INDUSTRIAL TRAINING FIELD REPORT

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LI Duration : 1 March 2021 – 16 July 2021

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1.0 INTRODUCTION

As part of my Diploma In Chemical Engineering I did a 20 weeks internship (1 March 2021 – 16 July 2021) at the FGV IFFCO SDN BHD that was established in 2006 as an processing food such as Edible Oils, Refinery, Food Manufacturing, Palm Oil Processing, Oils and Fats. Currently there are six departments of the company (Legal & Secretarial, Finance, Quality Assurance, HR & Administration, Supply chain and Factory Project & Maintenance). I was doing my internship at the Factory Project & Maintenance under Wastewater Treatment Plant. My main duty was to assist my supervisor to operate the plant, which included various tasks depending on the daily activities. However, the foremost are I specialized in creating an updated standard operating procedure for wastewater treatment plant.

I started my internship by learning the process of wastewater treatment plant that introduced by my supervisor. After that, my supervisor take me to go the plant to get some exposure in the plant. My supervisor teach me how to operate and control the important parameter in the plant. My internship was guided by my supervisor (Abdul Razak Bin Mohammed).

2.1.1 ORGANIZATION CHART

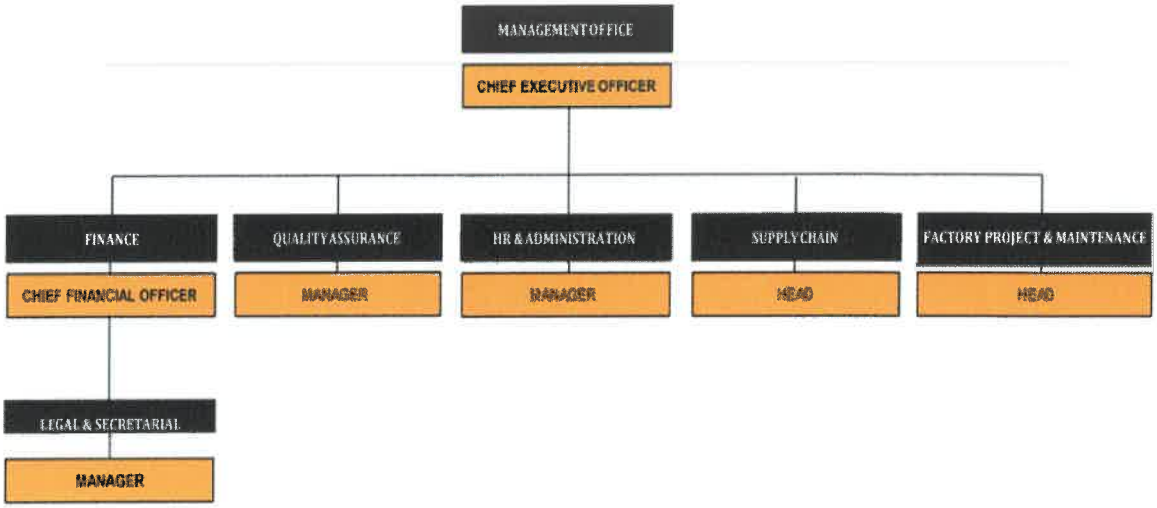


Figure 1: Organizational chart for FGV IFFCO

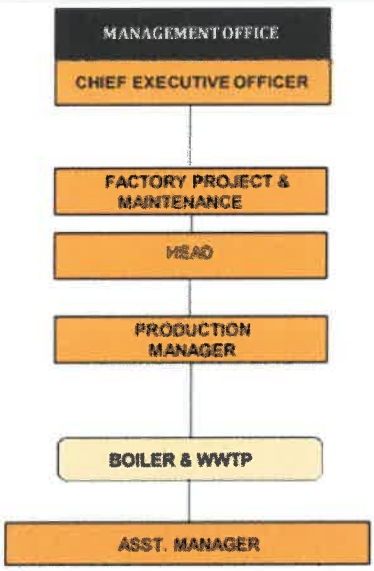


Figure 2: Organizational chart in the WWTP department

2.1.2 COMPANY VISION AND MISSION

VISSION

To be the preferred provider of essential and value-added foods for everyone, everywhere and every day.

MISSION

To deliver superior products and service through innovation and best practice

2.1.3 CORE BUSINESS

Products manufactured at its site are varieties of oils and fats with palm and lauric oil or its admixtures and fractions as main component in shortening, margarine, speciality oils and fats, ghee, cooking oils and bulk oils.

2.1.4 HISTORY OF THE COMPANY

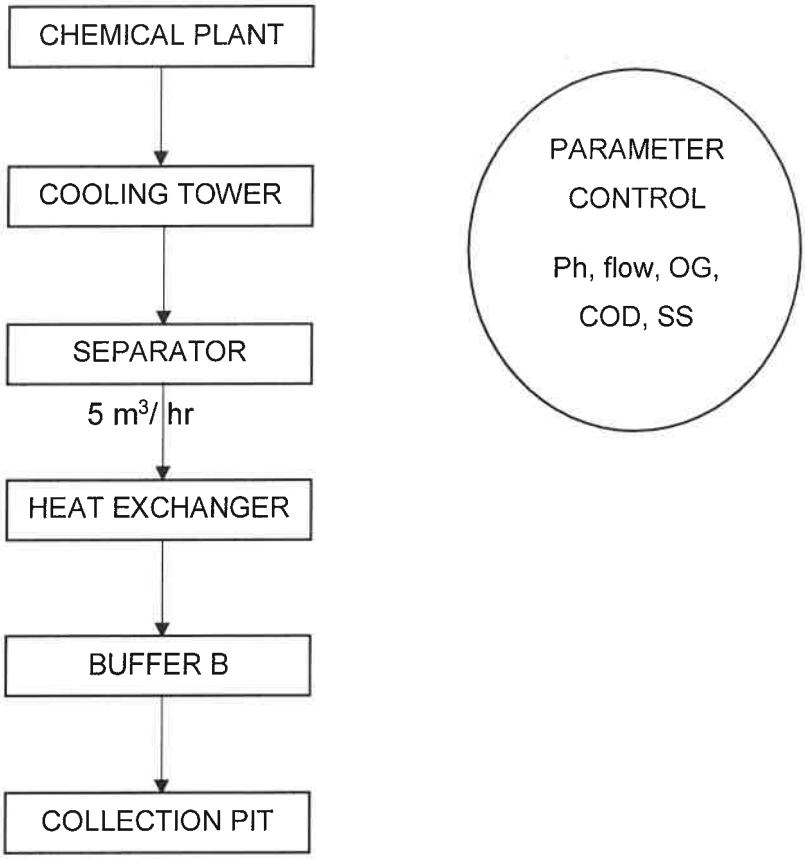
FGV IFFCO Sdn Bhd (formerly known as Felda IFFCO Sdn Bhd) is a joint venture company between FGV Holdings Berhad (FGV) and IFFCO Holdings Limited (IFFCO). This partnership between FGV, one of the world's largest plantation companies and Crude Palm Oil (CPO) producers and IFFCO, UAE's leading manufacturer and marketer of a wide range of fast moving consumer goods and industrial food products in the Middle East and Africa has created a company with expertise in manufacturing and distribution that is capable of fulfilling every requirement of the growing global fats and oils industry.

FGV IFFCO integrates the entire value chain from oil palm cultivation, milling, refining, processing, branding and distribution of a complete range of palm and palm kernel based oils and fats to global markets. FGV IFFCO not only produces and markets a wide range of products that cater to the daily needs of households across the world, but also manufactures derivatives and intermediates for baking, food and non-food uses as well.

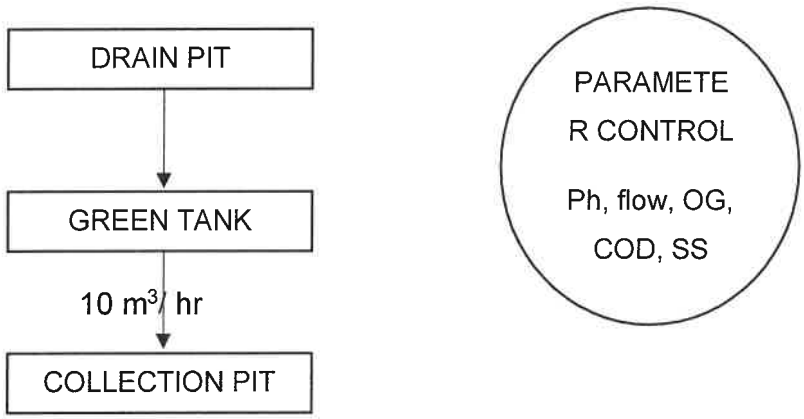
Building on FGV's and FELDA's origins as a Palm Oil Plantation Cooperative Farmers Movement, FGV IFFCO believes in sustainability and partnership with farmers, who cultivate the oil palm plantations and manage milling to produce palm oil.

2.2 PROCESS FLOW

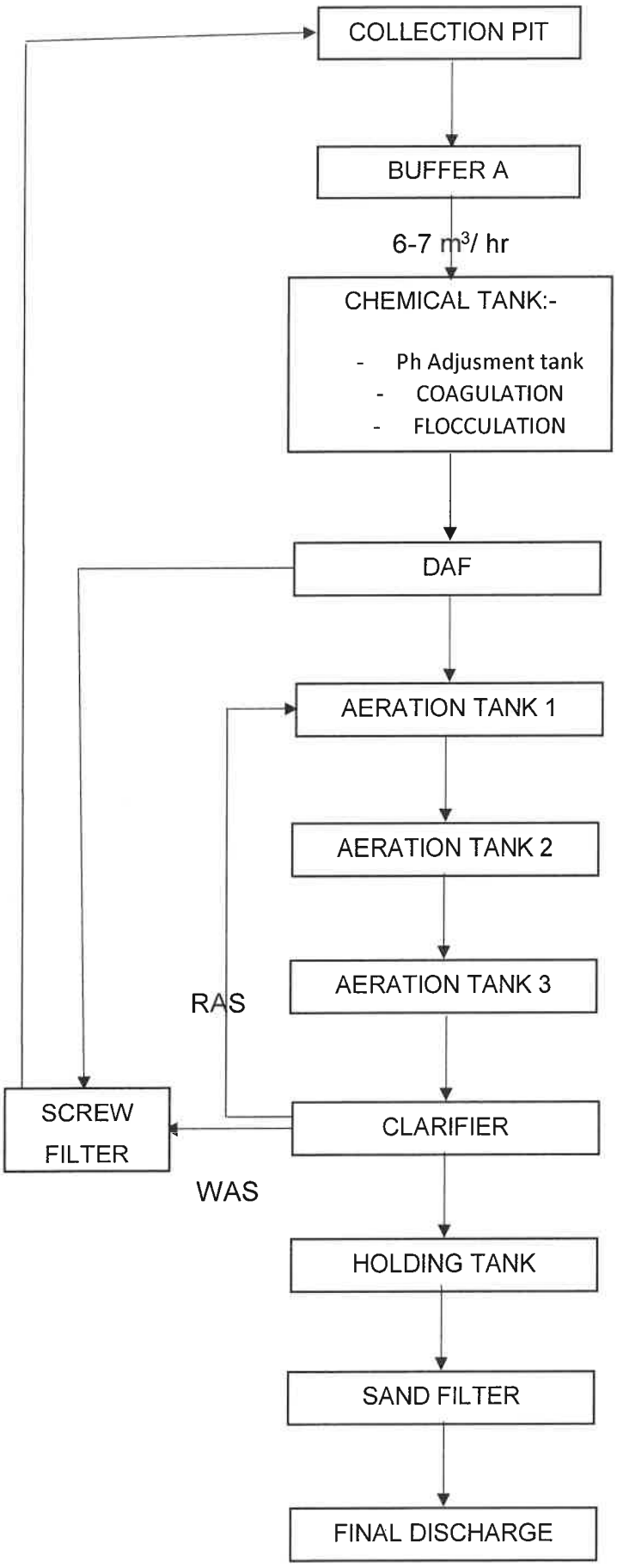
FROM CHEMICAL PLANT;



FROM DRAIN PIT 1-7;



FROM COLLECTION PIT;



THE FUNCTIONS OF EVERY UNITS

FROM CHEMICAL PLANT;

SEPARATOR

Waste from chemical plant will enter the separator to separate oil and grease within water.

COOLING TOWER PIPELINE

Cooling tower pipeline will enter the heat exchanger to make the temperature to the ambient temperature.

HEAT EXCHANGER

Heat transfer between cooling tower water and chemical plant wastewater. To decrease temperature of wastewater from 80°C to below 40°C.

BUFFER B

40m3 tank act as a buffer with air diffuser system at the bottom to homogenize water content. And the water will be transfer to the collection pit.

FROM DRAIN PIT 1-7;

DRAIN PIT

Water from the drain will pump into the green tank to go through the wasterwater treatment process.

GREEN TANK

The wastewater from drain pit will enter the green tank to undergo process of separation between water and solid.

FROM COLLECTION PIT;

COLLECTION PIT

To mixing all waste from chemical plant, cooling tower and drain.

BUFFER A

To homogeneous the pH, COD, suspended solid, BOD and Oil & Grease.

CHEMICAL TANK

To neutralize pH value and coagulant and flocculent process;

-Chemical dosing; cestfloc 1420 (polymer), cestfloc 1211(Coagulant) and Caustic Soda

-PH must be in 7-8 and always check formation of flock

Dissolved Air Flotation (DAF)

It is used to clarifier wastewater by the removal of suspended matter such as oil or solids.

AERATION TANK

AERATION TANK 3 AERATION TANK 2 AERATION TANK 1

Process involved activated carbon where contain microorganism to digest any remaining pollutant and contamination. Aeration alone helps oxidize organic and inorganic substance found in the wastewater by lowering down BOD and COD values. Activated sludge system are the key to the biological process that contain mixture of fungi, bacteria, rotifer and protozoa maintained in suspension by aeration mixing.

Always checking SV_{30} (Settling rate test). The good SV_{30} is in a range of 350 – 750. If not good it will effected the performance of the aeration process.

CLARIFIER

Clarified water from the secondary clarifier will then overflow to the final discharge sampling tank before discharge to the drainage system to ensure compliance to government standard required standard B.

HOLDING TANK

Intermediate holding tank to separate of purified effluent from the biological sludge take place.

SAND FILTER

It is used to filter suspended solid and do polishing when the filter pressure become high.

FINAL DISCHARGE

Act as small storage tank before treated water discharge into drainage system/river.

2.3 ACTIVITY

DAILY TASK AS A TECHNICIAN

TASK 1: Collecting sample

As a technician, they have to collect a sample every day in the morning for laboratory use. The type of the sample collected is;

EVERYDAY	MONDAY ONLY
INFLUENT SOFT OIL DAF AERATION TANK 3 EFFLUENT SKIMPIT 1-7	INFLUENT SOFT OIL DAF AERATION TANK 1-3 EFFLUENT SKIMPIT 1-7

The purpose of collecting sample is to analysis pH value, suspended solid, oil and grease, COD and MLSS. FGV IFFCO wastewater treatment plant is following the standard B; PH value (5.5 – 9.0), suspended solid (100ppm MAX) and COD (200ppm MAX). The Mixed liquor suspended solids (MLSS) is to measure the amount of activated sludge on the aeration tank 1 – 3. The good range of MLSS is 3000 mg/l.

TASK 2: Always record a reading of operation parameter every 2 hours

The purpose of recording a reading to keep maintaining the PH and to make sure the plant are running with properly.

TASK 3: Checking SV_{30} every 8 hours.

TASK 4: Fill chemical in chemical dosing tank if it was empty. (Caustic soda, Coagulant and polymer)

The technician will refill the chemical by using the bucket (40L) in the tank.

TASK 5: Fill UREA dosing to the aeration tank 3 every day in 12 pm.

The function of UREA is to make the bacteria (bio-sludge) life longer in the aeration tank.

TASK 6: Technician must fill chestfloc 1240(8kg) and Chestchem 7177MB (4kg) in the aeration tank 3.

Function: to make the settling rate for the sludge higher. And it will make the water from clarifier will be clear and don't have carry over sludge.

WEEKLY TASK AS AN INTERNSHIP STUDENT

WEEK 1: LEARNING ABOUT WASTEWATER TREATMENT PROCESS

On week 1, I had introduced about Wastewater Treatment Process by my industrial supervisor. My supervisor teach me how to operate and the flow of the plant process. In conclusion, my supervisor teach me well on how to operate the plant.

WEEK 2: LEARN ABOUT HOW BIO-SLUDGE TREAT WASTEWATER IN THE AERATION TANK

On week 2, I learn about what parameters that must be controlled in the plant. Such as SV30 (settling rate test), DO (dissolved oxygen) and pH value.

WEEK 3: LEARN HOW TO TROUBLESHOOT SCREWPRESS

On week 3, I learn about on how to troubleshoot the screw press. The screw press have a common problem such as, blockage pipe, pump and level sensor.

WEEK 4: LEARN MORE KNOWLEDGE ABOUT WWTP

On week 4, I ask more about wastewater treatment to my supervisor on how to maintain the good flocculation process.

WEEK 5: LEARN ABOUT SV30

SV30: The SV30 is a settling rate test. When mixed liquor is poured into a graduated settling vessel (large graduated cylinder or single purposed SV30 container); it is allowed to settle, undisturbed, for 30 minutes. To determine is how well the system is flocculating and what to expect from secondary clarification. Good SV30 will make the turbidity of effluent low.

WEEK 6: LEARN HOW DISSOLVE AIR FLOATATION (DAF) OPERATE.

On week 6, I learn how the DAF operate. The function of DAF is to separate wet sludge and water. The water will transfer to the aeration tank and sludge will transfer to the screw press. DAF will reduce the suspended solid in the influent.

WEEK 7: LEARN HOW TO OPERATE WWTP BY THE FLOWCHART GIVEN

On week 7, my supervisor asking me to help him by operate the plant because the technician not work on that week because of emergency leave. On that week, I learn many knowledge on how to operate the plant.

WEEK 8-9: LEARN HOW TO OPERATE SCREWPRESS

On week 8-9, I learn about on how to operate screw press with the operator. The function of screw press is to separate solid and water. Water will go to the collection pit and the solid (dry sludge will go the landfill).

WEEK 10-11: LEARN HOW CLARIFIER OPERATE

On week 10, I explore more about clarifier. The function of clarifier is to clarify the water from aeration tank. The bio-sludge on the clarifier will return to the aeration tank and the effluent water will transfer to the sand filter. On week 11, the clarifier have a problem cause of higher turbidity and carryover sludge. To solve the problem my supervisor said the SV30 on bio-sludge already drop and it makes the bio-sludge carry over on the surface of the clarifier.

WEEK 12: LEARN HOW PH OF AERATION TANK EFFECT THE PROCESS

On week 12, my supervisor identify that the effluent have a low PH and it not follow the standard B. The solution that my supervisor do is to give me a task to install a dosing pump of caustic soda to the aeration 3 tank to make the PH increase to 7.

WEEK 13-15: DOING A STANDARD OF PROCEDURE FOR WWTP

On week 13-15, I was work from home and my supervisor give me a task to do the SOP for the Wastewater Treatment Plant. (The example of SOP is on the APPENDIX)

WEEK 16: LEARN HOW TO MONITOR WATER LEVEL ON COLLECTION PIT

On week 16, I explore on how to monitor the level of water on collection pit. The effluent water are from drain pit and chemical plant. In this plant they do not have a sensor. It makes operator to give more attention on water level to avoid overflow of water on collection pit. If collection pit is full, the operator must increase the speed of pump to the chemical tank.

WEEK 17: LEARN THE FUNCTION OF CESTFLOC 1240 AND CESTCHEM 7177MB

On week 17, the technician used the CESTFLOC 1240 and CESTCHEM 7177MB for aeration tank. The function of CESTFLOC 1240 is to remove water impurities and increase the rate of settling rate. And the function of CESTCHEM 7177MB to make bio-sludge live longer.

WEEK 18: LEARN THE FUNCTION OF DRAIN PIT

On week 18, I learn the function of drain pit. Drain pit is a source of influent. When heavy rain happens on the plant, it will maintain the level of drain by transfer the water to the collection pit.

WEEK 19: LEARN THE FUNCTION OF SKIMPIT

On week 19, I learn the function of skimpit. The function of skimpit is to skim the oil and grease before it enter to the collection pit. By using the skimpit it will make the plant easier to separate oil and grease that contains in the influent water.

WEEK 20: CONCLUDE ALL THE TASK FOR THE TECHNICIAN

On week 20, I conclude all my internship experience to my supervisor and give out the standard of procedure of the plant that I have made on week 13 to 15.

2.4 MINI PROJECT

Project 1: 3/3/2021 Convert old sludge tank to the polymer tank.

Purpose: This old sludge tank is reuse to make a polymer mixing tank.

Problem: Technician must take a long time to mixing the polymer and water and the dosing polymer are use a lot. And the dosing polymer is 200L only. It will empty in 1 hour.

Problem solving: Technician will use this 1 tonne tank for mixing polymer and water. Then transferring it to the dosing chemical tank. It will cut a duration of mixing the polymer with water. And technician do not need to mix the polymer and water at the chemical dosing tank every 1 hour

Project 2: 14/4/2021 transferring water from effluent to the aquarium.

Purpose: Cleaning water in aquarium.

Problem: The aquarium have a lot of carryover sludge because of incoming waste that have a lower pH that make the bio sludge floating on the clarifier and made the effluent water turn brownish.

Problem solving: Change and clean the water in the aquarium and transfer a new effluent water to make it clean and have a clear water.

Project 3: 20/4/2021 Start to use chestfloc 1240 and chestchem 7177MB for aeration tank 3

Purpose: fill chestfloc 1240 8kg/2 shift and chestchem 7177MB 4kg/day

Problem: At the clarifier have a carryover sludge, that will made the turbidity of effluent will rise higher than 50 NTU

Problem solving: Technician will fill chestfloc 1240 8kg/2 shift and chestchem 7177MB 4kg/day to increase the settling rate of bio-sludge in the aeration tank 3

Project 4: 17/5/2021 installing dosing pump for caustic soda the aeration tank 3

Purpose: Install a caustic soda dosing to aeration tank 3

Problem: pH of the aeration tank 3 is low than 7.

Problem solving: Dosing the caustic soda to the aeration tank 3 to make the pH goes to 7.

Project 5: 17/5/2021 fill in the sodium carbonate to the aeration tank 3

Purpose: fill in the sodium carbonate to the aeration tank 3

Problem: pH of the aeration tank 3 is low than 7.

Problem solving: fill in the sodium carbonate to the aeration tank 3 because sodium will react with water and transform to the alkaline and will make the pH value increase to 7.

Project 6: 8/6/2021 Creating Standard operating Procedure for Wastewater treatment Plant

Purpose: Creating Standard operating Procedure for Wastewater treatment Plant

Problem: too old Standard Operating Procedure because this plant already makes many changes from 2015.

Problem solving: Do a new SOP for Wastewater treatment Plant. (The example of new SOP is on the APPENDIX)

3.0 Conclusion

After complete my industrial training, I had been exposed to a Wastewater Treatment Plant technician. Throughout my internship, I could understand more about the definition of a Wastewater technician and prepare myself to become a responsible and have higher thinking skills technician in future. Along my training period, I realize that observation is a main element to find out the root cause of a problem. Not only for my project but daily activities too. During my project, I cooperate with my supervisor and operators to determine the problems. Moreover, the project indirectly helps me to learn independently, discipline myself, be patient, self-trust, and take initiative and the ability to solve problems. Besides, my communication skills is strengthen as well when communicating with others. During my training period, I have received criticism and advice from engineers and technician when mistakes were made. However, those advices are useful guidance for me to change myself and avoid myself making the same mistakes again. Apart from that, I can also apply what I learn from introduction to environmental subject in semester 5. In conclusion, the activities that I had learned during industrial training really useful for me in future to face challenges in a working environmental.

APPENDIX

Standard Operating Procedure for Wastewater Treatment.

1. **Objective.**
   Explain general operating procedure of wastewater treatment plant.

2. **Scope.**
   Include all parameter and function for each process.

3. **Source of waste.**

3.1 Drain pit 1-7 /drain waste.
3.2 Cooling tower.
3.3 Chemical Plant.
3.4 Backwash.

4. **Chemical Preparation.**

4.1 Polymer, Cestfloct 1420: 200L Tank = 400g (small bottle): 200L.
4.2 Coagulant, Cestfloct 1211 = 200L.
4.3 Caustic Soda, NaOH = 200L.
4.4 Urea = 15 Kg/day

5. **Parameter Control for Wastewater Treatment.**

5.1 Chemical Oxygen Demand (COD).
5.2 Biological Oxygen Demand (BOD).
5.3 Suspended Solid (SS).
5.4 Oil & Grease.
5.5 pH.
5.6 Dissolve Oxygen (DO).
5.7 Mixed Liquor Suspended Solid (MLSS).
5.8 Mixed Liquor Volatile Suspended Solid (MLVSS).
5.9 SV 30

6. Performance Monitoring.

Parameter	Description
Chemical Oxygen Demand (COD).	• Use a strong Chemical Oxidizing Agent (Potassium Dichromate, $K_2Cr_2O_7$) to oxidize organic matter and some inorganic matter. • Test Method: i. Pipet 2ml wastewater sample into COD vials. ii. Place COD vials into reactor for heating 2 hours at 150 ^{0}C. iii. After digestion, get reading from spectrophotometer.
Solid Inventory. i. MLSS (Mixed Liquor Suspended Solids).	• The amount of total suspended solid material (organic & inorganic) in the mixed liquor sample taken from the aeration tank. • Test: A well mixed the sample is filtered through a filter and the residue retained on the filter is dried to a constant weight at 103^{0}C- 105^{0}C.
Solid inventory. ii. MLVSS (Mixed Liquor Volatile Suspended Solids).	• The amount of organic material suspended in the mixed liquor sample taken from the aeration tank. • Test: A well mixed the sample is ignited until constant at 550^{0}C.
SV 30 (Sludge Volume 30 min).	• Volume of settled activated sludge after 30 min of settling in a 1000 ml graduated cylinder or settlemeter.
SVI (Sludge Volume Index).	• Measure of the ability of biomass to settle. $\text{SVI}, \frac{\text{mL}}{\text{g}} = \frac{\text{SV 30}, \frac{\text{mL}}{\text{L}} \times 1000, \frac{\text{mg}}{\text{g}}}{\text{MLSS}, \frac{\text{mg}}{\text{L}}}$ • The common range of SVI is 50-150. • SVI < 50 may indicate pin floc condition result from old sludge age. i. Sludge age can reduce by wasting more sludge.

	• High SVI indicate poor bulking of sludge and Filamentous growth.
pH.	• Control at Chemical reaction and Biological Tank. • Control range: i. Operation Control: pH 6.5-pH 8.5. ii. Optimum: pH 7.
Nutrients.	• Minimum requirement is related to the BOD of the raw wastewater. i. The ratio is: BOD:N:P=100:5:1.
Dissolved Oxygen.	• Concentration is given in units of mg/L. • Optimum control: 2.0 mg/L.
Temperature.	• Optimum condition: i. 31 to 38 ^{0}C. • > 38^{0}C, the flocs will begin to disperse.
F/M ratio.	• Amount of food available to the number of microb in the aeration tank. $\frac{F}{M} = \frac{BOD, \frac{mg}{L} \times Flowrate, \frac{m^3}{d}}{MLVSS, \frac{mg}{L} \times Aeration\ tank, m^3}$ • For microbiological health and effective treatment the microorganisms (MLSS) under aeration should be maintained at a certain level for the amount of food (influent BOD) coming into the plant. • Control range: 0.1 - 0.3.
Biological Oxygen Demand (BOD).	• Amount of O_2 used by the microorganisms to biologically biodegrade (oxidize) the organic matter in the wastewater. • Organic matter increase, oxygen increase and BOD increase. • Test Method: i. Dilute wastewater sample and saturated with oxygen and microorganism seed. ii. Measure the Initial Dissolved Oxygen (DO). iii. The sample kept at 20^{0}C in the dark. iv. Incubate for 5 days. v. After 5 days, DO is measured again. vi. The difference between the final DO is the BOD.

7. Chemical Treatment.

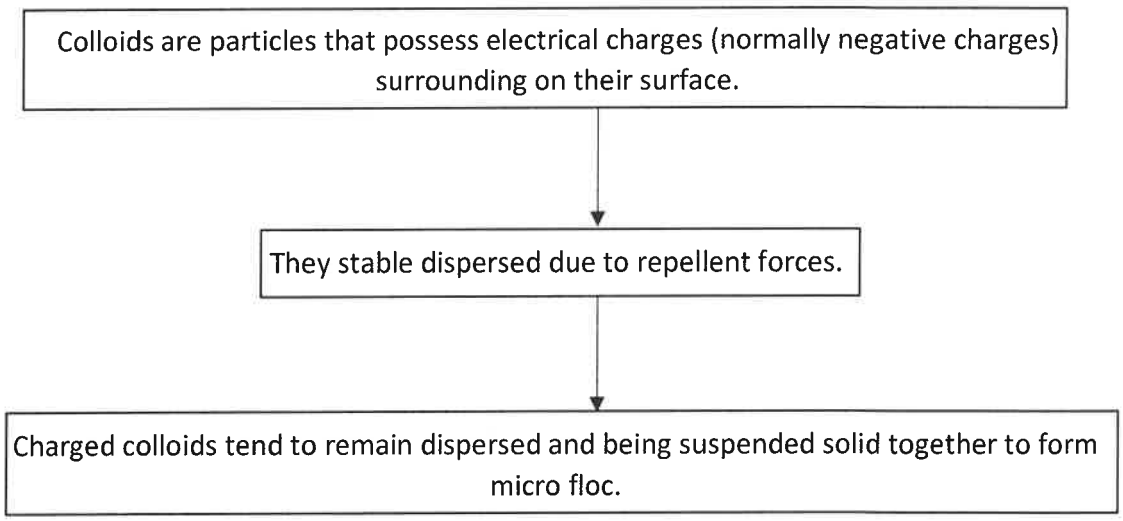
7.1 All water contain both Dissolved and Suspended Solids which will contributes to BOD and COD.

7.2 Chemical treatment (Coagulant and Flocculation process) are used to separate the suspended solid portion from the water.

7.3 The suspended particle (colloids) vary considerably in source, composition charge, particle size, shape and density.

7.4 Coagulation and Flocculation Process:

7.4.1 Stability of colloid particle:



7.4.2 Destabilization of colloid:

7.4.1.1 Charge of colloid can be reduced or eliminated then the colloids will gather together.

7.4.1.2 Destabilization of colloids by charge neutralization.

7.4.1.3 First forming small groups then larger aggregates and finally into visible floc particles.

7.5 Coagulation process:

7.5.1 Coagulation is the destabilization process of colloids by addition of chemicals that able to neutralize the negative charges of colloids.

7.5.2 The chemicals are known as coagulant which are charged positively (Na^{+}, Mg^{2+}, Al^{3+}, Fe^{3+}).

7.6 Jar Test:

7.6.1 Procedure:

7.6.1.1 pH adjustment:

NaOH (10% concentration) = 0.5ml – from pH 6.6 to pH 7.5.

7.6.1.2 Coagulant:

Alum (10% concentration) = 0.5ml – "pin floc" form.

7.6.1.3 Flocculant:

Polymer (0.2% concentration) = 0.5ml – to form larger floc.

7.6.2 Calculation formula:

7.6.2.1 Calculation Dosage, mg/L:

$$\text{Dosage, mg/L} = \frac{\text{Total Dosage of Chemical (ml)}}{\text{Total volume of Sample (ml)}} \times \frac{\text{Concentration of chemical (\%)}}{100\%} \times 10^6$$

7.6.2.2 Use of Chemical Formula:

$$\text{LPH} = \frac{\text{Total dosage of Chemicals (ppm)} \times \text{Incoming flowrate (MPH)}}{1000}$$

7.6.2.3 Chemical Preparation:

$$\% = \frac{\text{Chemical Usage (Kg @L)} \times 100}{\text{Volume of Chemical Tank (L)}}$$

7.6.2.4 Used of chemicals based on preparation:

$$\text{L} = \frac{\text{Chemical Used (L)} \times 100\%}{\text{Chemical Preparation (\%)}}$$

7.6.2.5 Pump Dosage (%):

$$\% = \frac{\text{Chemical Used (LPH)} \times 100\%}{\text{Chemical Pump Capacity (LPH)}}$$

7.7 Factors affect Chemical Treatment:

7.7.1 pH:

7.7.1.1 The optimum pH range varies depending on the coagulants used, but it is usually in between pH 6 to 8.

7.7.1.2 pH of incoming effluent.

7.7.2 Turbidity Wastewater:

7.7.2.1 Constituents and concentration of incoming effluent.

7.7.3 Mixing:

7.7.3.1 Essential for any chemical reaction (dispersion of chemical).

7.7.4 Chemicals:

7.7.4.1 Proper type and concentration of coagulant and flocculent.

8. Biological Treatment:

8.1. Introduction of Activated Sludge process:

8.1.1. Biological treatment process:

8.1.1.1. Use of microorganism to break down the organic matter in wastewater.

$$\text{Organic matter} \xrightarrow{O_2} CO_2 + H_2O + \text{Energy} + \text{New Biomass}$$

8.1.2 Suspended Growth mechanisms:

8.1.2.1 This process maintain a culture of organisms in suspension of wastewater liquid, either by vigorously aerating the liquid or by mechanical mixing.

8.1.2.2 Aerobic Bacteria grow and form particles that clump together:

8.1.2.2.1 These particles (flocs) are allowed to settle to the bottom of the clarifier, leaving a relatively clear liquid free of organic material and suspended solids after aeration process.

8.2 Factors affect Activated Sludge Growth Rate:

8.2.2 Nutrients:

8.2.2.1 $C_{60}H_{87}O_{23}N_{12}P$ (Formulation are approximations and may vary with time and species).
8.2.2.2 Important for bacteria growth and metabolic activity.
8.2.2.3 Nutrient deficiency can cause BOD/COD removal efficiency drop.

8.2.3 pH:

8.2.3.1 Acidic (low pH) or alkaline (high pH) condition can adversely affect microorganism growth and survival.
8.2.3.2 Enzymes which regulate the biochemical reaction in bacteria are very pH dependent.

8.2.4 Dissolved Oxygen Level:

8.2.4.1 Aerobic Bacteria need O_2 to convert food into energy for their growth.

8.2.5 Temperature:

8.2.5.1 High effect on the rate of cell growth.

8.2.5.1.1 An increase in temperature (within the range of temperature that bacteria can grow) doubles the rate of microbial growth.

8.2.5.2 Temperature increase, < O_2 dissolved in water.

8.2.5.2.1 O_2 is less soluble in warm water than in cold water.

8.2.6 Organic Loading (BOD/COD and Flow rate):

8.2.6.1 High flows can shorten the time necessary for the full treatment of wastewater.
8.2.6.2 Extremely high flows can wash microorganisms out of the plant through the final clarifier.

8.2.7 Presence of Toxins:

8.2.7.1 Depending on concentration of toxic material microorganisms could be destroyed or their metabolic rates affected.
8.2.7.2 Examples of Toxin:

8.2.7.2.1 Inorganic matter (copper, lead and silver).
8.2.7.2.2 Surfactants.
8.2.7.2.3 Phenols.

9. Wastewater Treatment Process.

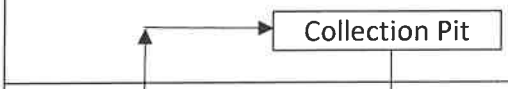
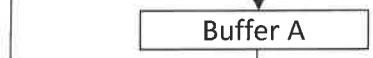
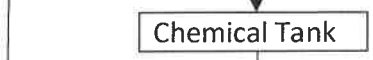
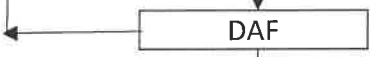
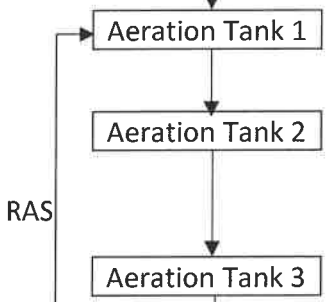
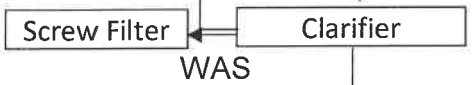
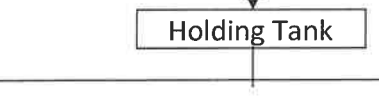
9.1 From discharge point 1-7/ drain waste:

From Discharge Point 1-7/ drain waste:	Description
Drain Waste ↓	Incoming wastewater treatment that flow into the wastewater treatment plant from raw influent.
Green Tank ↓	Green tank are used for catchment of all raw influent from plant before release to collection pit.
Collection Pit	Function: To mixing all waste from chemical plant, cooling tower and drain. Control: Level.

9.2 From Chemical Plant:

From Chemical Plant:	Description
Chemical Plant ↓	Incoming wastewater treatment that flow into the wastewater treatment plant from Soft Oil influent.
Cooling Tower ↓	Function: To decrease temperature of wastewater from 80 to 40^0C. Control: Temperature.
Separator/ Skimmer ↓	Function: It is used to separate Oil & Grease. Control: pH, flowrate, Oil & Grease, COD and suspended solid.
Buffer B ↓	Function: Buffer B is a holding tank influent from soft oil wastewater. Control: pH, Oil & Grease, COD and suspended solid.
Collection Pit	Function: To mixing all waste from chemical plant, cooling tower and drain. Control: Level

9.3 From Collection Pit:

From Collection Pit:	Description
	Function: To mixing all waste from chemical plant, cooling tower and drain. Control: Level
	Function: To homogeneous the pH, COD, suspended solid, BOD and Oil & Grease. Control: Level, pH and Oil & Grease.
	Function: To neutralize pH value and coagulant and flocculent process. Control: pH, level and flowrate.
	Function: It is used to clarifier wastewater by the removal of suspended matter such as oil or solids. Control: Flow, Oil & Grease and level.
	Function: Process involved activated carbon where contain microorganism to digest any remaining pollutant and contamination. Aeration alone helps oxidize organic and inorganic substance found in the wastewater by lowering down BOD and COD values. Activated sludge system are the key to the biological process that contain mixture of fungi, bacteria, rotifer and protozoa maintained in suspension by aeration mixing. Control: DO, MLSS, MLVSS, BOD, COD, SV30, pH and Oil & Grease.
	Function: To separate of purified effluent from the biological sludge take place. Control: DO, flow, level and separation of floc.
	Function: To separate of purified effluent from the biological sludge take place. Control: DO, flow, level and separation of floc.

	Function: It is used to filter suspended solid and do polishing when the filter pressure become high. Control: Suspended solid.
	Function: Act as small storage tank before treated water discharge into drainage system/river. Control: COD, BOD, TSS, Oil & Grease and pH.

10. Capacity Tank of Wastewater Treatment:

Bil	Description	Capacity
1	Collection Pit	$3.24m^3$
2	Buffer B	$127.1m^3$
3	Chemical Treatment	$6.13m^3$
4	DAF Tank	$10.8m^3$
5	Buffer A	$49.88m^3$
6	Aeration Tank 1	$74.86m^3$
7	Aeration Tank 2	$78.42m^3$
8	Aeration Tank 3	$424.7m^3$
9	Secondary Clarifier	$19.75m^3$
10	Holding Tank	$10.69m^3$
11	Sand Filter	$3.53m^3$
12	Sludge Tank	$1.57m^3$
13	Belt Press	$3m^3$/day

Total capacity of wastewater for a day: 810.67 m^3.

11. Operation of Wastewater Treatment.

11.1 Incoming Waste

11.1.1 Incoming Waste from discharge point:

11.1.1.1 Incoming waste from discharge point from plant will enter Green Tank 1.

11.1.1.2 Wastewater inside Green Tank will discharge waste if achieve high level by opened the actuator discharge point valve the waste will flow out by gravity flow and enter collection pit.

11.1.1.3 Wastewater flow going out are monitored.

11.1.2 Incoming Waste from Chemical Plant:

11.1.2.1 Incoming waste from Chemical Plant will enter cooling tower.

11.1.2.2 Cooling tower are used to decrease temperature of wastewater before enter separator.

11.1.2.3 Separator are used to separate Oil & Grease maximum at 100 ppm and then control the pH between 5.5 to 9, COD maximum at 100 ppm and suspended solid maximum at 200.

11.1.2.4 Challenge for chemical waste are inconsistent of pH between 5.5 to 9, not efficient, inconsistent flow and COD level higher than limit.

11.1.2.5 Waste from Separator are discharge by monitoring the flow and transferring the waste to Buffer B by opened the actuator discharge valve and then start the pump to transfer the waste that already separate from Separator to Buffer B.

11.1.2.6 Challenge for separator are insufficient storage of Oil & Grease collected.

11.1.2.7 Due to accumulation of solid and Oil & Grease Buffer B are used to control pH, Oil & Grease, COD, and suspended solid at temperature below 40^0C.

11.1.2.8 Wastewater inside Buffer B then transferred to collection pit by using the pump. The flow of wastewater enter collection pit will be monitored.

11.1.3 Incoming Waste from Cooling Tower:

11.1.3.1 Incoming wastewater from cooling tower enter directly to collection pit by monitoring the flow that enter collection pit.

11.2 Collection Pit and Buffer A.

11.2.1 Switch on agitator at collection pit.

11.2.2 Wastewater level that enter collection pit are monitored.

11.2.3 Collection Pit are used to mixing all waste from chemical plant, drain and cooling tower.

11.2.4 Then, overflow of wastewater in collection pit will discharge to Buffer A by open discharge pump and switch on the pump.

11.2.5 Buffer A are used to homogeneous the pH, COD, suspended solid, BOD and Oil & Grease.

11.2.6 Level inside Buffer A are monitored manually between 50 to 80% and pH sensor at 5.5 to 7.5 every 2 hours.

11.2.7 Temperature control of wastewater is attained by mixing the influent with the other influent to bring down the temperature differences.

11.2.8 Oil & Grease manually visually control from Buffer B and collection pit to prevent any entry into the wastewater treatment system.

11.2.9 Ensure mixer agitator are always functioning to prevent septic.

11.2.10 Then, wastewater from Buffer A discharge to chemical tank by open the actuator valve and start the pump to transfer wastewater to chemical tank.

11.3 Chemical Tank.

11.3.1 Wastewater from Buffer A then enter chemical tank at flowrate 8Mt/hr.
11.3.2 Influent in chemical tank are analyze by sending sample to lab.
11.3.3 To maintain the pH of influent at pH 7.0-8.5 inside chemical tank by dosing caustic soda or NaOH are used to increase the alkalinity of the waste if it below pH range of 5.5 using dosing pump.
11.3.4 Citric acid are used in powder form are manually setting the quantity if the pH range exceeded above pH values of 7.5.
11.3.5 To control flowrate into the Aeration tank and to determine the loading COD (kg/day).
11.3.6 COD loading=Concentration (Kg/m^3)×flowrate (m^3/day). COD concentration determined from daily analysis and flowrate based on flowmeter.
11.3.7 Then, chemical tank level are monitored at level of 80%. Next, switch on the 3 nos agitator if level achieve 80%.
11.3.8 After that, switch on dosing pump for coagulant and setting the quantity. Coagulant is used to destabilizes particles through chemical reaction between coagulant and colloids and bring out the impurities from the wastewater.
11.3.9 Then, switch on dosing pump for polymer and setting the quantity. Polymer are used after the coagulation and aid the flocculation process to form bigger flocs and settled to form sediment.
11.3.10 The mixer are set to slow mixing to avoid shearing force applied on the flocs. The dosing for chemical is determined by using jar test experiment to get optimal dosing of both coagulant and flocculent this is done by if there is any changes incoming influent from both Soft oil in Buffer B or raw influent from collection pit.
11.3.11 The pH reading are monitor to achieve target of pH 7 to 8 and monitor the overflow of wastewater to DAF tank.

11.4 Dissolved Air Flotation (DAF).

11.4.1 Wastewater from chemical plant enter DAF tank.
11.4.2 DAF tank are used to make sure the flocculation process take place without fail.
11.4.3 Level are monitored at 80% of tank.
11.4.4 Switch on circulation pump.
11.4.5 Switch on air valve for AMV.
11.4.6 Switch on scrapper.
11.4.7 Ensure the scrapper functioning all the time.
11.4.8 Switch on discharge valve to holding tank.
11.4.9 Switch on discharge to collection pit (recycle).
11.4.10 Switch on discharge sludge valve and pump to screw press.
11.4.11 Then, wastewater enter the holding tank.
11.4.12 From holding tank waste then enter the aeration tank by open discharge valve to aeration tank 1 and switch on discharge pump when level at medium and high level and switch off the pump when level reach low level.

11.4.13 All the lighter suspended matter which include Oil & Grease flow into the oil recovery tank and inform to soft oil operator to be manually recovered by pumping it into intermediate bulk container or IBC tank.

11.5 Aeration Tank 1, 2 and 3.

11.5.1 Wastewater from DAF tank are pump to the Aeration Tank where it is mixed with bacteria.
11.5.2 Aeration tank are used to established healthy biomass to optimize COD and Oil and Grease degradation.
11.5.3 Air diffused in the tank to supply the oxygen required for bacteria which performs the biological degradation of pollutants.
11.5.4 This system involve recycling of the sludge settle to the bottom of the clarifier and back to aeration 1, 2 and 3.
11.5.5 The number of suspended microorganism is monitored calculation of Mixed Liquor Suspended Solid/ Mixed Liquor Volatile Suspended Solid (MLSS/MLVSS) on each aeration tank and maintain around 400 mg/L.
11.5.6 Blower are introduced into aeration tank and the bubble diffuser to increase the surface area for efficient diffusion of oxygen to wastewater and also to prevent septic.
11.5.7 The level of dissolve oxygen in the aeration tank and monitored manually by the operator.
11.5.8 Monitor the level, DO and pH of wastewater in Aeration tank 1.
11.5.9 Ensure COD loading into Aeration Tank 1 less than 3500 mg/L.
11.5.10 Ensure the pH within 7.0 to 8.5 for effective bio-degradation process.
11.5.11 Switch on the air valve and blower.
11.5.12 On valve and discharge pump to Aeration tank 2.
11.5.13 Monitor the level, DO and pH of wastewater in Aeration tank 2.
11.5.14 Switch on air valve and blower.
11.5.15 On valve and discharge pump to Aeration tank 3.
11.5.16 Switch on air valve and blower.
11.5.17 Monitor the level, DO and pH of wastewater in Aeration tank 3.
11.5.18 Level of Aeration Tank 3 need to monitored consistently to avoid overflow especially when shock load.
11.5.19 Switch on discharge pump to clarifier and monitor the flow of wastewater inside tank.
11.5.20 Parameter control in Aeration tank are pH between 7-8, DO between 2-4 ppm, <LSS over 3500 ppm, MLVSS over 3000 ppm, COD, BOD, SV 30 between 350-700 ppm, Oil & Grease SV30 maintain at 50%.
11.5.21 MLSS, pH, DO, SV30, NH_3 and PO_4 are checked daily and microorganism ratio and MLVSS are checked weekly for aeration tank.
11.5.22 MLSS are maintained by monitor the RAS from secondary clarifier.
11.5.23 Adjust or monitor the flowrate of effluent from Aeration tank 3 to primary clarifier.
11.5.24 Culture the bacteria if needed for 8 hours.
11.5.25 To ascertain COD loading and then analyze NH_3 and PO_4 every morning.

11.5.26 Dose for macro and micro nutrients (MAP) or urea for C:N:P stabilization (if necessary), -C:N:P=100:5:1.

11.5.27 If COD larger than 3500 mg/L, flowrate from Buffer A are adjust to Aeration Tank 1 to reduce incoming flow.

11.5.28 Challenge in aeration tank are inconsistent of MLSS are less than 3500 ppm, inconsistent of MLVSS are less than 3000 ppm and SV30 are less than target or required due to low of MLSS.

11.5.29 Conduct test for SV30, DO and pH using instrument provided, if SV30 are 50% more the wastage or dewatering sludge need to run, DO larger than 2.0mg/L and pH larger than 7 if less or over add caustic soda (NaOH) or Sulphuric Acid (H_2SO_4) respectively.

11.6 Clarifier Tank.

11.6.1 Wastewater from Aeration Tank 3 enter clarifier tank and monitor the level of clarifier tank.

11.6.2 Overflow from clarifier tank enter to holding tank.

11.6.3 Secondary clarifier is where the separation are purified then recycled to aeration tank as returned activated sludge to ensure enough microorganism in the basins.

11.6.4 It is used to optimize sedimentation of MLSS and can be determined physically by conducting SV30 test (sludge volume 30 minutes test).

11.6.5 Parameter control in clarifier tank are separation of floc.

11.6.6 Challenges in handle clarifier tank are floc bulging.

11.6.7 Dissolved oxygen level are monitor for wastewater inside clarifier tank.

11.6.8 Flow level inside clarifier tank are also monitor.

11.6.9 Switch on discharge valve for returned activated sludge (RAS)/waste special management (WAS) pump.

11.6.10 RAS then recycle to Aeration Tank 1, while WAS are enter screw filter for sludge waste special management whereas the supernatant (clear water) will be discharge out fall chamber.

11.6.11 Physically the supernatant should be clear water.

11.6.12 Need to check physically of effluent discharge such as clear, murky or pin-floc.

11.6.13 Need to check RAS pump in operation with flowrate of 70% to 1005 of incoming effluent.

11.6.14 At holding tank, level are monitor and when level reach high level switch on discharge pump for wastewater to enter sand filter.

11.7 Sand Filter.

11.7.1 Wastewater from secondary clarifier then overflow to holding tank before pumped into the sand filter.

11.7.2 The sand filter is used to filter suspended solid and do polishing when the filter pressure become high.

11.7.3 Frequent backwashing is required to remove the accumulated suspended solid in the media bed.

11.7.4 Sand filter can remove 10% suspended solid in wastewater.

11.8 Final Discharge.

11.8.1 Final discharge point is act as small storage tank, whereas before treated water will be discharge into drainage system/river.

11.8.2 Effluent sample is taken at this point to check the following parameter at the QA lab on a daily basis follow DOE Standard B:

11.8.2.1 COD must comply with Standard B, < 200 mg/L.
11.8.2.2 BOD must comply with Standard B, < 50 mg/L.
11.8.2.3 TSS must comply with Standard B, < 100 mg/L.
11.8.2.4 Oil & Grease must comply with Standard B, < 10 mg/L.
11.8.2.5 pH must comply with Standard B, between 5.5-9.0.

12. Waste Discharge.

12.1 Sludge from screw press will throw to landfill.
12.2 Effluent/ treated wastewater will discharge to river.
12.3 Oil & Grease from separator will recycle back to plant.

TROUBLESHOOTING PART

1. COLLECTION PIT

If pH of collection pit is lower than 7;

- Stop or slowing the flow from buffer B;

(Buffer B have a lower pH and it will make the bacteria in the bio-sludge will die).

- Flow the waste from green tank to the collection pit to stabilize the pH.

2. BUFFER A

If buffer A is full;

- Slow down the flow from buffer A
- Slow down the flow from green tank and stop pump from Drain pit 2
- Slow down the flow from chemical plant

3. CHEMICAL TANK

If pH is lower than range of 6-8

- Increase the dosing pump of caustic soda to the chemical tank

If flocculation not form a fine floc

- Increase the dosing pump of polymer and coagulant to the chemical tank.

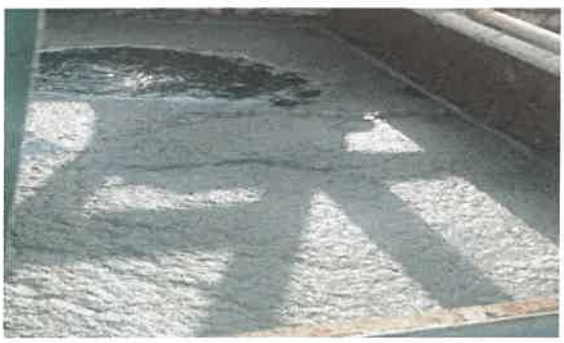
4. DAF (DISSOLVE AIR FLOATATION)

If DAF not separate sludge with efficiently

- Check the AMT(AIR MIXING TANK reading);
- Make sure DAF reading is;

Pump press(Bar)	Air press(Bar)	Airflow(L/min)	Scrapper (Hz)
3.0	5.0	10.0	6.0

- Make sure surface of DAF have a fine bubble and discharge clean water



- If it is not operate properly quickly check and clean the pipe for AMT.
- Maybe it have a sludge blocked at the pipe.

5. SCREW FILTER

If wet sludge not pumping from sludge tank

- Increase the pump energy to pump the sludge
- Check pipe at the outlet from sludge tank; maybe the sludge blocked at the outlet pipe.

If the screwpress not operate.

- Check sensor;

check the sensor and clean the sensor; because the sludge that already accumulate around the sensor causes the sludge pump operate.

6. AERATION TANK 1,2,3

If pH is lower than range of 6-8

- Dosing a caustic soda at the aeration tank 3

If SV_{30} is lower than 350

- Standby to fill new bio-sludge on each aeration tank

7. CLARIFIER TANK

If have floating sludge on surface clarifier

- Pumping the floating sludge to the aeration tank 3.
- Make sure have dosing the chestfloct 7177MB 10kg/day and Chestchem 1240 4kg/shift
- Standby to fill new bio-sludge

8. HOLDING TANK

If holding tank is full

- On pump from the outlet holding tank

9. SAND FILTER

If sand filter not work efficiently

- Service and refill carbon

If effluent have carry over sludge

- Quickly close sand filter and recycle the sludge to the aeration tank 1