of the rheometer.
- Loosen the locking screw for gap setting.
- On the touch screen panel user interface select 'configuration' followed by 'set measuring gap'
- Place the calliper with the thickness that corresponds to the desired gap on the sample plate.
- Slowly lower the measuring geometry by pressing the lift release lever to the right and then turning the left-hand wheel clockwise using the fold-out crank handle, raising the measuring geometry until it locks into place.
- Remove the calliper and make sure the computer is connected to the instrument by a network cable
- Using the syringe load 1ml of clear gel sample onto the sample plate.
- Slowly lower the measuring geometry by pressing the lift release lever to the right and then turning the lift hand wheel clockwise using the fold-out crank handle. Stop when the measuring geometry is completely lowered.
- Click the start button at the bottom of the job editor window.
- When the test is finished, raise the measuring geometry from the sample plate and a distinctive snowflake will be present.
- The viscosity reading will be recorded.

4.2.1.2 Cone Penetration

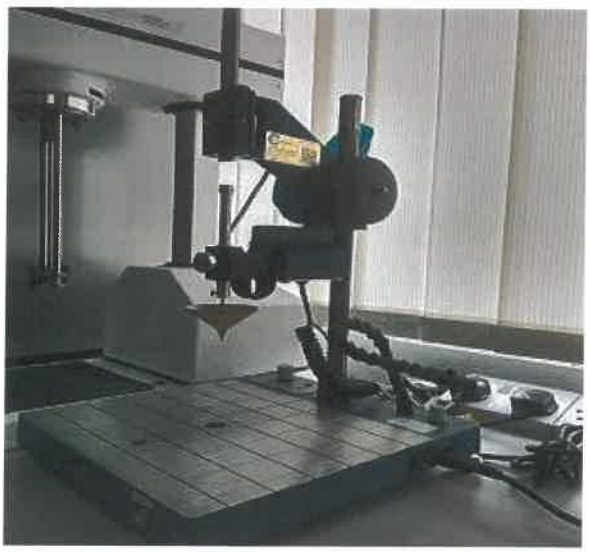

Figure 3 Cone Penetrometer

- Clean the cone and make sure that its clean.
- Raise the dropper to the highest point.

- Adjust the middle knob on the dial until it touches the dropper.
- Set the reading to zero by pressing the enter knob on the dial.
- Fill the gel in sample dish and scrape it flat.
- For negative cone penetration, let the sample dish in the freezer for a day while for 25˚C, let it in the room for a day before testing it on penetrometer.
- Adjust the dropper until the tip of the cone touches the surface of the gel.
- Press the start button until it touches the top of the dropper.
- Record the reading.

4.2.1.3 Oil Separation & Volatile Loss

Figure 4 Oil Separation and Volatile Loss

- Make sure the glass beaker, metal rod and cone are completely dry.
- Weigh and record the beaker and tare to zero.
- Place the metal rod and tare to zero.
- Weigh and record the wire-gauzed cone and tare to zero.
- Weigh and record the gel. The weight of gel is 10g with a range of error 9.8g to 10.2g.
- Place it into the preheated oven with temperature set as per customer requirements for 24 hours.
- After 24 hours, weigh the gel with the wire-gauzed cone.
- Calculate the volatile loss by using formula: (initial gel + cone) -(final gel + cone) / initial gel*100
- If no oil can be seen in the beaker, oil separation is 0.
- If oil can be seen in the beaker, calculate the oil separation by using formula: (final beaker -initial beaker)/initial gel*100

4.2.1.4 Compound Flow

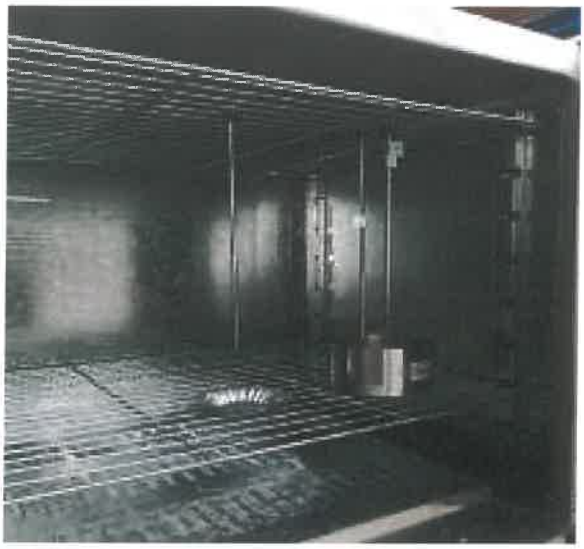

Figure 5 Compound Flow

- Clean the metal tube, 30cm length with 4mm diameter.
- Extract sample of gel by using syringe. Make sure no air bubbles in the syringe.
- Push the gel at one end of the metal tube until it comes out from the other end.
- Wipe the excess gel.
- Hang it in the oven at 70˚C for 24 hours.
- Here is no capping and allowance for thermal expansion.
- Place an aluminum tray underneath.
- The observation after 24 hours is record.

4.2.1.5 Drop Point

Figure 6 Drop Point

- Clean and make sure the test tube and the cup are clean and dry.
- Fill the cup ensuring there are no air bubbles by using a syringe.
- Insert the rod through the small bottom opening in the cup so it protrudes about 2.5cm.
- Move the rod in circular motion in a circle where the top touches the edge of the cup and upward to remove the conical section of the gel within the cup.
- Place the hot plate unit to the retort stand using the clamp.
- Insert the thermometer through the test tube lid bung.
- Insert one thermometer through the rounded piece of cork.
- Insert the thermometer depth gauge into the test tube and place the thermometer with the cork until it touches the gauge. Do not force it in.
- Adjust the tube lid bung until it holds the thermometer. Make sure that the apparatus is assembled correctly.
- Remove the thermometer with the cork without adjusting the location of the cork and the thermometer depth gauge.
- Place the sample cup with gel into the test tube and insert thermometer with the cork carefully. He thermometer should not touch the sample.
- Fill the beaker with 500ml of silicone oil and place the magnetic stirrer into the beaker.
- Suspend the thermometer at the lid bung so that the bulb is approximately level with the thermometer in the test tube.

- Switch on the stirrer to speed of 280RPM and ramped up to 700 RPM.
- Switch on the heater to 280˚C and increase it slowly to 505˚C.
- Make sure that the temperature difference between two thermometer is within 1˚C - 2˚C.
- Record both temperature from both thermometers and calculate the average temperature when the gel first drops.

4.2.1.6 Density

- Weight the 1ml syringe and tare to 0.
- Take 1ml of the gel and weight the syringe.
- The weight of the gel is divided with the volume which is 1ml. Therefore, the density of the gel can be determined.

4.2.1.7 Oxidation Induction Time (OIT)

Figure 7 Differential Scanning Calorimeter (DSC3)

- Switch on DSC3 and the computer to open the software.
- Click the open method and choose the suitable method accordingly.
- Write the sample name and the weight.
- Send the experiment.
- Open both the nitrogen and oxygen valves.
- Open the furnace lid by using tweezers.
- Weight the crucible and tare to 0.
- Weight 10mg of gel with error within 9,8mg to 10.2mg.
- Place the crucible with gel at the sample place which is marked as S.

- Put the furnace lid back to its place and start the test.
- Check the nitrogen and oxygen level from time as it may change.
- After the test is done, click the session and choose the evaluation window. Click the open file followed by the open curve and draw a square at the curve. Click TA and choose onset. Draw the tangent line and read the OIT results.

4.2.2 Duties in Production Thixotropic Gel

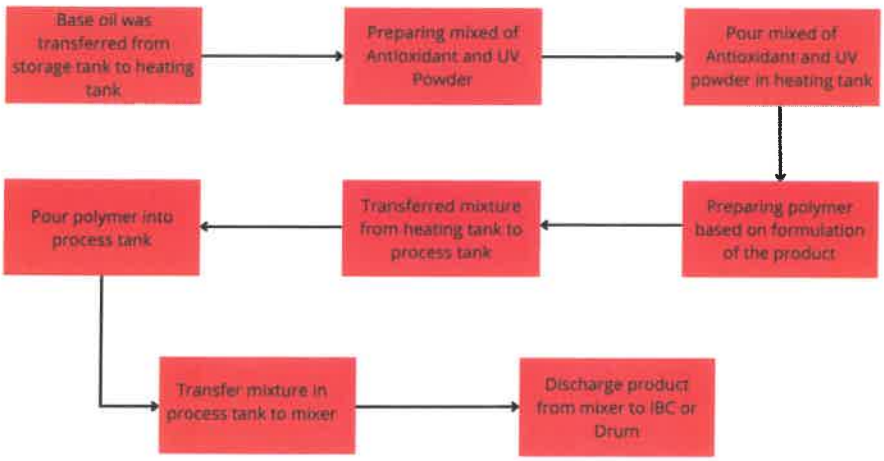

Figure 8 Process Flow Diagram of thixotropic Gel Production

3000Kg base oil was transferred from storage tank to heating tank with transfer rate was 200 kg/min – 230kg/min for 13-15 minutes. Initial base oil temperature was 31˚C to 32˚C.Formulation specification will be prepared by production office. Base oil in heating tank was heat until temperature reach 90˚C then the mixed of antioxidant and UV powder was mix with hot oil in heating tank. Mix of base oil, antioxidant and UV powder was heat until temperature reach 110˚C.After mixture in heating tank was heated until temperature reach 110˚C, mixture will be transferred to process tank. Polymer was choose based on formulation and based on type of the product. Weight the polymer following the formulation accurately. Weighted polymer will be place in the trolley. Top of polymer bag will be cut off for easier when transferring to process tank. Polymer will be transferred to process tank after mixture in heating tank are completely transferred to process tank with transfer rate 275kg/min for 6 minutes. Pump specification was at 50Hz pump was operating 2898rpm and on actual condition pump was operating at 44.4Hz. Process tank will mix all the material using stirrer until temperature of the mixture reaches 110˚C. Specification of pump motor is 1500rpm at 50Hz and on actual condition pump was operate at 44.7Hz. Mixture in process tank will be transferred to mixer. Transfer rate of mixture from process tank to mixer was 61.67kg/min. Pump specification was 3000rpm at 50Hz while actual condition

pump was operated at 44Hz. In mixer, mixture that has no additional raw material to be added will straight to vacuum process that will take around 10 minutes to be ready for discharge. If there will additional raw material that to be addedco, mixture will undergo mixing process for 10 minutes then vacuum process for another 10 minutes. Vacuum pump specification was 3000rpm at 50Hz while actual reading of vacuum pump at SCADA software was 44.6Hz. Pump motor for stirring specification was 735rpm at 50Hz while at SCADA shows reading of operating motor was 48Hz. After mixture complete all process in mixer, all mixture is become product that can be delivered to customer. The product from mixer will be transferred to Intermediate bulk container or Drum depending on customer request. After all product has been transferred to IBC or Drum, all containers will be sealed to prevent any spilled of product and prevent product from being contaminated while being transport to customer.

4.2.3 Duties in Production Fibre Reinforced Plastic

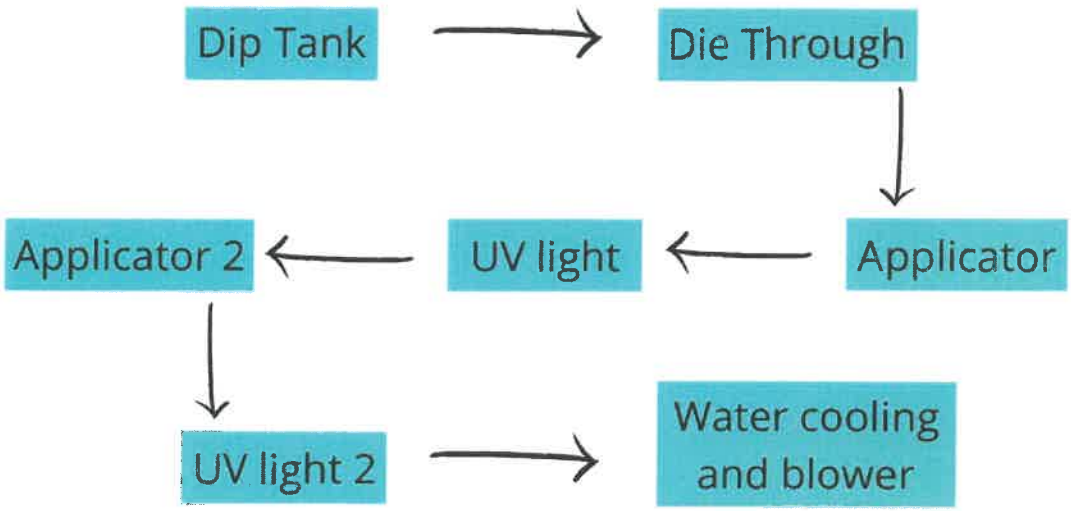

Figure 9 Process Flow Diagram for FRP Production

Bobbin was weight to record the initial weight of bobbin. Bobbin was arranged on creel table following the spec of yarn. Yarn will be pulled in 7 lines while each line consists of 6 bobbins. Yarn was pulled through dip tank. Dip tank was filled with resin A at 80°C - 150°C. Yarn will be dipped in the resin completely then move to next process. After yarn has been dipped in dip tank, yarn will go through die through. Die through is an applicator for yarn to be shape based on desired diameter. After yarn go through die through, yarn will go through applicator. At applicator, resin B will be applied on yarn while yarn go through applicator. Resin B is use at room temperature. Then, Yarn will go through UV light. The purpose of UV light is

to cure the yarn to make the yarn become hard. Hen yarn will go through water cooling and blower. While yarn go through water cooling, water cooling will wash away the resin that has been with yarn from previous process. Blower is to dry the yarn from water from water cooling. After yarn has been dry by blower, yarn will go through applicator 2. At applicator 2, yarn will be applied with resin 3. After resin 3 has been applied on yarn, yarn will undergo UV light. At UV light 2, resin C on yarn will be dried by UV light. After yarn was completely dried, yarn will be tied on drum at stake up station.

4.2.4 Project 1

Title

UV Aging of 150N Base Oil with Combination of Antioxidant, Pour Point Depressant and UV Stabilizer.

Objective

To observe the impact of yellowish pour point depressant when mix with base oil based on 400N AS01 formulation ratio.

Methodology

1. 3 labelled beakers with different mixtures were prepared. He formulation ratio was prepared as below:

Beaker	Formulation Ratio
1	Base Oil (150N) – 274.35g Antioxidant – 0.6g PPD – 0.9g UV Stabilizer – 0.15g
2	Base Oil (150N) – 274.35g PPD – 0.9g
3	Base Oil (150N) – 274.35g

Table 3 Formulation ratio Project 1

2. Mixture in beaker 1 and beaker 2 were stirred using magnetic stirrer until the temperature of each mixture reached 100°C.
3. Then, the mixtures were set aside to let it cool down.
4. Lastly, the mixture was placed in the UV box.

Results & Discussion

The test was conducted on 7th January 2022 under Ms Mok Chon Yee and Mr Jeremy's supervision. Below is the picture of each mixture on Day 1.

DAY 1

Beaker	Observation
• Mixture of 150N Base oil, Antioxidant, UV absorber and Pour Point Depressant 	• Clear mixture. • No oxidation occurs.
• Mixture of 150N Base Oil and Pour Point Depressant 	• Clear mixture. • No oxidation occurs.
• Pure 150N Base Oil 	• Clear mixture. • No oxidation occurs.

Table 4 Day 1 (Project 1)

DAY 2

Beaker	Observation
• Mixture of 150N Base oil, Antioxidant, UV absorber and Pour Point Depressant 	• Clear mixture. • No oxidation occurs.
• Mixture of 150N Base Oil and Pour Point Depressant 	• Clear mixture. • No oxidation occurs.
• Pure 150N Base Oil 	• The mixture become slight yellowish due to a photochemical reaction from UV exposure.

Table 5 Day 2 (Project 1)

DAY 5

Beaker	Observation
• Mixture of 150N Base oil, Antioxidant, UV absorber and Pour Point Depressant 	• Clear mixture. • No oxidation occurs.
• Mixture of 150N Base Oil and Pour Point Depressant 	• The mixture become yellowish due to a photochemical reaction from UV exposure.
• Pure 150N Base Oil 	• The mixture become yellowish due to a photochemical reaction from UV exposure.

Table 6 Day 5 (Project 1)

DAY 6

Beaker	Observation
• Mixture of 150N Base oil, Antioxidant, UV absorber and Pour Point Depressant 	• Clear mixture. • No oxidation occurs.
• Mixture of 150N Base Oil and Pour Point Depressant 	• The mixture become yellowish due to a photochemical reaction from UV exposure.
• Pure 150N Base Oil 	• The mixture become yellowish due to a photochemical reaction from UV exposure.

Table 7 Day 6 (Project 1)

DAY 7

Beaker	Observation
• Mixture of 150N Base oil, Antioxidant, UV absorber and Pour Point Depressant 	• Clear mixture. • No oxidation occurs.
• Mixture of 150N Base Oil and Pour Point Depressant 	• The mixture become yellowish due to a photochemical reaction from UV exposure.
• Pure 150N Base Oil 	• The mixture become yellowish due to a photochemical reaction from UV exposure.

Table 8 Day 7 (Project 1)

DAY 8

Beaker	Observation
• Mixture of 150N Base oil, Antioxidant, UV absorber and Pour Point Depressant 	• Clear mixture. • No oxidation occurs.
• Mixture of 150N Base Oil and Pour Point Depressant 	• The mixture become yellowish due to a photochemical reaction from UV exposure.
• Pure 150N Base Oil 	• The mixture become yellowish due to a photochemical reaction from UV exposure.

Table 9 Day8 (Project 1)

DAY 9

Beaker	Observation
• Mixture of 150N Base oil, Antioxidant, UV absorber and Pour Point Depressant 	• Clear mixture. • No oxidation occurs.
• Mixture of 150N Base Oil and Pour Point Depressant 	• The mixture become yellowish due to a photochemical reaction from UV exposure.
• Pure 150N Base Oil 	• The mixture become yellowish due to a photochemical reaction from UV exposure.

Table 10 Day 9 (Project 1)

DAY 10

Beaker	Observation
• Mixture of 150N Base oil, Antioxidant, UV absorber and Pour Point Depressant 	• Clear mixture. • No oxidation occurs.
• Mixture of 150N Base Oil and Pour Point Depressant 	• The mixture become yellowish due to a photochemical reaction from UV exposure.
• Pure 150N Base Oil 	• The mixture become yellowish due to a photochemical reaction from UV exposure.

Table 11 Day 10 (Project 1)

Discussion

The oxidation of a hydrocarbon fluid consists of three fundamental steps: initiation, propagation, and termination. With these steps in mind, oxidation can be controlled by modifying one or more of its steps or phases. This is accomplished by restricting the source

of oxygen (the initiation), reducing the number of reaction cycles (the propagation), or introducing alternate stopping methods (increasing termination). To some extent, all these methods are used in the formulation of lubricants. The process begins with the initiation, and preventing oxygen is the first line of defence.

From observations above, we can observe that mixture 1, consist of 150N base oil, PPD, UV absorber and antioxidant have no changes during the period of experiment due to the fact that no oxidation occurs on the mixture. Antioxidants are components that prevent the auto-oxidation of oils and fats by providing hydrogen to free radicals formed during the autoxidation initiation and propagation stages meanwhile UV stabilisers protect the polymer from UV energy's degradative attack, as well as exposure to fluorescent light and filtered daylight.

For the mixture 2 which consist of 150N base oil and PPD, we can observe that the colour of mixture changed to yellowish on Day 5 since there is oxidation occurs on the mixture inside the UV box. However, there is no changes in functionality of the raw materials thus the yellowish PPD can still be used as it doesn't give any impact towards the product. Then, for mixture 3 which is pure base oil, it turns slightly yellowish on the second day and become bright yellow on Day 5 due to oxidation.

Conclusion

If indicated oxidation take place and it may affect the Oxidation Induction Time (OIT) values of the gel. At day 5, base oil without antioxidant has discolouration occurred. Slightly yellowish PPD can be utilised with incorporation with antioxidant.

4.2.5 Project 2

Title

Ageing properties of Flame Retardant gel in UNIGEL Compounds SDN BHD

Objectives

To inspect the ageing properties of fire-retardant gel.

Methodology

Equipment and Materials

The equipment and materials involved were Differential Scanning Calorimeter (DSC), STARe Software Version 14.00, Aluminium crucible 40µl, tweezer, oven, UV box, beaker, oxygen gas, nitrogen gas and FR AS01 gel.

Experimental Procedures

Aging Test Sample Preparation

1. Prepare and label 18 pieces of 100mL beaker.
2. Fill 20g FR AS01 into each beaker.
3. Place beaker with CONTROL on the table at ambient temperature.
4. Place beaker with AGING label into UV box.
5. Take out the sample on respective days and test the viscosity and OIT.

OIT test

Sample Preparation

1. Weight the empty crucible pan.
2. Tare the value to zero
3. Fill the crucible pan with approximately 9.8-10.2 mg f sample. Taking care not to spill any sample on the rim or bend the rim.
4. If sample does get on the rim, or the pan or rim become bent, the sample should be discarded, and the step repeated with a new crucible pan.
5. Only place the crucible at the crucible tray and not at other surface to avoid contamination.
6. Ensure sample weight is noted key into STARe Software.

Instrument Set Up

1. Switch on the DSC3 machine and PC with STARe Software.
2. Login into Stare Software and key in the login ID.
3. At open window file, select UNIGEL 100min-30deg (METHOD) then click Okay.
4. Key in the sample name and weight of the sample.
5. Click send experiment and a red line at the bottom of the window will appear
6. Remove the furnace lid with tweezer. Deposit it on the furnace lid support
7. Place the reference crucible on the left crucible position of the DSC sensor indicated with "R"
8. Then, place the sample crucible on the left crucible position of the DSC sensor indicated with "S".
9. Place the furnace lid back on the furnace with tweezers.
10. After that, click okay until it shows 'measurement' in red column at the bottom of the window.

11. Then the analysis will run for 100 minutes.

Plotting Graph

1. Go to Mettler: Stare Default DB V14,00 software
2. Then, click session and choose evaluation window
3. To analyses the oxidation, draw a square around the graph then click TA after that select onset.

Viscosity Test

Instrument Set Up

1. Switch on the HAAKE Viscometer iQ.
2. Place the water level stabilizer on the parallel plate and make sure the water stabilizer's bubble in the central position.
3. Insert the C35 2°/TI (clear gel) in its place.
4. Put the gap setting's instrument on the parallel plate [0.1mm (clear gel)]
5. Loose the knurled knob fixing screw.
6. Turn the micrometre screw to the left end.
7. Slowly drop the coaxial cylinder geometry till it touch the hap setting's instrument.
8. Tighten the knurled knob fixing screw.
9. Turn the micrometre screw again to the right end.
10. On the touch screen panel, enter the configuration button.
11. Choose "set measuring gap"
12. Turn the micrometre slowly until the measuring gap bar turns green.

Sample Analysis

1. Open Rheowin Job Manager and open the relevant method.
2. Using the syringe load 1mL of clear gel sample onto the sample plate.
3. Press the lift release lever to the right and the slowly turn the lift hand wheel clockwise using the fold out crank handle. Stop when the measuring geometry is completely lowered.
4. Click the start button at bottom of 'job editor' window in the Rheowin job manager software. When prompted, enter the sample details (batch umber, grade, filename etc) onto window that appears then click OK.
5. When the test is finished, raise the measuring geometry from the sample plate using the lift hand wheel on the left-hand side of the instrument. Note that when UNIGEL is

under test, a distinctive snowflake pattern should be present on the test piece and the test plate. If this is not present, then the test is declared invalid.

6. The viscosity data is shown at the bottom of the right-hand window on the software and take the viscosity values at 50 s^{-1}.

Oil Separation and Volatile Loss

1. Make sure the glass beaker, metal rod and cone are completely dry.
2. Weigh and record the beaker and tare to zero.
3. Place the metal rod and tare to zero.
4. Weigh and record the wire-gauzed cone and tare to zero.
5. Weigh and record the gel. The weight of gel is 10g with a range of error 9.8g to 10.2g.
6. Place it into the preheated oven with temperature set as per customer requirements for 24 hours.
7. After 24 hours, weigh the gel with the wire-gauzed cone.
8. Calculate the volatile loss by using formula: (initial gel + cone)-(final gel + cone) / initial gel * 100
9. If no oil can be seen in the beaker, oil separation is 0.
10. If oil can be seen in the beaker, calculate the oil separation by using formula: (final beaker -initial beaker)/initial gel*100

Results & Discussions

Accelerated Ageing @100°C (Thermal Ageing in Oven)	
	
Day 0	Day 1
	

Day 2	Day 3
	
Day 4	Day 5
	
Day 6	Day 7

Table 12 Accelerated Ageing @100°C (Thermal Ageing in Oven)

Observation of UV Aging

Control vs UV Ageing (UV ageing test chamber)			
			
Day 0		Day 1	
			
Day 2		Day 3	

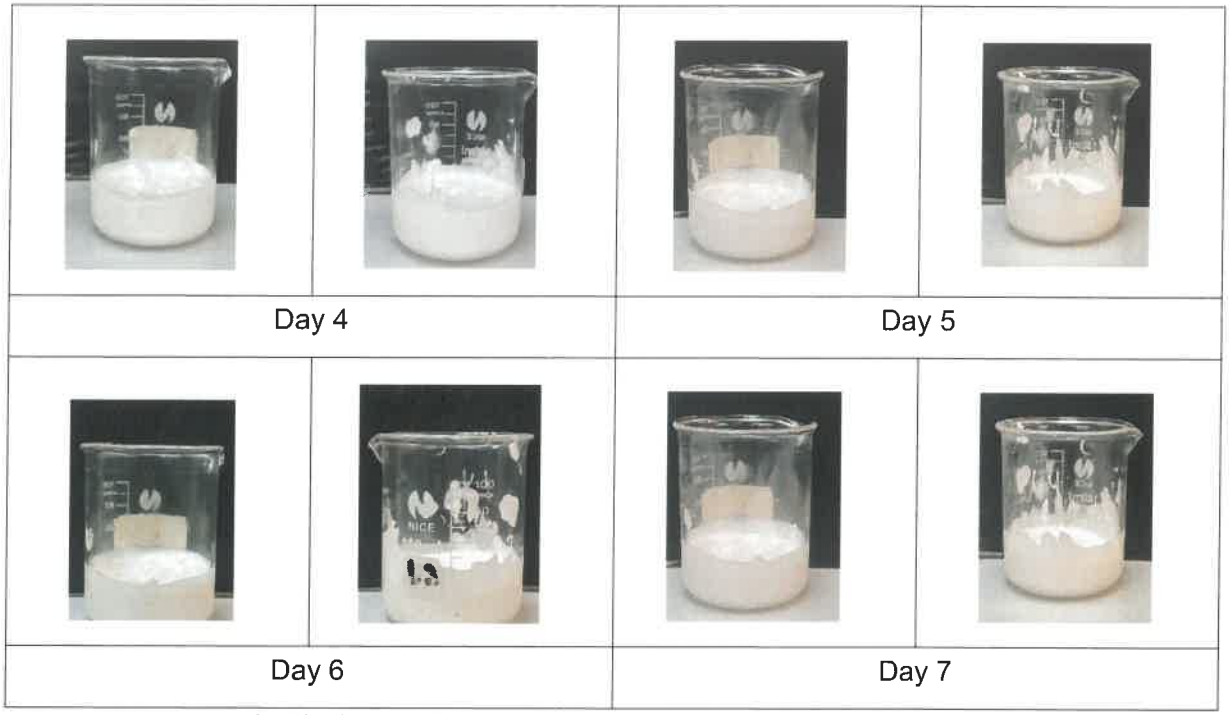

Table 13 Control vs UV Ageing (UV ageing test chamber)

Viscosity and Oxidation Induction Time of UV Ageing

Date	Day	Room Temperature (25°C)		UV Ageing	
		OIT (mins)	Viscosity @ 25°C @ 50 1/s (Pa.s)	OIT (mins)	Viscosity @ 25°C @ 50 1/s (Pa.s)
7/3/2022	0	>100	21.45	>100	21.45
8/3/2022	1	>100	21.85	-	17.01
9/3/2022	2	>100	20.82	-	17.15
10/3/2022	3	>100	20.47	-	16.73
11/3/2022	4	>100	20.4	-	16.46
14/3/2022	5	>100	20.32	-	16.27
15/3/2022	6	>100	20.47	-	15.89
16/3/2022	7	>100	20.25	90.67	15.81

Table 14 Viscosity and Oxidation Induction Time of UV Ageing

Oil Separation and Volatile Loss testing of FR gel.

Date	Day	Initial beaker wt (g)	Final beaker wt (g)	Oil Sep (%)	Cone wt (g)	Gel weight (g)	Initial Gel + Cone	Final Gel + Cone	Vol loss (%)
7/3/2022	0	99.5438	-	-	3.4085	10.181	13.5895	-	-
8/3/2022	1		99.5438	0				13.5729	0.16
9/3/2022	2		99.5438	0				13.5718	0.17
10/3/2022	3		99.5438	0				13.5703	0.19
11/3/2022	4		99.5438	0				13.5699	0.19
14/3/2022	5		99.5438	0				13.5694	0.20
15/3/2022	6		99.5438	0				13.5692	0.20
16/3/2022	7		99.5438	0				13.5683	0.21

Table 15 Oil Separation and Volatile Loss testing of FR gel.

Experimental results

Accelerated Aging Time (AAT): Desired Real Time (RT)

$Q_{10}^{[(TAA-TRT)/10]}$

AAT= time for which sample held at elevated temperature (year)

RT= Shelf life (1,2 or 3 years)

Q_{10}= Ageing factor (2.5)

T_{AA}= Accelerated ageing temperature

T_{RT}= ambient temperature (assumed for above calculation of ageing periods to be 25°C)

Example Calculation (Day 1)

$T_{AA} = 100°C$

$T_{RT} = 25°C$

$Q_{10} = 2.5$

$$RT = AAT \times Q_{10}^{\left[\frac{TAA-TRT}{10}\right]}$$

$$RT = 1 \times 2.5^{\left[\frac{100-25}{10}\right]}$$

$$RT = 965.05\ days \div 365 \frac{days}{year}$$

$$= 2.6\ years$$

Days @100°C	Years @ 25°C
1	2.6
2	5.3
3	7.9
4	10.6
5	13.21
6	15.86
7	18.51

Discussion

From the data, graph of viscosity versus day are plotted for both accelerated ageing and UV ageing.

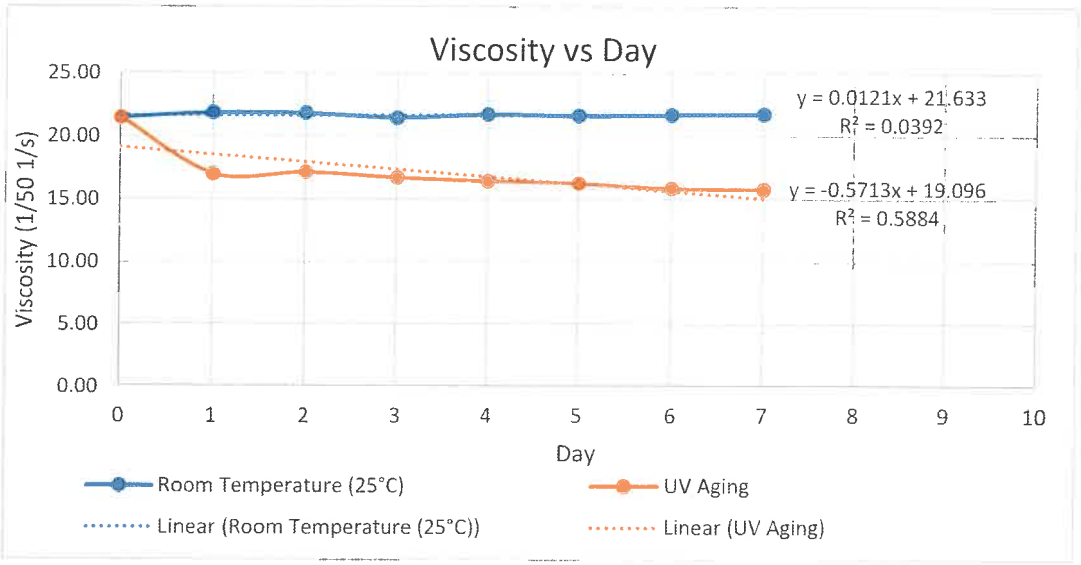

Table 16 Viscosity VS Day (Project 2)

From the graph, it can be seen that the viscosity of the gel for UV ageing is a linear stable graph with a slight fluctuation at day 2, whereas the graph for control shows a decrease in viscosity and reach a constant rate of 21.0 Pa·s. This is because the viscosity test done on the gel sample under the effect of control aging is equivalent to 18.51 years whereas for UV aging is just up to 7 days. Viscosity of gel exposed with UV accelerated aging has been decreasing over period of time and able to meet the minimum limit of viscosity specification. When the gel exposed to UV light for 7 days, the gel undergoes UV degradation process thus the gel oxidized.

The oxidation of a hydrocarbon fluid consists of three fundamental steps: initiation, propagation, and termination. With these steps in mind, oxidation can be controlled by modifying one or more of its steps or phases. This is accomplished by restricting the source of oxygen (the initiation), reducing the number of reaction cycles (the propagation), or introducing alternate stopping methods (increasing termination). To some extent, all these methods are used in the formulation of lubricants. The process begins with the initiation, and preventing oxygen is the first line of defence.

From observation table of thermal ageing in oven, there is no oil layer at the top of the gel indicating bonding of polymer and base oil is still intact. There is trace number of volatiles lost in flame retardant gel whereas the volatile loss percentage is 0.16% after 24 hours been placed in the oven at temperature 100°C. The percentage of volatile loss increased until day 7 which is until 0.21% of volatile loss. As a conclusion, FR gel is well performed under 100°C thermal aging with low volatile loss and no oil separation issue.

Conclusion

To conclude, FR gel able to meet the approved specification of viscosity test, OIT test, oil separation and volatile loss, UV aging test and no oil separation take place in thermal aging.

4.3 Problem encountered and approach adopted for solving problem

There are several problems that I have encountered during the 24 weeks of my internship. As a chemical engineering student, I tried to solve the problem calmly and rational. One of the problems that I encountered during my internship was lack of information about the product that UNIGEL has produce. It is important to well known about the type of products itself, the function of product and the properties of the products because it will make it easier to differentiate the products and know the procedure of handling the product such as method of taking sample for quality check and method that been use for quality check. For me to solve the problem, I come up with solution that I always refer the manual procedure of all the products so that I can avoid any mistake when handling any products.

Another problem that I have encountered during my internship was its hard for me to have communication with other staff or workers. The factor that I think that lead to the problem was I was new to the working environment, and I don't have much confident to have a communication with them. Because of that, it effects my working performance because I was too afraid to ask for help and ask if I don't have knowledge about something. By that, I come up with fresh mindset that I must be more confident with people and just ask anything relevant without afraid of anything because if I don't ask then I will never expand my knowledge.

4.4 Professional and ethical issues

Professionalism and ethics are important profession in workplace. Professional ethic can be defined as professional accepted standards of personal and working behaviour, value, and guiding principles. In the new era of working experience, works can be harder to be done by staff because of that guideline or principles are needed to guide them. Professional ethics mentality helps workers to think that what should they do when they faced with problem and solve the problems. In other way, professional ethics can improve working experience become healthier and increase in term of productivity of company.

UNIGEL took the concept of professional and ethics in working very serious because company wants to keep a healthy environment of working in factory. UNIGEL also want to ensure that all staff and workers can be their best results of working that can help company to increase their output. UNIGEL also taking safety of workers and workplace very seriously to prevent any incident happen to workers in workplace. All that shows that UNIGEL provide a healthy and safe environment of workplace before, during and after working hours.

4.5 Health, environmental and sustainable aspects

Sustainability can be defined as the ability to maintained something at a certain rate or level. This term also can be used as a process by which something can be kept at a certain rate. Nowadays, due to the increment of social and environmental problems that our society facing, sustainability has been increasingly used in a particular strategy.

The principles of sustainability are the foundations of the term and concept of sustainability. Consequently, sustainability is made up of 3 elements which is environmental, economy, and social. These elements also informally known as planet, profit, and people. In engineering context, the process of designing or operating systems in such a way that they use energy and resources in a way that does not jeopardise the natural environment or future generations' ability to meet their own needs.

Environmental

Here in UNIGEL Compounds SDN BHD, we implement SDG 12 which is responsible consumption and production by recycling the residue gel to the labelled liquid waste container to reuse the gel. Sustainable consumption and production entails encouraging resource and energy efficiency, as well as providing access to basic services, green and decent jobs, and a higher quality of life for all. Its implementation aids in the achievement of overall development goals, the reduction of future economic, environmental, and social costs, the strengthening of economic competitiveness, and the reduction of poverty.

Health

UCSB provides a positive work environment for its employees by providing complete facilities and a friendly work environment and comply the ISO 14001. ISO 14000 is a quality management system for the environment. It includes requirements for achieving and maintaining environmentally sound business practises. The entire business process is taken into account, from product development to product performance and, finally, product disposal.

The use of personal protective equipment (PPE) by employees performing any operation at the production plant or entering the warehouse is required to ensure their safety while working. This is done to ensure that all unwelcome incidents are avoided, and that employee security is maximised. PPEs include coveralls, safety boots and helmets, and safety glasses. Depending on the workplace, an additional piece of PPE, such as a mask, should be worn. For example, when visiting the production site, employees must wear full PPE to ensure their safety due to the warehouse's numerous potential hazards.

In UNIGEL, employers must provide a safe working environment for their employees regardless of the type of work they do. The control of safety is connected to all personnel and should be reliably consented at anytime, anywhere in the work area. The SSF department had created contingency plan areas to deal with emergencies. During an emergency, everyone is advised to remain calm in order to avoid a chaotic and panicked situation that could worsen the situation. Everyone must follow the instructions and exit through the nearest exit. The assembly point is already set up at every terminal, offshore platform, and office.

Economy

In UNIGEL, there were a lot of gel waste collected during the process. First, the output waste from mechanical filter of process tank. The mechanical filter needs to be flushed from time to time to avoid the clogging of gel and sediment when transferring the gel into mixer. Then, before discharging the product into drum or IBC, the pipe inline at the discharge point need to be flushed to remove the residue of previous product. This is to maintain the quality of finished goods. Then, the gel waste from flushing of mechanical filter and pipe inline of discharge point will be recycle into the process tank. By recycle the gel waste, UNIGEL has minimized the schedule waste thus reduced the schedule waste cost.

CHAPTER 5: CONCLUSION

5.1 Conclusion

24 weeks as an intern student for UNIGEL company has taught me a lot in terms of working experience. I have learned about how factory operates with combination of machines to produce finish goods. During my internship period in UNIGEL, it has opened my eyes and give me a clear view on production industry, and they operate.

In addition, I have improved and develop practical skills such as communication skill, time management skill and problem solving. I'm grateful for having a chance to utilize my knowledge throughout my internship training. The opportunity of this internship gives me the networking in my profession for my future purpose. Therefore, I can conclude that my internship objectives are achieved and it full of exposure.

5.2 Suggestion and Recommendations

In my opinion, this internship program was a good exposure for student to apply what they have learn in engineering school. It has also help student to expand their knowledge and skills so that student can be an outstanding worker in future with an extra knowledge and skills.

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Individual – Ms Mok Chon Yee (Industrial raining Supervisor)

Individual – Jamie Jeremy (Lab Technician)

Individual – Radzi Bin Rashid (Production Leader)

APPENDIX

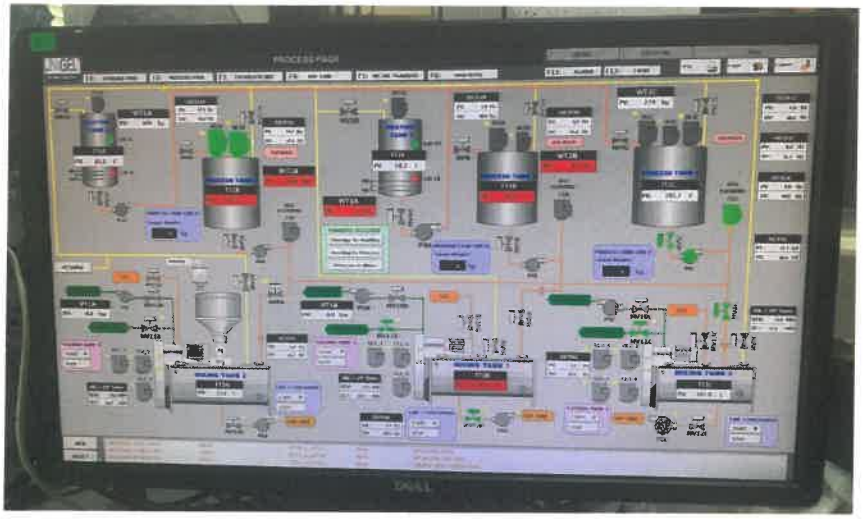

Figure 10 Distributed Computer System for process flow

Figure 11 Sample cables by Premier cable

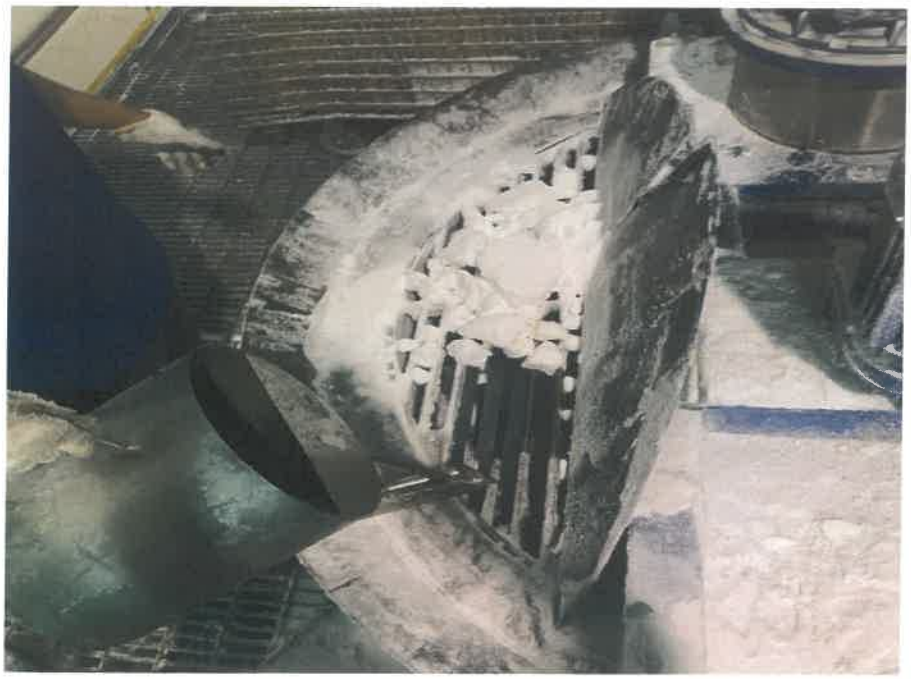

Figure 12 Pour polymer into Process tank

Figure 13 Changing new nitrogen gas

Figure 14 Cleaning the strainer

Figure 15 Creel table

Figure 16 Stacked Up Machine