UNIVERSITI TEKNOLOGI MARA MALAYSIA

Kualiti Alam

INDUSTRIAL TRAINING FIELD REPORT

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Programme : Diploma in Chemical Engineering (EH110)

ID : 2018246238

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UNIVERSITI TEKNOLOGI MARA MALAYSIA

Kualiti Alam

TABLE CONTENT

INTRODUCTION

Industrial training is an important component in engineering curriculum and one of the courses that listed in the course outline for student to get a diploma in Chemical Engineering at UiTM. This opportunity is a good chance for the student to gain exposure in real industry while be in studying. Students will be placed at selected departments or organizations during the industrial training for a period of time, to expose themselves about the real industry and also to relate what they had been learned theoretically at university with the real applications. All the students must complete at least 14 weeks of industrial training with 7 credits hours in order to get the award of Diploma of Chemical Engineering. This industrial training was implemented during the semester 6 which is last semester for diploma in Chemical Engineering.

Industrial training is a program that help the student to give an extra information and insight about the real industry for all the undergraduate students. This industrial training needs to be evaluated by the supervisor and lecture who in charge in this industrial training. This evaluation is to evaluate the student's performance during the industrial training. This opportunity will make the students to better understand about the engineering works in general and can enhance the knowledge and experience of the students related to their courses during their internship. This is an advantage for them to gain all the experience and knowledge and it is detrimental if they did not used it. All the knowledge and experience will be used in future career.

At the end of the industrial training, all the undergraduate's students should be able to:

i. To identify the types of work that chemical engineers do in real engineering world and appreciate the theoretical knowledge learnt.
ii. Perform basic engineering practices, including technical writing report, communication with colleagues, handling project and generating proposal for betterment of the industries.
iii. Have higher level of integrity, ethical and accountability in practicing engineering.

ORGANIZATION BACKGROUND

1.1 Company's Profile

Kualiti Alam Sdn Bhd (KASB) is one of the subsidiaries companies of the Cenviro Sdn Bhd. Cenviro Sdn Bhd, is stands for "Clean Environment" which is owns by the Khazanah Nasional Berhad's investment in sustainable development. Kualiti Alam Sdn Bhd owns and operates the only Integrated Hazardous Waste Management Centre (WMC) in Malaysia which had been in operation since 1998. Kualiti Alam provides a complete service for scheduled waste disposal from "cradle to grave" which includes collection of waste, proper handling, identification, treatment, recycle & recovery and disposal of schedules waste.

WMC hold license to handle 76 from 77 categories of Schedules Waste listed under Environmental Quality Regulation 2005 excluding the radioactive and explosive type waste. However, they are fully licensed to treat Technologically Enhanced Naturally Occurring Radioactive Material (TERNOM) waste by Atomic Energy Licensing Board (AELB) of Malaysia. Ternom waste is a waste that have low value in radioactive other than radioactive waste. Ternom Waste that being transferred to the WMC is from drilling process of Oil & Gas company which is the waste is sludge. Sludge form drilling process is classified as Ternom Waste.

In 1996, Kualiti Alam Sdn Bhd was operated the first collection of waste includes the daily transportation of waste form waste generator (industry) to the Waste Management Centre (WMC) within the peninsular Malaysia. All the vehicles are equipped with the necessary safety and communication equipment liked Global Positioning System (GPS) tracking system, in order to ensure the safety of the scheduled waste transported from the waste generator (WG) to Waste Management Centre.

The integrated WMC is located at Ladang Tanah Merah A3 Division, Bukit Pelanduk, Negeri Sembilan. These facilities have the capacity to store, treat and dispose of more than 100,000 tonnes of all kinds of hazardous waste annually. This is the end-to-end facilities comprise of Incineration Plant, Physical and Chemical Treatment Plant, Solidification Plant, Scheduled Waste to Energy Plant, Clinical Waste Management Centre and Vertical Secured Landfill.

As a major industry in the Malaysian environmental services industry, Kualiti Alam has the opportunities and capabilities to meet the environmental needs in the waste disposal and management. The services include the properly managing and handling waste provided help to preserve Malaysia's environmental.

Figure 1.1: Overview of Waste Management Centre (WMC)

1.2 Company's Corporate Structure

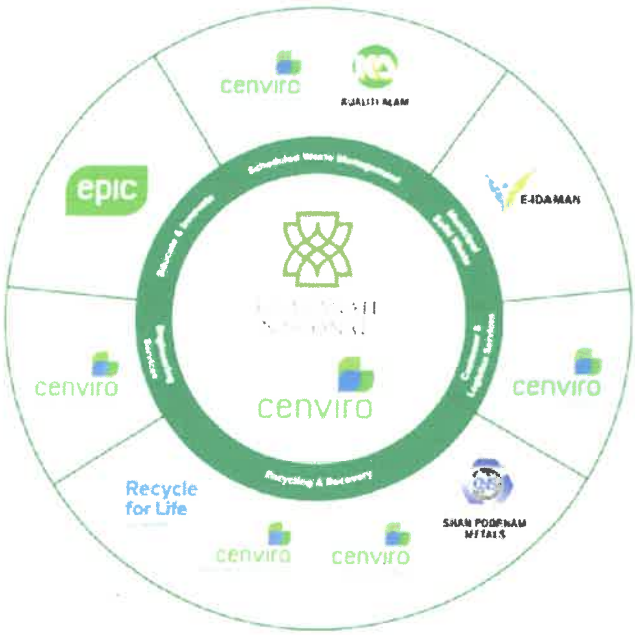

Figure 1.2: Company's Corporate Structure

1.3 Company's Logo

Figure 1.3: Kualiti Alam Sdn Bhd Corporate Logo

1.4 Company's Vision

The Modern Resource Company

1.5 Company's Mission

We deliver safe and innovative waste recovery and recycling solutions in the drive towards full circular economy.

1.6 Company's Core Value

Known as a "SHIELD"

i. Safety
ii. Holistic
iii. Integrity
iv. Environment
v. Lean
vi. Diversity and Inclusiveness

1.7 Organizational Chart

1.7.1 Kualiti Alam Sdn Bhd

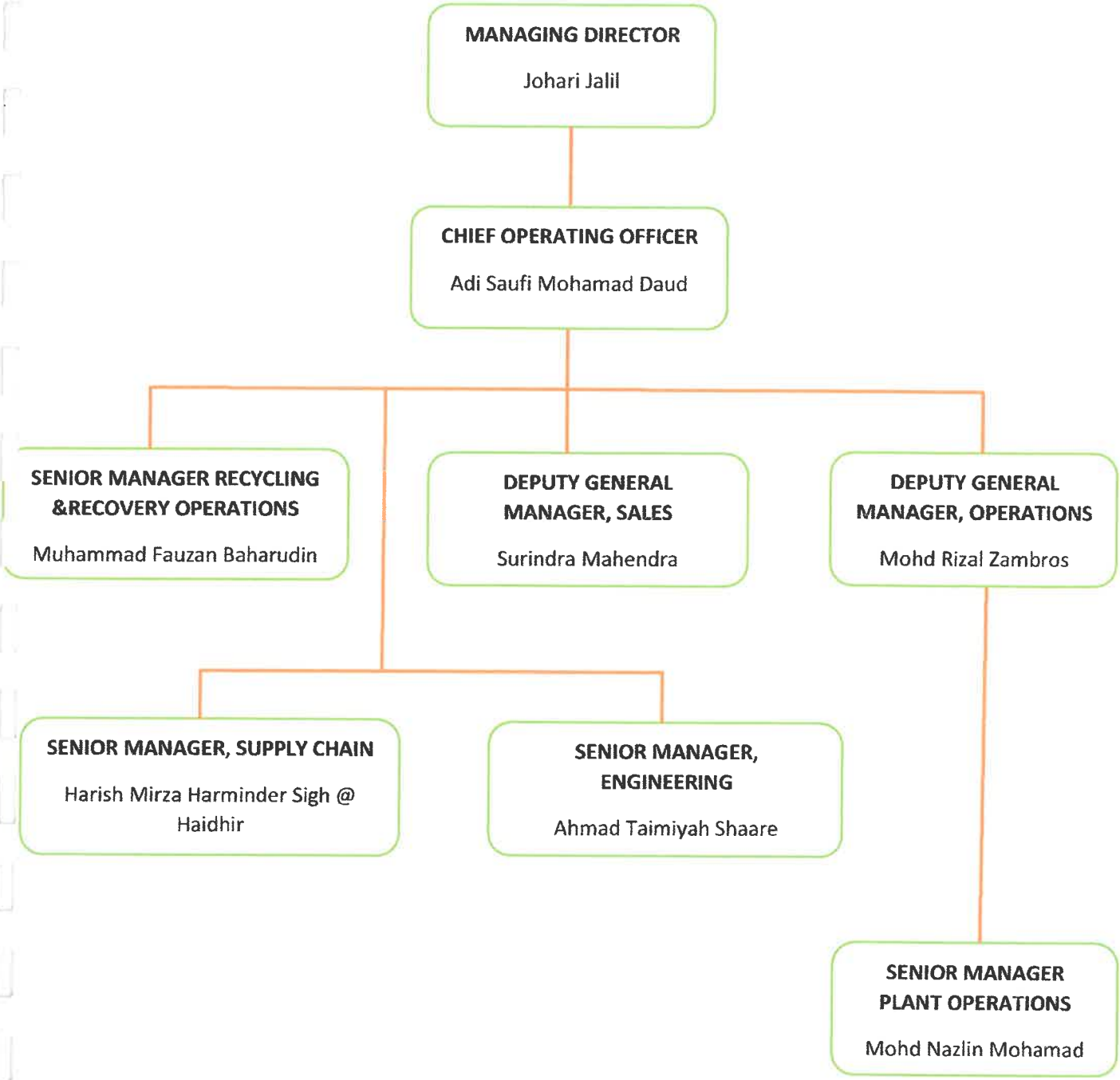

Figure 1.4: Kualiti Alam Sdn Bhd Organization Chart

1.7.2 Production 1

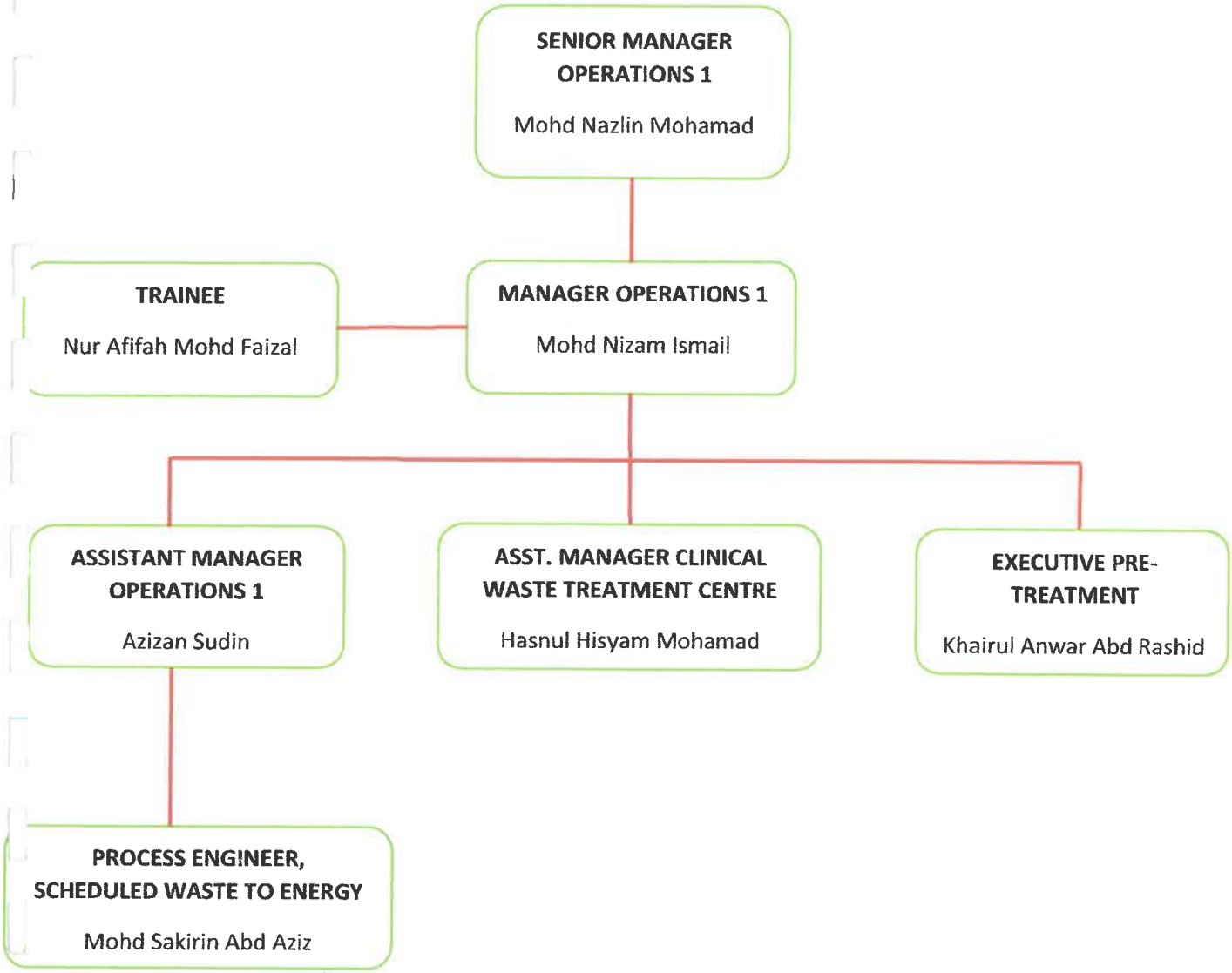

Figure 1.5: Production 1 Organization Chart

OVERALL PROCESS FLOW

Figure 2.1: Overall Process Flow WMC

The overall process flow started from the collection process from the waste generator. Waste generator is an industry or school that sent the waste to the WMC. During this process, a Marketing Agent (Cenviro Services) advises the Waste Generator about the proper waste packing and labelling to prepare waste for delivery to Kualiti Alam (KA). Before activating the waste collection, waste generator and Kualiti Alam must signed a Scheduled Waste Transportation and Treatment Agreement (SWTTA). After sign the agreement, the Marketing Agent will provide the transportation vehicle deployment between the Waste Generator and Kualiti Alam.

Upon arrives at the WMC, the vehicle will be weight together with the waste at the weighbridge before transferred to the warehouse. Then, the waste containers will be bar-coded, and the data will be logged into Electronic Integrated Waste Information System (EIWIS) to ensure all the data were accurate and reliable. At the warehouse, Inspection and Sampling team will take a sampling of waste from each waste that which has just arrived at the WMC. The sampling of waste will be transferred to the lab to be analyse. Then, the Waste Evaluation Centre (WEC) will evaluate the results and considered which plant is suitable for all the waste and the waste is ready for treatment or disposal.

There are 6 plants in the Waste Management Centre which includes the Incineration (INC) 1 plant, Schedule Waste to Energy (SWTE) plant, Physical and Chemical Treatment plant, Solidification plant, Clinical Waste Treatment Centre and Vertical Secured Landfill. To identified which of the waste is suitable, it is based on 2 types of waste which is Organic Waste and Inorganic Waste.

Organic waste is a material that contains of carbon content and it will produce a carbon dioxide (CO_2) and carbon monoxide (CO) gases while being burned. Inorganic waste is a material that contain chemical substances which is acidic or alkaline waste and difficult to decompose such as cyanide and chromate waste. Organic waste is for Incineration plant and Schedule Waste to Energy plant while inorganic waste is for Physical and Chemical Treatment plant and Solidification plant. For Clinical Waste Treatment Centre (CWTC), it is specifically for clinical waste only that came from a private hospitals and clinics. These facilities also treat and dispose a COVID-19 waste from the government hospitals.

DAILY ACTIVITIES

22 March until 26 March 2021

Day	Description of practical training experience
1	- Briefing about the background's company, rules, overall process flow and other's department in Kualiti Alam Sdn Bhd. Briefing were conducted by the human resources management. - Briefing about the safety and security by Head of Safety and Security Environment's (HSSE) departments. - Introduce myself to the supervisor for the first time which is **Mr Mohd Nizam Bin Ismail**, that worked as Manager of Operation 1 in Kualiti Alam Sdn Bhd. - Briefing about the task, projects and activities during the industrial training in the KASB. - Introduce myself to the all of the employees in Incineration 1 operations which is to the assistant manager, supervisor's plant, panel and technician. - At the end of the day, Mr Nizam (supervisor) handed over the schedule industrial training for 17 weeks in KASB.
2	- In the morning, started to do the first task which is to find the information regarding to the company background and nature of business of Kualiti Alam Sdn Bhd based on the schedule that has been given by supervisor yesterday. - Do the research about the KASB via their website which is Cenviro Sdn Bhd and also based on the information that been given by the supervisor. - In the evening, briefing about the incineration 1 operation which includes the types of equipment, overall process flow, etc by Mr Nasharuddin that worked as a supervisor plant. - Going to the plant visit with Mr Nasharuddin after the briefing session complete to show the overview of the incineration plant.
3	- In the morning, continue the briefing session with Mr Nasharuddin about the incineration plant which is about the characteristic of the waste that being treat and dispose in incineration plant. - After the session finished, continue to do the research and gather all the information about the Kualiti Alam Sdn Bhd. - In the evening, learn about the others with others internship student which is from Physical & Chemical Treatment plant and Mechanical Engineering departments. • Nurul Atiqah – Internship of PCT plant • Alya Wafa – Internship of Mechanical Engineering department.

	- Briefing a little a bit about the process of Incineration 1 Operation to the both of the trainee based on the information that collect form the Mr Nasha session and also from the manual book of INC1 Operation that has been given by Mr Azizan, that worked as an Assistant Manager of Incineration Plant. - At the end of the day, gathered all the information throughout the day in the notebook.
4	- In the morning, continue to do the first task which is to gathered all the information about the Kualiti Alam Sdn Bhd and Cenviro Sdn Bhd. - All the information will be gathered in the notebook to ensure all the information is easier to find when do the presentation to the Mr. Nizam at the end of the week. - In the evening, read the manual book of Incineration 1 Operations to prepare for the second task which is Understanding the Operation of Incineration 1 plant. - Jot down the important information of Incineration 1 operation based on the manual book in the Microsoft Words.
5	- In the morning, started to prepare for the presentation of task one which is The Background of Kualiti Alam Sdn Bhd. - Finished up the gathered information before present to the Mr Nizam in the evening for the presentation weekly. - In the evening, continue to read the manual book for the Incineration 1 Operation to prepare for the next task. - Presentation started at 3.00 pm in the meeting room with the Mr Nizam (supervisor). - Comment after the presentation: • Find the definition of organic and inorganic waste • Find about the Ternom Waste

29 March until 2 April 2021

Day	Description of practical training experience
1	- In the morning, find the definition of the organic and inorganic waste based on the comment after the presentation with Mr Nizam. - Find also the information about the Technology Enhanced Naturally Occurring Radioactive Material or known as "TERNOM" waste. - Started to do the Process Handbook for Incineration 1 Operation based on the new task that given by the supervisor on Friday. - In the evening, continue do the second task which is to understand the overall process of INC1 operation. - Sketch the overall process flow in the A4 paper based on the collected information about it.
2	- In the morning, ask Mr Yuzaini about the process flow of INC 1 operation which is • The flow rate for each of the waste and material that used in the operation. - Based on the information, continue do the sketch and fill up the information to finished the sketching of process flow INC 1. - In the evening, started to sketch the overall process flow in the Microsoft Excel as required by the supervisor. - Find the information about the 3T + 1O which is the principles or rules for complete combustion in the Rotary Kiln (RK) and Secondary Combustion Chamber (SCC) which this equipment used to burn all the waste.
3	- In the morning, ask Mr Ganesan about the overall process flow for INC 1 which is • The flowrate for the substances that used in the process such as process water, cooling water, ambient air and etc. - After that, ask about the information of the 3T + 1O and compared the information that has been researched early with this information. - In the evening, continue ask Mr Ganesan about the stocker. Stocker is used in SWTE plant. • To determine the function of the stocker than Secondary Combustion chamber (SCC) used in the SWTE plant. - Continue to fill up the information about the process flow into the Microsoft Excel based on information that being told by Mr Ganesan.
4	- In the morning, continue do the second task which understand the process flow of INC 1 operation. • The function of the INC 1 operation • The types of the treated waste

5 April until 9 April 2021

Day	Description of practical training experience
1	Started the third task which is Understanding others Operation 1 Plant: • Schedule Waste to Energy Plant (**SWTE**) • Clinical Waste Treatment Plant (**CWTC**) • Pre-Treatment (**PTR**) Attached at Pre-Treatment for one day. **PIC**: Mr. Khairul (Executive Pre-Treatment) - Briefing about the overall process flow of Pre-Treatment by Mr. Khairul in his office. • The overall process flows • Intro about 6 unit in the pre-treatment which includes bunker, vacuum tank, tank farm, shredding, drum mainline and poison plant. • The characteristics of all the waste • The types of waste treated • How to labelling and distributed all the waste based on their characteristic - After the session complete, went to the site visit which is to show the overview of the 6 unit in the pre-treatment with Mr. Khairul. - In the evening, followed Mr. Khairul went to logistics area or warehouse to identify and select waste for SWTE and INC1 plant as well as to know the process flow how to identify the waste based on their labelling and packaging. • Warehouse – a storage place for all types of waste that came from the waste generator.
2	Attached at Schedule Waste to Energy plant for two (2) day. **PIC**: Mr. Sakirin (process engineer) & Mr. Khairul Anuar (supervisor) - Briefing about the Schedule Waste to Energy plant by Mr Sakirin that worked as a process engineer in the SWTE plant. • The introduction of the process flow of SWTE plant. - Continue briefing session by the Mr. Khairul Anuar that worked as a supervisor in SWTE plant. • The detailing of the overall process flow of SWTE plant. • The types of waste treated. • The characteristics of the waste.

	- After the session complete, went to site visit with Mr Khairul starting from the bunker until heat recovery boiler system to show the overview and also the equipment that used in the plants.
3	- In the morning, continue the site visit with Mr Khairul which is starting from the turbine system until flue gas treatment system. - Have some briefing about the process flow with Mr Romzi which is worked as a panel control room in SWTE plant. - Gathered all the information and started do the slide presentation about the overall process flow SWTE before present to Mr Sakirin in the evening. - In the evening, presentation started at 2.30 pm in the meeting room with the Mr Sakirin (process engineer) about the overall process flow of SWTE plant.
4	Attached at Clinical Waste Treatment Centre for one day. **PIC**: Mr. Hasnul Hisyam (ASS. Manager CWTC), Mr Firdaus (supervisor). - Briefing about the Clinical Waste Treatment Centre by Mr Firdaus that worked as supervisor in CWTC plant. • The detailing of the overall process flow of SWTE plant. • The types of waste treated. • The characteristics of the waste. - After the session complete, went to the site visit which is to show the overview of the process flow of CWTC plant. To look visually how to treat and dispose the clinical waste. - In the evening, started to gathered all the information about the Pre-Treatment, SWTE plant and CWTC plant in the Microsoft Words.
5	- In the morning, started do the progress handbook for INC plant starting from 2 April until 8 April 2021. - Finishing the report about the others operation 1 which includes Pre-Treatment, Schedule Waste to Energy plant and Clinical Waste Treatment Centre before present it to Mr Nizam (supervisor). - In the evening, revise back all the information regarding to the task given and do the final touch up before present. - Presentation started at 3.00 pm in the meeting room with the Mr Nizam (supervisor).

12 April until 16 April 2021

Day	Description of practical training experience
1	Started the fourth task which is Understanding others Kualiti Alam Plant Operation: • Physical & Chemical Treatment Plant (**PCT**) • Solidification Plant (**SOLI**) • Special Waste Treatment Disposal (**SWTD**) • Vertical Secured Landfill (**VSL**) Attached at Physical & Chemical Treatment Plant for one day. **PIC**: Mr. Tajul Arifin (ASST. Manager Operation 2) - Briefing about the Physical & Chemical Treatment plant by Mr Tajul that worked as assistant manager of the PCT plant. The briefing also involved the internship student which is Nurul Atiqah (Trainee PCT plant). • The detailing of the overall process flow of PCT plant. • The types of waste treated. • The characteristics of the waste. - After the session complete, went to the site visit which is to show the overview of the process flow of PCT plant. To look visually how to treat and dispose the inorganic liquid waste. - In the evening, followed Atiqah to do the small scale of WG waste that arrived at the PCT plant. • Small scale – to know the portion or ratio between the waste and the caustic soda/lime carbide which is to reduce the temperature of the waste during the mixing process to prevent any problem (explosive) occurred during that process.
2	Attached at Solidification plant for one day. **PIC**: Mr. Tajul Arifin (ASST. Manager Operation 2) & Mr Jaafar (panel). - Briefing about the Solidification plant by Mr Tajul that worked as assistant manager of the Ops 2 Operation. The briefing also involved the internship student which is Nurul Atiqah (Trainee PCT plant). • The detailing of the overall process flow of SOLI plant. • The types of waste treated. • The characteristics of the waste. - Continue briefing by Mr Jaafar that worked as a panel in the SOLI control room. • The detailing about the process flow of PCT plant • The issues/problem occurred and safety in the SOLI plant.

	- After the session complete, went to the site visit which is to show the overview of the process flow of SOLI plant. To look visually how to treat and dispose the inorganic solid waste. - In the evening, continue briefing about the SOLI plant and started to gathered all the information about PCT and SOLI plant in Microsoft Words.
3	Attached at Special Waste Treatment Disposal (SWTD) plant for one day. **PIC**: Mr. Tajul Arifin (ASST. Manager Operation 2) - Briefing about the Special Waste Treatment Disposal plant by Mr Tajul that worked as assistant manager of the Ops 2 Operation. The briefing also involved the internship student which is Nurul Atiqah (Trainee PCT plant). • The detailing of the overall process flow of SWTD plant. • The types of waste treated. • The characteristics of the waste. • The issues/problem occurred and safety in the SWTD plant. - After the session complete, went to the site visit which is to show the overview of the process flow of SWTD plant. To look visually how to treat and dispose the special waste liked cylinder gases and pressurize material. - In the evening, introduces myself to the SWTD employees and continue the briefing about the SWTD plant by Mr Zakaria which worked as a supervisor in that plant.
4	Attached at the Vertical Secured Landfill (VSL) for one day. **PIC**: Mrs. Shahira (Senior Engineer) - Briefing about the Vertical Secured Landfill by Mrs Shahira that worked as senior engineer of the Vertical Secured Landfill. The briefing also involved the internship student which is Nurul Atiqah (Trainee PCT plant). • The detailing of the overall process flow of VSL plant. • The types of waste treated. • The characteristics of the waste. • The issues/problem occurred and safety in the plant. - After the session complete, went to the site visit which is to show the overview of the process flow of VSL plant. To look visually how to dispose all the internal (KASB) and external waste (WG). - In the evening, followed Atiqah to do the small scale of WG waste that arrived at the PCT plant.

5	- In the morning, started do the progress handbook for INC plant starting from 9 April until 15 April 2021. - Finishing the report about the operations 2 which includes Physical & Chemical Treatment plant, Solidification plant, Special Waste Treatment Disposal plant and Vertical Secured Landfill before present it to Mr Nizam (supervisor). - In the evening, revise back all the information regarding to the task given and do the final touch up of the slide presentation before present it to the Mr Nazlin (Senior Manager Plant Operations) - Presentation started at 4.00 pm in the meeting room with Mr Nazlin with others internship students.

19 April until 23 April 2021

Day	Description of practical training experience
1	- In the morning, meet supervisor to discuss and do some presentation about last week task which is Understanding others Operations in Kualiti Alam. - Have also some discussions about next task which is Detail Technical understanding on INC1 Plant Operations. • Plant detail process low • Plant daily troubleshooting and operational issues • Plant support facility – instrument air, service air, etc - In the evening, started do the given task which is detailing on process flow of Incineration 1 operation. - Refer the information in the manual book first before ask workers about the information.
2	- In the morning, continue do the fifth task which about the detail process flow of incineration operations plant. • Do the research about the concept of demi water system and also boiler water system of INC1. • Do the research about the information for support facility – instrument air, service air, etc. - In the evening, started to sketch overall process flow of incineration operations • Incineration system • Heat recovery boiler system
3	- In the morning, continue to do the same task which is detailing of process flow INC1 plant. • Ask Mr Rauf about the information of support facility and also for the capacity every tank in the plant. • Ask Mr Yuzaini about the information of demi water and boiler water system. - In the evening, continue to ask about the overall process flow of INC1 operations to Mr Rauf and Mr Yuzaini. - Gathered all the given information in the notebook before transfer it into Microsoft Words.
4	- In the morning, do the report for all the gathered information to ensure it will be easier to find when do the presentation and also to get more understanding about every process flow. • Information of demi water system • Information of boiler system • Information of support facility – instrument air, service air, etc

	- In the evening, finished the sketching for overall process flow • Incineration system • Heat recovery system - Fill up the information for both system in the Microsoft Excel which the place to sketch the process flow.
5	- In the morning, finish the slide presentation for Operations 2 which about the overall process flow for every plant: • Physical & Chemical Treatment plant • Solidification plant • Special Waste Treatment Disposal • Vertical Secured Landfill - In the evening, continue do the task by doing some research about support facility which is about Cooling Water Tower. - Started do the progress handbook for INC plant starting from 16 April until 22 April 2021.

26 April until 30 April 2021

Day	Description of practical training experience
1	- In the morning, continue do the research about Cooling Water Tower to complete the task given for information of support facility in the plant. • The function and concept of the Cooling Water Tower. • The characteristics of the Cooling Water Tower. - In the evening, continue do the sketching for overall process flow of INC 1 operations on the A4 paper before transfer it into Microsoft Excel. • Flue gas treatment system
2	- In the morning, do the analysis and report about the gathered information of Cooling Water Tower in Microsoft Words for better understanding about the process. • The concept of Cooling Water Tower • The characteristics of Cooling Water Tower - In the evening, continue do the sketching for overall process flow of INC1 operations in the Microsoft Excel. • Flue gas treatment system
3	- In the morning, ask Mr Yuzaini about the detail of every equipment in flue gas treatment system to fill up the information in the Microsoft Excel. • Mass flowrate for every equipment. - Fill up the information given in the Excel after getting the information from the Mr Yuzaini. - In the evening, continue asking Mr Yuzaini about the concept of the Cooling Water Tower and to confirm the researching information gathered. - Gathered all the information in the Microsoft Words after getting the confirmation from the Mr Yuzaini.
4	- In the morning, followed Mr Rauf to the site to look the process cleaning of Cooling Water Tower and Wet Scrubber. • This situation happened when minor shutdown occurred due to repairing the IDF 1. - During the cleaning process, Mr Rauf also explained about the process flow. • Cooling Water Tower • Wet Scrubber - In the evening, continue to gathered all the information given in the Microsoft Words.

5	- In the morning, started do the slide presentation for INC 1 detailing process flow before present it to Mr Nizam. • Plant detail process low • Plant daily troubleshooting and operational issues • Plant support facility – instrument air, service air, etc - In the evening, started do the progress handbook for INC plant starting from 23 April until 29 April 2021. - Finished the overall report for this task which is Detail Technical understanding on INC1 Plant Operations.

4	- In the morning, started to do the report for overall process flow of SWTE Operations based on the old and new information given. • Plant detail process low • Plant daily troubleshooting and operational issues • Plant support facility – instrument air, service air, etc - In the evening, started to sketch overall process flow of incineration operations • Turbine system • Flue gas treatment system
5	- In the morning, fill up the new information given about the process flow into the Microsoft Excel. - Finished up the report for the overall process flow of SWTE Plant Operations. - Started do the progress handbook for INC plant starting from 3 May until 6 May 2021.

10 May until 14 May 2021

Day	Description of practical training experience
1	- In the morning, has an induction programme that held by the Environmental Preservation and Innovative Centre (EPIC) via Microsoft Team for the whole day. • The operations in Kualiti Alam Sdn Bhd • Kualiti Alam Sdn Bhd Nature Business • Cenviro Sdn Bhd Nature Business - The induction started from 9.00 am until 4.00 pm
2	- In the morning, continue induction programme session for day 2 via Microsoft Team for the whole day. • Talk about every department involved in Kualiti Alam Sdn Bhd. - The induction started from 9.00 am until 1.00 pm
3	- In the morning, asking Nurul Atiqah (internship student's PCT plant) about the process flow of the PCT plant. • Process flow of the lime carbide and acid in the reactor • Preparation of the mixing process of acid waste and ice. - Started do the progress handbook for INC plant starting from 7 May until 11 May 2021.
4	**HOLIDAY (HARI RAYA AIDILFITRI)**
5	**HOLIDAY (HARI RAYA AIDILFITRI)**

17 May until 21 May 2021

Day	Description of practical training experience
1	- In the morning, started to do the Project 1 which is Module Training Operations 1 that has been given in the first week by the supervisor. • Company background of the Cenviro Sdn Bhd and Kualiti Alam Sdn Bhd. • Incineration 1 plant Operations • Schedule Waste to Energy plant Operations • Clinical Waste Treatment Centre • Pre-Treatment - Started to find information for Company Background of the Cenviro and Kualiti Alam Sdn Bhd. - In the evening, continue to do the same task which to find the information about the company background for Cenviro and Kualiti Alam.
2	- In the morning, started to compile all the information that had been collected from the first task that be jot down in a notebook and also in the Microsoft Words. • Company Background of Cenviro and Kualiti Alam. - Finished up the compile process about the information for Company Background of the Cenviro and Kualiti Alam Sdn Bhd and transfer it into the Microsoft Words. - In the evening, started to find information for Pre-Treatment and Incinerations Operations. • Overall process flow • Definition/purpose of the facilities • Identify major problem/issues in the plant.
3	- In the morning, started to compile all the information that had been collected from the third task that be jot down in a notebook and also in the Microsoft Words. • Overall process flow for INC1 and Pre-Treatment. • Definition/purpose of the facilities • The major problems/issues in the plant. - Finished up the compile process for the information of Pre-Treatment Operations. - In the evening, finished up the compile process for the information of Incineration 1 Plant Operations. - Started do the progress handbook for INC plant starting from 11 May until 18 May 2021.

4	- In the morning, gathered all the information to start do the slide for the first project which is Module Training by using Canva. - Started the slide with Company Background of the Cenviro Sdn Bhd and Kualiti Alam Sdn Bhd. - In the evening, finished up the slide module of the Company Background of the Cenviro and Kualiti Alam before move to the next facilities which is Pre-Treatment facilities and Incineration 1 Plant Operations. - After finished the slide, do some comparison with the slide that supervisor give for the references.
5	- In the morning, continue to do the Module Training's slide for the Nature Business of the Company and the overall process flow for Operations 1. • Begin with the waste collection until dispose process. - In the evening, continue the same task which is to do the Module Training's slide for the Overall process flow of Operations 1. - Started do the progress handbook for INC plant starting from 18 May until 20 May 2021.

24 May until 28 May 2021

Day	Description of practical training experience
1	- In the morning, continue to do the Module Training's slide for the Nature Business of the Company and the overall process flow for Operations 1. • Overall process flow for Operations 1. ➢ Pre-Treatment Operations. ➢ Incineration 1 Plant Operations. ➢ Schedule Waste to Energy Plant Operations. ➢ Clinical Waste Treatment Centre Plant Operations. - In the evening, finished up the same task which is to do the Module Training's slide for the Overall process flow of Operations 1.
2	- In the morning, continue to do the Module Training's slide for the Pre-Treatment part. • Definition of the Pre-Treatment Operations. • Overall process flow PTR - In the evening, finished up the same task which is to do the Module Training's slide for the definition and overall process flow of Pre-Treatment Operations.
3	- In the morning, continue to do the Module Training's slide for the Incinerations 1 Plant Operations part. • Definition of the INC 1 Plant Operations. • Overall process flow INC1 Plant Operations - In the evening, finished up the same task which is to do the Module Training's slide for the definition and overall process flow for the INC1 Plant Operations.
4	- In the morning, continue to do the Module Training's slide for the Incinerations 1 Plant Operations part. • Detailing on every equipment in the plant. ➢ The major problem/issues on every equipment ➢ The critical parameter for every equipment - In the evening, finished up the same task which is to do the Module Training's slide for the detailing on every equipment in the plant for the INC1 Plant Operations.
5	- In the morning, final touch up for the Module Training's slide for the Incinerations 1 Plant Operations part. • Definition of the INC 1 Plant Operations. • Overall process flow INC1 Plant Operations.

	• Detailing on every equipment in the plant. - In the evening, continue to do the final touch up for the same task which is to do the Module Training's slide for the definition, overall process flow and detailing on every equipment for the INC1 Plant Operations. - Started to find information for Schedule Waste to Energy (SWTE) VS Incineration (INC) 1 Operations.

31 May until 4 June 2021

Day	Description of practical training experience
1	- In the morning, started to compile all the information that had been collected from the third task that be jot down in a notebook and also in the Microsoft Words. • Schedule Waste to Energy (SWTE) • Incineration (INC) 1 Operations - Finished up the compile process for the information of SWTE versus INC1 Plant Operations. - In the evening, started to find information for Schedule Waste to Energy (SWTE) Plant Operations. • Overall process flow • Definition/purpose of the facilities • Identify major problem/issues in the plant.
2	- In the morning, started to compile all the information that had been collected from the third task that be jot down in a notebook and also in the Microsoft Words. • Overall process flow for SWTE Plant Operations. • Definition/purpose of the facilities • The major problems/issues in the plant. - Finished up the compile process for the information of Schedule Waste to Energy (SWTE) Plant Operations. - In the evening, finished up the compile process for the information of Schedule Waste to Energy (SWTE) Plant Operations.
3	- In the morning, continue to do the Module Training's slide for the Schedule Waste to Energy (SWTE) Plant Operations part. • Definition of the SWTE Plant Operations. • Overall process flow SWTE Plant Operations - In the evening, finished up the same task which is to do the Module Training's slide for the definition and overall process flow for the INC1 Plant Operations. - Continue to do the Module Training's slide for the Schedule Waste to Energy (SWTE) Plant Operations part. • Detailing on every equipment in the plant. ➢ The major problem/issues on every equipment ➢ The critical parameter for every equipment
4	- In the morning, continue to do the Module Training's slide for the Schedule Waste to Energy (SWTE) Plant Operations part. • Detailing on every equipment in the plant.

	➢ The major problem/issues on every equipment ➢ The critical parameter for every equipment - In the evening, finished up the same task which is to do the Module Training's slide for the detailing on every equipment in Schedule Waste to Energy (SWTE) Plant Operations. - Started to find information for Clinical Waste Treatment Centre Operations. • Overall process flow • Definition/purpose of the facilities
5	- In the morning, started to find information of Process Handbook for Incineration 1 and Schedule Waste to Energy Plant Operations. • Identify the major problems/issues. • Identify the root causes. • Identify the corrective point. - Started to compile all the information that had been collected from the third task that be jot down in a notebook and also in the Microsoft Words. • The major problems/issues • The root causes • The corrective point

7 June until 11 June 2021

Day	Description of practical training experience
1	**HOLIDAY**
2	- In the morning, continue to do the Module Training's slide for the Clinical Waste Treatment Centre (CWTC) Plant Operations part. • Definition of the SWTE Plant Operations. • The characteristics of the treated waste. - In the evening, finished up the same task which is to do the Module Training's slide for the definition and the characteristics of CWTC Plant Operations.
3	- In the morning, continue to do the Module Training's slide for the Clinical Waste Treatment Centre (CWTC) Plant Operations part. • Overall process flow of CWTC plant, starting from collecting process until dispose process. - In the evening, finished up the same task which is to do the Module Training's slide for the overall process flow of CWTC Plant Operations. - Continue to do the Module Training's slide for the Process Handbook for Incineration 1 and Schedule Waste to Energy Plant Operations part. • The major problems/issues • The root causes • The corrective point
4	- In the morning, started to do the Project 3 which is Schedule Waste to energy (SWTE) Reverse Osmosis Membrane Optimization that has been given in the first week by the supervisor. • Definition Reverse Osmosis • Overall Treatment Process Flow ➢ Detailing on every equipment • Detailing on Reverse Osmosis info. ➢ The effectiveness of RO membrane • Lifespan of Reverse Osmosis • Summary. - Started to find all the information for SWTE Reverse Osmosis Membrane Optimization project. - In the evening, continue to do the same task which to do some research about the reverse osmosis process. • Definition of the Reverse Osmosis • Overall Treatment Process Flow ➢ Detailing on every equipment

5	- In the morning, continue do the research about the project by using the manual book of SWTE plants and also from the internet. • Definition of the Reverse Osmosis • Overall Treatment Process Flow ➢ Detailing on every equipment - In the evening, started to compile all the information that had been collected from the previous task which is about the Detailing of SWTE Plant Operations. • Definition of the Reverse Osmosis • Overall Treatment Process Flow ➢ Detailing on every equipment

14 June until 18 June 2021

Day	Description of practical training experience
1	- In the morning, started do the research about the project by using the manual book of SWTE plants and also from the internet. • Lifespan of the Reverse Osmosis ➢ Reverse Osmosis Membrane ➢ Carbon Filter ➢ Micro Filter - In the evening, continue do the research about the project by using the manual book of SWTE plants and also from the internet. • Lifespan of the Reverse Osmosis ➢ Reverse Osmosis Membrane ➢ Carbon Filter ➢ Micro Filter
2	- In the morning, started to compile all the information that had been collected from the manual book of SWTE plants and the internet. • Lifespan of the Reverse Osmosis ➢ Reverse Osmosis Membrane ➢ Carbon Filter ➢ Micro Filter - In the evening, finished up the compile process for the information of Schedule Waste to energy (SWTE) Reverse Osmosis Membrane Optimization.
3	- In the morning, gathered all the information to start do the slide for the third project which is Schedule Waste to energy (SWTE) Reverse Osmosis Membrane Optimization by using Canva. - Started the do the slide for project 3. • The project's Objective • The Definition of the Reverse Osmosis • The Overall Treatment Process Flow - In the evening, finished up the slide for the project's objective, definition of the RO process and the overall treatment process flow.
4	- In the morning, continue to do the Schedule Waste to energy (SWTE) Reverse Osmosis Membrane Optimization project's slide part. • Overall Treatment Process Flow ➢ Detailing on every equipment - functions and lifespan of the membrane.

	- In the evening, finished up the same task which is to do the Schedule Waste to energy (SWTE) Reverse Osmosis Membrane Optimization project's slide part. • Overall Treatment Process Flow ➢ Detailing on every equipment – functions and lifespan of the membrane.
5	- In the morning, continue to do the Schedule Waste to energy (SWTE) Reverse Osmosis Membrane Optimization project's slide part. • Detailing on Reverse Osmosis info. ➢ The effectiveness of RO membrane • Lifespan of Reverse Osmosis Membrane - In the evening, continue do the same task which is to do the Schedule Waste to energy (SWTE) Reverse Osmosis Membrane Optimization project's slide part. • Detailing on Reverse Osmosis info ➢ The effectiveness of RO membrane • Lifespan of Reverse Osmosis Membrane

21 June until 25 June 2021

Day	Description of practical training experience
1	- In the morning, started to do the Project 2 which is Schedule Waste to Energy (SWTE) Minor Shutdown Case Study that has been given in the first week by the supervisor. • The Objective case studies • The Duration of Shutdown • List of the Department and Contractor involved • List of work prepared by ➢ Maintenance ➢ Process technician ➢ Contractors ➢ Electrical & Instruments • List of Work Identify • Actual of Project Gant Chart Progress • Conclusion - Started to find all the information for Schedule Waste to Energy (SWTE) Minor Shutdown Case Study project. - In the evening, continue to do the same task which to find information for Schedule Waste to Energy (SWTE) Minor Shutdown Case Study. • Definition of the Shutdown • Purpose of the Shutdown in general
2	- In the morning, continue to find and collect all the information about the shutdown process. • The definition of the shutdown • Purpose of the shutdown - In the evening, continue to do the same task which to do some analysis about the information of SWTE shutdown that had been given by the supervisor which is Mr Nizam. - Jot down all the information on the A4 paper before transfer to the Microsoft Words for better understand about the process.
3	- In the morning, continue to find and collect all the information about the shutdown process. • The objective of the SWTE shutdown • The duration of SWTE shutdown • The list of department and contractor involved - In the evening, continue to do the same task which to do some analysis about the information of SWTE shutdown that had been given by the supervisor which is Mr Nizam.

	• The objective of the SWTE shutdown • The duration of the SWTE shutdown • The list of departments and contractors involved - Jot down all the information on the A4 paper before transfer to the Microsoft Words for better understand about the process.
4	- In the morning, continue to find and collect all the information about the shutdown process. • The list of work prepared by ➢ Maintenance ➢ Process technician ➢ Contractors ➢ Electrical & Instruments - In the evening, continue to do the same task which to do some analysis about the information of SWTE shutdown that had been given by the supervisor which is Mr Nizam. • The list of work prepared by ➢ Maintenance ➢ Process technician ➢ Contractors ➢ Electrical & Instruments - Jot down all the information on the A4 paper before transfer to the Microsoft Words for better understand about the process.
5	- In the morning, continue to find and collect all the information about the shutdown process. • The list of work identifies ➢ Major works – issues, root cause, corrective and preventive action. ➢ Minor works - In the evening, continue to do the same task which to do some analysis about the information of SWTE shutdown that had been given by the supervisor which is Mr Nizam. • The list of work identifies ➢ Major works – issues, root cause, corrective and preventive action. ➢ Minor works - Jot down all the information on the A4 paper before transfer to the Microsoft Words for better understand about the process.

28 June until 2 July 2021

Day	Description of practical training experience
1	- In the morning, started to compile all the information that had been collected in a notebook and A4 paper and transfer it to the Microsoft Words. • List of department and contractors involved • List of work prepared ➢ Maintenance ➢ Process technician ➢ Contractors ➢ Electrical & Instruments - In the evening, finished up the compile process for the information of Schedule Waste to energy (SWTE) Minor Shutdown Case Study. • List of works identify ➢ Major works – issues/problems, root cause, corrective and preventive action. ➢ Minor works – issues/problem, root cause, corrective and preventive action.
2	- In the morning, gathered all the information to start do the report case study for the second project which is Schedule Waste to energy (SWTE) Minor Shutdown Case Study. - Started to do the report case study for project 2. • The project's Objective • The Duration of the SWTE Shutdown • The List of Departments and Contractors involved - In the evening, finished up the report case study for the project's objective, the duration of SWTE shutdown and the list of departments and contractors.
3	- In the morning, continue to do the Schedule Waste to Energy (SWTE) Minor Shutdown Case Study project report part. • The List of Work Prepared ➢ Maintenance ➢ Process technician - In the evening, finished up the same task which is to do the Schedule Waste to energy (SWTE) Minor Shutdown Case Study project report part. • The List of Work Prepared ➢ Contractors ➢ Electrical & Instruments

4	- In the morning, continue to do the Schedule Waste to Energy (SWTE) Minor Shutdown Case Study project report part. • The List of Work Identify ➢ Major works – issues/problems, root cause, corrective action and preventive action - In the evening, continue do the same task which is to do the Schedule Waste to energy (SWTE) Minor Shutdown Case Study project report part. • The List of Work Identify ➢ Minor works – issues/problems, root cause, corrective action and preventive action.
5	- In the morning, finished up to do the Schedule Waste to Energy (SWTE) Minor Shutdown Case Study project report part. • The List of Work Identify ➢ Minor works – issues/problems, root cause, corrective point and preventive point. - In the evening, started to analyse the Gantt Chart progress for the Schedule Waste to Energy (SWTE) Minor Shutdown project report. • Feeding system • Incineration system ➢ Rotary kiln ➢ Stocker

5 July until 9 July 2021

Day	Description of practical training experience
1	- In the morning, continue to analyse the Gantt Chart progress for the Schedule Waste to Energy (SWTE) Minor Shutdown project report. • Heat recovery boiler system ➢ Boiler, superheater, economizer • Turbine system ➢ Turbine ➢ Air cooler condenser (ACC) • Flue gas treatment system ➢ Semi dry reactor ➢ Bag filter ➢ Wet scrubber ➢ De-Plummer ➢ Stack - In the evening, started to do the task which is to do the Schedule Waste to energy (SWTE) Minor Shutdown Case Study project report part by using Microsoft Words. • The Gantt Chart Progress ➢ Feeding system ➢ Incineration system
2	- In the morning, continue to do the Module Training's slide for the Schedule Waste to Energy (SWTE) Plant Operations part. • SWTE vs INC 1 Operations. ➢ Pro and Cons for Schedule Waste to Energy (SWTE) Plant Operations - In the evening, finished up the same task which is to do the Module Training's slide for the Schedule Waste to Energy (SWTE) Plant Operations part. • SWTE vs INC 1 Operations ➢ Pro and Cons for Incineration (INC) 1 Plant Operations - Continue to do the Module Training's slide for the Schedule Waste to Energy (SWTE) Plant Operations part. • Clinical Waste Treatment Centre (CWTC) process ➢ Microwave Ecosteryl
3	- In the morning, continue to do the task which is to do the Schedule Waste to energy (SWTE) Minor Shutdown Case Study project report part by using Microsoft Words. • The Gantt Chart Progress ➢ Heat recovery boiler system

	➢ Turbine system - In the evening, continue do the task which is to do the Schedule Waste to energy (SWTE) Minor Shutdown Case Study project report part by using Microsoft Words. • The Gantt Chart Progress ➢ Flue gas treatment system - Started to collect information for Industrial Training Presentation. • Info of activities and projects during the industrial training
4	- In the morning, continue to do the Schedule Waste to energy (SWTE) Reverse Osmosis Membrane Optimization project's slide part. • Lifespan of Reverse Osmosis Membrane ➢ Adding some information about the RO Membrane. - In the evening, continue do the same task which is to do the Schedule Waste to energy (SWTE) Reverse Osmosis Membrane Optimization project's slide part. • Lifespan of Reverse Osmosis Membrane ➢ Adding some information about the filtered
5	- In the morning, gathered all the information about the activities and the projects during industrial training. - Started do the slide presentation for present to the supervisor, Mr Nizam. • Company's Background of Kualiti Alam and Cenviro Sdn Bhd. • Overall process flow/Nature business • Operations 1 ➢ Pre-treatment ➢ Incineration 1 plant ➢ Schedule Waste to Energy plant ➢ Clinical Treatment plant • All the projects ➢ Module Training Ops 1 ➢ SWTE Minor Shutdown Case Study ➢ SWTE Reverse Osmosis Membrane Optimization - In the evening, presentation started at 4.00 pm with the Mr Nizam (supervisor) via Microsoft Teams. - Comment after the presentation: • Do some corrective point regarding to the false information. • Adding some information to make the system completed.

13 July until 17 July 2021

Day	Description of practical training experience
1	- In the morning, started to do the corrective point that being told last week during the presentation with the supervisor, Mr Nizam. • Overall process flow for Kualiti Alam Sdn Bhd • Overall process flow for Operations 1 ➢ Incineration 1 plant ➢ Schedule Waste to Energy plant - In the evening, continue do the corrective point about the overall activities and projects during the industrial training. • Overall process flow for Operations 1 ➢ Clinical Waste Treatment Centre • Report Project 2 ➢ Schedule Waste to Energy (SWTE) Minor Shutdown Case Study.
2	- In the morning, started to do the slide presentation for Industrial Training Presentation which is on 22 July 2021 with the panel of UiTM Pasir Gudang and supervisor, Mr Nizam. • Introduction • Overview ➢ Company, location, duration, department and supervisor's name. - In the evening, continue to do the slide presentation for Industrial Training Presentation. • Company's Background of Kualiti Alam Sdn Bhd ➢ Group structure
3	- In the morning, started to do the slide presentation for Industrial Training Presentation. • Nature business/ Overall Process Flow ➢ Begin with collection process until dispose process • Activities ➢ To know about Operations 1 i. Pre-Treatment Operation - In the evening, continue to do the slide presentation for Industrial Training Presentation. • Activities ➢ To know about Operations 1 i. Incineration (INC) 1 Operation ii. Schedule Waste to Energy (SWTE) Operation

4	- In the morning, started to do the slide presentation for Industrial Training Presentation. • Activities ➢ To know about Operations 1 i. Clinical Waste Treatment Centre (CWTC) Operation - In the evening, continue to do the slide presentation for Industrial Training Presentation. • Project 1 ➢ Module Training Operations 1
5	- In the morning, started to do the slide presentation for Industrial Training Presentation. • Project 2 ➢ Schedule Waste to Energy (SWTE) Minor Shutdown Case Study. - In the evening, continue to do the slide presentation for Industrial Training Presentation. • Project 3 ➢ Schedule Waste to Energy (SWTE) Reverse Osmosis Membrane Optimization - Started to settle all the document and submit all the PPE clothes and accessories to the Admin Department.

PROJECT ASSIGNED

4.1 PROJECT 1

MODULE TRAINING OPERATIONS 1

This module training was constructed because it will be used to train all the operation 1 staff likes supervisor, panel, process technician, operator and forklift driver. Moreover, this module also be used for annually refreshment training or training for new employee. This module as a references module if there are a problem or confusion about the operations 1. Operations 1 plant include the Pre-Treatment Operations, Incineration (INC) 1 Plant Operations, Schedule Waste to Energy (SWTE) Plant Operations and Clinical Waste Treatment Plant Operations.

4.1.1. Objective of this project

- To know the characteristics of each plant in Operations 1
- Understand the overall process flow for Operations 1

4.1.2. Kualiti Alam's Background

Kualiti Alam Sdn Bhd (KASB) owns and operates the only Integrated Hazardous Waste Management Centre (WMC) in Malaysia. KASB has been entrusted by the Government of to undertake the Privatization of Malaysia's 1st Integrated Hazardous Waste Management System on 18 December 1995. To meet this requirement, the WMC commenced full operations in 2000 to serve the complete management of hazardous waste from "cradle to grave". It includes from the collection of waste at the waste generators likes industry, school and hospitals, transportations, treatment, recycle and recovery to final disposal.

The WMC are designed to treat more than 100,000 tons of all classes of hazardous wastes types which liquid and solid annually. The Waste Management Centre (WMC) hold license to handle 76 from 77 categories of Scheduled Waste that listed under Environmental Quality Regulation 2005 except the radioactive and explosive waste. However, WMC can treat the Technologically Enhanced Naturally Occurring Radioactive Material (TERNOM) waste. It can be treated here due to lower of value radioactive. The type of TERNOM waste that be treated here is sludge that came from the drilling process a t the Oil & Gas Industry.

The WMC is the end-to-end facilities comprise of Incineration 1 plant, Physical & Chemical Treatment plant, Solidification plant, Vertical Secured Landfill, Schedule Waste to Energy plant and Clinical Waste Treatment Centre. This facility is able to develop practical waste management strategies to meet the needs of large and small generators alike. Innovative management ways are designed to satisfy all regulatory requirements to protect and facilitate the present activities and also future operations.

Figure 4.1: Incinerator Stack

Kualiti Alam is a company that can provide up to date knowledge about the environmental regulations, helping the customers/clients to comply with ever changing waste legislations. KASB also serves the complete cervices which are focused, concise and all aspects of the job are handled professionally, economically and in total compliance.

4.1.3. Operation 1 Overall Process Flow

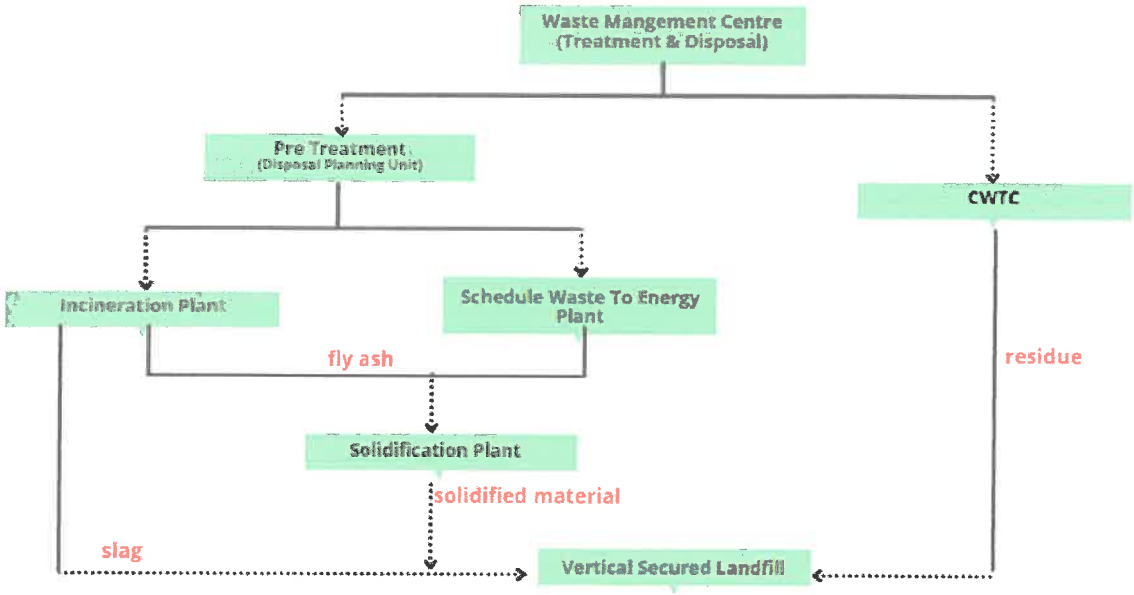

Figure 4.2: The overall process flow Operations 1

First of all, the waste is generated at the waste generator liked from industry, school or hospitals. Then, all the waste is transported by vehicle that provided by the Cenviro Sdn Bhd to the Waste Management Centre (WMC). The WMC will provides a complete service for the hazardous waste disposal, begin from the transportation for the waste until to the final disposal at the secured landfill.

Upon the waste arrival at WMC, the vehicle will be weight first together with its contents are taken at the weighbridge and transferred it to the warehouse where sampling and lab analysis is done. When the lab result come out only then the waste will be treated.

At Operations 1, there are four (4) types of treatment process which are:

i. Pre-Treatment
ii. Incineration 1 Plant
iii. Schedule Waste to Energy Plant
iv. Clinical Waste Treatment Plant

Then, all the organic liquid and solid waste were transferred to the Organic waste feed preparation or can be known as the Pre-Treatment (PTR), before transfer it to the Incineration

(INC) 1 plant operations and Schedule Waste to Energy (SWTE) plant operations. In both of two (2) operations it will produce fly ash as a by-product and then, it will be transferred to the solidification plant to be treated and dispose. While waste with total organic carbon (TOC) also known as slag below 10% will be transferred directly to the secured landfill for final disposing.

At the Clinical Waste Treatment Centre, all the clinical waste forms the hospital or clinic will be directly transferred to the CWTC plant. The waste does not need to go to the Pre-Treatment to be repacking and labelling. The clinical waste will be repacking the CWTC plant by their own workers. If there are a lot of bag log of clinical waste, it will be transferred to the SWTE plant operations and INC 1 plant operations. At the end of the production, the residue will be produced and it will be transferred to the secured landfill for final disposal.

KASB is an integrated waste management centre (WMC) because at the WMC the process is end-to-end that connected to one another in cohesion. This facilities process is synchronized and depend on another to function properly, if there is any problem at one of the plants, it will make the whole plant performance decreasing.

4.1.4. Pre-Treatment Process Flow

Organic waste (solid & liquid) received at the PTR from lightly contaminated to highly contaminated with debris and complex chemicals waste mixtures. Therefore, the characterization of feed material is a most important factor in selecting the suitable waste to be treated at the incineration 1 plant and schedule waste to energy plant.

The objective of Pre-Treatment:

- To prepare waste and supply it for Incineration (INC) 1 plant operations and Schedule Waste to Energy (SWTE) plant operations.

In the pre-treatment facility operations, there are 6 units to prepare the waste for incineration plant and schedule waste to energy plant which are bunker, shredder, repacking (drum mainline), vacuum tank, tank farm and poison plant. There are two (2) types of waste which are solid and liquid. Both of the waste has their own types of waste that shown in the figure 4.3.

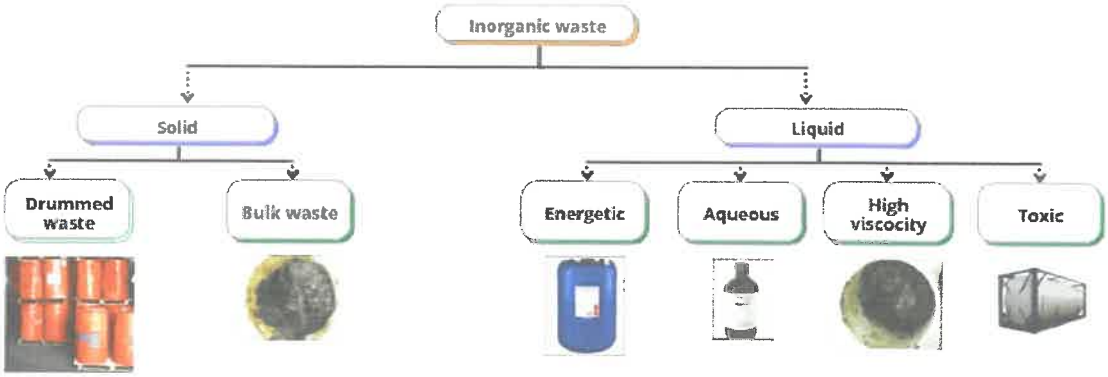

Figure 4.3: Types of waste (slod and liquid)

The main considerations in the selection of appropriate types of waste in the pre-treatment are shown in the Table 4.1.

Table 4.1: Properties for solid and liquid waste

LIQUID WASTE PROPERTIES		BULK WASTE PROPERTIES	
Energetic waste	CV > 10 MJ/kg	Calorific value (CV)	10-15 MJ/kg
Aqueous waste	CV < 10 MJ/kg	ph	>4
Viscosity	<500 cps	Flash point	>50 °C
Polymerization	No	Size	6" x 6" x 6"
Ph	>4	Total Sulphur	< 1 %
Size	Max 4mm	Total chloride	< 3.5 %

4.1.4.1 Overall Process Flow Pre-Treatment

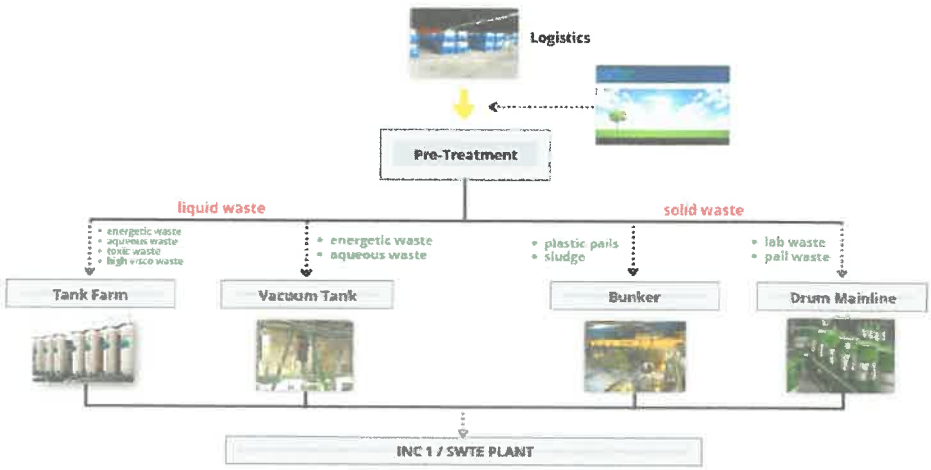

Figure 4.4: Overall Process Flow Pre-Treatment

4.1.5. Incineration 1 Process Flow

Incineration 1 plant is a waste treatment process that involves the combustion of organic substances that contained in the materials. This plant is considered as a thermal treatment because it used high temperature to treat the organic waste liked contaminated sludge, expired chemical, wastewater and etc.

This plant treat about 100 tonnes per day of organic waste includes 40 tonnes per day of solid waste while treat 60 tones per day of liquid waste. Furthermore, the incineration waste materials were converts the waste into fly ash, slag, flue gas and heat. The flue gas that produces in the plant must be cleaned of gaseous and particulate pollutants before dispersed into the atmosphere.

The detail of the flowrate for each of the waste transferred into the equipment in plant is shown in the Table 4.2 and Table 4.3.

Table 4.2: Flow rate for solid waste

SOLID WASTE	
Bulk waste	144 batch/day
Drummed waste	96 drum/day
Clinical waste	50 bag/day

Table 4.3: Flow rate for liquid waste

LIQUID WASTE	
High viscosity waste	9.6 tones/day
Energetic *oil waste	8.4 tones/day
Aqueous *liquid waste	12 tones/day
Toxic waste	7.2 tones/day

4.1.5.1 Overall Process Flow INC 1

Incineration process can be divided into 3 system:

i. Incineration system
ii. Heat recovery boiler system
iii. Flue gas treatment system

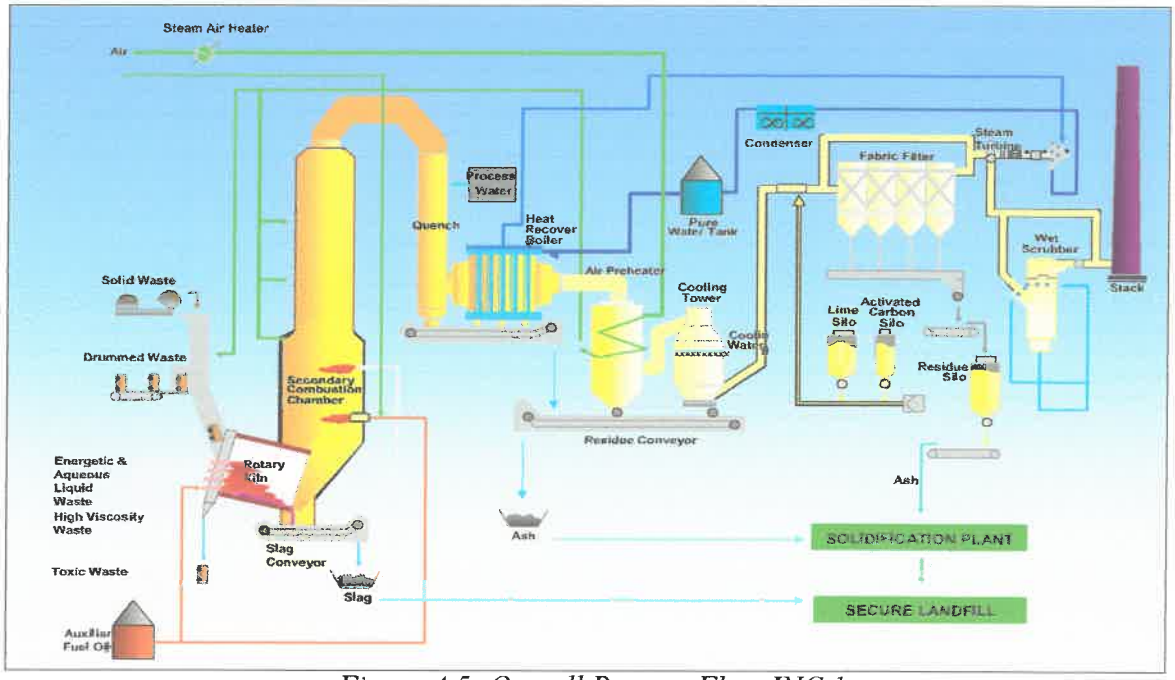

Figure 4.5: Overall Process Flow INC 1

4.1.5.1.1 Incineration System

Incineration system consists two (2) types of equipment which are Rotary Kiln and Secondary Combustion Chamber. Both of these is the important equipment in this plant because without this 2 equipment, the waste cannot be treated properly and it will cost the performance of the plant.

The Rotary Kiln is known as a heart of this incineration system which operated in higher temperature which from 1000 °C until 1200 °C to ensure achieve the excellent burnout. By achieving the excellent burnout, this plant could achieve the max destruction efficiency which is 99.98%. The process in the rotary kiln started with the combustion of solid and liquid, then with drying process and lastly gasification process. In addition, resident time for complete burn the waste is approximately 30 to 90 minutes depends on the waste characteristics and slag.

Secondary Combustion Chamber (SCC) also works same like the rotary kiln but in this equipment, it is a chemical combustion which is to burnout the flue gas only that produce from the rotary kiln. In this SCC, it applies a Vortex-SCC concept where the combustion air and liquid waste are injected tangentially. It is to make the proper mixed between both of these substances to achieve a complete burnout. The flue gas that come out from the SCC must in high temperature which is 1200 °C because higher temperature will make higher in pressure. The pressure will used for the boiler process. Moreover, the resident time for SCC to complete burnout is higher than 2 seconds.

The destruction of organics compound is determined by the 3T + 1O principles which consists of temperature, time turbulence and oxygen. Temperatures is the most important part because its determines either the waste is completely burn or not with that temperature. Time refers to the length time to complete destroy the hydrocarbon that contain in the waste.

Turbulence is referring to mix the proper air flow in the chamber between the oxygen and combustion air. If the mixing process is improper, the flue gas will out without complete burning. A better mix will result in a higher rate of destruction of the organics. Last factors are oxygen, with the proper amount of the oxygen will make the combustion process in higher rate and efficient in the help of combustion air to burning the waste. All of the factors were important to achieve maximum destruction efficiency which 99.99%.

4.1.5.1.2 Heat Recovery Boiler System

Heat Recovery Boiler system consists three (3) types of equipment which are Quencher, Boiler and Air Preheater. This system basically a series process to cool down the flue gas before flue gas being clean in flue gas treatment system and also to generate a steam to use for purging system.

Flue gas from the SCC will flows to the quencher before enter boiler. Quencher is used to cooldown the temperature of the flue gas. The temperature from 1200 °C will be drop from 700 °C to 650 °C. The flue gas's temperature must in range in that value because if the temperature is lower or higher than the temperature, it will make the boiler become tripped.

After being cool, the flue gas will enter into the boiler to generate steam. To generate a steam in the boiler is by cooling the flue-gas in the boiler with higher pressure from the SCC. The temperature of the flue gas must in range 700 to 650 °C to avoid the tube boiler corrosive or plugging. The steam that produces in this system will be used for purging system.

The last equipment in this system is air preheater. Air preheater is used to save the consumption fuel in the incineration system by producing the combustion air. In this equipment, it used heat transfer concept which the heat from the flue gas will heat the ambient air that flows in the air preheater, then the ambient air will do the cooling process which it will cooldown the flue gas at the same time.

4.1.6. Schedule Waste to Energy Process Flow

Schedule Waste to Energy plant is a waste treatment process that involves the combustion of organic substances that contained in the materials. This plant is considered as a thermal treatment because it used high temperature to treat the organic waste liked contaminated sludge, expired chemical, wastewater and etc same liked Incineration 1 plant operations.

However, this plant also can generate power about 3.4 megawatt/hour to light up approximately 9500 homes. It is a bit different with the Incineration 1 plant operations. In this plant, it just not only treats and dispose the waste, it also can generate a power for Tenaga Nasional Berhad.

This plant treat about 100 tonnes per day of organic waste includes 60 tonnes per day of solid waste while treat 40 tonnes per day of liquid waste. Furthermore, the incineration waste materials were converts the waste into fly ash, slag, flue gas and heat. The flue gas that produces in the plant must be cleaned of gaseous and particulate pollutants before dispersed into the atmosphere.

The detail of the flowrate for each of the waste transferred into the equipment in plant is shown in the Table 4.5 and Table 4.6.

Table 4.5: Flow rate for solid waste

SOLID WASTE	
Bulk waste	45 tones/day
Drummed waste	5 tones/day
Clinical waste	20 tones/day

Table 4.6: Flow rate for liquid waste

LIQUID WASTE	
High viscosity waste	5 tones/day
Energetic *oil waste	10 tones/day
Aqueous *liquid waste	15 tones/day
Toxic waste	0.01 tones/day

4.1.6.1 Overall Process Flow SWTE Plant

Incineration process can be divided into 4 system:

i. Incineration system
ii. Heat recovery boiler system

iii. Turbine system

iv. Flue gas treatment system

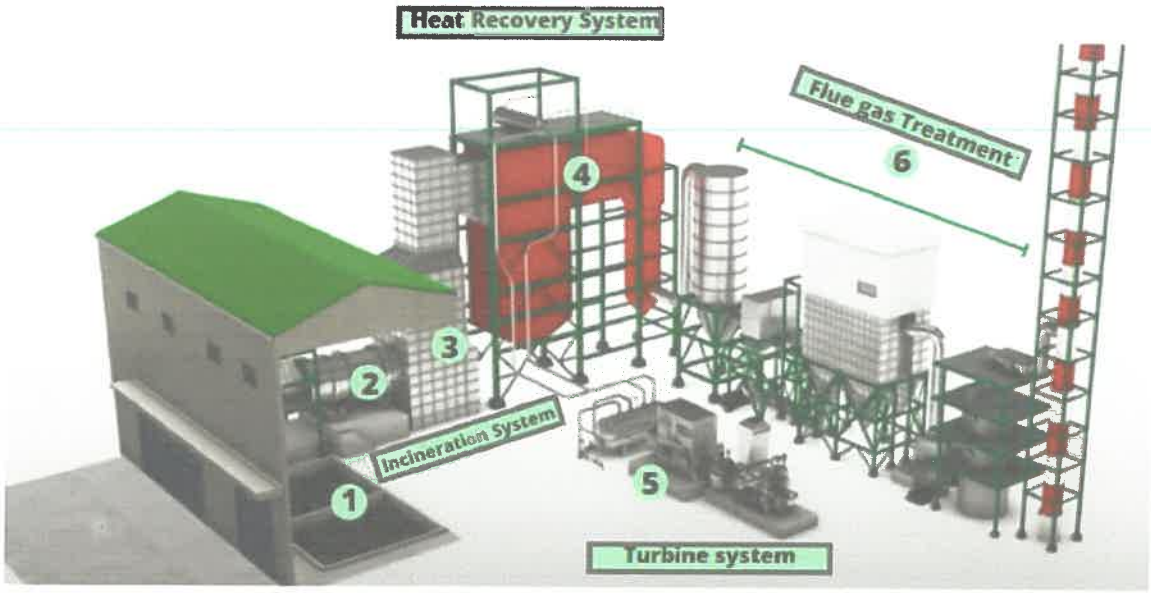

Figure 4.6: Overall Process Flow SWTE Plant

4.1.6.1.1 Incineration System

Incineration system consists two (2) types of equipment which are Rotary Kiln and Stocker. Both of these is the important equipment in this plant because without this 2 equipment, the waste cannot be treated properly and it will cost the performance of the plant.

The Rotary Kiln for SWTE plant is a bit smaller than INC 1. The temperature for this RK is not higher than 600°C. The range temperature for this RK is from 400°C to 600°C only. If the temperature is higher than 600°C, it will cost problem in the stocker which is the waste is stuck at the moving grate. Even though the temperature is lower than rotary kiln in INC 1, but the excellent burnout also can be achieved which is 99.99%. In this process, all the waste were burn with 45% only before enter the stoker. The process in the rotary kiln is a combustion of solid and liquid waste take place which is physical process.

Stocker also works same like the rotary kiln but in this equipment but in the stocker, it contains a moving grate which is to maintain and push the temperature by burning the waste from rotary kiln. This process is a physical and chemical combustion which is to burnout the waste at the moving grate and the flue gas that produce from the rotary kiln. In this process, all the waste were burn with 55% to complete burnout the waste and to achieve maximum destruction which 99.99%. The flue gas that come out from the SCC must in high temperature

which is 1200 °C because higher temperature will make higher in pressure. It needs to achieve 27 bars of pressure to use at the boiler to generate a steam for generate the power at the turbine.

4.1.6.1.2 Heat Recovery Boiler System

Heat Recovery Boiler system consists three (3) types of equipment which are Boiler, Super heater and Economizer. This system basically a series process to cool down the flue gas before flue gas being clean in flue gas treatment system and also to generate a steam to use for turbine system.

The high pressure of flue gas will enter into the boiler to generate steam. To generate a steam in the boiler is from the heat of the flue gas, it will heat the boiler water in the boiler drum. From that, it will produce a saturated steam. The pressure of steam must higher 27 bar because it will trip the turbine if lower than 27 bar. The steam that produces in this system will be used for generate power.

The steam will flow through super heater first before transferred into the turbine. The saturated steam that produces from the boiler must be heated first to produce dry steam because if the saturated steam were flow into the turbine, it will make the turbine trip and disturb the performance of the plant.

The last equipment in this system is economizer. Economizer is used to heat the boiler water from the deaerators and cool down the flue gas at the same time. In this equipment, it used heat transfer concept which the heat from the flue gas will heat the boiler water that flows in the economizer, then the boiler water will do the cooling process which it will cooldown the flue gas at the same time.

4.1.6.1.3 Turbine System

Turbine system consists two (2) types of equipment which are Turbine and Air Cooler Condenser (ACC). In this system basically where the steam is used to generate power to the Tenaga Nasional Berhad(s).

Turbine is used to generate power from the super heater steam (dry steam) to the grid of Tenaga Nasional Berhad. It will generate power about 3.4 megawatt/hour. There are some factors that need to be control in this process which are the temperature steam must 240 °C and the pressure steam must higher than 26 bar because to prevent the turbine tripped. However, if

the turbine in maintenance or unfunctional the steam will transfer to the ACC. ACC is used to produce a process water to the deaerator tank.

4.1.6.1.4 Flue Gas Treatment System

Flue Gas Treatment system consists six (6) types of equipment which are Semi Dry Reactor, Dry Venturi, Bag Filter, Wet Scrubber, De-Plumer and Stack. In this system the flue gas will be clean first before dispersed it into the atmosphere. This system is a crucial part to control because all the hazardous waste must follow the value that required by the DOSH before dispose into the atmosphere.

The flue gas from the economizer will be flow through the semi dry reactor first. The purpose of the semi dry reactor is used to control the temperature of the flue gas before enter bag filter by using atomized water. The temperature must be control between 160 °C to 190°C. If the temperature is higher or lower from the range, it will be occurring a problem at the bag filter.

Before enter the bag filter, the flue gas will through the dry venturi where the lime silo and activated carbon were injected into the bag filter at the same time. The lime silo is used to neutralize the acidic gases in the flue gas while activated carbon is used to absorbs heavy metal or dust than contain in the flue gas. After that, it will through the bag filter. The used of bag filter is to collect all dust in the flue gas by through the bag filter efficiently. The temperature of the flue gas must in a range from 160 °C to 190°C because if the temperature higher than 190°C, the bag filter will burn while if the temperature lower than 160°C, it will make the bag filter wet and it will cost difficulty to filtered the dust.

The filtered gas will go to the wet scrubber for further cleaning. In the wet scrubber, it will control and trapped hydrochloric gas and sulphur dioxide gas. By using caustic soda, it will control and trapped the hydrochloric gas and sulphur dioxide gas. Furthermore, the flue gas will be cooldown first in the quencher before enter the wet scrubber. Before the treated gases transferred to the stack, it will through the de-plumer. De-Plumer is used to reducing the formation of the smoke in a stack and cool down the gases at the same time. At the end, the treated gases will be transferred to the stack. Stack will disperse the gases into the atmosphere.

The detail of the emission value is same as the Incineration 1 Plant Operation which is be shown in Table 4.4.

All the pictures for Module Training Operations 1 which for the Incineration 1 Plant Operation and Schedule Waste to Energy Plant Operation will be showed in the PROJECT 1-APPENDICES.

4.1.7. INC 1 versus SWTE

Incineration 1 plant Operations and Schedule Waste to Energy (SWTE) plant Operations are in the same process which is to treated and dispose the hazardous waste. The process flows are quite similar which each other but there are some pros and cons between both of these plant operations. The difference will be shown in the Table 4.7 and Table 4.8.

Table 4.7: Pros and Cons of Incineration Plant

INCINERATION PLANT	
PRO	CONS
Higher durability in the Rotary Kiln due to the max temperature is 1200°C	Cannot generate power, just treat and dispose the hazardous waste only.
The low potential of flag is stuck at the slag conveyor	Cannot to reduce the formation of the smoke at the stack

Table 4.8: Pros and Cons of Schedule Waste to Energy Plant

SCHEDULE WASTE TO ENERGY PLANT	
PRO	CONS
Available to treat, dispose and also to generate a power to Tenaga Nasional Berhad(s).	Low durability in the Rotary Kiln due to a temperature lower than 600°C
Consists of De-Plumer and make to reduce the formation of smoke at the stack.	High potential of moving grate stuck due to the melting slag if the temperature is higher than 600°C.

4.1.8. Clinical Waste Treatment Centre Process Flow

Clinical Waste Treatment Centre plant is a Malaysia's First Non-Incineration Clinical Waste Treatment Centre. In this plant, it used microwave to treat the clinical waste that come from hospital and clinic. It is zero emissions technology from Belgium and non-harmful effects with eco-friendly process which are no need a water, steam, burning and smoke.

This plant treats about 28 tonnes per day of clinical waste. If there are a lot of quantity of bag log, it will be transferred to the INC 1 and SWTE plant operations. INC 1 operations will treat about 50 bag per day while SWTE operations will treat 20 tones per day. In this plant, there are four (4) quantity of microwave by using technology Belgium. Each microwave will treat 7 tones per day. CWTC also equipped with 2 cold storage facilities to store the non-treated clinical waste. Once the clinical waste is being treat, it will fall into the same category as household rubbish.

In addition, the quantity of the clinical waste that being treat at the INC 1 is much lower than SWTE because if used a higher volume of clinical waste, it needs to do a major modification on the solid feeder system which is the hopper. The hopper in the INC 1 is much smaller than in SWTE plant. Even though, the quantity of clinical waste in the SWTE is higher than INC 1, it must not exceed that actual value because it will affect the rotary kiln refractory lining and it will reduce the daily plant throughout.

4.1.8.1 Overall Process Flow Clinical Waste Treatment Centre Operations.

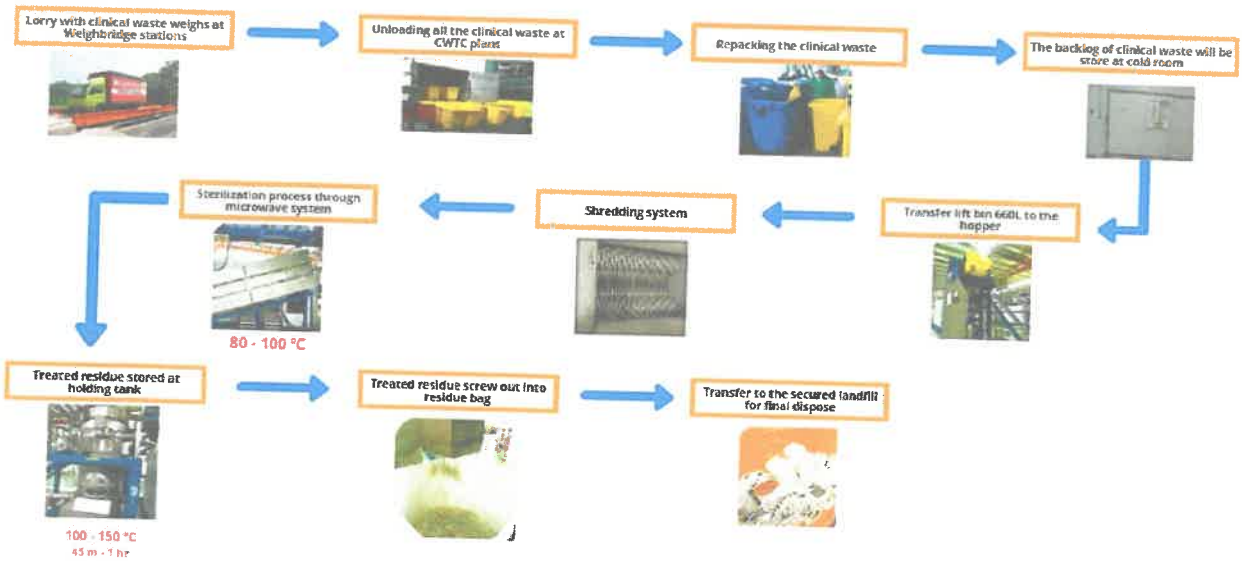

Figure 4.7: Overall Process Flow CWTC plant

First of all, the lorry from the waste generator that contains a clinical waste will be weighs first at the weighbridge stations. The clinical waste no need goes to Pre-Treatment because PTR only supply the hazardous waste for incineration plant and schedule waste to energy plant. After being weight, the lorry will go to the CWTC plant to unloading all the clinical waste. In this moment, the repacking process will be done which the 220 L bin of clinical waste will be transferred into the 660 L bin.

Then, all the backlog of clinical waste will be store at cold room to make sure the hazardous substances will not be exposed to the workers in the plant. The COVID-19 clinical waste will be repacking in the jumbo bag and directly being disposed at the incineration plant and schedule waste treatment plant because the waste needs to be disposed immediately to prevent any infection within all the workers.

After the waste done the repacking process, the 660 L bin will be transferred to the hopper by using a lifter. In the hopper, all the waste will be shred into the very small particles which is 20 mm diameter before going to the microwave for sterilization process. After shredding the waste, it will be transferred into the microwave. In this microwave, the waste will be heated to 100°C. the microwave heating consists of 2 boxes of the beam (12kW). This microwave is in the stereo mode with controlled field polarization which is to heat the waste to the core and rapid rise the temperature. Which this process, it will make complete destruction of the pathogenic organisms in the waste.

Before the residue will be transfer to the secured landfill, the residue will be treated again in the holding tank. The temperature in the holding tank is from 100°C to 150°C in about 45 minutes to 1 hour. This is to make sure the residue is completely does not contain any harmful bacteria. Holding tank also can be used as a backup equipment because if the temperature in the microwave is lower than the actual temperature, the residue will be treated at the holding tank.

Lastly, the treated residue will be out from the holding tank by using screw out into the residue bag. Once treated, the clinical waste falls into the same category as household rubbish. Then the residue will be transferred to the secured landfill for final disposal.

4.1.9.2 **Progress Handbook for Schedule Waste to Energy (SWTE) Plant Operation.**

Date: 1 May until 29 May 2021

EQUIPMENT	ISSUES/PROBLEM	ROOT CAUSE	CORRECTIVE POINT
Feeding System	- Lance Aquoues interupt/clogged.	- Due to the presence of sediment in the lance	- Stop AQ feeding and do the flushing at the AQ line. Tell PTR to transfer sediment into the tank 9 (HV)
	- Lance Energetic missing/clogged	- Due to the waste too sticky and presence of the sediment.	- Stop the feeding and do the flushing at the EN line.
Boiler	- Boiler chute clogged	- Due to the harden ash stuck in the chute.	- Cleared the harden ash by the PT
	- Boiler water high conductivity in a boiler drum	- Still have higher in impurities/mineral in the water	- Do the bottom blowdom boiler
Semi Dry Reactor	- Rotary feeder tripped/clogged	- Presence of the lump dust is due to the presence of water.	- Open the rotary feeder and cleared it by the PT
	- Bottom chute clogged	- Due to harden ash stuck in the chute	- Cleared the harden ash by PT

4.2 PROJECT 2

SCHEDULE WASTE TO ENERGY (SWTE) MINOR SHUTDOWN CASE STUDY

Every year KASB's Schedule Waste to Energy (SWTE) plant will be shutdown. Shutdown can be defined as temporary closure of the building or factory to perform some maintenance for a long period of time and usually take 2 weeks to 1 month. Thus, it takes a lot of work to be scheduled in a relatively short period of time. Therefore, it is a complex and complicated process to do. So, it required a proper planning to prevent the problem during the shutdown. By schedule a proper planning, it can help to increase the plant efficiency and reduce the plant's downtime.

4.2.1 Before Shutdown

The objective of the Scheduled Waste to Energy (SWTE) plant shutdown is:

i. To replace the current thinning bricks (15 rings) with castable, it is because due to the rotary kiln shell temperature reading were in range of 350 – 380 degree C at the thinning area.

ii. To repair the tube burst (1-4) at the superheater part is also one of the major problems occurred when do the inspection at the superheater.

iii. To do an internal maintenance work and process cleaning such as change micro filter, to change gate valve, cleaning boiler's tube etc.

The shutdown activity involves a lot of works, departments, vendors and contractors as well as all the KASB staff in the plant will be involved. Thus, shutdown activities require a proper planning of the budget, period of time and the manpower to ensure the maximum efficiency of the plant and also to make sure all the activities will go according to plan and finish on time.

Details on the shutdown's list of departments and contractors involved are shown in the Table 4.2.1, while the details on the shutdown's list of operations and contractors will be shown in the PROJECT 2 – APPENDICES.

EXTERNAL	INTERNAL
KSB	KAO
CIC	MT
Tepat Con	ENI
Boiler Master	KAM
Emrot	ENG
Darco Water	SM
Excellift	
AKR	
Atlas Copco	
LF Bina	
MCIE	

Table 4.8: List of Departments and Contractors Involved.

At this point, project management skills are crucial, it is because it would determine either the project will be succeeded or failure. Therefore, it is important to make sure to prepare a proper planning of the budget, period of time and manpower before started the shutdown.

To know the works, go accordingly to the plan and finish on time, a Gantt chart was also be constructed by using Microsoft Excel. In the Gantt chart, all the detail and the time allocated were listed accordingly based on the activities.

In addition, the equipment that were list in the operations and maintenance of the SWTE shutdown, pictures must be taken before the shutdown works begin. The purpose of this works is to compare these pictures with the pictures after the shutdown and it can be evaluated, either the contractor that was assigned to the job is doing correctly or not. Other than that, is to have a proper record keeping and for asset disposal that is going to be done after the shutdown works finishes.

Before Shutdown Pictures

Figure 4.8: Ramp Pusher

Figure 4.9: Moving Grate

Figure 4.10: Micro Filter

Figure 4.11: Super Heater's Tube

4.2.2 During Shutdown

The Schedule Waste to Energy (SWTE) plant shutdown started on the 19th May 2021 at 8.30 am which the feeding of waste process into the Rotary Kiln begin to stop. The plant needs to be cooled down first before started the shutdown work and this process takes three days which is started from 19th May until 21st May 2021. On the 22nd May the shutdown works begin to start.

To know the exactly works to determined on every works, the list of works identify were constructed before starting the shutdown, it is to make sure to determine the works is classified as a major works or as a minor works. This part is important to be done because to know the issues/problem of the equipment before doing some replacement or maintenance.

4.2.2.1 Major Works Identify

i. Rotary Kiln (RK):

Issues	Root cause	Corrective Action	Preventive Action
The rotary kiln shell temperature reading was in the range of 350 – 380 at the bricks thinning area (lower than actual temperature)	- Has been used for a long time in high temperature that makes the bricks/refractory become thinner.	- Do the shutdown process, replace the current bricks (15 rings) with castable to make sure it has high durability when used in high temperature.	- Take time when do the cooling and heating process to prevent the bricks from deterioration. - Used high quality of coating that has high durability to prevent it melting in higher temperature.

ii. Stoker:

Issues	Root cause	Corrective Action	Preventive Action
The stoker shell temperature reading was lower than actual value temperature.	- Has been used for a long time in high temperature that makes the bricks/refractory become thinner.	- Do the shutdown process, replace the currents bricks with castable to make sure it has high durability when used in high temperature.	- Take time when do the cooling and heating process to prevent the bricks from deterioration. - Used high quality of coating that has high durability to prevent it melting in higher temperature.

iii. Super Heater (SH):

Issues	Root cause	Corrective Action	Preventive Action
Tube burst at (1-4) that cause leaking problem.	- Tube become thinner due to the corrosion. - Due to the presence of excessive pressure that make the tube expand from its usual shape.	- Do the shutdown process. - Cutting the tube, take out the tube from the place and welding back at the top and bottom header.	- Make sure the value of conductivity of boiler water is below than 0.2 micro siemens/cm to prevent corrosion happened in a short time. - Used tube that has high durability that prevent tube from burst when applied excessive pressure.

iv. Demineralized water treatment:

Issues	Root cause	Corrective Action	Preventive Action
Value conductivity of the boiler water cannot reach below than 0.2 micro siemens/cm.	- Micro filter and reverse osmosis (RO) membrane has used in long time, where it be coated with the impurities – minerals, molecules, and particulate matter.	- Change micro filter and membrane with the new one after being cleaned. It is to ensure the filtered become more efficiency.	- Know the lifetime for every filter to make sure to prevent the conductivity of boiler water higher than actual value. - Do the weekly check-up as the lifetime gets closer.

4.2.2.2 Minor Works Identify

i. Feeding System (Ramp pusher):

Issues	Root cause	Corrective Action	Preventive Action
The ram pusher plate deforms and the roller grate in a bad condition with the rust and corrosion.	- It being used in long time. - Being exposed to the water, air and the high temperature that make the rusting and corrosion process takes place.	- Refurbish the body (ram pusher) especially the plate and the roller grate, so that can used again for long time.	- Used material substances that has high durability towards the air, water, and temperature to prevent rusting and corrosion happened again.

ii. Feeding System (2nd drum pusher):

Issues	Root cause	Corrective Action	Preventive Action
2nd drum pusher hydraulic cylinder damage	- It being used in long time. - Improper alignment between the load and the cylinder, thereby resulting in bending problems.	- Replace and install new hydraulic cylinders to make sure the process can work again in long time.	- Make sure has performed proper alignment between the load and cylinder to prevent this problem happened again.

iii. Stoker:

Issues	Root cause	Corrective Action	Preventive Action
Thermocouple malfunction - TIA 204 A - TIA 204 B - TIA 204 C	- It being used in long time. - Sensor inside the thermocouple damage and unfunctional.	- Replace and install new thermocouple to sensor back the temperature inside the stocker.	- Do the check-up daily after install the new thermocouple to monitor if anything problem happened again. - Change with another brand of thermocouple.

iv. Moving Grate:

Issues	Root cause	Corrective Action	Preventive Action
Moving grate plate and holes in bad condition and damage (cannot supply air through the hole).	- The hardened melting waste covers the entire plate including the holes, so the combustion air cannot flow through the holes.	- Cleaning the moving grate plate and holes from the hardened waste. - Change the damage and old moving grate with the new ones to ensure	- Make sure the temperature inside the rotary kiln is to be control from 400 to 600-degree Celsius to prevent the waste melting when enter the moving grate.

vii. Bag Filter (Top Screw conveyor):

Issues	Root cause	Corrective Action	Preventive Action
Top screw conveyor in a bad condition with the rust and corrosion, also the shape of the top is changed.	- It being used in long time. - Being expose to the air and water that make rusting and corrosion process take places.	- Fabricate and install new top screw conveyor, so that it can used again in long time.	- Used a material that has high durability due to always being exposed to the air and water. - Used coated material that have high durability.

viii. Wet Scrubber:

Issues	Root cause	Corrective Action	Preventive Action
The process of scrubbing is not efficient.	- Spray nozzle is coated with the dust and impurities from the flue gas, that makes the impurities cannot be extracted efficiently.	- Dismantle the spray nozzle and cleaning it to ensure the spray clean from the dust and impurities.	- Do the weekly check-up to make sure the spray in good condition, so that it can make the process scrubbing more efficient.

ix. Cooling Water Tower:

Issues	Root cause	Corrective Action	Preventive Action
The water is contaminated with the impurities and the value of the hardness is higher than actual value.	- The filter and fines are being used in long time. - The filter and fines were coated with the impurities like mineral, particulate matter, etc., that make the process of filtered not smooth.	- Service and cleaning the fines and filter to make sure the filtered process is going smoothly and get the exact value.	- Do the weekly check-up to make sure all the filter in good condition, so that the filtered process more is efficient.

x. Strainer at all equipment:

Issues	Root cause	Corrective Action	Preventive Action
The strainer is coated with the impurities liked dust, minerals, particulate matter, etc. that flow through the strainer.	- It being used in long time. - There are a lot of impurities that flow through every strainer to make sure the pipe is not clogged by those impurities.	- Service and cleaning the strainer and install it back. It is to prevent the pipe being clogged if the strainer cannot filter the impurities.	- Do the weekly check-up to make sure all the strainer in good condition, so that the filtered process is more efficient.

4.2.3 After Shutdown

After the shutdown works and maintenance has finished, the supervisor will do the inspection first before proceed to the firing process. All of the works that in the shutdown list must be in good and operating condition. The purpose of the firing process is to light-up the rotary kiln and bring up the temperature before feeding process can be started.

At this moment, there were a lot of paperwork that need to be done to ensure all the shutdown operation is well documented. This paperwork is containing two things which is the shutdown summary of the activities and the before and after pictures of the works that be done during the shutdown.

Before and After Shutdown Pictures.

The before and after shutdown pictures are important in this project. It is because all the pictures are serves as a proof that the contractor and all the staff were doing their job accordingly to the plant and doing it correctly. These pictures also can used to do a proper documentation for the shutdown activities. For viewing, some of the pictures were presented in the PROJECT 2.

Summary of Shutdown Activities

The summary of shutdown activities is a time table or schedule for the time needed for the work to be done. To keep track on the shutdown activities, the daily progress of the shutdown was mark down in this summary. It is easier and better solution to keep track the activities. This summary was done by referring to the daily status update during the shutdown.

In addition, for this shutdown, the summary is like a Gantt chart for the time needed for the work to be done. The purpose of this summary is to use as a reference for the future shutdown and also do some improvement that can be made for better planning and much more accurate schedule. The Gantt chart for this shutdown can be seen in the PROJECT 2 appendices.

4.3 PROJECT 3

SCHEDULE WASTE TO ENERGY (SWTE) REVERSE OSMOSIS MEMBRANE OPTIMIZATION.

During the Schedule Waste to Energy (SWTE) plant shutdown, reverse osmosis (RO) membrane and other filtered membrane were being change and cleaned after a several years. This requirement is an essential for the plant performance to being more effective and optimize. By doing this, it can be evaluated either the replacement and cleaning process is effective or not for the plant performance.

The objective of this project:

- To know the effectiveness of the reverse osmosis membrane after being clean by using CIP performance and replacement.

Reverse Osmosis (RO) is one of the filtered appliances in the Demineralized Water Treatment system to produce the demineralized water that used for generate a steam. Reverse Osmosis system can be defined as a water purification process that purifies a water by using a force or pressure to push the water through the semipermeable membrane. This membrane is used to remove the impurities in the water liked ions, unwanted molecules and larger particles from the water resources such as soft water or hard water.

In this system also used others filtered membrane liked carbon filter, micro filter and mixed bed polisher. All of this equipment is important to produce a better quality of demineralize water to generate a steam and can avoid any problem occurred during the transfer of the water in the tube. Moreover, this water conductivity is the crucial part to be controlled, so by implement this system in the plant, it can reduce the value conductivity. Based on the requirement, the value of the conductivity is must lower than 0.2 micro siemens per centimetres. This value must be followed to avoid any problem happened over the tube liked corrosion, scaling, etc.

This system is important or the crucial part in the Schedule Waste to Energy plant operations because it need to control the value conductivity of the water for avoid the problem happened regularly in the plant that can cost the performance of the plant.

4.3.1 Overall Treatment Process

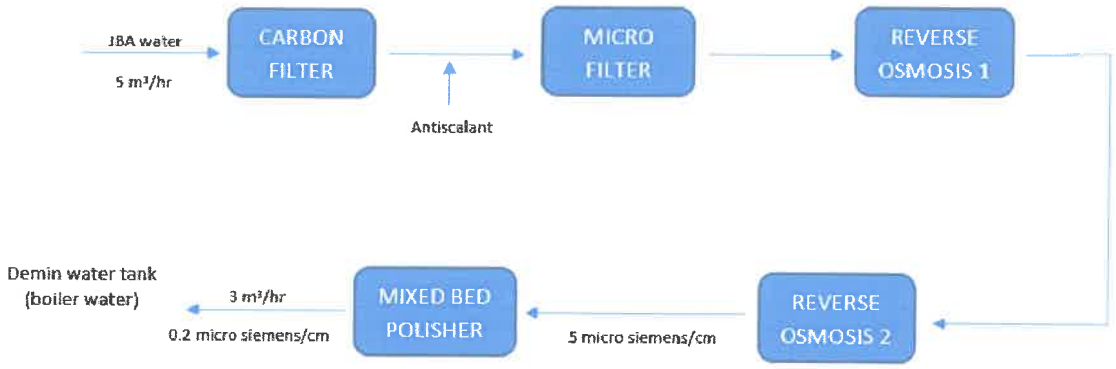

Figure 4.12: Overall Treatment Process.

The overall process flow for reverse osmosis system consists of carbon filter, micro filter, reverse osmosis 1st stage, reverse osmosis 2nd and lastly mixed bed polisher. All of this equipment has their own purpose and works in this system. The process flow started when water flow from the JBA water tank follows as shown in the Figure 4.5. After the city water is fed into the carbon filter with 5 m^3/hr, 3 m^3/hr of demineralized water will be produced from the Reverse Osmosis System.

The purpose of the carbon filter is as a pre-treatment equipment in this system, it supposes to remove the smell, taste, organic compounds, extracting free chlorine form water, absorb heavy metal, dust, etc. This equipment is an important part in the reverse osmosis system because it will protect the delicate reverse osmosis membrane, extends its life and prevent frequent fouling.

After the water being filtered in the carbon filter, it will flow through the micro filter for further filtered process. The purpose of this micro filter is to minimize the troubles occurred liked blocked the porous of the reverse osmosis membrane. This micro filter used cartridge filter that consists of porous fibre layer that function to remove all the suspended solid from 5 micro siemens per centimetres of size. Due to this filter, the suspended solid cannot block the RO membrane. Both of this filtered which carbon and micro filter are important equipment to ensure the lifespan of the reverse osmosis membrane permanent and long lasting.

Then, it flows through the 1st reverse osmosis stage before through the 2nd RO stages. With the presence of second stage, it will make the filtered process more optimum to remove

the impurities. As explained before, reverse osmosis system is a separation process that uses forces or pressure to push the water through the semipermeable membrane to remove the impurities that contains in the water liked ions, unwanted particles, hardness, dust, etc. This filtered need to be implement in the system to produce a better quality of demineralized water for boiler and turbine system to ensure the efficiency of the plant is optimum.

Reverse osmosis is a process that used external pressure to move the liquid across membrane from high concentration to a lower concentration. It is different with the osmosis process which the liquid moving from low concentration to a high concentration of liquid and this process did not used pressure to move the liquid through the membrane. The water that produces at the 2^{nd} stage of RO membrane is called as permeate water while residual water is called as a concentrate. The value of the conductivity at the end of the 2^{nd} stage must 0.5 micro siemens/cm to ensure that the performance of the plant is in optimum state.

Lastly, the permeate water will through the mixed bed polisher while the concentrate will be transfer to the waste water treatment or JBA water tank for recycle the water back to being process again. The purpose of the mixed bed polisher is to control the value of conductivity and minimizing the residual of TOC/SiO_2 and also to ensure the value conductivity is below than 0.2 micro siemens/cm because to prevent aby scaling and corrosion happened in the tube. Mixed bed polisher is a process that when ion exchange reaction is occurred based on strong acid (cation) and strong base (anion) exchange resin to be mixed and filled. The strong acid that be used is hydrochloric acid (HCL) while strong base is a sodium hydroxide (NaOH).

At the end of the process, the purified water will be transfer to the Demin water tank before transfer it to the boiler drum for generate steam.

4.3.2 Lifespan for The Membrane and Filtered.

4.3.2.1 Carbon Filter

Lifespan: 6 months to 1 year

4.3.2.2 Micro Filter

Lifespan: 6 months to 1 year

Both of these filters are known as a pre-filter which the most important equipment to ensure the lifespan of the RO membrane is long lasting. But if ignore the exact time to replace, it will disturb the effectiveness of a filtration process which mean all the filters cannot filtered the impurities 100%. If this two of filters is be taking care, this system can live until 10 to 15 years if regularly change and clean the filters.

4.3.2.3 Mixed Bed Polisher

Lifespan: Once a year

This filter is known as a post-filter which to control and minimizes the value of conductivity to 0.2 micro siemens/cm, this filter act same like the others filter which it can be problem for the system if ignore the exact time to replace the filter.

4.3.2.4 Reverse Osmosis (RO) Membrane

Lifespan:

- Replacement:
  - 3 to 7 years
- Cleaning:
  - 2 to 4 cleanings per year (surface water)
  - 1 to 2 cleanings per year (well water)

There are several factors that the replacement and cleaning must be done. Firstly, is to prevent the low permeate flow and high salt passage over time. Second is to indicate severe fouling which becomes worse and last but not least to make the lifespan of the membrane long lasting.

4.3.3 The Effectiveness of Reverse Osmosis Membrane

4.3.3.1 Data and Results

March Cleaning:

VALUE CONDUCTIVITY (BEFORE)	VALUE CONDUCTIVITY (AFTER)
37.48 us/cm	4.050 us/cm (1ST stage) 4.665 us/cm (2nd stage)
Result:	SUCESSFUL

June Replacement (Shutdown):

VALUE CONDUCTIVITY (BEFORE)	VALUE CONDUCTIVITY (AFTER)
26.57 us/cm	10.7 us/cm (1ST stage) 6.80 us/cm (2nd stage)
Result:	UNSUCESSFUL

4.3.3.2 Discussion

To know the effectiveness of the reverse osmosis membrane, the data value of conductivity was taken before and after cleaning process as well as the data before and after for replacement procedure. These data will be determined either the cleaning and replacement process is a good process or bad process.

From that data, it shown that for March cleaning the value before being clean is 36.48 micro siemens/cm and after being clean the value is reduced to the 4.050 micro siemens/cm for 1st stage while 4.665 micro siemens/cm for 2nd stages. The value after being clean shows that it lower than 5 micro siemens/cm, so it proves that by cleaning the membrane the value of the permeate conductivity will reach at the actual value which is below than 5 micro siemens/cm.

While for the June replacement, it shown that the value before being replace is 26.57 micro siemens/cm and after being replace the value is reduced to 10.7 micro siemens/cm for 1st stage while 6.80 micro siemens/cm for 2nd stage. At this process, although the value is reduced but at the end of the results it shows that the value was higher than 5 micro siemens/cm. This problem happened due to the leaking occurred at the pressure vessel.

Pressure vessel is used to give the pressure to push the water through the semipermeable membrane to remove all the impurities (ions, larger particles, etc). If there is a leaking occurred at the pressure vessel it will disturbs the filtered process that can make the performance decreasing. Due to this problem, it proves that the filtered process is unsuccessfully and make the value of the permeate conductivity is higher than 5 micro siemens/cm. To make sure this

problem does not happen again, must do the weekly check-up of the pressure vessel to ensure all the equipment in a good condition.

4.3.3.3 Conclusion

This project presents about the SWTE Reverse Osmosis (RO) Membrane Optimization. Reverse osmosis is a water purification process that purifies a water by using a force or pressure to push the water through the semipermeable membrane. This membrane is used to remove the impurities in the water liked ions, unwanted molecules and larger particles from the water resources such as soft water or hard water.

The objective to be achieved in this project is to know the effectiveness of the reverse osmosis membrane after being clean by using CIP performance and replacement. CIP is stands for Clean in Place which means the equipment was cleaned at their place without taking them out and clean at another place. There are two (2) methods to determine the membrane is effectiveness after being used in along time. First method is CIP cleaning and second is by replacement methods.

As the results shown in the data, it proves that results after CIP performance is successful because the value of permeate conductivity is below than 5 micro siemens/cm which for the 1st stage the value is 4.050 micro siemens/cm while for 2nd stage is 4.665 micro siemens/cm while it different with the results after replacements. It is because the value of permeate conductivity is higher than 5 micro siemens/cm which for 1st stage is 10.7 micro siemens/cm and for 2nd stages is 6.80 micro siemens/cm. This problem happened due to the leaking occurred at the pressure vessel that disturb the performance of the filtered process. If there is no problem occurred during the replacement basically the result will lower than 5 micro siemens/cm.

To be concluded, both of these methods are successful but due to some problem occurred at the appliances, it disturbs the performance of the filtered process. Then, it is important to follow the requirement of the cleaning and replacement process of the membrane and filtered. Thus, it will damage the other's part if ignore the date because all the equipment is connected to each other in this system. By doing the cleaning and replacement at the exact date, it will make the reverse osmosis system can live until 10 to 15 years if regularly change and clean the filters.

CONCLUSION

The industrial training program is completed for 17 weeks started on 22nd of March 2021 and end on 16th of July 2021. During 17 weeks of attachment at Incineration 1 Plant Operation at the Kualiti Alam Sdn Bhd, Waste Management Centre, it has successfully provided a lot of beneficial knowledge and a unique experience because KASB is the only Hazardous Waste Management Centre in Malaysia that handles all types of hazardous waste except for explosive waste and radioactive waste.

The technical and non-technical skills that been developed in during the industrial training is an opportunity to prepare for the real working environment in the future. The learning process from the both skills liked overview of the plant design, process flow, hazardous waste handling, operation and maintenance activities. All of these are the valuable knowledge and experience that had been given during the industrial training in the KASB.

One of the unique experiences that get in the KASB is the shutdown activities because during the shutdown all the capabilities are being put to test. There is also another skill that need in this shutdown which is technical, management, technical, observation and communication. All of these skills need to be implemented in this activities t ensure the shutdown progress work according to plan without any problems happened.

During the industrial training, the crucial or the challenging thing that happened is to communicate with everyone in the plant. Communication skill is one of the personal skill developments when do the industrial training in KASB because to know all the purpose, characteristics, process flow, operation and maintenance things, it need to communicate with their workers to get the information. So, to know all the process and to know all the workers the communication skill needs to be develop. For that matter, all the activities or task assigned will be going smoothly without any obstacles.

By improving the communication skills, it also enhances the leadership qualities. During the industrial training, it being exposed with the real working environment, so it develop the strong mental, physical and emotional spirit because all of these need to have to overcome the obstacles and odds that might be faced in the future career. Moreover, the KASB in the only

place that treat and dispose Hazardous Waste, thus it has a lot of things need to be prepared and learn.

As a conclusion, all the course outcome that has been set earlier, which to identify the types of work that chemical engineers do in real engineering, perform basic engineering practices, including technical writing report, communication with colleagues, handling project and generating proposal for betterment of the industries and have higher level of integrity, ethical and accountability in practicing engineering were be able to achieve. Therefore, the industrial training was successfully completed and it has been very beneficial from the beginning to the end.

APPENDICES

PROJECT 1

1. Incineration 1 Plant Operation

i. Incineration System

Figure 6.1: Rotary Kiln

Figure 6.2: Secondary Combustion Chamber

ii. Heat Recovery Boiler System

Figure 6.3: Boiler & Air Pre-Heater

iii. Flue Gas Treatment System

Figure 6.4: Flue Gas Treatment System

2. Schedule Waste to Energy (SWTE) Plant Operation.

a) Incineration System

Figure 6.5: Rotary Kiln

Figure 6.6: Stocker

b) Heat Recovery Boiler System

Figure 6.7: Boiler

c) Turbine System

Figure 6.8: Turbine

d) Flue Gas Treatment System

Figure 6.9: Semi Dry Reactor

Figure 6.10: Bag filter

Figure 6.11: Wet Scrubber

APPENDICES

PROJECT 2

1. List of Operations & Maintenance

NO	AREA	OPERATIONS /MAINTENANCE	DEPARTMENT/CONTRACTOR
1	Feeding System	To fabricate water spray pipe for hopper	KAM
		To service existing grabber	KAO
		Cleaning and service strainer Aqueous	KAO
		Cleaning and service basket filter Energetic	KAO
		Cleaning and service (RO) pump strainer	KAO
2	Rotary Kiln	To replace sealing plate at RK feeding and discharged zone	CIC
		To replace refractory for 15 rings using castable	CIC
		To refurbish ramp pusher housing (body)	Tepat Con
3	Stoker	To repair bricks at stoker	CIC
		To service slag conveyor (repair apron conveyor, platform and replace bearing discharge).	CIC
		To modify additional manhole door at Moving Grate chamber	Tepat Con
		To repair refractory for stoker area	CIC
		To fabricate spare moving grate discharge plate	CIC
		Install new thermocouple TI A204 A, B and C	ENI
		Cleaning and service moving grate	KAO
4	Boiler	Cleaning tube boiler	KAO
		Service boiler ash rotary feeder	KAO
		Change drum ash	KAO
5	Superheater	Repair pipe leaking (tube 1-4)	Boiler Master (BM)
		Cleaning tube superheater	KAO
		Service and cleaning ash rotary feeder	KAO
6	Economizer	Change drum ash	KAO
		Cleaning tube economizer	KAO

7	Demi water system	Install flowmeter for Demin system	KAM
		Change new resin mix ned polisher	KAO
		Change micro filter	KAO
		Change and reinstall reverse osmosis (RO) membrane	Darco Water
8	Deaerator	Replace flanges gasket	KSB
9	Turbine	To modify steam trap pipe	KAO
		To replace gasket coupling turbine gearbox	KAM
10	Air Cooler Condenser	To service ACC gearbox and balancing	KAO
		To reposition strainer location vacuum pump	KAM
11	Semi Dry Reactor (SDR)	Service lime metering device 50TB001 gearbox	KAO
12	Bag Filter	Replace bag filter short piece purging pipe	KAM
		Install bag filter spool piece purging pipe	KAM
		To fabricate fabric filter discharge screw conveyor	EMROT
13	IDF	To fabricate new FRP pipe for wet scrubber	KAO
		Replace IDF bearing	KAO
14	Wet scrubber	To change gate valve	KAM
		To replace pipe position for wet scrubber PW Emergency Spray	KAM
		Cleaning and service strainer pump	KAO
15	Air Compressor	Install exhaust fan 1 & 4 unit	LF Bina
16	Cooling Water Tower	Cleaning fines and filter cooling water tower	KAO
		Cleaning and service strainer PW pump	KAO
17	Process Water	Cleaning and service strainer PW pump	KAO

2. Progress Gantt Chart

a. Feeding System

MONTH	MAY													JUNE													
WORK/DATE	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cooling down process	8.30 am																											
To fabricate water spray pipe for hopper																												
To service existing grabber																												
Cleaning and service basket filter Energetic																												
Cleaning and service Aqueous strainer																												
Cleaning and service RO pump strainer																												
Surrounding area																												
Ramp up temperature (start feeding)																												4.30 pm

b. Support Faility System

MONTH	MAY													JUNE													
WORK/DATE	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Air Compressor																												
Install exhaust fan 1 & 4 unit																												
Cooling Water Tower																												
Cleaning fines and filter cooling water tower																												
Cleaning and service strainer CWT																												
Process Water																												
Cleaning and service strainer PW pump																												

c. Incineration System

MONTH	MAY													JUNE													
AREA/WORK	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Rotary kiln																												
To replace sealing plate at RK feeding and discharge zone																												
To replace refractory for 15 rings using castable																												
To refurbish ramp pusher housing (body)																												
Stocker																												
To repair bricks at stocker																												
To service slag conveyor (repair apron conveyor, platform and replace bearing discharge)																												
To modify additional manhole door at moving grate chamber																												
To repair refractory for stocker area																												
To fabricate spare moving grate discharge plate																												
Install new thermocouple TIA 204 A, B, C																												
Cleaning and service moving grate																												

d. Heat Recovery Boiler System

MONTH	MAY													JUNE													
WORK/DATE	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Boiler																												
Cleaning tube boiler																												
Service boiler ash rotary feeder																												
Change boiler drum ash																												
Superheater																												
Cleaning tube superheater.																												
Repair pipe leaking (tube 1-4)																												
Service and cleaning ash rotary feeder																												
Economizer																												
Cleaning economizer tube																												
Change economizer drum ash																												
Demi water system																												
Install flowmeter for Demin system																												
Cleaning and service strainer Demin water																												
Change micro filter																												
Change and reinstall reverse osmosis (RO) membrane																												
Deaerator																												
Replace flanges gasket deaerator																												

e. Turbine System

MONTH	MAY													JUNE													
WORK/DATE	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Turbine																												
To modify steam trap pipe																												
To replace gasket coupling turbine gearbox																												
Air Cooler Condenser																												
To service ACC gearbox and balancing																												
To reposition strainer location vacuum pump																												

f. Flue Gas Treatment System

MONTH	MAY													JUNE													
WORK	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Semi Dry Reactor (SDR)																												
Service lime metering device 50TB001 gearbox																												
Bag Filter																												
Replace bag filter short piece purging pipe																												
Install bag filter spool piece purging pipe																												
To fabricate fabric filter discharge screw conveyor body																												
IDF																												
To fabricate new FRP pipe for wet scrubber.																												
Replace IDF bearing																												
Wet Scrubber																												
To change gate valve																												
To replace pipe position for wet scrubber PW Emergency spray																												
Cleaning and service strainer																												

3. Before & After Pictures

NO.	WORK	BEFORE	AFTER
1	To refurbish ramp pusher housing (body)	Start: 27 May 2021 	Complete: 29 May 2021 
2	Cleaning and service moving grate plate	Start: 27 May 2021 	Complete: 30 May 2021 
3	Change micro filter	Start: 28 May 2021 	Complete: 28 May 2021 

NO.	WORK	BEFORE	AFTER
4	Repair pipe leaking (tube 1-4)	Start: 28 May 2021 Top header  Bottom header 	Complete: 11 June 2021 Top header  Bottom header