



CHE 353: INDUSTRIAL TRAINING FIELD REPORT

PRIDE- CHEM INDUSTRIES SDN BHD

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CHAPTER 1: INTRODUCTION TO INDUSTRIAL TRAINING (CHE353).

1.1 Introduction.

Industrial training can be described as a program that will provide students with good practical training within a specified time frame. Students will be exposed to professional skills and experience in a working environment. All UiTM students from Diploma in Chemical Engineering (EH110) were required to attend the internship for 17 weeks to fulfil the requirements in the diploma program for semester 6. The main objective of industrial training is to allow students to learn and improve their talents under the supervision and guidance of experts from both inside and outside the university. This will help the student to develop new experience, knowledge, and skills despite implementing all the theory and skills that they have learned by completing their task during industrial training.

In addition, students will be able to enhance their knowledge and significant skills at the companies that they are training. This is because they will gain both theoretical and practical knowledge according to their internship assessment. They will also have some chances to develop their skills in work ethics, management, and communication soft skills among the employers and employees. Industrial training is important to students to make them aware of the current technologies and chemical process methods that relevant to our industries. This will encourage students to get through to the associate rules and standard processes related to chemical and product management. Therefore, UiTM will be able to produce graduates who are market ready.

1.2 Job Scope.

For 17 weeks, I have been trained in Pride-Chem Industries Sdn. Bhd as I believe this company will introduce me to the real side of job scope as a Chemical Engineer. Pride-Chem Industries Sdn. Bhd is Singapore leading manufacturer and trader of high purity ammonia and copper specialty chemicals. This company also offers waste management services in Singapore and Malaysia. For my industrial training, my job responsibilities are:

- Provide support to improve production performance and troubleshooting.
- Conduct review of process and operations to enhance operations safety.
- Maintain up-to-date departmental procedures and controlled documents.
- Provide engineering analysis and recommendation on problem-solving efforts to ensure that all aspects of problems, including safety and environmental concerns, are addressed.
- Involvement in procuring of engineering spare parts and equipment for projects.

- Assist engineer and supervisor to upkeep of plant maintenance
- Daily monitoring of Environmental Equipment and calibration of instruments.

CHAPTER 2: COMPANY PROFILE.

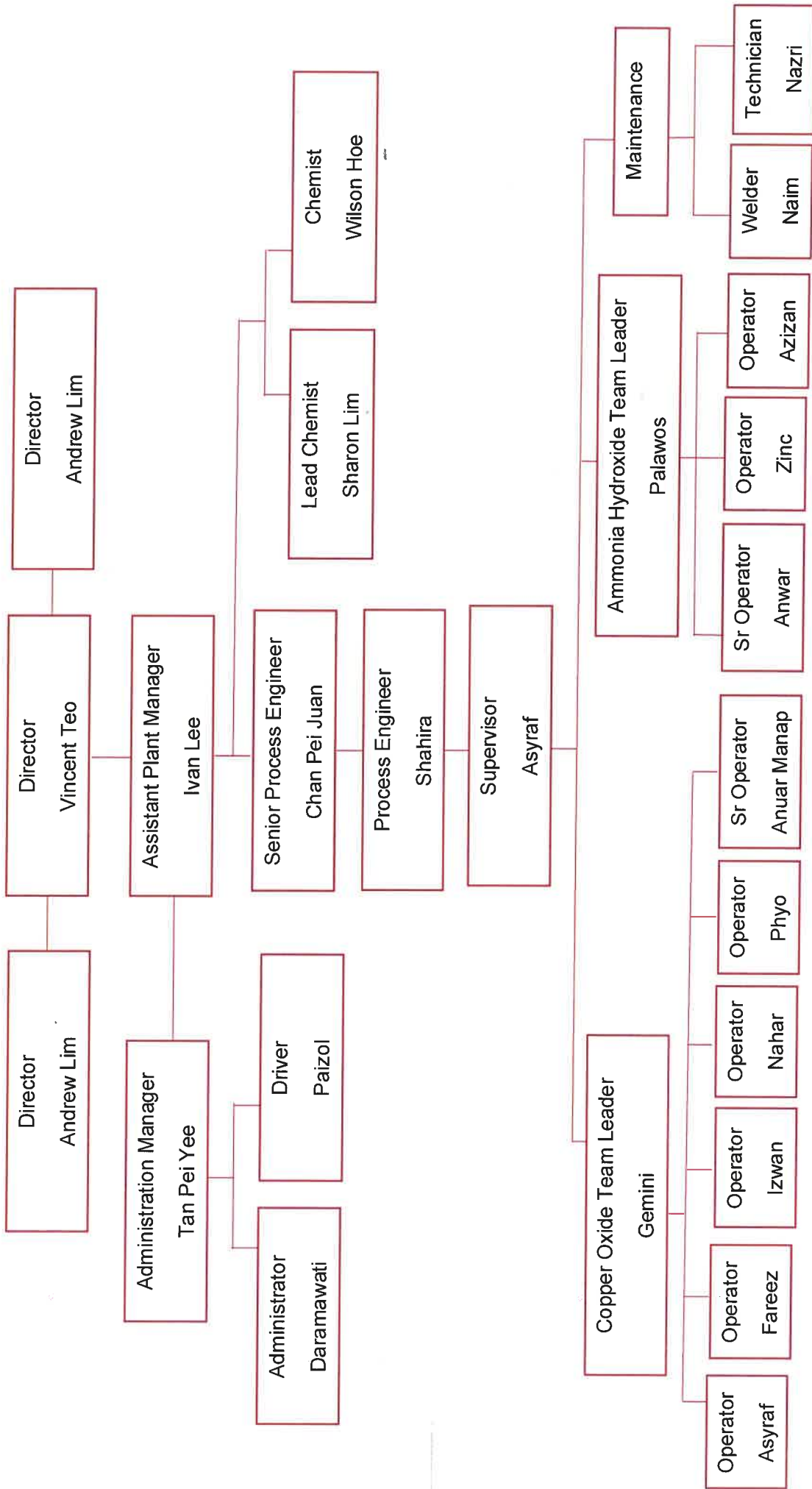
2.1 History of the company

Pride Chem Industries Sdn. Bhd was established in Singapore since 1977 at Tuas View Lane. This company is a leading manufacturer and trader of high purity Ammonia and Copper chemicals in South East Asia. Pride- Chem also recovers and treats hazardous waste materials from electronic and other various industries. Their expertise in separation, purification and formulation technologies enable them to produce high quality products and services according to their customer needs. It has strong presence in Singapore by providing other products, such as Poly Aluminium Chloride (PAC), Anhydrous Ammonia (NH₃), custom blending and specialized Ammonia purging service. This chemical company has strong customer base in Europe, United States and Asia Pacific.

Pride-Chem was founded in 1946 as Chop Seng Hin, a tiny humble family business in Singapore that manufactured soap goods. Seng Hin Chemical & Manufacturing Pte Ltd began trading anhydrous ammonia gas and manufacturing ammonium hydroxide products in 1977. In 1983, Pride-Chem Industries Pte Ltd was established to collect and treat hazardous toxic waste from PCB industries manufacturing copper oxide. Both entities operated separately until 1987, when Pride-Chem and Seng Hin combined to become the Pride-Chem we know today. Pride-Chem (Malaysia) Sdn Bhd was established in Johor Malaysia to enhance industrial capacity. Pride-Chem has subsequently grown, improved, and expanded its product line, quality, and services.

On November 1991, Pride Chem Industries Malaysia joint venture between Pride-Chem Singapore & Coogee Chemical Australia before fully owned by Pride-Chem Industries Pte Ltd. This company located at PLO 232, Jalan Keluli 1, Pasir Gudang Industrial Estate, 81700 Pasir Gudang, Johor. In Malaysia, Pride- Chem focusing on recovery and treatment of Spent Cupric Chloride (CuCl₂) to Copper Oxide (CuO) and trading of high purity ammonium hydroxide. This company also involved in industrial waste management from electronic and other various company.

2.2 Organizational Chart



2.3 Health, Safety and Environmental Policy.

- Provide a safe and healthy environment in which their employees, visitors and customers can carry out their business.
- Firmly believe in and are committed to ensuring that their operations are carried out in a way that ensures the health and safety of everyone.
- Do not produce or render any service likely to cause an accident or exposure that may result in personal injury, damage to equipment or loss in process.
- Each member of their organization is responsible for health and safety and will be held accountable for their actions.

Any and all other policies and procedures must support and comply with this policy statement.

CHAPTER 3: PROCESS FLOW.

3.1 Pre-Treatment – Iron Extraction.

Cupric chloride (CuCl_2) were collected from other company and transferred into the reaction tanks. In order to extract the ions in the cupric chloride (CuCl_2), monosodium phosphate (MSP) and sodium hydroxide (NaOH) were added into the reaction tanks for separation process. This reaction will then be settled down for three days to separate the liquid and slurry. After three days, the mixture was pumped to filter press for filtration process. This process will filtrate cupric chloride (CuCl_2) to be transferred into storage tanks and produce iron sludge as by-product.

The iron sludges will then be dispersed and transferred in reaction tank for recovery process. In the reaction tank, another separation process occurred to separate copper sulphate (CuSO_4) and PAM sludge. Polymer and sulphuric acid (H_2SO_4) will be added in reaction tank and the mixture will pumped to filter press for filtration process. At the end of the filtration process, the copper sulphate (CuSO_4) will be stored in storage tanks for further treatment.

3.2 Recovery process – Copper Extraction.

Copper extraction begins by dispersing the iron sludge (FES sludge) which is the by-product from iron extraction. The liquid will then be transferred into the reaction tank. Sulphuric acid, H_2SO_4 were added into the reaction tank until the pH is less than 2 to extract the copper. After achieved pH 2, the cationic polymer was added to separate between the sludge and liquid. The process continues by filtration process using filter press to separate liquid, copper

sulphate (CuSO_4) and PAM sludge or SCH sludge. The copper sulphate, CuSO_4 is then transferred into storage tank to be use in copper oxide treatment.

3.3 Copper oxide treatment.

Copper oxide from spent etchant obtained from electronic waste company can be recovered by reaction with caustic soda. Firstly, caustic soda and cupric chloride (CuCl_2) must be added into reaction tank by open the valves. The amount of caustic soda and cupric chloride (CuCl_2) must be based on laboratory chemist guidance. It can be determined by observed the levels of the tanks. Caustic soda must be added before cupric chloride (CuCl_2) in order to avoid the mixture, turn into gel form instead of CuO sludge. The reactor content will be mixed by agitator to let the mixture react for an hour.

Besides, the sample of the reaction will be taken to test pH and the reactor liquor temperature. The optimum pH for this reaction is between 12.5 to 13.0. If the pH is low, caustic soda must be added to increase the pH value. The mixture sample will be sent to lab to confirm the pH. After reached the predetermine level of reaction tank, the reaction must be flush with water and allowed to react with the agitator on. The reaction will generate a lot of heat and released the acid fumes. Therefore, the acid scrubber must be switched on to neutralized the fumes. The reaction will then be cool and settle down for one night.

3.4 Industrial Effluent Treatment Process (IETS).

The raw water from the processing process will be pumped and transferred to the Equalization tanks No. 1 and 2. In this equalisation tank, the wastewater would be homogenized. The equalized water would be pumped to a three-stage chemical treatment tank to extract all colloidal waste and suspended particles at specific gravity. These will require chemicals such as metals precipitant, coagulant, pH adjuster, and polymer to be dose in this treatment process. Firstly, caustic soda will be added to adjust the pH around 8.5 to 9.0. Sulphuric acid will be dosed to tune back when the pH is too high which is above 9. pH adjustment is important to ensure the dissolved heavy metals such as copper, iron, nickel and zinc precipitate. The coagulant used is poly-aluminum chloride, PaCl will partially neutralized the charge and coagulate the metals in waste water. The significant polymeric will be added to further agglomerate the fine floc to improve the settling and compactness of the sludge by increase the density of sludge. The pH of the waste water will be measured by pH sensor in the chemical reaction tank.

The wastewater from the chemical reaction tank will be flow into the clarifier tank gravitationally. The concentrated sludge will be transferred to sludge Thickener tank while supernatant water will flow into sand filter, zeolite filter and activated carbon filter for further

treatment to remove the dissolved organic solid, colour and odour. Sand filter is used for the first column to remove suspended solid and reduce BOD and COD content. Then, the filtered water will be moved to the zeolite filter to remove Ammonia Nitrogen and heavy metals. Final filtration media is high absorption activated carbon which is used to reduce COD, BOD and heavy metals. The final filtered water will then flow to the oxidation tank for further treatment to remove sulphide and ammoniacal nitrogen. It may require the oxidant to be dosed in this treatment process. The oxidized treated will be transferred by pump to carbon rising tank before discharging to public drain.

The sludge at the clarifier will settle and transferred to the sludge thickener tank. Then, the supernatant water will be transferred to the sludge clarified water tank to be pumped back to the clarifier while the settle sludge will be pumped into the filter press. Filter press is used to carry out dewatering process of the sludge from sludge thickener tank and the filtrate water will be transferred back to the clarifier. The sludge cake will be removed frequently.

CHAPTER 3: DAILY MONITORING/TASK AND ASSESMENT.

4.1 Perform pH meter daily calibration.

The pH probe must from flocculation tank must be washed by using brush before rinsed it with deionized water. This is to remove any sludge that stick to the pH sensor. The pH probe will be soak in pH 7 buffer for offset adjustment. If the sensor read the pH value above or below 7, then measured value must be changed to 7.00 to set the offset. After accept the new calibration data, the pH probe from flocculation will be changed with the chemical probe to perform the same steps. The offset for chemical tank pH probe must be change at the panel systems.

4.2 Perform daily monitoring for IETS.

After the calibration, the adjustment in flocculation must be performed to ensure the size of floc formed is good. The waste water treatment system in Pride Chem Industries Sdn. Bhd do not operate continuously. Therefore, the polymer will degrade and the pH will drop after overnight. Caustic soda will be added if the pH value in flocculation tank drop below 8.5. After adding the caustic, blowing should be perform in order to mix the caustic with the waste water to make it homogenized. If the size of floc is still small, polymer will be added into flocculation tank to form bigger flocs and will be able to settle down before start the IETS system from panel. The data must be recorded at morning and evening for IETS monitoring for DOE report.

4.3 Perform acid and ammonia scrubber monitoring.

The record of acid and ammonia scrubber data is important as it need to be reported to the Department of Environmental, DOE. Firstly, we need to check pressure different (ΔP) for both demister and packing by opening the valves and record its value. The outlet temperature, pH value, flowrate and pressure bar for recirculation pump also need to be record to ensure the value is still according to the specific range. Next, the data recording was continuing to measure air flow rate in acid scrubber system by using pitot tube anemometer. Turn the pitot tube anemometer on by pressing "On/Off" button and hold "SETUP" button to enter the setup mode for 2 seconds. After the setup display icon appear, press the "AVG REC" button until the display show "in" inches and select the duct shape. Press the "AVG REC" button again to store the setting and proceed to the air duct area. Set the pitot tube at 16 inches for acid scrubber and 24 inches for ammonia scrubber before press the "AVG REC" button several time until "ALL" and "yes" word displaced on the screen until "beep" sound is heard. Exit setup mode by hold "SETUP" button for two second. Then, press the "P/V/F" button to select the unit for the flow which is in "CFM". Press the "HOLD ZERO" button to get a reading 0.000 and remove the gas cap from scrubber systems. After that, insert the sensor port perpendicular into the acid scrubber system opening and the value was recorded. Remove the sensor port and return the gas cap to its placed and twist it closed. The result will be record into the form provided and excel for graph plotting.

FORM 2-1

PRIDE CHEM INDUSTRIES SDN BHD
 DAILY PERFORMANCE MONITORING OF SCRUBBER 2 (ACID)
 MONTH & YEAR: _____

Day	[16"] Air	ΔP	ΔP	ΔP	Temp	Temp	pH	Recirculation Pump		Remark
	Flowrate, cfm	Demister, in W.G.	Packing, in W.G.	Scrubber, in W.G.	in, °C	out, °C		Flowrate, LPH	Pressure, bar	
	(1000-5000)	(0.4-1.5)	(1.0-2.5)	(1.5-3.0)	(20-40)	(20-40)	(6.0-9.0)	(12000-15000)	(0.8-1.2)	
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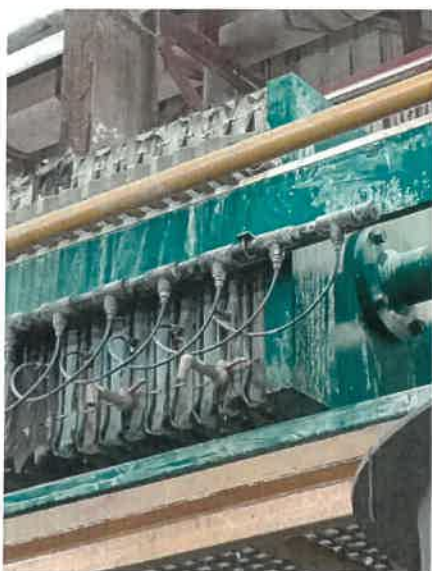
4.4 Mini project daily task.

4.4.1 Flushing time monitoring.

During monitoring flushing time at filter press in copper oxide treatment, I was assigned to do several tasks to study the relationship between total dissolved solid (TDS) and chloride content in wet cake and flushing water.



- i) Collect flushing water sample and check total dissolved solid (TDS) value by using TDS meter.



Sampling valve



TDS meter

- ii) Record total dissolved solid (TDS) value data in Excel.
- iii) Analyse chloride content in wet cake sample.
 - Weighing 2.5g of wet cake by using weight scale.
 - Dilute the wet cake with nitric acid, HNO₃.
 - Analyse the diluted wet cake by using chloride content analyser.



4.4.2 Silver removal jar test procedure.

In order to obtain the results on the efficiency of sulphide precipitation method to remove silver content in waste water, I have conducted several jar tests by using production method in lab scale.

- i) Add the coagulant which is poly-aluminium chloride, PAC or ferrous sulphate, FeSO₄ to coagulate the particles in wastewater.

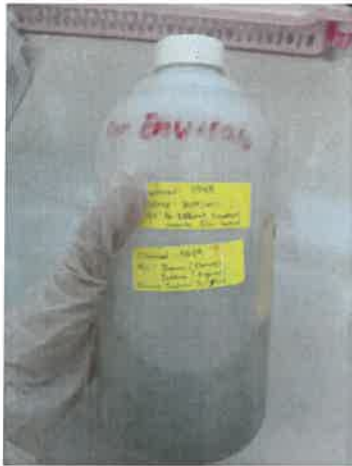


Ferrous sulphate,
FeSO₄



Poly-aluminium chloride,
PAC

- ii) Do pH adjustment until pH 8.0 to 8.8.
- iii) Add the sulphide chemical which are either Aqua Met T or Sodium sulphide.



Sodium sulphite, Na₂S



Aqua Met T, CNa₂S₃

- iv) Add flocculant which is anionic polymer.



Anionic polymer

- v) Filter the flocs and collect the water to analyse the silver content by using ICP.



Digestion



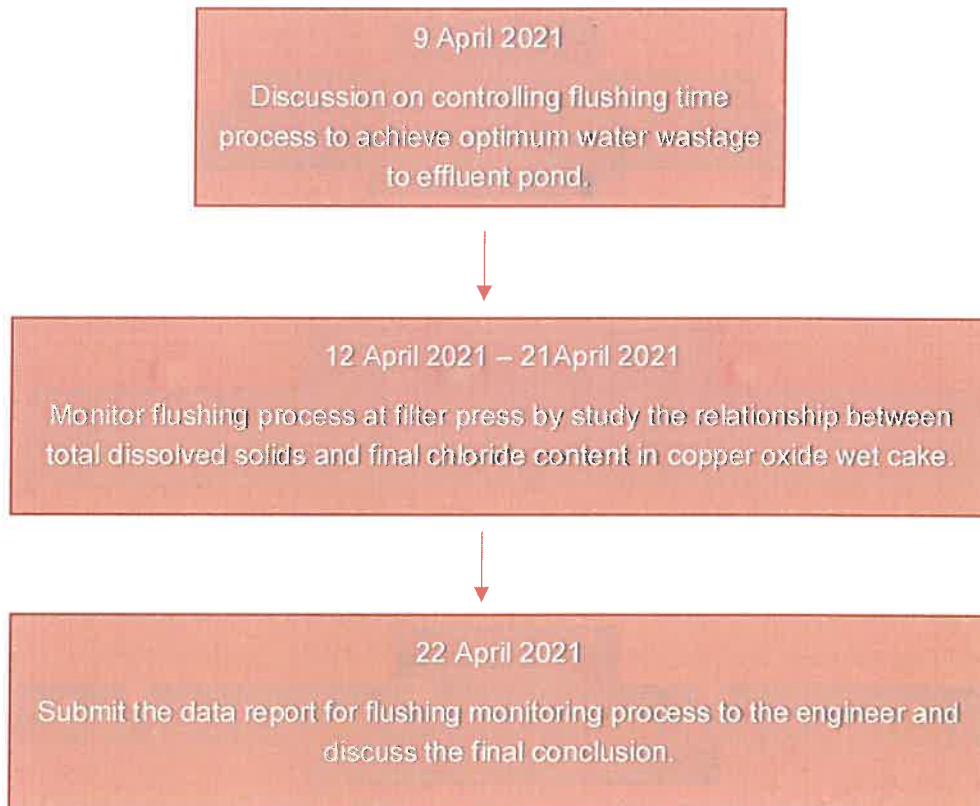
ICP analysis

- vi) Record the final data which are the pH, chemical dosing, initial and final copper and silver content.

CHAPTER 5: MINI PROJECT: IETS TROUBLESHOOTING.

5.1 Process Improvement project: Flushing time monitoring at filter.

5.1.1 The timeline for flushing monitoring project.



5.1.2 Description on flushing monitoring project.

On 9 April 2021, I was assigned by the engineers in Pride-Chem Industries Sdn.Bhd. to assist them in controlling flushing time during filtration process to minimize the water wastage to effluent pond. In order to achieve optimum water used during flushing process, I need to study the relationship between total dissolved solids for each unwashed and washing flushing water to pass the requirement in final chloride content results in their wet cake. The chloride content in wet cake should be below than 0.02% to meet the requirement before the product can be released.

Unwashed wet cake obtained from the reaction between copper chloride and caustic soda. This reaction produces copper oxide as their major product and sodium chloride as by-product. Washing wet cake is produced by dispersing the wet cake from unwashed process and wash it with city water. The mixture from the reaction was feed into the filter press to undergo filtration process so it can fill the void spaces between the filter plates. After the feeding process is done, the process was continued by flushing water into the filter press. This

is important because it acts as first forced to push the slurry out before compress it with air. Based on current method used, the flushing time was controlled at unwashed stage while for washing stage the operators will measure the total dissolved solid (TDS) below 0.60 ppm to pass the requirement. However, the previous data shows this method was less efficient as some of the chloride content in wet cake cannot pass.

On 12 April 2021, I started to collect the flushing water for each 30 minutes from unwashed and washing stage to measure the total dissolved solid (TDS) and chloride content. The data was recorded in excel to observe the pattern in flushing process. However, after two days monitoring the process, the data obtained shows that there is no relationship between chloride content in wet cake and flushing water. For washed stage, the chloride content in wet cake can pass at total dissolved solid (TDS) below 0.50 ppm. Therefore, flushing time for washing can be reduced for only 15 to 20 minutes to pass the requirement. The water used for flushing process at washed stage also can be reduced.

For unwashed stage, there are different types of reaction occurred so it needs more time to study on each different flushing process. At this stage, I observed that most of the total dissolved solid (TDS) is more than 10 ppm even after 120 minutes of monitoring. I believe that total dissolved solid (TDS) cannot be the indicator to ensure the chloride content in wet cake passed. Therefore, I started to do comparison on chloride content in wet cake at different flushing time. After three days monitoring, the optimum flushing time for unwashed stage is 90 minutes. The data shows after 90-minute flushing, the chloride content is either pass at <0.02% or almost pass in between 0.03% to 0.02%. If the results are between 0.03% to 0.02%, it still can easily pass during washing stage.

Lastly, I started to do comparison in water generated before and after monitoring. Based on the result obtained, the flushing time reduce after monitoring which also will generate less water compared to before monitoring. However, the results for water generated is only estimation based on the water level in effluent ponds. It can be estimated water produced is 33m³ for 120 minutes. After monitoring, the operator teams only flushing for 90 minutes for unwashed stage which reduce 25% of water compared to before monitoring. Besides, for single washed stage, they flushing until total dissolved solid (TDS) is below <0.5 ppm so it takes from 20 to 25 minutes for flushing process. At this stage, water can be reduced until 75% and the purpose of this project was achieved as they can minimize their water usage.

5.1.3 Data on flushing monitoring for Single wash stage.

Date	Filter Press/Reaction	Measured value	30 minutes	60 minutes	90 minutes	Wet cake (chloride content) (%)
Monday (12/4/21)	A	TDS	0.18	0.18	0.14	<0.01
		Cl content (%)	<0.0070	<0.0070	0.0027	
	E	TDS	<0.0070	-	-	<0.01
		Cl content (%)	0.55	-	-	
Tuesday (13/4/21)	E	TDS	1.55	0.66	-	>0.02
		Cl content (%)	0.048	0.0148	-	
	A	TDS	1.05	0.33	-	>0.02
		Cl content (%)	0.0344	0.008	-	
Wednesday (14/4/21)	E	TDS	0.16	-	-	<0.01
		Cl content (%)	<0.0070	-	-	
	E	TDS	0.23	-	-	<0.01
		Cl content (%)	-	-	-	

5.1.4 Data on flushing monitoring for unwashed stage.

Date	Filter Press/Reaction	Measured value	30 minutes	60 minutes	90 minutes	120 minutes	Wet cake (chloride content) (%)
Monday (12/4/21)	C	TDS	>10	>10	>10	>10	>0.02
		Cl content (%)	70.42	70.42	70.42	0.633	
Tuesday (13/4/21)	C	TDS	-	>10	>10	-	>0.02
		Cl content (%)	-	5.3264	4.8629	-	
	TDS	1.05	0.36	-	-	<0.01	
	Cl content (%)	0.0344	0.0122	-	-		
C	TDS	0.23	-	-	-	<0.01	
	Cl content (%)	-	-	-	-		
Wednesday (14/4/21)	C	TDS	>10	>10	1.98	-	<0.01
		Cl content (%)	-	-	-	-	
	TDS	>10	>10	0.77	-	<0.01	
	Cl content (%)	-	-	-	-		

Thursday (15/4/2021)	C	TDS	>10	8.80	-	-	<0.01
		Cl content (%)	-	-	-	-	<0.01
		TDS	>10	4.65	-	-	<0.01
	C	Cl content (%)	-	-	-	-	<0.01
		TDS	>10	0.66	-	-	<0.01
		Cl content (%)	-	-	-	-	<0.01
Friday (16/4/2021)	C	TDS	>10	>10	-	-	>0.02
		Cl content (%)	-	-	-	-	<0.01
		TDS	>10	>10	-	-	<0.01
	C	Cl content (%)	-	-	-	-	<0.01
		TDS	>10	>10	-	-	>0.1
		Cl content (%)	-	-	-	-	>0.1
Tuesday (20/4/2021)	C	TDS	>10	>10	5.01	-	>0.02
		Cl content (%)	-	-	-	-	>0.02
		TDS	>10	>10	1.93	-	>0.02
	C	Cl content (%)	-	-	-	-	>0.02
		TDS	>10	>10	0.68	-	>0.01
		Cl content (%)	-	-	-	-	>0.01

5.1.5 Final results for flushing timing monitoring.

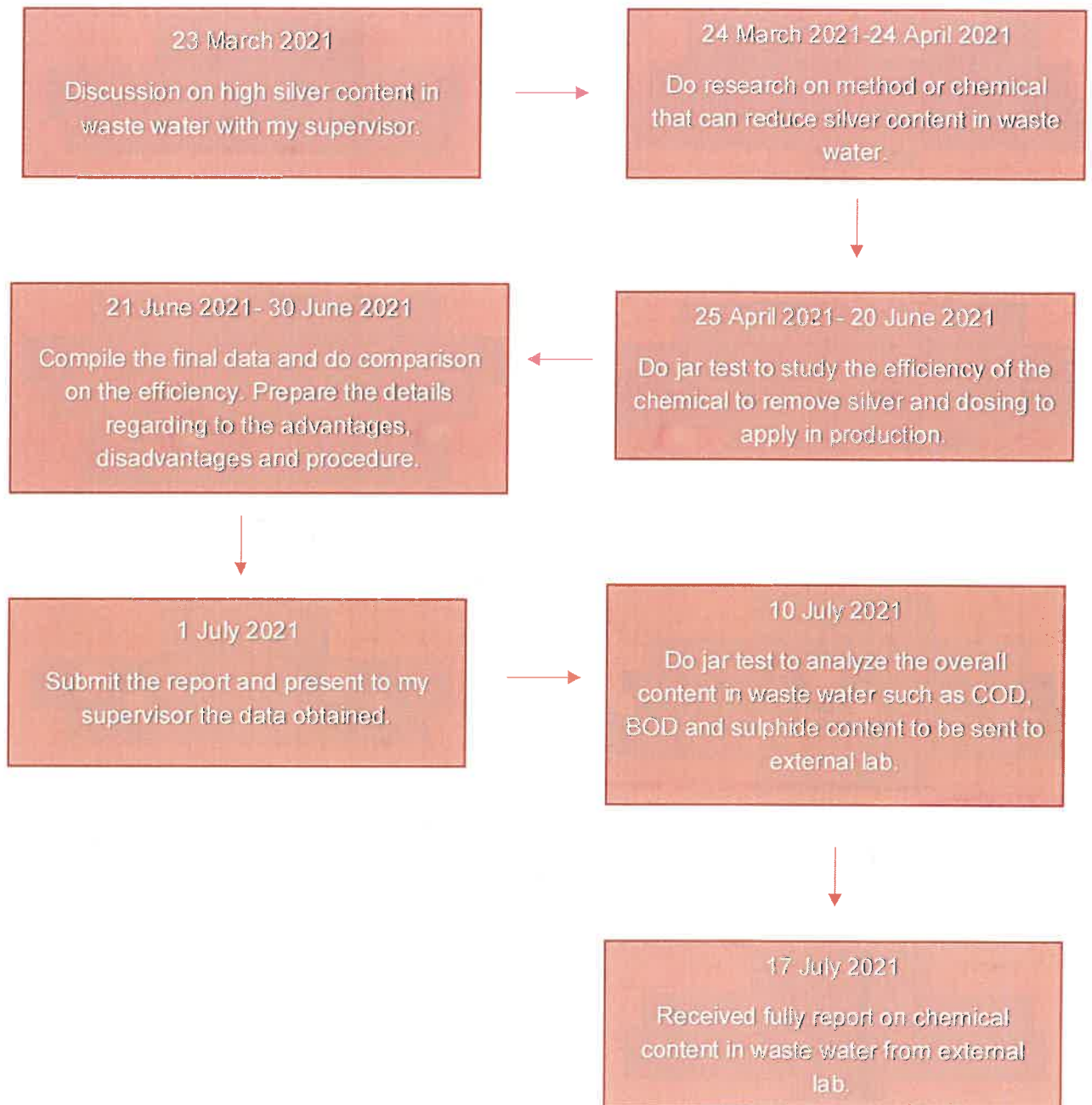
Stage	Duration	Total dissolved solid
Unwashed	90 minutes	Not homogenized
Single wash	20-25 minutes	<0.5

5.1.6 Data on water generated.

Stage	Before flushing time monitoring	After flushing time monitoring
Unwashed	33 m ³	25 m ³
Single wash	33 m ³	9 m ³

5.2 Silver Removal by using sulphide precipitation.

5.2.1 The timeline for silver removal project.



5.2.2 Description on silver removal project.

On 23 March 2021, I was assigned by my supervisor, Ms. Chan Pei Juan to help her to reduce silver content in industrial wastewater. This is because the initial silver content in this company's wastewater do not pass the requirement of Department of Environmental (DOE). Based on DOE specs, silver content in wastewater must be at least below than 1.0 mg/L for standard A and 0.1 mg/L for standard A. The main reason of high silver content in waste water is because this company only got primary treatment which is focusing on copper removal as the metal content is the highest. The method that they use to remove copper is hydroxide precipitation where the copper will be remove between pH 8.0 to 8.8. In addition, this method require treatment at pH 11 to 12 to remove silver.


I started the research on efficient method to remove silver from 24 March 2021 until 24 April 2021. Based on the research, there are two method to remove heavy metal content in wastewater which are hydroxide precipitation and sulphide precipitation. After do several study on procedure and chemical use in sulphide precipitation method, I started to do jar test to observe the efficiency of this method and suitability to apply in production. The chemicals that can be use are ferrous sulphate (FeSO_4), sodium sulphite (Na_2S) and Aquamet T (CNa_2S_3). Based on the jar test in lab scale, sulphide reagent is a bit difficult for dosing as it will produce yellowish or dark colour of water after treated. Therefore, it takes more time for me to do more jar test to measure the efficiency to remove silver.

From 23 June until 30 June 2021, I started to compile the data for comparison between three sulphide chemicals and prepare some report with proper procedure and detail to report to the engineers regarding on silver removal project. After submit the report, I did some discussion with my supervisor and do QnA session on this project. After a week, my supervisor asks me to prepare another sample to send the water treatment to external lab. The purpose of sending sample to external lab is to check the overall content such as COD, BOD and sulphide content in wastewater. In this company's lab, the chemists can only measure heavy metals content with ICP analysis. After receive the result from external lab, we can observe the silver is reduce and adding sulphide chemicals did not affect any other chemical content become higher. For overall process, sulphide chemicals can be use and efficient in improving chemical content in wastewater but difficult in dosing.

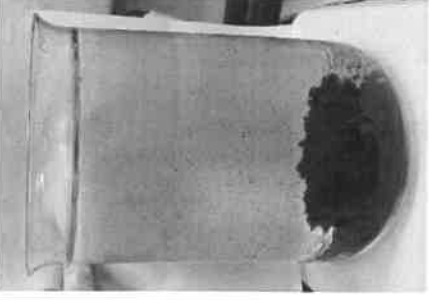
5.2.3 Data for jar test by using FeSO₄ as coagulant.

Neutralization reagent	Initial	-
Coagulant	-	2 ml FeSO ₄
Flocculant	-	3 ml Anionic Polymer
Colour of solution	-	Clear
Rotten Egg smell	-	No
Copper (mg/L)	2.97	0.89
Ag (mg/L)	24.8707	0.1876
pH	12.34 @23.9 °C	8.13 @ 29.7°C
Picture		

5.2.4 Data for jar test by using PAC + Na₂S.

Neutralization reagent	Initial	0.1 ml Na ₂ S
Coagulant	-	12ml PAC
Flocculant	-	15ml Anionic Polymer
Colour of solution	-	Clear
Rotten Egg smell	-	Weak
Copper (mg/L)	0.15	0.07
Ag (mg/L)	24.8707	0.1876
pH	12.23@23.9 °C	8.80 @ 24.1°C
Picture		

5.2.5 Data for jar test by using FeSO₄ + Na₂S.

Neutralization reagent	Initial	0.1 ml Na ₂ S
Coagulant	-	8ml FeSO ₄
Flocculant	-	20ml Anionic Polymer
Colour of solution	-	Yellowish
Rotten Egg smell	-	No
Copper (mg/L)	0.15	0.02
Ag (mg/L)	24.8707	0.4305
pH	12.23@23.9 °C	8.10 @ 24.2 °C
Picture		



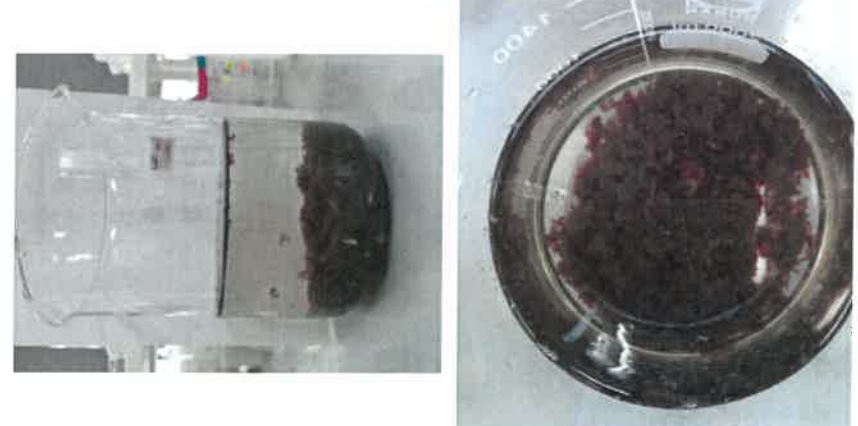
5.2.6 Data for jar test by using 12 ml PAC +0.1 ml Aqua Met T (CNa2S3).

Neutralization reagent	Initial	0.1ml Aquamet T (CNa2S3)
Coagulant	-	12ml PAC
Flocculant	-	15ml Anionic Polymer
Colour of solution	-	Yellowish → Become clear after 2 days
Rotten Egg smell	-	Weak
Copper (mg/L)	0.15	0.19
Ag (mg/L)	24.8707	0.1379
pH	12.23@23.9 °C	8.65 @ 24.1 °C
Picture		



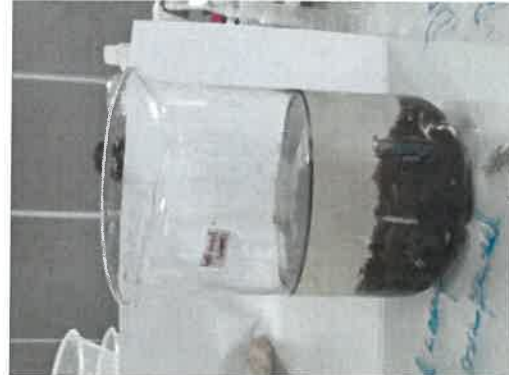
Remarks: For this effluent sample, the solution become dark yellowish when use PAC 8ml (production method). After add PAC to 12 ml, the yellowish colour become very light and clear after 2 days.

5.2.7 Data for adjustment pH on Aquamet T 0.1ml.

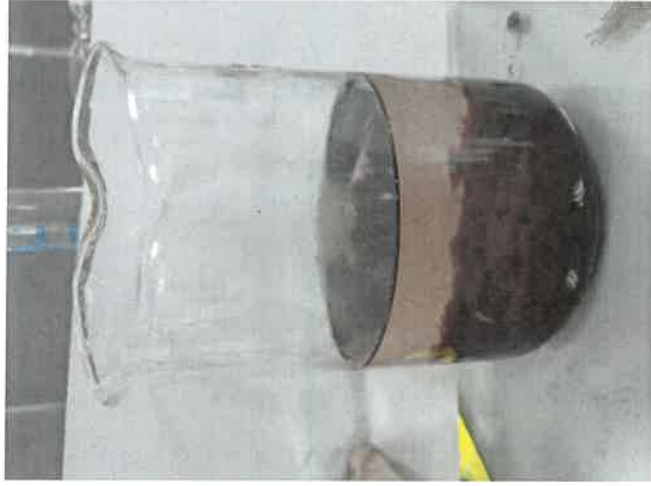
Neutralization reagent	Initial	0.1ml Aquamet T (CNa2S3)	0.1ml Aquamet T (CNa2S3)	0.1ml Aquamet T (CNa2S3)
Coagulant	-	4 ml PAC	4 ml PAC	4 ml PAC
Flocculant	-	6 ml Anionic Polymer	6 ml Anionic Polymer	6 ml Anionic Polymer
Colour of solution	-	Clear	Clear	Clear
Rotten Egg smell	-	No	No	No
Copper (mg/L)	4.34	1.16	0.97	0.67
Ag (mg/L)	33.1659	4.4391	3.1261	1.2988
pH	12.23@26.4°C	7.53 @31.0°C	8.05 @30.2°C	8.71@30.2°C

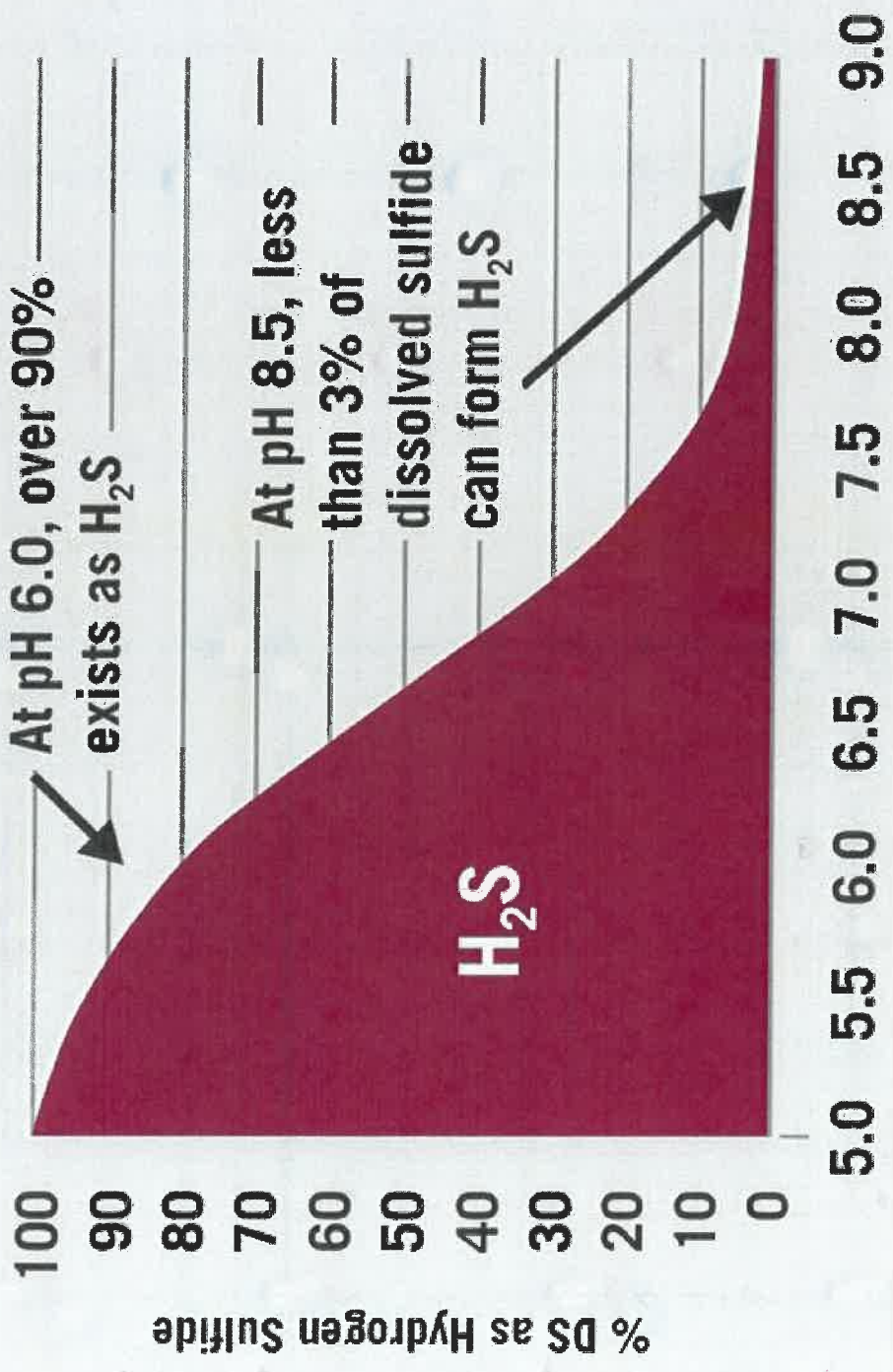
<p>Picture</p>				
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5.2.8 Data for adjustment on Aquamet T dosing.

Neutralization reagent	Initial	0.125 ml Aquamet T (CNa2S3)	0.125 ml Aquamet T (CNa2S3)	0.150 ml Aquamet T (CNa2S3)
Coagulant	-	4 ml PAC	4 ml PAC	4 ml PAC
Flocculant	-	6 ml Anionic Polymer	6 ml Anionic Polymer	6 ml Anionic Polymer
Colour of solution	-	Clear	Clear	Clear
Rotten Egg smell	-	No	No	No
Copper (mg/L)	4.34	0.67	0.63	0.63
Ag (mg/L)	33.1659	0.3274	2.1637	-0.0968
pH	12.23@26.4°C	8.31@27.4°C	8.67@29.3	8.67@29.3°C
Picture				

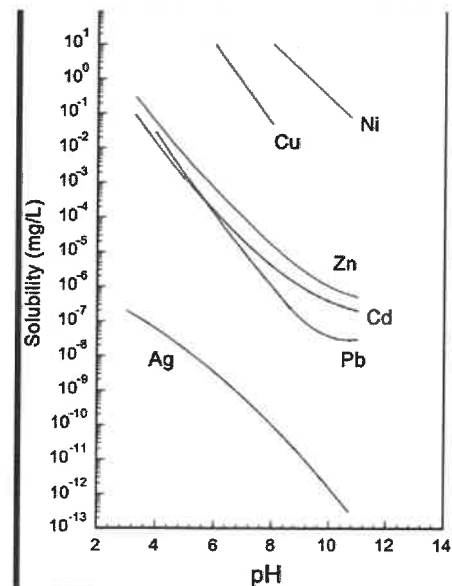
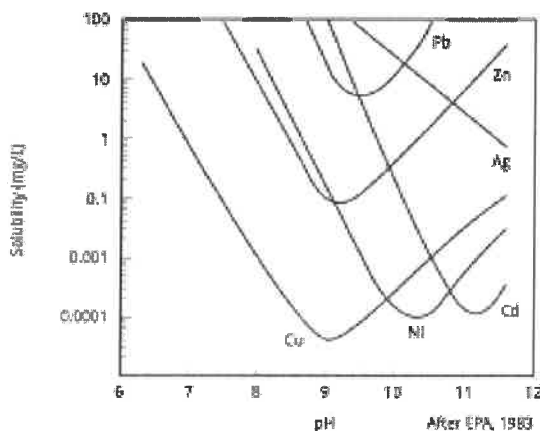
The picture below shows the example result if we overdose the volume of Aqua Met T and Na₂S.





5.2.9 Discussion for Silver Removal Project

Hydroxide precipitation is one of the most widely used method to remove heavy metals from industrial waste water. However, this precipitation method has limitation in treating mixed metal effluents as it cannot be removed at a single pH. In this research work, sulphide precipitation method was found to remove heavy metals more efficient than hydroxide precipitation. Based on the figure below, sulphide precipitation can remove a high degree of metals due to the lower solubility of metal sulphide over a broad pH range. According to the solubility- pH relationship, for hydroxide precipitates remove copper at pH (8.5 to 9.5) and silver at pH (11 to 12). For sulphide precipitation, the optimum pH for copper is pH 8 to 9 and silver at a range of 8 to 10. Therefore, copper and silver can be removed at a single pH using sulphite precipitation. The example for sulphide precipitant is sodium sulfite (Na_2S), sodium trithiocarbonate solution (Aqua Met T, Na_2CS_3) and ferrous sulphate (FeSO_4).



Sulphide precipitation gains little attention because of the sulphide dosing and process control difficulty due to the sensitivity of the process. Moreover, it also has potential to release toxic gaseous which is hydrogen sulfide (H_2S) so it must be conducted in alkaline condition at pH 8 to 12 to prevent the gas formation. Based on the results obtained by using FeSO_4 as coagulant, silver content can be removed until 99% from the initial value which is 24.8707 mg/L. The colour of flocs formation is black and the size is fine. This is the easiest way to remove silver as it can be dose at the same dosing with current coagulant used which is poly-aluminium chloride, PAC. Ferrous sulphate as coagulant also decrease the amount of sludge generated compared to PAC.

Besides, sulphide precipitation also can be used by adding sodium sulphite, Na_2S after pH adjustment. The result shows that the silver content can be reduce until below 0.20 mg/L

and copper at 0.07 mg/L. However, the clear water only can be obtained after add PAC until 12 mg/L for this effluent (collected from EQ tank, Unwashed + washing). Otherwise, the sample will turn to black or yellowish with strong rotten egg smell. Sodium sulphite also was tested with FeSO₄ as coagulant. The flocs obtained is black and high density. Silver content also can be reduced until 98%. By using sodium sulphite in production, the dosing of chemical is a bit difficult to control and might produce strong rotten egg smell when overdosed but efficient in remove heavy metals.

Aqua Met T is a sodium trithiocarbonate solution. After observed the performance of Aqua Met T with poly-aluminium chloride (PAC), it is preferable to use this chemical compared to sodium sulphite. This is because the flocs produced by adding Aqua Met T are denser over a broad pH range. Based on the results achieved, the dosing of the chemical still can be adjusted depends on the initial copper and silver content. If the initial copper content is high (pure unwashed), the dosing of Aqua Met T for 1L is 0.15ml. The results also show high pH remove more heavy metal compared to low pH. When the pH is low at 7.53 and 8.05, the silver content are 4.4391 mg/L and 3.1261 mg/L. At pH 8.67, the final silver content result is 1.2988 mg/L. Therefore, high pH is better for Aqua Met T to remove copper and silver.

After justification on Aqua Met T results, I tried to increase the dosing at 0.125ml and 0.15ml to do comparison on final silver content. At pH 8.67, the silver content at dosing 0.125 ml is 2.1637 mg/L and -0.0968 mg/L at dosing 0.15ml. Based on the data obtained, 0.15ml of Aqua Met T can reduce the silver content better. Negative value shows that the silver content is too low so the ICP cannot detect. However, the increasing of Aqua Met T dosing might cause overdose chemicals which will lead to strong rotten egg smell and water become yellowish. It is preferable to either ask lab to do jar test before determine the volume of Aqua Met T added in flocculation tank or use dosing 0.1ml for 1L and treat at high pH (8.8-8.9). Since we treat different type of effluents such as AN unwashed, PTA unwashed and washing, I think it is better to do jar test to determine the Aqua Met T dosing at least for 1- or 2-week trial run. This is because I noticed the dosage of the Aqua Met T change with the initial copper content.

Aqua Met T dosing.

Lab Scale	Flocculation size	Production scale
0.1 ml	8m ³ /8000 L	800 ml
0.125 ml	8m ³ /8000 L	1000 ml
0.150 ml	8m ³ /8000 L	1200 ml

Advantages of sulphite precipitation:

- The amount of sludge generated less than hydroxide precipitation.
- No pre-treatment/post treatment is needed.
- Efficiently to remove heavy metals over a broad pH range.
- Faster reaction rate due to high reactivity between sulphide and heavy metal ions.

Disadvantages of sulphite precipitation method:

- If the waste water becomes acidic (less than pH 7), there is the possibility of hydrogen sulphide, H₂S gas emission. Therefore, the process should not occur in acidic conditions.
- Produce rotten egg smell (sulphide smell) and water become yellowish if overdosed the chemicals.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS.

For conclusion, industrial training in Pride Chem industries has equipped me as a trainee in knowledge and skills especially in troubleshooting that help me to understand more in the real job scope as chemical engineers. Throughout the period of internship, I was able to gain a lot of knowledge in wastewater treatment such as the start-up procedure and overall process monitoring to produce good quality of water before discharge. This industrial training was a good experience for me and I was lucky to get the opportunities to be a part of member in this company. I am also humbled on the chance given to participate in their project which are flushing time monitoring and silver removal in industrial waste water.

I would like to thank my industrial training supervisors, Ms. Chan Pei Juan for sharing a lot of knowledge and help me to understand the overall chemical process in this company. I am also able to enhance my communication skills and leadership that would help me to serve well in the future. I am very thankful to be surrounded by wonderful workers in this company as they always support and give me some advice in making my industrial training become a success journey for me to end my diploma course.

Last but not least, I am really glad to be able to finish my industrial training within 17 weeks despite this pandemic of COVID- 19. For recommendation, I hope the students are given more project to be involve so that we can gain as much of knowledge as we could. Other than that, the faculty also should increase the internship duration for students to gain experience in real working environment.

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