

Chapter 5 Metal Works Sub-sector

5.1 Detailed Enterprise Study

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CASE STUDY M-01

Thu Duc Textile Garment Engineering Company

Survey Date : 6 December 1999
25,28 and 29 February 2000

1. General

1.1 Profile

Thu Duc Textile Garment Engineering Company is a state-owned company that was established in 1986. The company mainly manufactures spare parts and equipment for the textile industry. The company profile is summarized in Table 1 and Figure 1.

Table 1 Company Profile

Name of Company	Thu Duc Textile Garment Engineering Company
Ownership	State-owned
Address	21B Tan Hoa, Phuong Linh Trung, Thu Duc
Tel	0084-8969307
Established	1986
Number of Employees	127
Area	22,000 m ²
Main Products	Spare parts and equipment for the Textile industry

1.2 Business Status

1.2.1 Production

Table 2 shows production and sales of the company in 1998.

Table 2 Production and Sales in 1998

Item	Production(Ton)	Turnover(million VND)
Mechanical and Casting Products	138 (200)	4,721.50
Plastic Products	100 (300)	755.09
Total	238 (500)	5,476.59

() shows Design Capacity

1.2.2 Debt

From Commercial Bank : 560 million VND
From National Bank for long term investment : 2,912 million VND

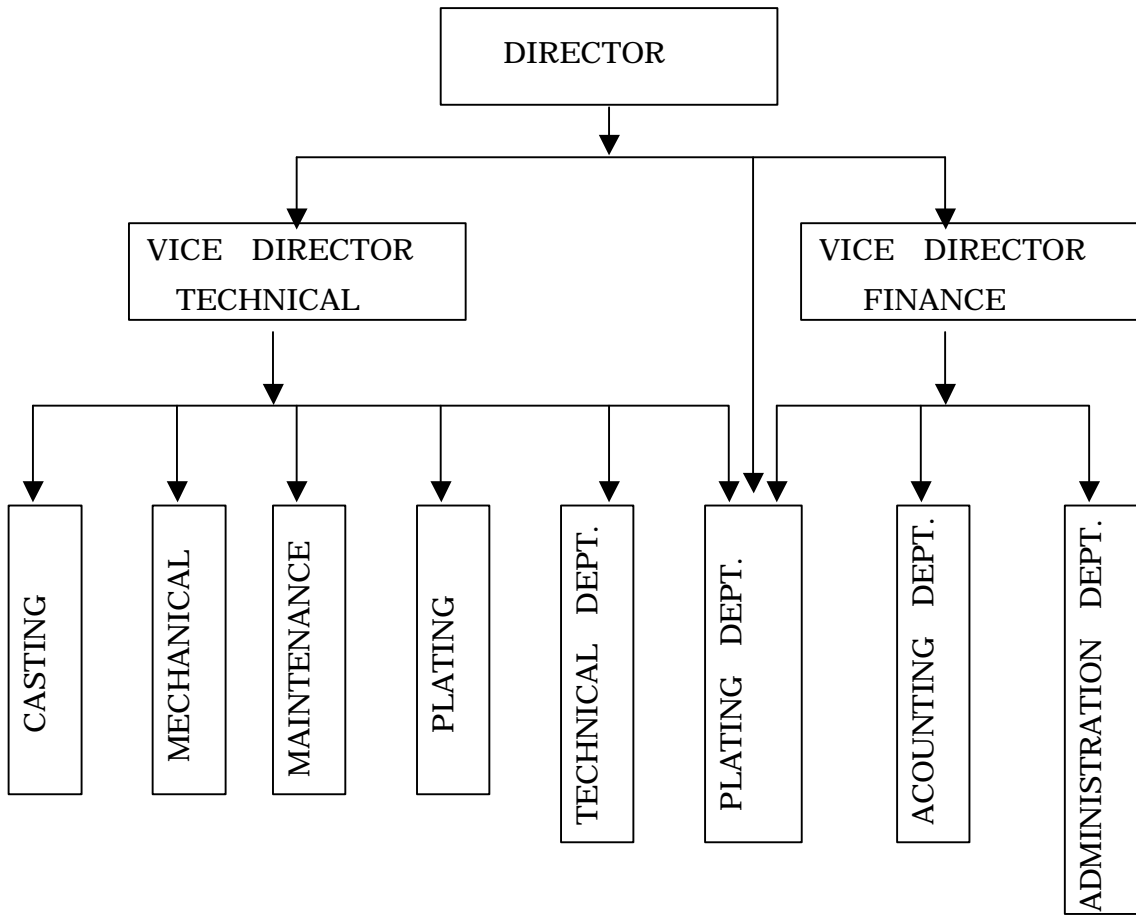


Figure 1 Organization of the Company

2. Production Technology

2.1 Overall Process

The block flow diagram of the company is shown in Figure – 2.

*Water supply : 50 m³/day

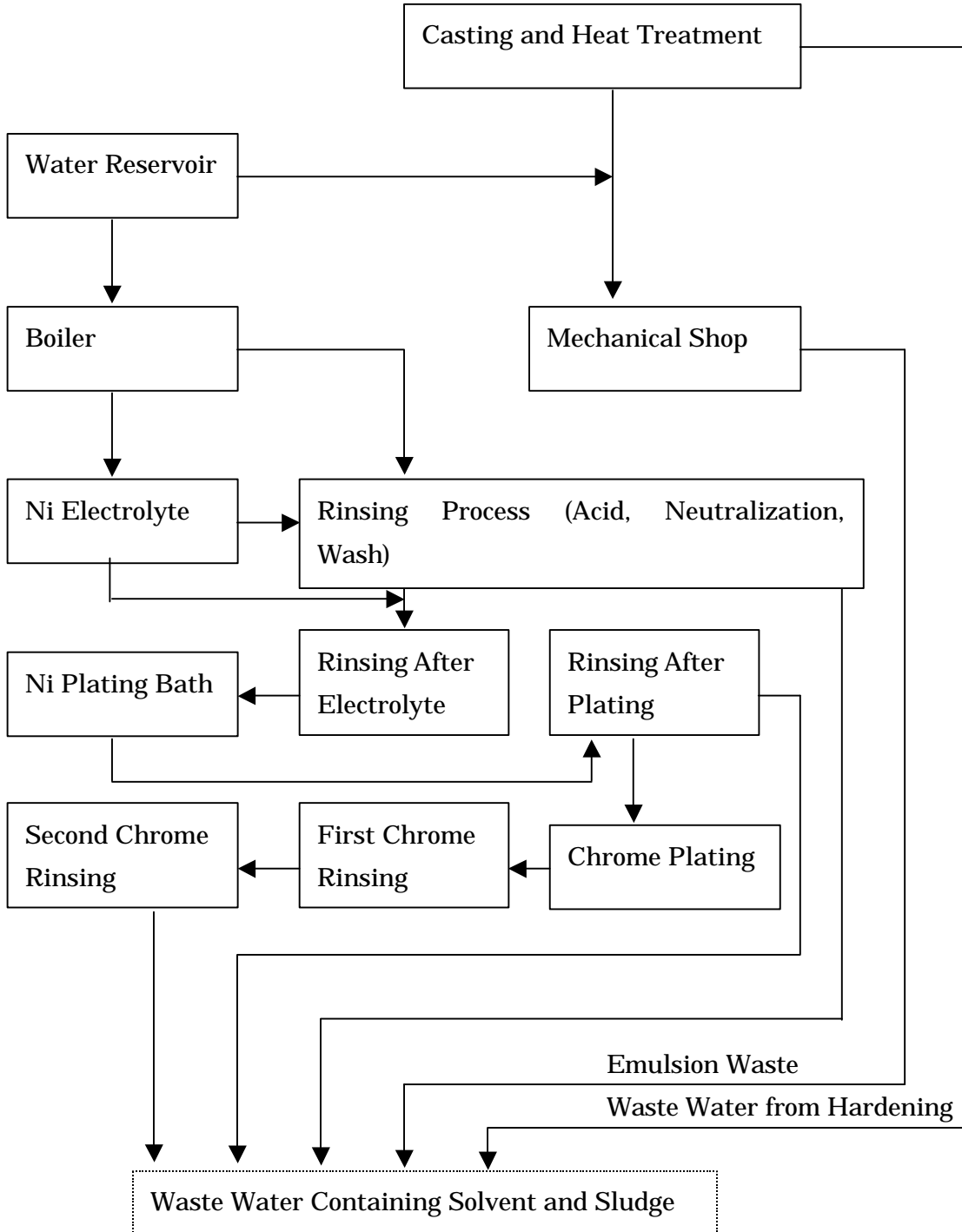


Figure – 2 Block Flow Diagram of the Company

2.2 Ni-Cr Plating Process

The block flow diagram of Ni-Cr plating is shown in Figure 3.

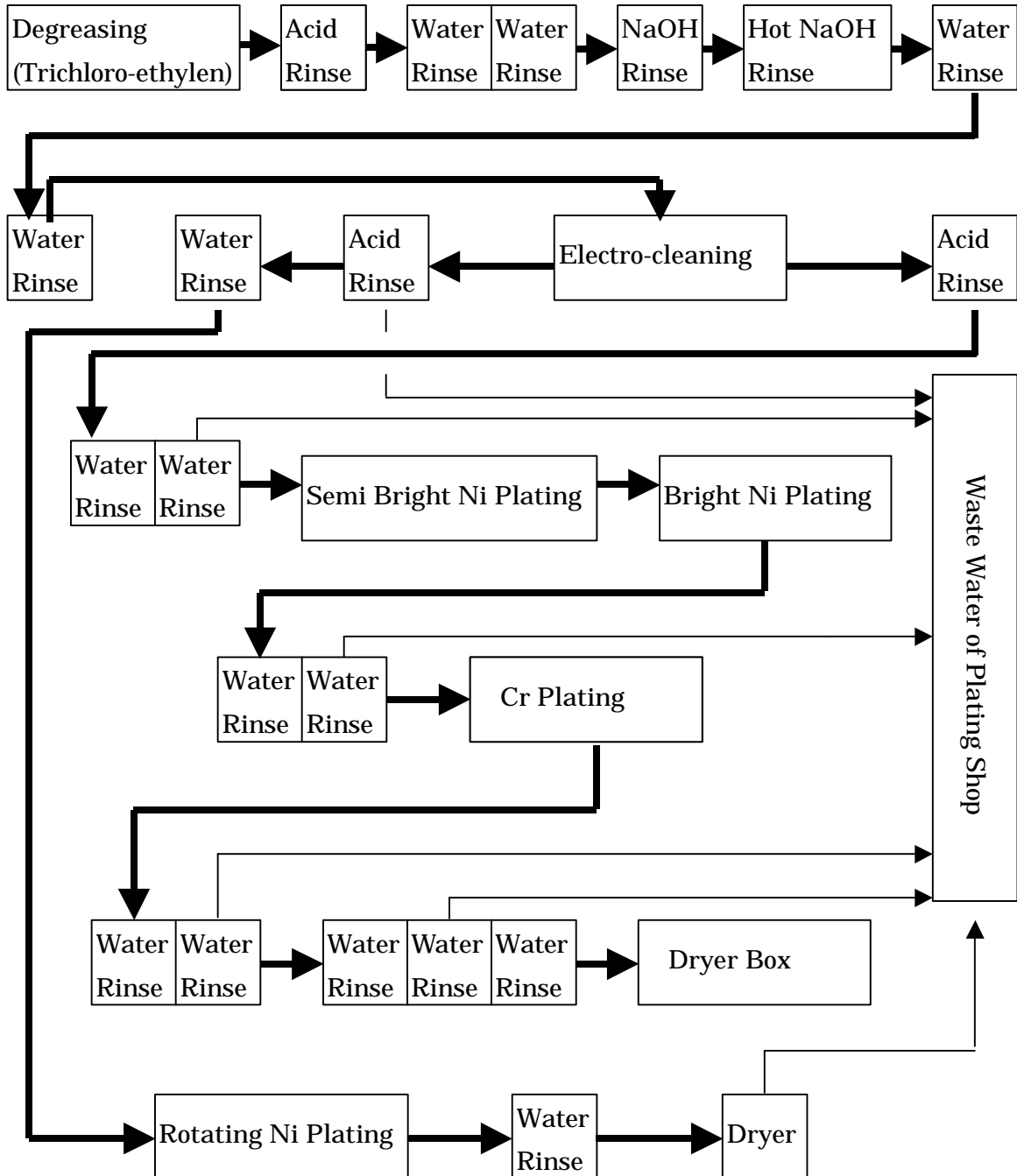


Figure 3 Block Flow Diagram of Ni-Cr Plating

2.3 Material Consumption

Table 3 Material Consumption

Item	Amount	Unit Price	Total (VND)
1. For mechanical			
-Iron cast ingot	100 Ton	2,800 D/Kg	280,000,000
-iron cast + steel	50 Ton	2,500 D/Kg	125,000,000
-Ferro	20 Ton	20,000 D/Kg	400,000,000
-Steel plate	50 Ton	5,000 D/Kg	250,000,000
-Rolled steel	100 Ton	5,000 D/Kg	500,000,000
-Cutter attachment			100,000,000
-Lubricating oil	3 Ton	10,000 D/Kg	30,000,000
-Sand	240 m ³	500,000 D/m ³	120,000,000
-Silica	5 Ton	3,000 D/Kg	15,000,000
-CO ₂	1.5 Ton	100,000 D/bin	7,200,000
-Resin, sand	3 Ton	10,000 D/Kg	30,000,000
-Water	2,250 m ³	3,100 D/ m ³	6,975,000
-FO fuel	30 Ton	3,500 D/Kg	10,500,000
-Coal	25 Ton	1,200 D/Kg	30,000,000
-Electricity	54,540 Kwh	850 D/Kwh	46,359,000
2. For plating			
-Cr ₂ O ₃	500 L	34,000 D/L	17,000,000
-Trichloro- ethylen	1,500 L	2,500 D/L	3,750,000
-NaOH	1,000 Kg	5,000 D/Kg	17,000,000
-HCL	3,500 Kg	1,800 D/Kg	3,750,000
-Water	11,000 m ³	3,100 D/ m ³	34,100,000
-DO fuel	5,800 L	3,200 D/L	6,300,000
-Electricity	8,500 Kwh	850 D/Kwh	7,225,000
Grand Total			2,040,159,000

3. Management Technology

The company has made a big investment in casting and mechanical shops over the last three years. In addition, the company has a technical tie-up with a Japanese company in the plating process. Because of this, the plating process is new and well managed. However, waste water from the plating shop is directly discharged outside without treatment, even though the company has an incomplete water treatment unit.

4. Industrial Waste Water

Almost all industrial waste water from the company is discharged from the plating shop.

4.1 Drainage System of the Plating Shop

The drainage system of the plating shop is shown in Figure 4.

4.2 Waste Water Quality

Waste water samples were taken in this study at the points shown in Figure 4.

4.2.1 Sampling on 6 December 1999

The results of quality analysis of the samples are summarized in Table 4.

Table 4 Waste Water Quality (6 December 1999)

Item	Unit	①	②	③	④	⑤	TCVN
Flow rate	m ³ /day						
pH			6.26	2.63	10.8	2.98	5.5-9
Oil	mg/l		0	1.8	0	2	1or10
BOD	mg/l		1	6	2	8	50
COD	mg/l		4	16	5	29	100
Cyanide	mg/l		0.03	0.01	0.01	0.03	0.1
Cu	mg/l		0.06	0.66	0.05	0.58	1.0
Fe	mg/l		0.23	1.08	0.27	1.28	5.0
Zn	mg/l		0.12	0.35	0.09	0.29	2.0
Cr ⁺⁶	mg/l		0.18	0.632	0.09	0.467	0.1
Ni	mg/l		4.38	0.31	2.63	0.27	1.0
Pb	mg/l		trace	0.045	trace	0.22	0.5

4.2.2 Sampling on 28 February 2000

The results of quality analysis of the samples are summarized in Table 5.

Table 5 Waste Water Quality (28 February 2000)

Item	Unit	①	②	③	④	TCVN
Flow rate	m ³ /day					
pH		2.3	6	2.6	9.8	5.5-9
Oil	mg/l					1or10
BOD	mg/l					50
COD	mg/l					100
Cyanide	mg/l					0.1
Cu	mg/l	0.33	0.01	0.82	0.04	1.0
Fe	mg/l	18.8	0.61	2.16	0.62	5.0
Zn	mg/l					2.0
Cr ⁺⁶	mg/l	(0.86)	(0.1)	(39.1)	(1.85)	0.1(1.0)
Ni	mg/l	248.85	11.52	4.49	0.85	1.0
Pb	mg/l					0.5

* () shows total Cr.

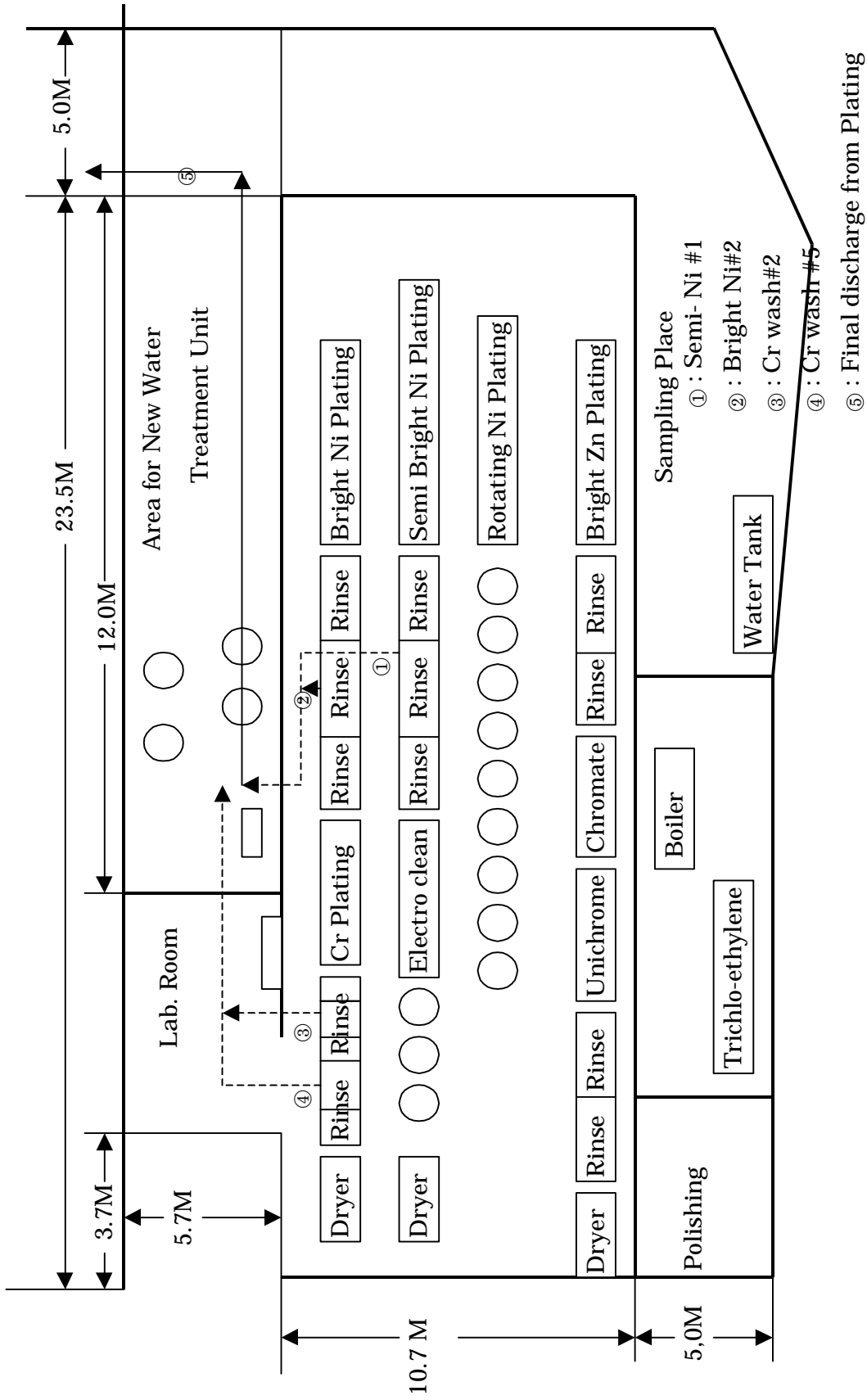


Figure 4 Drainage System of the Plating Shop

5. Countermeasures for Industrial Waste Water Pollution Prevention

5.1 Present Problems

At present, the main problems of the company are as follows:

- (1) Future Plan for the Plating Shop
- (2) Operational Improvements
 - 1) The working environment of the shops
 - 2) Waste chemicals from the Cr plating bath
 - 3) The heat source of plating bath heaters
- (3) Water Treatment Unit

5.2 Improvement Items for Production Technology

5.2.1 Determine Future Plans for the Plating Shop

Industrial waste water pollution in the company comes from plating shop waste water. Therefore, the company should determine their future plan for the plating shop urgently. On the premise that a waste water treatment unit is indispensable for waste water discharged from the plating shop, the company has to investigate whether it is better to operate the plating shop as one process in a textile mechanical parts manufacturing company, or to have an independent plating shop which concentrates on plating in that area.

5.2.2 Operational Improvements

The plating shop is new and the basic technology used is at a fairly advanced level. However the following items are recommended:

- (1) Improvement of the working environment through better arrangement and cleaning.
 - Material and/or equipment shouldn't be put directly on the floor.
 - Increase the capacity of the fume exhauster.
- (2) Investigate reusing waste from the Cr plating bath.

There are purification methods for reusing waste from Cr plating baths, such as filtration and electrolysis. Chemical manufacturers or specialists in universities can be consulted on this matter.

- (3) Change the heat source from a steam heater to an electric heater

Considering that there is heat loss, the heat source should be changed to an electric heater.

5.2.3 Water Treatment Unit

The company has a set of equipment that can be used for constructing a water treatment unit, which include three tanks with agitators, a filter press etc., but the water treatment unit has not yet been completed. The water treatment unit needs to be completed if the company intends to continue plating operations.

5.3 Water Treatment

According to the results of waste water quality analysis, a water treatment unit must be introduced. The conceptual design of a water treatment unit was carried out in this Study and is summarized as follows:

5.3.1 Design Basis

- (1) Volume of Waste Water: 70 m³/day
- (2) Waste Water Quality

Table 6 Waste Water Quality

Item	Unit	Base Data	TCVN5945
pH		2.98	5.5-9
Oil	mg/l	2	1or10
BOD	mg/l	8	50
COD	mg/l	29	100
Cyanide	mg/l	0.03	0.1
Cu	mg/l	0.3	1.0
Fe	mg/l	5.6	5.0
Zn	mg/l	0.29	2.0
Cr ⁺⁶ (total Cr)	mg/l	(10.5)	0.1 (1.0)
Ni	mg/l	66.4	1.0
Pb	mg/l	0.022	0.5

5.3.2 Conceptual Design

- (1) Flow Sheet

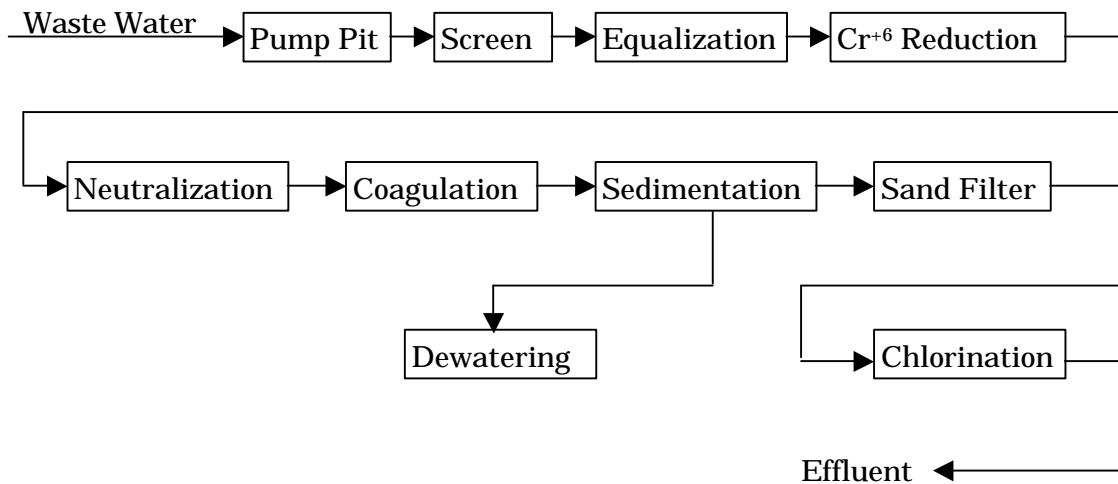


Figure 5 Flow Sheet

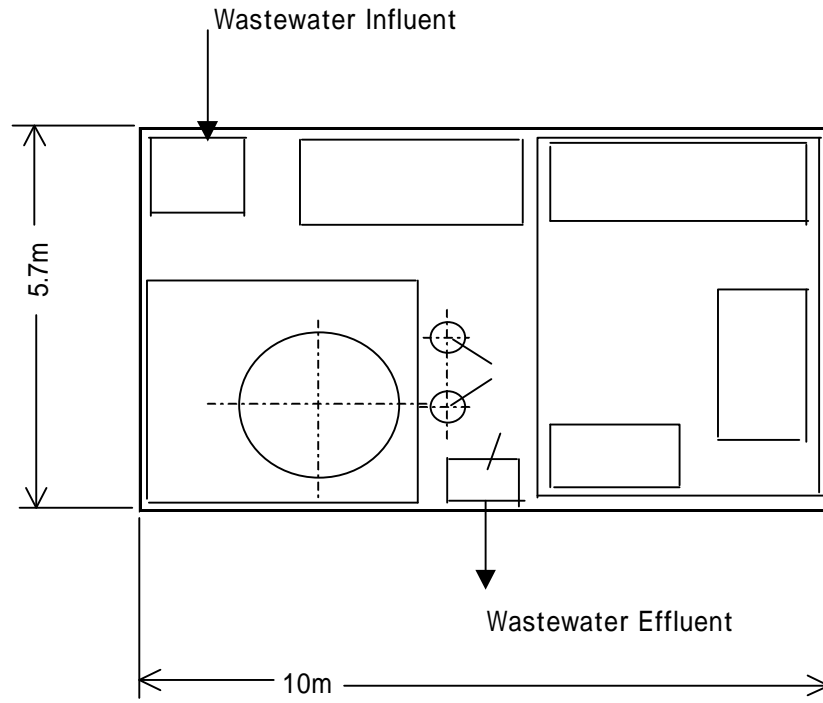
(2) Main Equipment List

Table 7 Main Equipment

Name of Equipment	No. of Req'd	Remarks
Pump Pit	1	3m ³ , RC
Wastewater Pump	2	Submerged, 0.25m ³ /min 1.1kw
Screen	1	1mm mesh
Equalization Tank	1	47m ³ , RC, 3m * 4m * 4.5m depth
Transfer Pump	2	Volute, 0.04m ³ /min 0.2kw
Cr ⁺⁶ Reduction Tank	1	Existing 6m ³ Tank and Mixer
Neutralization Tank	1	Existing 3m ³ Tank and Mixer
Coagulation Tank	1	0.7m ³ , Steel (Resin Lining), Mixer
Sedimentation Tank	1	2.2m dia. 11m ³ , Corn Bottom, steel
Dewatering Facilities	1	Existing Filter Press
Sand Filter	2	0.6m dia.
Chlorination Tank	1	0.7m ³ steel
Chlorinator	1	Hypochlorinator
Chemical Dosing	1set	Sodium Sulfite Tank and Feed Pumps Sulfuric Acid Tank and Feed Pumps Caustic Soda Tank and Feed Pumps Sodium Hypo. Tank and Feed Pumps PAC Tank and Feed Pumps Polymer Tank and Feed Pumps
Control Building	1	4mW * 5.5mL Steel Slated

(3) Plot Plan

A proposed plot plan is shown in Figure 6.



- Pump Pit
- Equalization Tank
- Reaction Tanks (Existing)
- Cr⁺⁶ Reduction Tank
- Neutralization Tank
- Sedimentation Tank
- Chemical Dosing Equipment
- Filter Press (Existing)
- Sand Filters
- Chlorination Tank
- Control Building
- Electrical Panel

Figure 6 Plot Plan

(4) Required Cost

The rough estimated cost is about 700millionVND.

6 Recommendations for Improvement

6.1 Short Term Countermeasures

(1) Determine future plan for the Plating Shop

The recommendation of the Study team is that the plating shop should be set up to operate independently in the near future.

(2) Operational Improvements

- 1) Improvement in the working environment through better arrangement and cleaning.
- 2) Investigate reusing waste from the Cr plating bath.
- 3) Change the heat source from a steam heater to an electric heater.

(3) Investigation of water treatment unit installation

6.2 Mid and Long Term Countermeasures

(1) Promotion of a specialized, independent plating company

By consolidating plating shops, including the employees of surrounding state-owned companies, and rearranging the organization of the plating shop, the plating shop will become a specialized plating company which mainly performs Ni-Cr plating. If necessary, the plating shop must be expanded. Furthermore, modernization of the plating shop needs to be considered. Thu Duc Textile Garment Engineering Company must exist as a mechanical parts and equipment manufacturing company whose plating work orders will be placed with the new plating company.

(2) Profit Improvement Through Scale Enlargement

Both companies shall enlarge their businesses and profits by utilizing their specialties.

- 1) Break Even Point Chart Application
- 2) Promotion of Cleaner Production Activities

(3) Installation of a Water Treatment Unit

The new plating company needs a complete water treatment unit. If required to utilize the water treatment unit fully, treatment of surrounding companies

waste water can be performed. For that purpose, the company need to have enough technology concerning water treatment.

6.3 Implementation Schedule and Future Image

The implementation schedule plan is shown in Figure 7. The central government and local government need to be consulted on the plan.

Activity	2000-2001	2002-2005	Future Image
1. Investigation of Future Plans			No discharge of pollution An independent, competitive company that specializes in plating A profitable company that performs Ni-Cr plating
2. Operational Improvement			
3. Investigation on Water Treatment			
4. Establishment of a Plating Company			
5. Perform Profit Improvement			
6. Installation of a Water Treatment Unit			

Figure 7 Implementation Schedule Plan and Future Image

Thanh Luan Manufacturing and Trading Co., Ltd.

Survey Date: 10 December, 1999

1 & 2 March, 2000

1. General**1.1. Profile**

Thanh Luan Manufacturing and Trading Co., Ltd. is a private company that was established in 1999 as a plating company. Formerly, the company was a plating shop of Vietronic Tan Binh. The company profile is summarized in Table 1.

Table 1 Company Profile

Name of Company	Thanh Luan Manufacturing and Trading Co., Ltd.
Ownership	Private
Address	244 Street, 4 Bao Chi Section, Thao Dien Ward, Distict 2, Ho Chi Minh
Tel	8.8999126
Established	1999
Number of Employees	76
Area	700 m ²
Main Products	Assembled parts, Plated & Dyed parts, Imported material

1.2. Business Status**1.2.1 Production**

Table 2 shows average production and sales of the company per month.

Table 2 Average Production and Sales Per Month

Item	Unit	Production	Turnover (million VND/month)
Ni-Cr Plating	m ² /month	150,007	150.01
Zn Plating	m ² /month	1,690	50.62
Brass Plating	m ² /month	417	50.06
Total		152,114	250.69

1.2.2 Debt

No information.

1.2.3 Company Cost Breakdown (average/month)

Table 3 Company Cost Breakdown (average/month)

Item	Percentage (%)	Value (million VND/month)
1) Materials	32	80
2) Labor Cost	28.13	70
3) Power & Water	7.6	19
4) Manager Fees	3.2	8
5) Depreciation	6.4	16
6) Tax (V.A.T.)	10	25
7) Bank Interest	4	10
8) Land Fees	2	5
9) Other Expenses	2	5
10) Profits	4.8	12
Total	100	250

2. Production Technology

2.1 Process

2.1.1 Brass Plating

The block flow diagram of brass plating is shown in Figure 1.

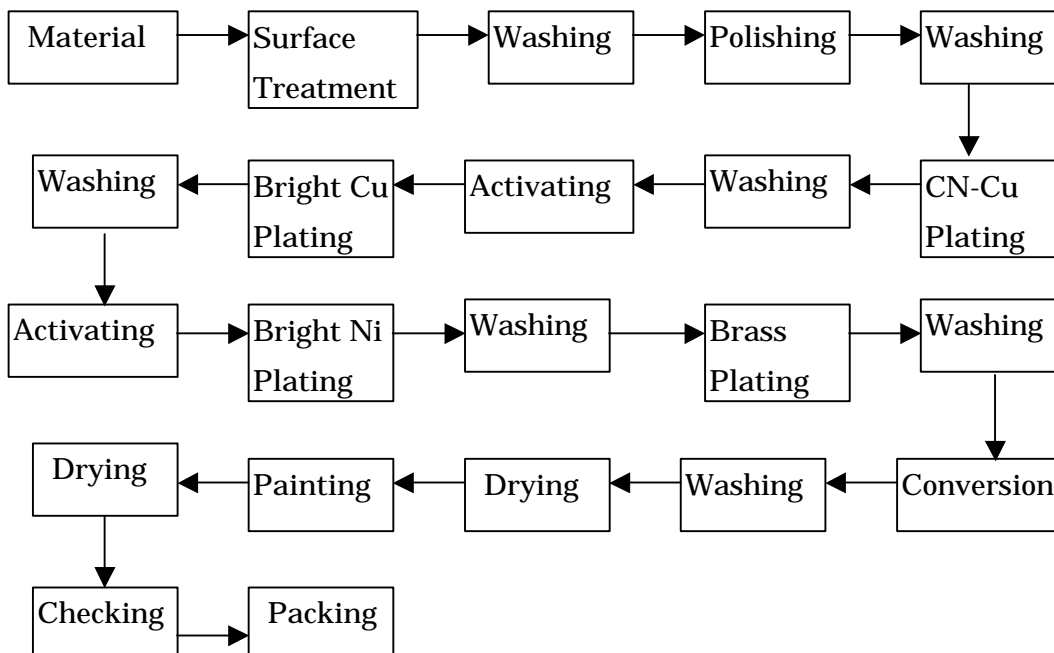


Figure 1 Block Flow Diagram of Brass Plating

2.1.2 Zinc Plating

The block flow diagram of zinc plating is shown in Figure 2.

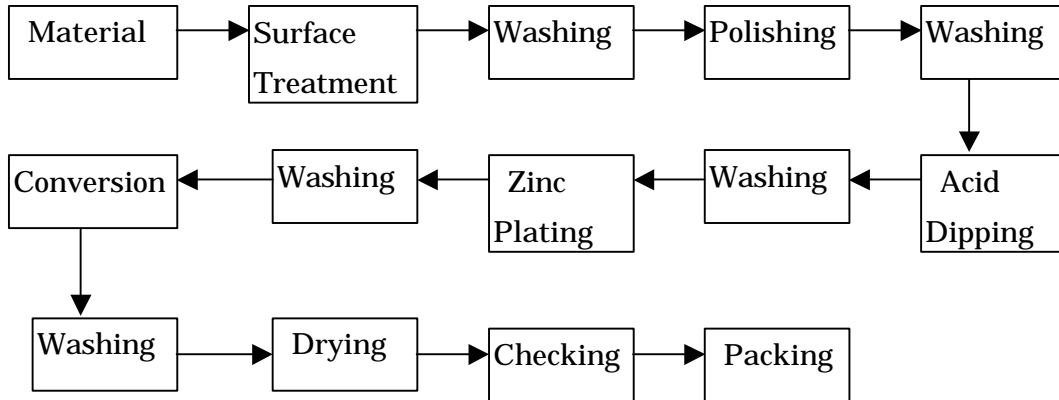


Figure 2 Block Flow Diagram of Zinc Plating

2.1.3 Chromium Plating

The block flow diagram of chromium plating is shown in Figure 3.

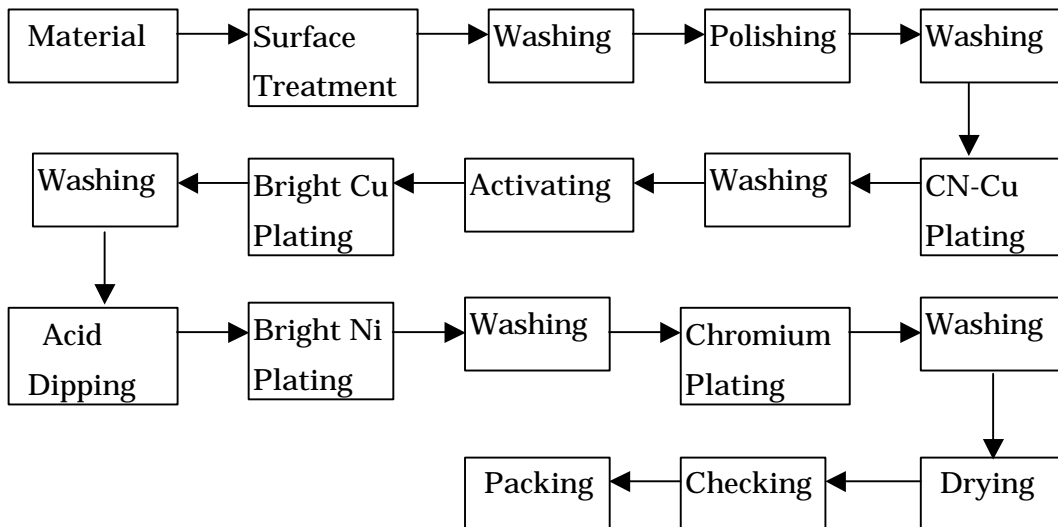


Figure 3 Block Flow Diagram of Chromium Plating

2.1.4 Plastic Plating

The block flow diagram of plastic plating is shown in Figure 4.

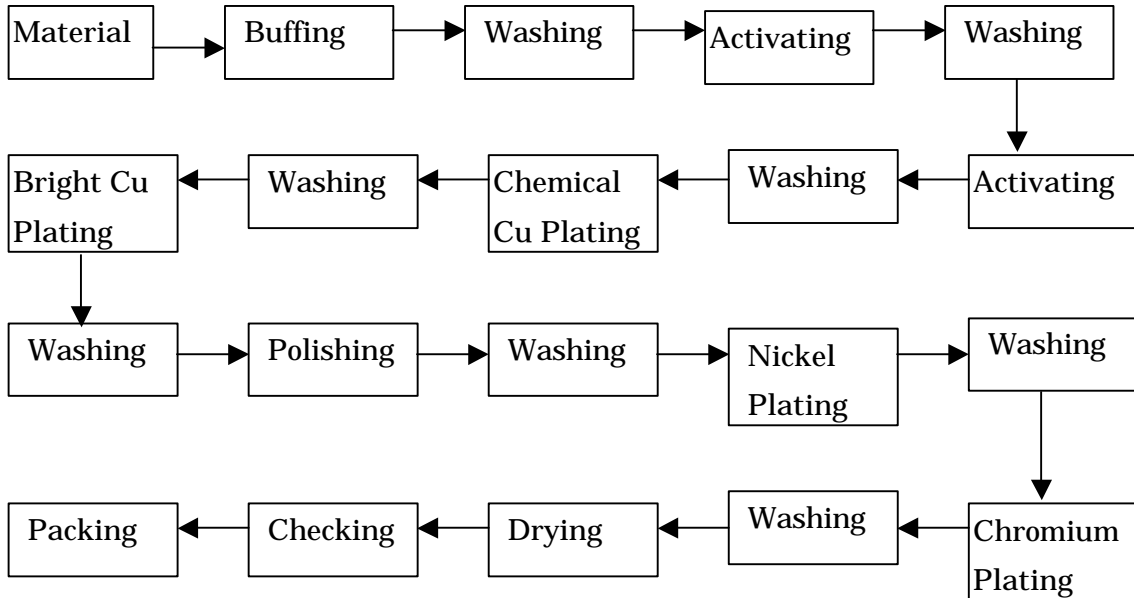


Figure 4 Block Flow Diagram of Plastic Plating

2.2 Main Equipment of the Company

Table 4 Main Equipment of the Company

Equipment	Units	Equipment Name	Units
Plating bath	22	Mixing equipment	5
Rectifier	19	Hydrometer	1
Drier	4	Thermometer	1
Heater	5	pH meter	1
Centrifugal drier	3	Current density meter	1
Pump	11	Analytical equipment	1 set
Pressure equipment	2		

3. Management Technology

The company is managed and controlled by one Director. The Director has sufficient knowledge about plating. The company is active and has high performance. And also, the company has the intention to move to a industrial zone within two to three years. However, the Director still feels there is a necessity to install a water treatment unit in the existing plating shop.

4. Industrial Waste Water

4.1 Layout and Drainage System of the Company

The layout and drainage system of the company is shown in Figure 5.

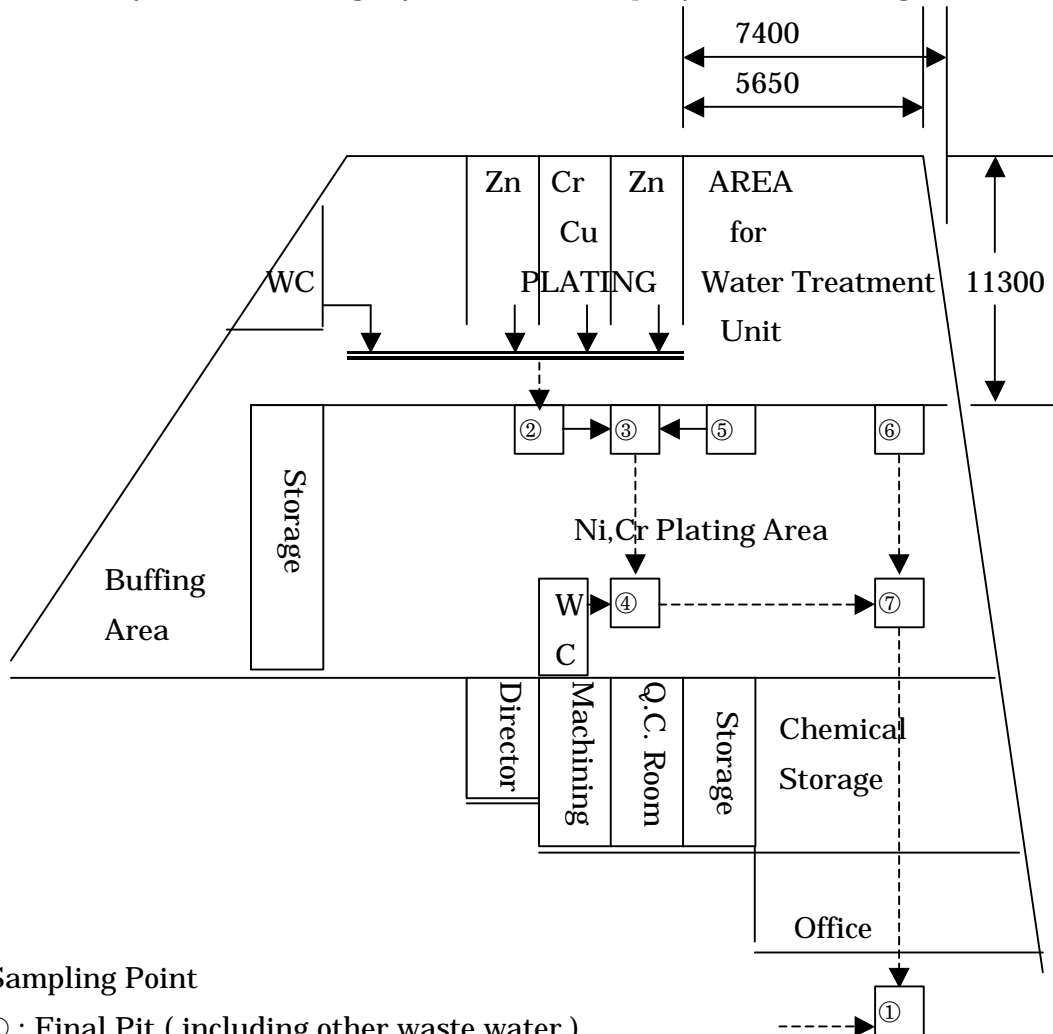


Figure 5 Layout and Drainage System of the Company

4.2 Waste Water Quality

Waste water samples were taken in this study at the points shown in Figure 5.

4.2.1 Sampling on 10 December 1999

The results of quality analysis of the samples are summarized in Table 5.

Table 5 Waste Water Quality (10 December 1999)

Item	Unit	* ①	* ②	* ④	* ⑦	TCVN5945
Flow rate	m ³ /day	20				
pH		5.6	9	4.4	7.5	5.5-9
Oil	mg/l	12	10	15	8	1or10
BOD	mg/l	3	6	5	3	50
COD	mg/l	39	55	165	79	100
SS	mg/l					100
Cyanide	mg/l	3.29	1.19	0.19	0.89	0.1
Cu	mg/l	0.38	0.46	1.81	1.62	1.0
Fe	mg/l					5.0
Zn	mg/l	0.86	2.55	1.8	2.33	2.0
Cr ⁺⁶	mg/l	0.108	0.026	0.813	0.491	0.1
Ni	mg/l	0.37	0.25	2.84	2.05	1.0
Pb	mg/l	0.017	0.081	0.046	0.059	0.5

- Sampling places ①,②,④,⑦ are shown in Figure 5.

4.2.2 Sampling on 2 March 2000

The results of quality analysis of the samples are summarized in Table 6.

Table 6 Waste Water Quality (2 March 2000)

Item	Unit	*①	*②	*③	*④	*⑤	*⑥	*⑦	TCVN
Flow Rate	m ³ /d							27	
pH		5.1	2.9	3.55	3.07	3.6	3.27	3.64	5.5-9
Oil	mg/l	8.4	6	0	6.6	4.4	0	0.6	1or10
BOD	mg/l	14	11	3	5	3	5	7	50
COD	mg/l	34	39	13	16	13	14	23	100
SS	mg/l	91	31	104	92	32	30	154	100
Cyanide	mg/l	1.9	0.6	0.6	0.5	0.1	8	0.6	0.1
Cu	mg/l	14.7	10.7	3.07	3.54	1.05	25.8	5.08	1.0
Fe	mg/l	3.97	18.8	36.2	28.0	0.66	6.77	16.7	5.0
Zn	mg/l	4.26	26.4	18.6	17.5	0.53	1.13	11.0	2.0
Cr ⁺⁶	mg/l	5.41	2.6	31.6	26.7	55.6	1.65	25.3	0.1
Ni	mg/l	12	3.71	7.78	6.67	15	20.7	9.11	1.0
Pb	mg/l	0.06	0.52	0.95	0.43	0.46		0.74	0.5
Al	mg/l	0.45	5.5	0.24	0.73	0.57	2.12	0.19	

- Sampling places ① ~ ⑦ are shown in Figure 5.

5. Countermeasures for Industrial Waste Water Pollution Prevention

5.1 Present Problems

At present, the main problems of the company are as follows:

- (1) Arrangement of the Plating Facilities
- (2) Operational Problems
 - 1) The working environment of the shops
 - 2) Insufficient ascertainment of improvement points
 - 3) Amplification of Cleaner Production Activities
- (3) Relocation of the Company

5.2 Improvement Points for Production Technology

5.2.1 Rearrangement of Plating Facilities

It is necessary to rearrange the plating facility in order to be able to separate CN contained waste water and Cr contained waste water. A pit for CN waste and a pit for Cr waste must be built. The waste water amount of each type of waste water needs to be measured for the purpose of waste water treatment unit design.

5.2.2 Operational Improvement

Basically, the technology level of the company is high. However, further improvements that need to be made are as follows:

- (1) Improvement of the working environment through better shop arrangement and cleaning

Nothing should be placed directly on the floor. Various tanks which have been placed on the floor, need to be put on movable carts, so the layout can be arranged according to the job flow. Unnecessary material in the shop needs to be removed. The walk way needs to be clearly painted. Making work easy brings about high productivity and high quality, which makes for increased good business chances.

- (2) Ascertainment of improvement points by utilizing a Break Even Point Chart

The company already has obtained the necessary data. This data can be used for understanding present conditions, clarifying problems, determining investment effects, etc.

- (3) Proceed with Cleaner Production Activities

The company has already initiated an activity for gathering employees' ideas during meetings. By systemizing this activity, it will become a Cleaner Production Activity. The company will be able to gather employees' ideas more effectively, if

this activity is systemized.

5.2.3 Investigation on Industrial Zone Relocation

The company is located in a city area, so the company has to investigate the possibility of relocation to an industrial zone. If the company introduces a waste water treatment unit, this relocation will not be required. However, existing space is limited for expanding the business, so the merit and demerits must be investigated carefully.

5.3 Water Treatment

According to the results of waste water quality analysis, it is necessary that a water treatment unit be introduced. A conceptual design of the waste water treatment unit was carried out in this Study and is summarized as follows:

5.3.1 Design Basis

(1) Amount of Waste Water

- Waste water containing cyanide: 17m³/day
- Waste water containing Cr⁺⁶ : 10m³/day
- Total waste water: 27m³/day

(2) Waste Water Quality

Table 7 Waste Water Quality

Item	Unit	Base Data of CN Waste	Base Data of Cr ⁺⁶ Waste	TCVN5945
pH		3.27	3.07	5.5-9
Oil	mg/l	0	6.6	1or10
BOD	mg/l	5	5	50
COD	mg/l	14	16	100
SS	mg/l	30	92	100
Cyanide	mg/l	8	0	0,1
Cu	mg/l	25.79	3.54	1.0
Fe	mg/l	6.77	28.01	5.0
Zn	mg/l	0	24.6	2.0
Cr ⁺⁶	mg/l	1.26	37.4	0.1
Ni	mg/l	15.8	9.34	1.0
Pb	mg/l	<0.02	0.43	0.5

5.3.2 Conceptual Design

(1) Flow Sheet

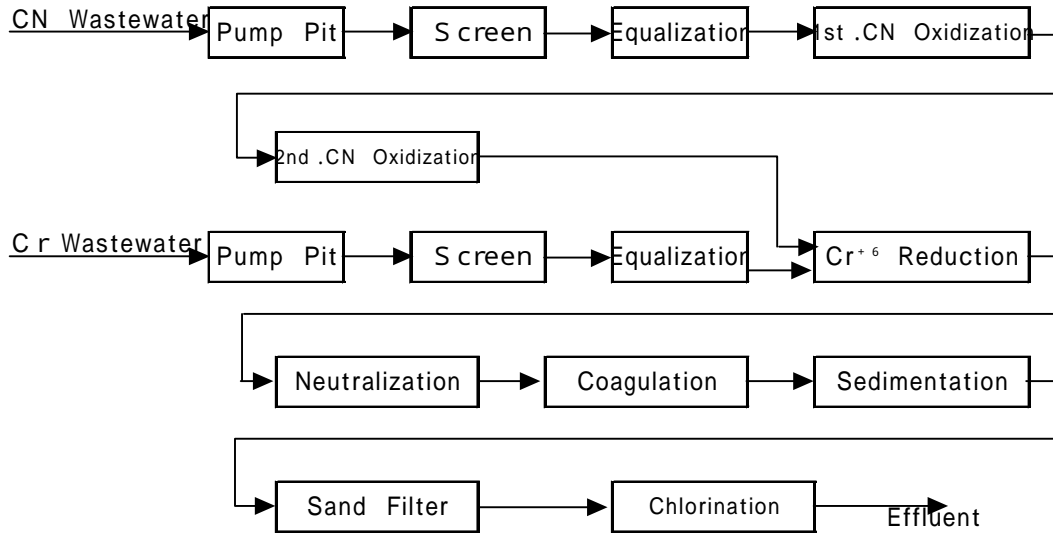


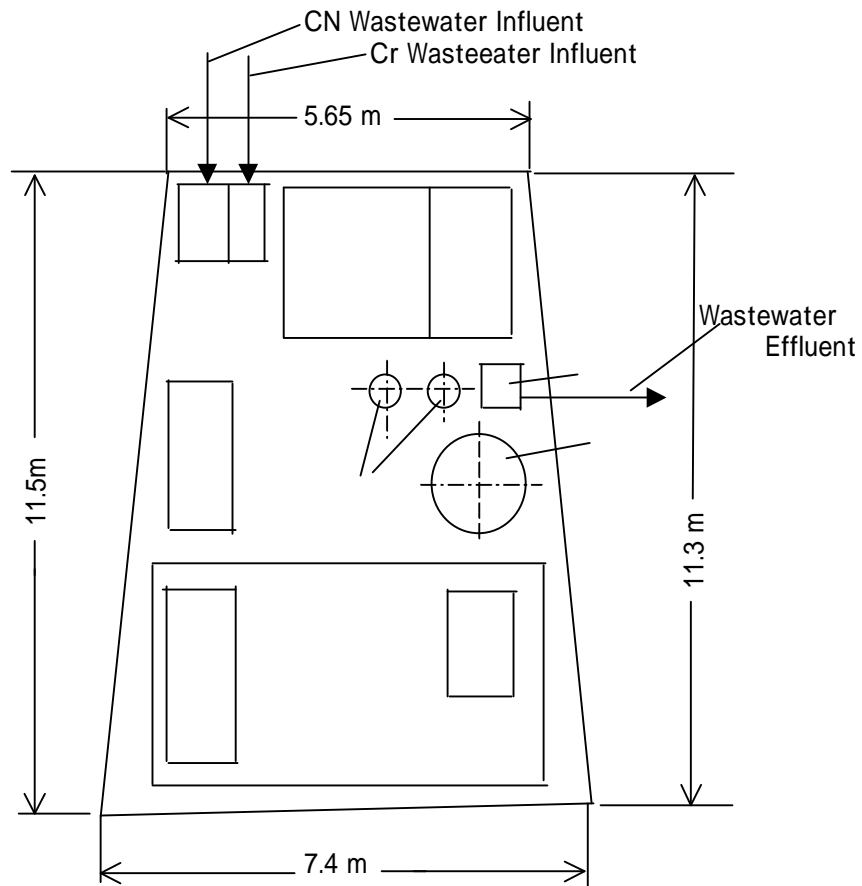
Figure 6 Flow Sheet

(2) Main Equipment List

Table 8 Main Equipment List

Name of Equipment	No. of Req'd	Remarks
Pump Pit for CN Wastewater	1	0.7m ³ RC
Pump Pit for Cr Wastewater	1	0.4m ³ RC
Wastewater Pump for CN WW.	2	Submerged, 0.08 m ³ / min 0.4kw
Wastewater Pump for Cr WW.	2	Submerged, 0.06 m ³ / min 0.4kw
Screen	2	1mm mesh
Equalization Tank for CN WW	1	11 m ³ RC, 2.5m * 2.5m * 2.5m depth
Equalization Tank for Cr WW	1	7 m ³ RC, 1.5m * 2.5m * 2.5m depth
Transfer Pump for CN WW	2	Volute, 0.015 m ³ / min 0.2kw
Transfer Pump for Cr WW	2	Volute, 0.007 m ³ / min 0.2kw
1st. CN Oxidation Tank	1	1.4m ³ , Steel (Resin Lining), Mixer
2st. CN Oxidation Tank	1	1.4m ³ , Steel (Resin Lining), Mixer
Cr ⁺⁶ Reduction Tank	1	2.2m ³ , Steel (Resin Lining), Mixer
Neutralization Tank	1	1m ³ , Steel (Resin Lining), Mixer
Coagulation Tank	1	0.3m ³ , Steel (Resin Lining), Mixer
Sedimentation Tank	1	1.4m ³ , dia. 6m ³ , Corn Bottom, Steel
Sand Filter	1	1.4m ³ , dia Steel
Chlorination Tank	1	0.3m ³ , Steel
Chlorinator	1	Hypochlorinator
Chemical Dosing	1set	Sodium Sulfito Tank and Feed Pumps Sulfuric Acid Tank and Feed Pumps Caustic Soda Tank and Feed Pumps PAC Tank and Feed Pumps Sodium Hypo. Tank and Feed Pumps
Control Building	1	4mw * 6mL Steel Slated

(3) Plot Plan



- Pump Pit for CN Wastewater
- Pump Pit for Cr Wastewater
- Equalization Tank for CN Wastewater
- Equalization Tank for Cr Wastewater
- Reaction Tanks
- CN Oxidation Tanks, Cr⁺⁶ Reduction Tank
- Chemical Dosing Equipments
- Sedimentation Tank
- Sand Filters
- Chlorination Tank
- Electrical Panel
- Control Building

Figure 7 Plot Plan

(3) Required Cost

The rough estimated cost is about 500 million VND.

6. Recommendations for Improvement

6.1 Short Term Countermeasures

- (1) Rearrangement of Plating Facilities
- (2) Operational Improvement
 - 1) Improvement of the working environment through better shop arrangement and cleaning
 - 2) Ascertainment of improvement points by utilizing a Break Even Point Chart
 - 3) Proceed with Cleaner Production Activities
- (3) Investigation on industrial zone relocation

6.2 Mid and Long Term Countermeasures

- (1) Installation of a Waste Water Treatment Unit

The company needs an appropriate waste water treatment unit and treatment technology. The required funding for this investment shall be discussed with related authorities and application of a private company promotion system must also be fully considered. One other possibility is to treat the company's waste water along with waste water from other companies.

- (2) Relocation to an Industrial Zone

If it is feasible to relocate, the maximum assistance of the government will be required. Automation and modernization need to be applied at the new facility.

- (3) Establishment of a Plating Association

To make good relationships with the government, it is necessary to organize a Plating Association among the private plating companies. At first it will be better to organize area by area, and then proceed with developing a national organization.

To perform plating works, it is indispensable to have a water treatment unit. It is necessary to develop a common understanding that plating costs must include waste water treatment fees. A more severe bonus and penalty system need to be introduced for waste water treatment.

6.3 Implementation Schedule and Future Image

An implementation schedule plan is shown in Figure 8. This plan needs to be reviewed by the central government and local government.

Activity	2000-2001	2002-2005	Future Image
1. Rearrangement of Plating Facility			<p>A private plating company that discharges no pollution</p> <p>A competitive plating company with a water treatment unit</p> <p>A leading private company with good profits and improvement activities</p>
2. Operational Improvements			
3. Investigation on Relocation			
4. Investigation of a Water Treatment Unit			
5. Relocation to an Industrial Zone			
6. Establishment of a Plating Association			

Figure 8 Implementation Schedule Plan and Future Image

Agriculture Machine and Tractor Company

Survey Date: 13 December 1999

6-8 March 2000

1. General**1.1 Profile**

Agriculture Machine and Tractor Company is a state-owned company that was established in 1960 as a tractor manufacturing company. The company profile is shown in Table 1 and Figure 1.

Table 1 Company Profile

Name of Company	Agriculture Machine and Tractor Company
Ownership	State-owned
Address	Chu Van An Str., Hadong Town, Hatay Province
Tel	84-04-8542747
Established	1960
Number of Employees	700
Area	40,000 m ² (Hanoi) 60,000 m ² (Total)
Main Products	Tractor(8-15 HP), Agriculture machine (gear box, pump, insect spray, seed remover etc.)

1.2 Business Status**1.2.1 Production**

Table 2 shows production and sales of the company in 1998.

Table 2 Production and Sales in 1998

Item	Unit	Production	Turnover (million VND)
Tractor 12	Piece	1,100	6,380
Cultivator 12	Piece	800	1,840
Tractor	Piece	605	4,719
Pesticide 161	Piece	10,658	799.35
Pesticide 121	Piece	7,236	542.7
Tractor BS8	Piece	20	77
Other accessories	Ton	200	5,000
Total			19,358.05

1.2.2 Debt

From the Commercial Bank : 4 billion VND

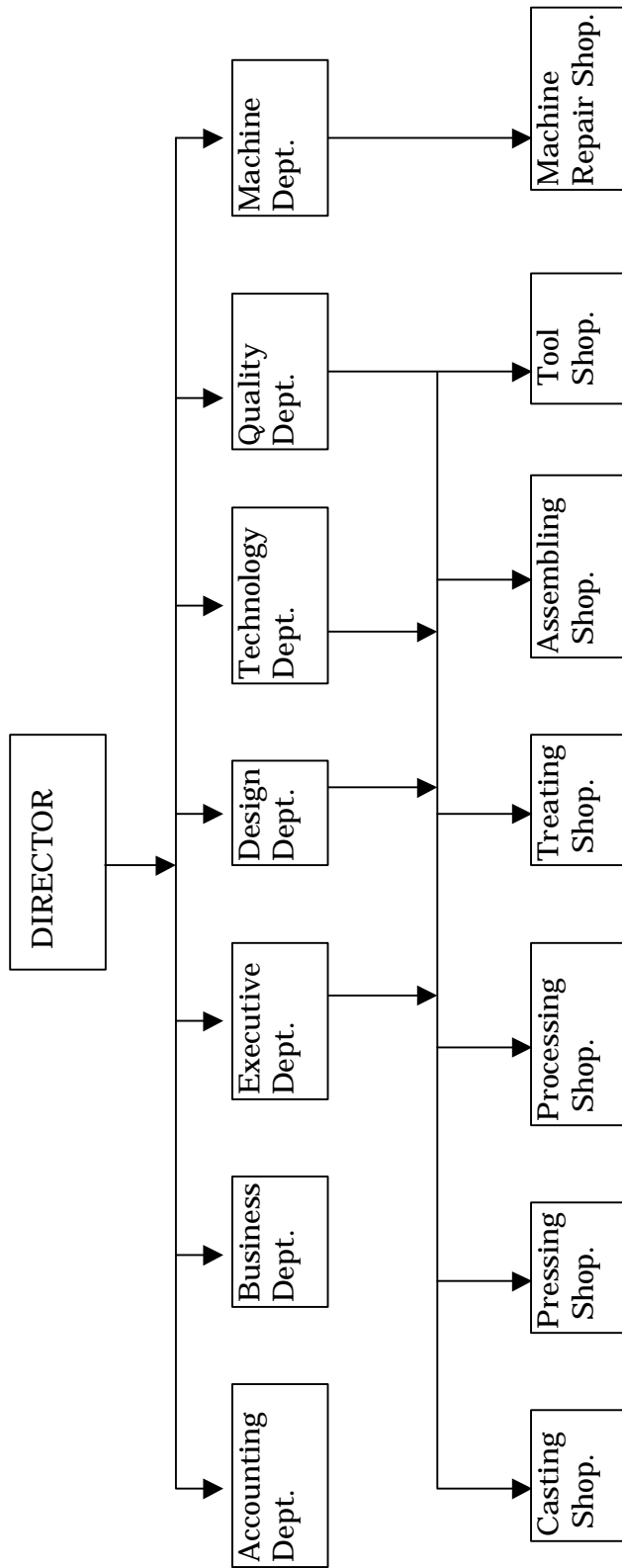


Figure 1 Organization of the Company

2. Production Technology

2.1 Process

The block flow diagram of the company is shown in Figure 2.

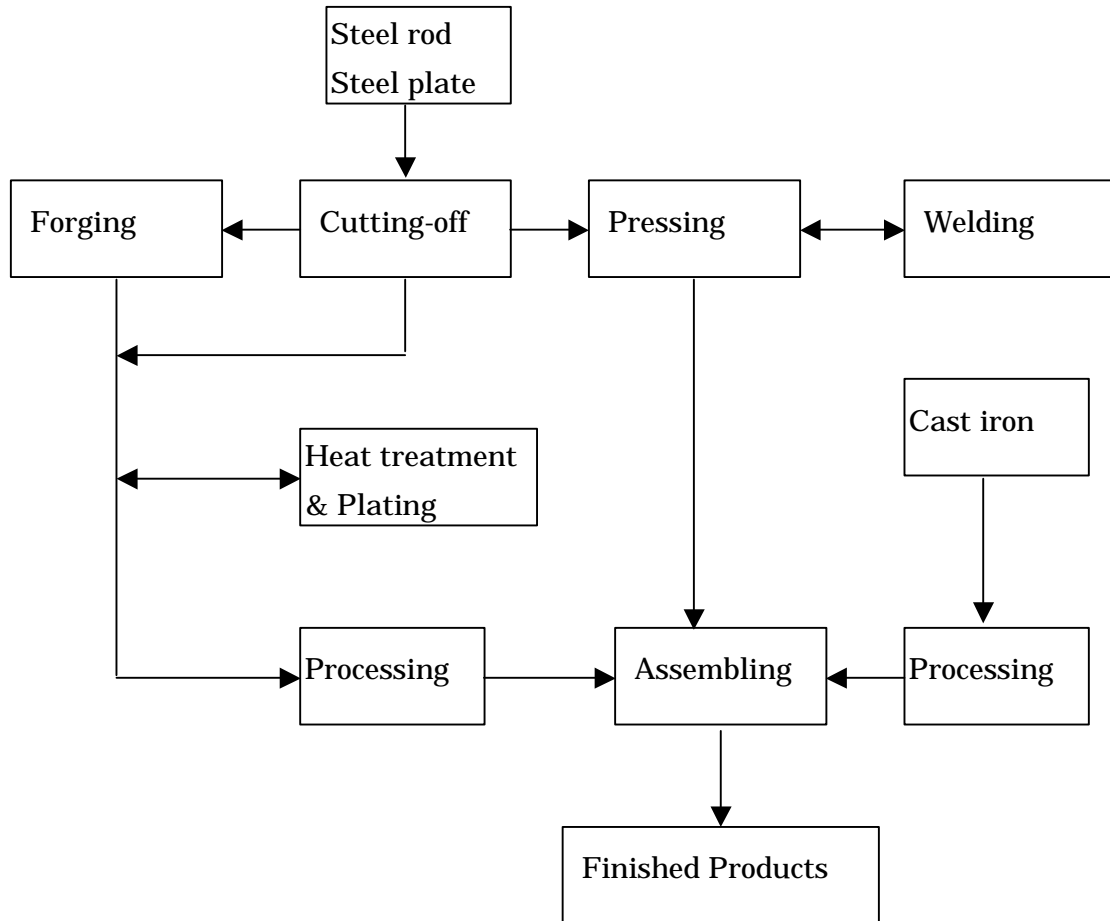


Figure 2 Block Flow Diagram of The Company

2.2 Material and Utility Consumption

Table 3 Material and Utility Consumption

Material	Unit	Consumption	Price (VND)
I. Tractor12			
-Cast iron	kg/year	115,500	254,100,000
-Steel	kg/year	226,600	1,472,900,000
-Oil	kg/year	6,340	42,478,000
-NaOH	kg/year	34	160,800
-H3BO3	kg/year	46	603,200
-HCL	kg/year	191	2,678,200
-H2SO4	kg/year	38	95,750
-Paint	kg/year	780	15,598,000
-Plastic	kg/year	307	3,685
-Coal	kg/year	54,363	35,879,580
-Electricity	kWh/year	467,133	373,706,400
II .Cultivator 12			
-Cast iron	kg/year	41,040	90,288,000
-Steel	kg/year	43,280	281,320,000
-Oil	kg/year	1,260	8,442,000
-NaOH	kg/year	3	15,840
-H3BO3	kg/year	6	72,800
-HCL	kg/year	19	261,800
-H2SO4	kg/year	4	9,250
-Paint	kg/year	878	17,552,000
-Coal	kg/year	30,084	60,168,000
-Electricity	kWh/year	134,721	107,776,800
III. Tractor			
-Cast iron	kg/year	75,468	166,029,600
-Steel	kg/year	164,560	1,069,640
-Oil	kg/year	3,817	25,573,900
-NaOH	kg/year	2	8,640
-H3BO3	kg/year	3	37,700
-HCL	kg/year	10	141,400
-H2SO4	kg/year	2	5,000
-Paint	kg/year	1,051	21,020,000
-Coal	kg/year	43,318	86,636,000
-Electricity	kWh/year	345,517	276,413,600
IV Pesticide Sprav			
-Steel	kg/year	20,327	131,121,500
-NaOH	kg/year	5	23,520
-H3BO3	kg/year	12	158,600
-HNO3	kg/year	10	20,800
-HCL	kg/year	283	3,967,600
-H2SO4	kg/year	45	113,250
-Plastic	kg/year	1,411	2,821,400
-Electricity	kWh/year	98,262	78,609,600
V. Accessories			
-Cast iron	kg/year	75,000	165,000,000
-Steel	kg/year	125,000	812,500,000
-NaOH	kg/year	3	13,440
-H3BO3	kg/year	1	9,100
-HCL	kg/year	1	8,400
-H2SO4	kg/year	16	39,500
-Coal	kg/year	54,363	108,726,000
-Electricity	kWh/year	467,133	373,706,400
Total Water	m ³ /year	218,400	393,120,000
Grand Total			5,293,004,695

3. Management Technology

The company's management recognizes their present situation well. The company has a project to build a new painting shop to improve the quality of products. The first priority of the company is to improve productivity and quality. Their next priority is to improve environmental pollution prevention measures. However, it is necessary for the company to perform more exact quantitative analysis in order to gain a better sense of their management direction.

3.1 Plating Cost Breakdown

Table 4 Plating Cost Breakdown

Item	Cost	Percentage (%)
Wages	76,000 VND/m ²	30
Materials	91,200 VND/m ²	40
Electricity	15,900 VND/m ²	7
Water	6,800 VND/m ²	3
Depreciation	15,900 VND/m ²	7
Taxes	11,400 VND/m ²	5
Over head	18,200 VND/m ²	8
Total	235,400 VND/m ²	100

4. Industrial Waste Water

4.1 Drainage System of the Company

The drainage system of the company is shown in Figure 3.

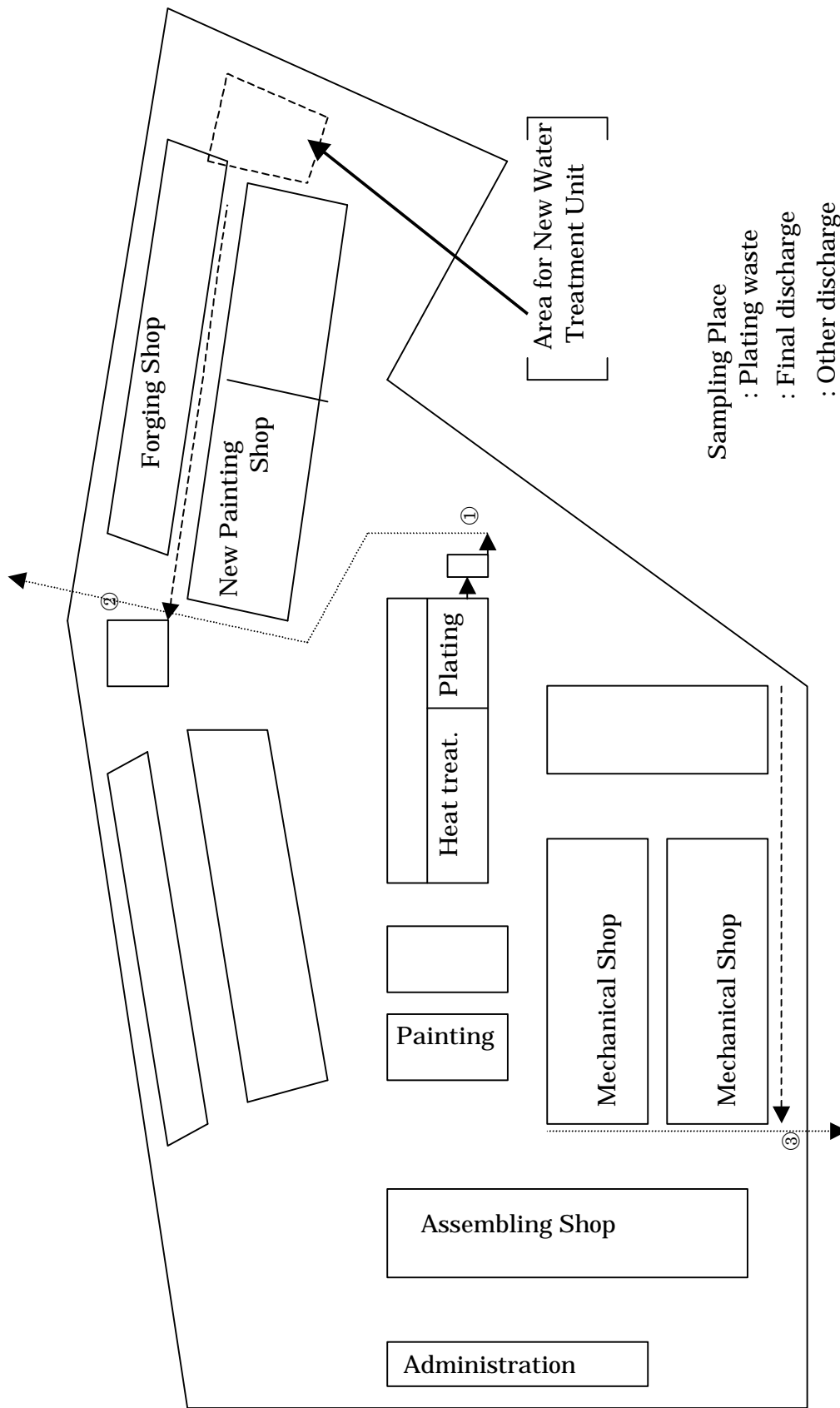


Figure 3 Drainage System of the Company

4.2 Waste Water Quality

Waste water samples were taken in this study at the points shown in Figure 3.

4.2.1 Sampling on 13 December 1999

The results of quality analysis of samples are shown in Table 5.

Table 5 Waste Water Quality (13 December 1999)

Item	Unit	①	②	③	TCVN
Flow Rate	m ³ /day				
PH		7.1	7.61	8.03	5.5-9
Oil	mg/l	0.2	0.41	0.33	1or10
BOD	mg/l	12.83	13.2	18.04	50
COD	mg/l	51.2	47.8	87.6	100
SS	mg/l				100
Cyanide	mg/l	trace	0.01	trace	0.1
Cu	mg/l	0.68	0.31	0.27	1.0
Zn	mg/l	1.26	0.93	2.64	2.0
Cr ⁺⁶	mg/l	2.67	0.322	0.048	0.1
Ni	mg/l	0.423	0.008	0.008	1.0
Pb	mg/l	trace	trace	trace	0.5
Cd	mg/l	0.011	0.122	0.204	0.02

4.2.2 Sampling on 7 March 2000

The results of quality analysis of samples are summarized in Table 6.

Table 6 Waste Water Quality (7 March 2000)

Item	Unit	①	②	③	TCVN
Flow Rate	m ³ /day	10	23.5	76.5	
pH		6.8	8.3	6.78	5.5-9
Oil	mg/l	0.2	0.21	0.09	1or10
BOD	mg/l	32.6	40	28.2	50
COD	mg/l	41	57.4	44.5	100
SS	mg/l	151	74	22	100
Cyanide	mg/l	0.02	0.03	0.01	0.1
Cu	mg/l	0.56	0.87	0.22	1.0
Zn	mg/l	1.96	0.82	1.41	2.0
Cr ⁺⁶	mg/l		0.12	0.05	0.1
Ni	mg/l	5.9	6.9	54	1.0
Pb	mg/l	0.13	0.027	0.04	0.5
Cd	mg/l		0.07	0.06	0.02

5. Countermeasures for Industrial Waste Water Pollution Prevention

5.1 Present Problems

At present, the main problems of the company are as follows:

- (1) Investigation for Future Direction
- (2) Operational Problems
 - 1) The working environment of the shops
 - 2) Insufficient ascertainment of improvement points
 - 3) No Cleaner Production Activities
- (3) Waste Water Treatment

5.2 Improvement Points for Production Technology

5.2.1 Investigation for Future Direction

The company's main industrial waste water problem is waste water discharged from the plating shop. It is indispensable to have a water treatment unit for waste water discharged from a plating shop. However, it is not feasible to install a water treatment unit in the Company because they have a very small plating shop. In the near future, plating will be replaced by painting and/or plastics. So it is better to consolidate the plating shop and its employees with other plating shops that already have a water treatment unit. Plating work orders shall be placed with the consolidated plating company.

5.2.2 Operational Improvements

To increase company profits, it is necessary to constantly make improvements. The basic items that need to be improved are as follows:

- (1) Improvement of the working environment through good shop floor arrangement and cleaning

Nothing should be placed directly on the floor. Various tanks which have been placed on the floor, need to be put on movable carts, so the layout can be arranged according to the job flow. Unnecessary materials in the shop need to be taken out. The walk way needs to be clearly painted. Making work easy brings about high productivity and high quality, which makes for increased business chances.

- (2) Ascertainment of improvement points by utilizing a Break Even Point Chart

The company already has obtained the necessary data. The data can be used for understanding the present conditions, clarifying problems, and determining effects of investment etc.

(3) Proceed with Cleaner Production Activities

The company already has an activity for gathering employees' ideas during meetings. By systemizing this activity it will become a Cleaner Production Activity. The company will be able to gather employees' ideas more effectively if they systemize this activity.

5.2.3 Investigation of Water Treatment Unit Installation

To recognize the impact of water treatment units, an investigation of a water treatment unit in an existing plating shop needs to be performed urgently.

5.3 Waste Water Treatment

According to the results of the waste water quality analysis, it is necessary to introduce a waste water treatment unit. The conceptual design of a waste water treatment unit was carried out in this Study and is summarized as follows:

5.3.1 Design Basis

(1) Amount of Waste Water

15 m³/day

(2) Waste Water Quality

Table 7 Waste Water Quality

Item	Unit	Base Data	TCVN5945
pH		6.8	5.5-9
Oil	mg/l	0.2	1or10
BOD	mg/l	32.6	50
COD	mg/l	51.2	100
SS	mg/l	151	100
Cyanide	mg/l	0.02	0.1
Cu	mg/l	0.68	1.0
Zn	mg/l	1.96	2.0
Cr ⁺⁶	mg/l	2.67	0.1
Ni	mg/l	5.9	1.0
Pb	mg/l	0.13	0.5

5.3.2 Conceptual Design

(1) Flow Sheet

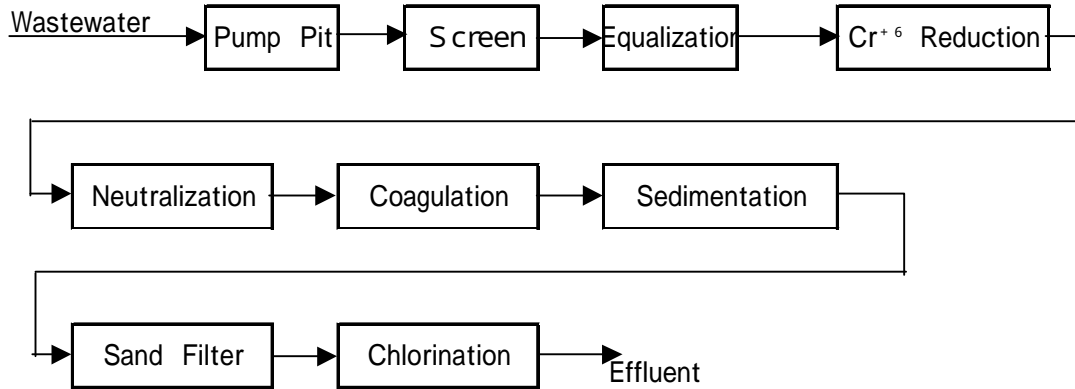


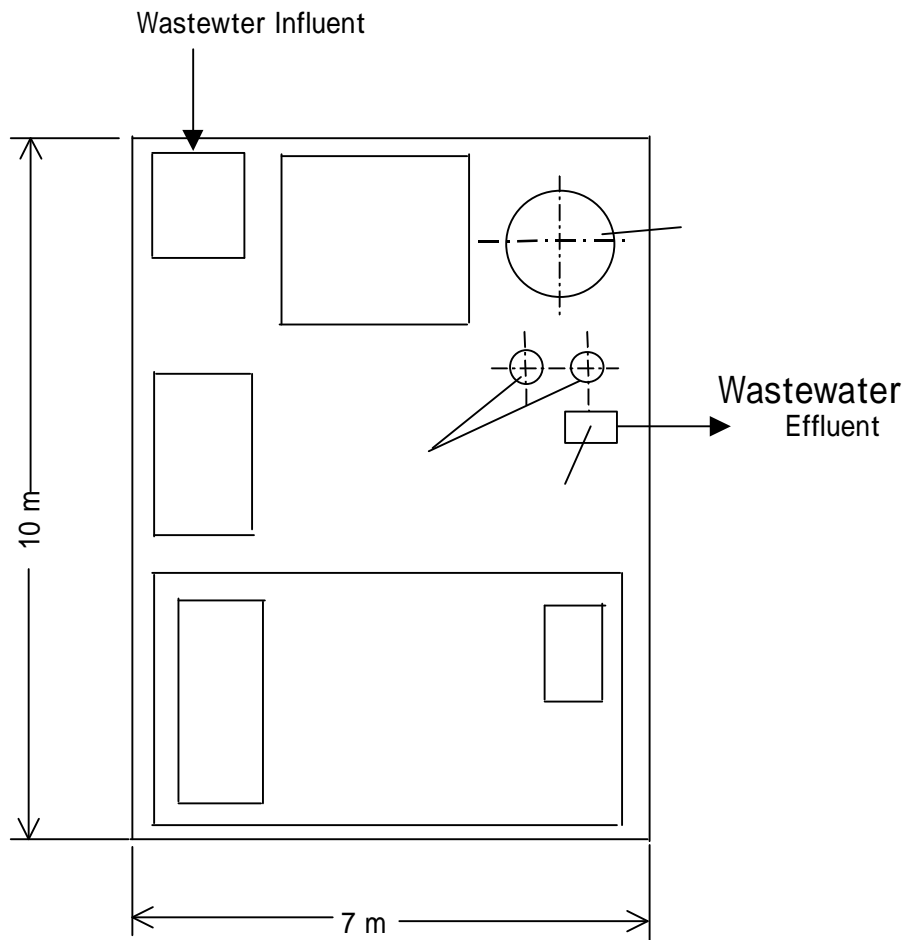
Figure 4 Flow Sheet

(2) Main Equipment List

Table 8 Main Equipment List

Name of Equipment	No. of Req'd	Remarks
Pump Pit	1	1m ³ , RC
Wastewater Pump	2	Submerged, 0.08m ³ /min 0.4kw
Screen	1	1mm mesh
Equalization Tank	1	10m ³ , RC, 2.5m * 2.5m * 2m depth
Transfer Pump	2	Volute, 0.015m ³ /min 0.2kw
Cr ⁺⁶ Reduction Tank	1	1.3m ³ , Steel (Resin Lining), Mixer
Neutralization Tank	1	0.6m ³ , Steel (Resin Lining), Mixer
Coagulation Tank	1	0.2m ³ , Steel (Resin Lining), Mixer
Sedimentation Tank	1	1.2m dia. 2.5m ³ , Corn Bottom, Steel
Chlorination Tank	1	0.2m ³ , RC
Chlorinator	1	Hypochlorinator
Chemical Dosing	1set	Sodium Sulfite Tank and Feed Pumps Sulfuric Acid Tank and Feed Pumps Caustic Soda Tank and Feed Pumps Sodium Hypo. Tank and Feed Pumps PAC Tank and Feed Pumps
Control Building	1	4mW * 6mL Steel Slated

(3) Plot Plan



- Pump Pit
- Equalization Tank
- Reaction Tanks
- Cr⁺⁶ Reduction Tank
- Neutralization Tank
- Chemical Dosing Equipments
- Sedimentation Tank
- Sand Filters
- Chlorination Tank
- Electrical Panel
- Control Building

Figure 5 Plot Plan

(4) Required Cost

The rough estimated cost is about 370 million VND.

6 Recommendations for Improvement

6.1 Short Term Countermeasures

(1) Investigation for Future Direction

It is not feasible to install a water treatment unit in the Company because they have a very small plating shop. So, it is better to consolidate the plating shop and its employees with other plating shops that already have a water treatment unit. Plating work orders shall be placed with the consolidated plating company.

(2) Operational Improvements

- 1) Improvement of the working environment through good shop floor arrangement and cleaning
- 2) Ascertainment of improvement points by utilizing a Break Even Point Chart
- 3) Proceed with Cleaner Production Activities

(3) Investigation of Water Treatment Unit

6.2 Mid and Long Term Countermeasures

(1) Replacement of the Plating Facility and Employees

According to structural improvements the company will make, the plating work orders shall be sent outside the company. If this is done, there will not be any industrial waste water pollution problems in the company.

(2) Expansion of Mechanical Processing, Painting and Assembling

Characteristic processes, like painting, need to be expanded if plating orders are outsourced. Government instruction and/or promotion of expansion of the characteristic processes is very important.

(3) Installation of a Water Treatment Unit

It is recommended that a neutralization unit for waste water discharged from the painting shop be installed.

6.3 Implementation Schedule and Future Image

The implementation schedule plan is shown in Figure 6. The plan needs to be reviewed and discussed with the central government and local government.

Activity	2000-2001	2002-2005	Future Image
1. Investigation of Future Plans			A non-polluting company without a plating shop A traditional company with an efficient painting process A profitable company that produces machines related to the agricultural field
2. Operational Improvements			
3. Investigation for Water Treatment Unit			
4. Transference of Plating Shop			
5. Expansion of Painting Process			
6. Installation of Neutralization Unit			

Figure 6 Implementation Schedule Plan and Future Image

Tu Son Standard Parts Factory

Survey Date: 15 December 1999
9, 10 & 13 March 2000

1. General**1.1 Profile**

Tu Son Standard Parts Factory is a state-owned company that was established in 1963 as a standard parts manufacturing company. The company profile is summarized in Table 1 and Figure 1.

Table 1 Company Profile

Name of Company	Tu Son Standard Parts Factory
Ownership	State-owned
Address	Tu Son Town, Tien Son District, Ha Bac Province
Tel	01-24-3163
Established	1963
Number of Employees	357
Area	50,000 m ²
Main Products	Various kind of Bolts and Nuts

1.2 Business Status**1.2.1 Production**

Table 2 shows production and sales of the company in 1998.

Table 2 Production and Sales of the Company in 1998

Item	Unit	Design capacity	Production	Turnover (US\$)
Bolt M5-M16	Ton/year	105	49	
Nut M5-M16	Ton/year	160	71	
Fine bolt M12-M48	Ton/year	555	278	
Fine nut M12-M48	Ton/year	190	93	
Screw	Ton/year	50	25	
Bolt and Nut	Ton/year	150	72	
Foundation Bolt	Ton/year	130	63	
Total	Ton/year	1,340	651	1,150,200

1.2.2 Debt

From the Bank : 200,000 US\$

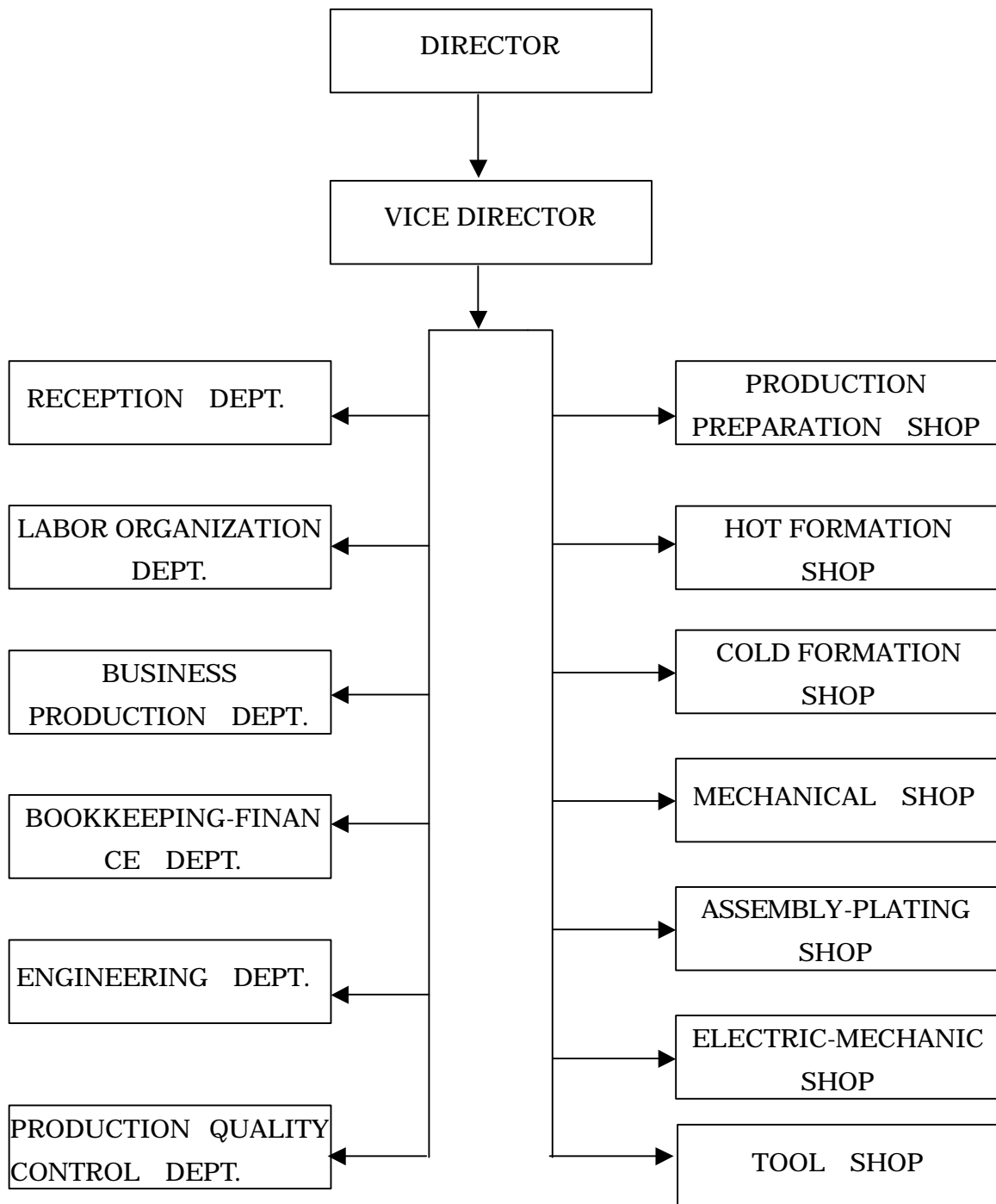


Figure 1 Organization of the Company

2. Production Technology

2.1 Plating Process for Bolts, Nuts and Washers

The plating process for bolts, nuts and washers is shown in Figure 2.

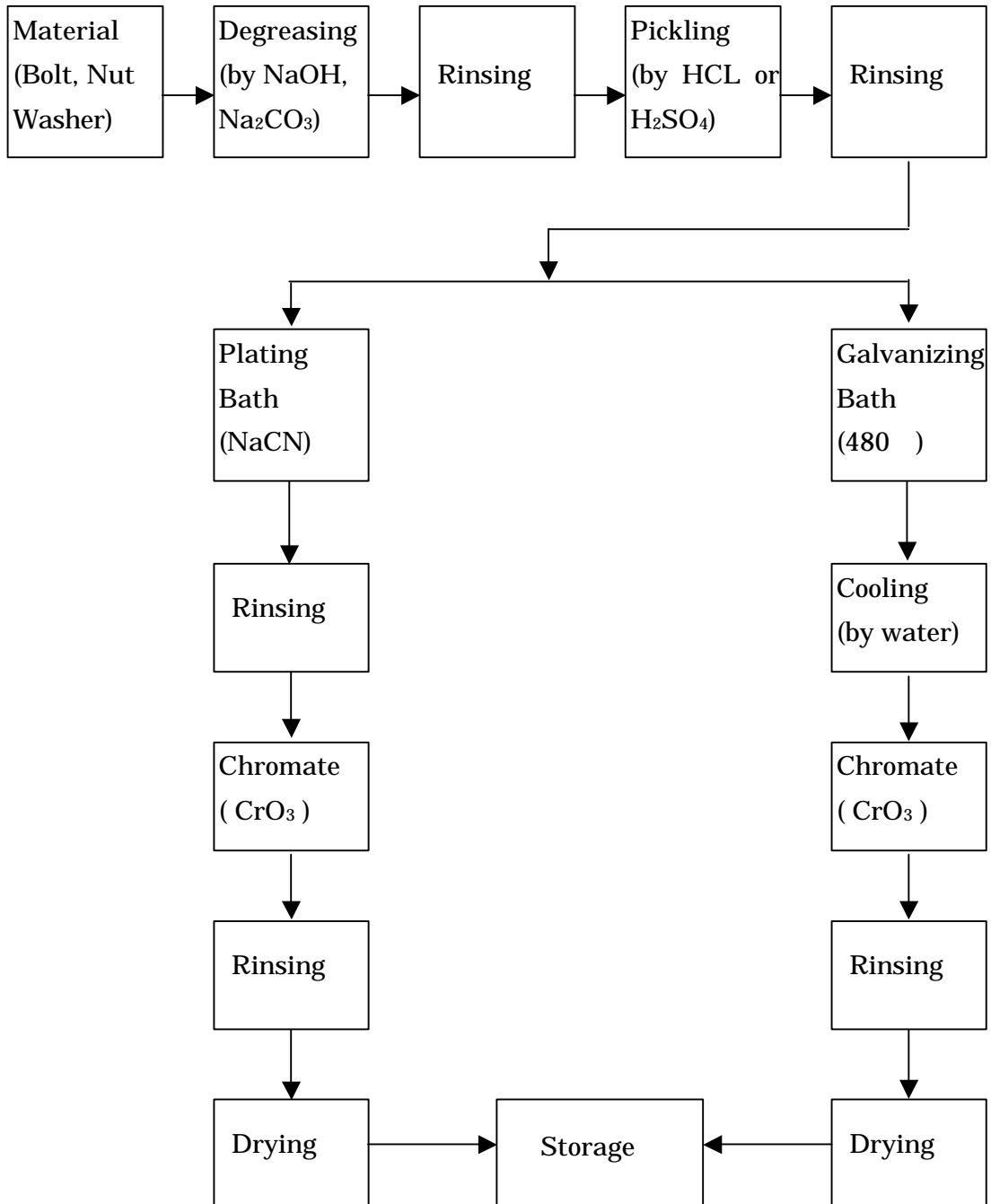


Figure 2 Plating Process for Bolts, Nuts and Washers

2.2 Quality Control Procedure

The quality control procedure of the company is shown in Figure 3.

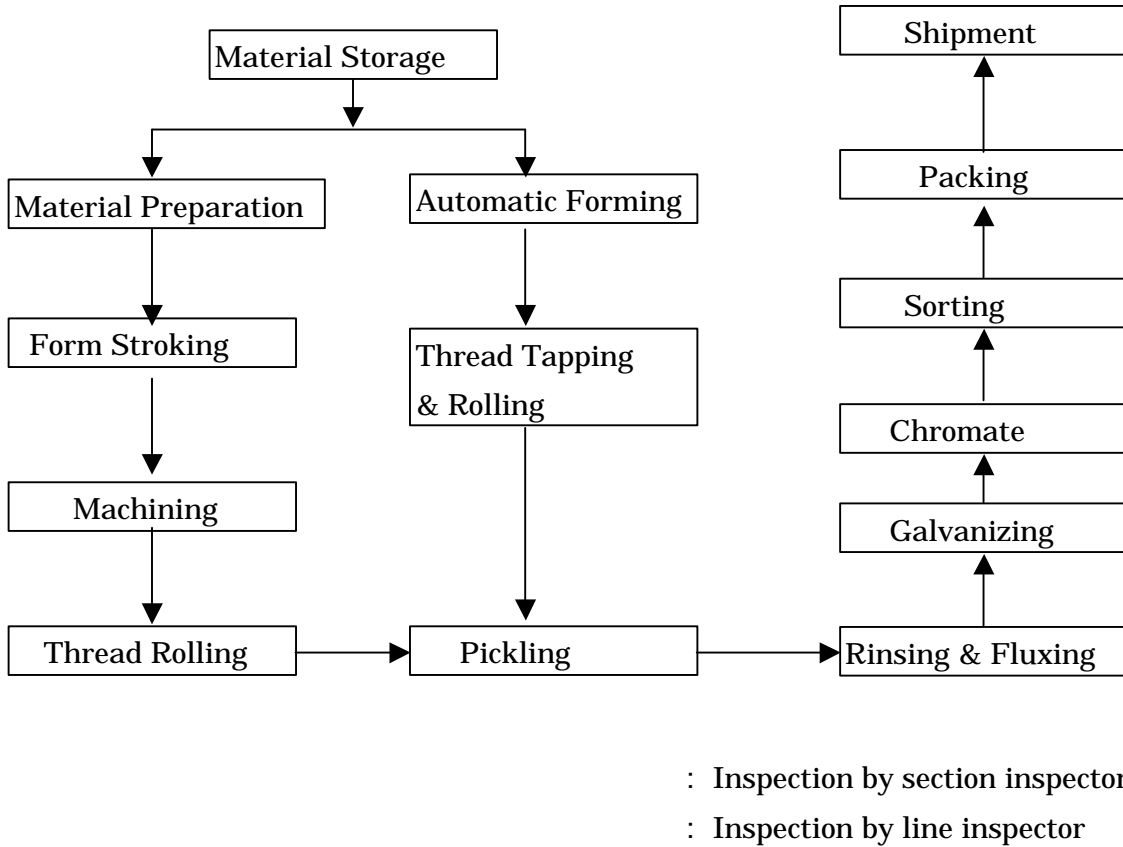


Figure 3 Quality Control Procedure

3. Management Technology

The company is a specialized company in bolts and nuts manufacturing. In terms of plating work, mainly Zn plating is performed in the company. Being “specialized” is beneficial for plating. It was decided by Management and General Director that Zn plating will be consolidated in the company. Already a new plating shop has been constructed and a part of the shop is in operation.

4. Industrial Waste Water

Almost all industrial waste water of the company is discharged from the plating shop.

4.1 Drainage System of the New Plating Shop

The drainage system of the new plating shop is shown in Figure 4.

4.2 Waste Water Quality

Waste water samples were taken in this study.

4.2.1 Sampling on 15 December 1999

The results of quality analysis of the samples are summarized in Table 3.

Table 3 Waste Water Quality (15 December 1999)

Item	Unit	Zn(CN) Plate Out	Acid wash Out	Hot dip Zn Out	Final	TCVN
Flow rate	m ³ /day					
pH		10.4	2.14	3.79	6.75	5.5-9
Oil	mg/l	0.17	0.24	trace	0.22	1or10
BOD	mg/l	14.9	27.3	34.2	17.4	50
COD	mg/l	136.2	192.4	188.6	89.8	100
Cyanide	mg/l	0.02	0.01	0.03	0.43	0.1
Fe	mg/l	0.12	4.28	10.2	0.48	5.0
Zn	mg/l	1.4	1.28	0.91	2.7	2.0
Cr ⁺⁶	mg/l	0.082	0.007	0.018	trace	0.1
Ni	mg/l	0.066	0.083	0.025	0.008	1.0
Pb	mg/l	0.045	0.945	0.135	0.023	0.5

4.2.2 Sampling on 10 March 2000

The results of quality analysis of the samples are summarized in Table 4.

Table 4 Waste Water Quality (10 March 2000)

Item	Unit	Zn(CN) Plate Out	Zn(CN) Rinse Tank inside	New Plating Shop Out	TCVN
Flow Rate	m ³ /day	10			
pH		9.95	8.2	2.8	5.5-9
Oil	mg/l	0.18	trace	trace	1or10
BOD	mg/l				50
COD	mg/l	68.2	113.2	61.2	100
Cyanide	mg/l	0.213	0.01	0.02	0.1
Fe	mg/l	2.65	0.56	3.5	5.0
Zn	mg/l	2.35	1.09	1.02	2.0
Cr ⁺⁶	mg/l	(0.43)	(0.025)	(0.59)	0.1
Ni	mg/l	2.17	1.45	2.26	1.0
Pb	mg/l	trace	trace	0,54	0.5

* () shows total Cr.

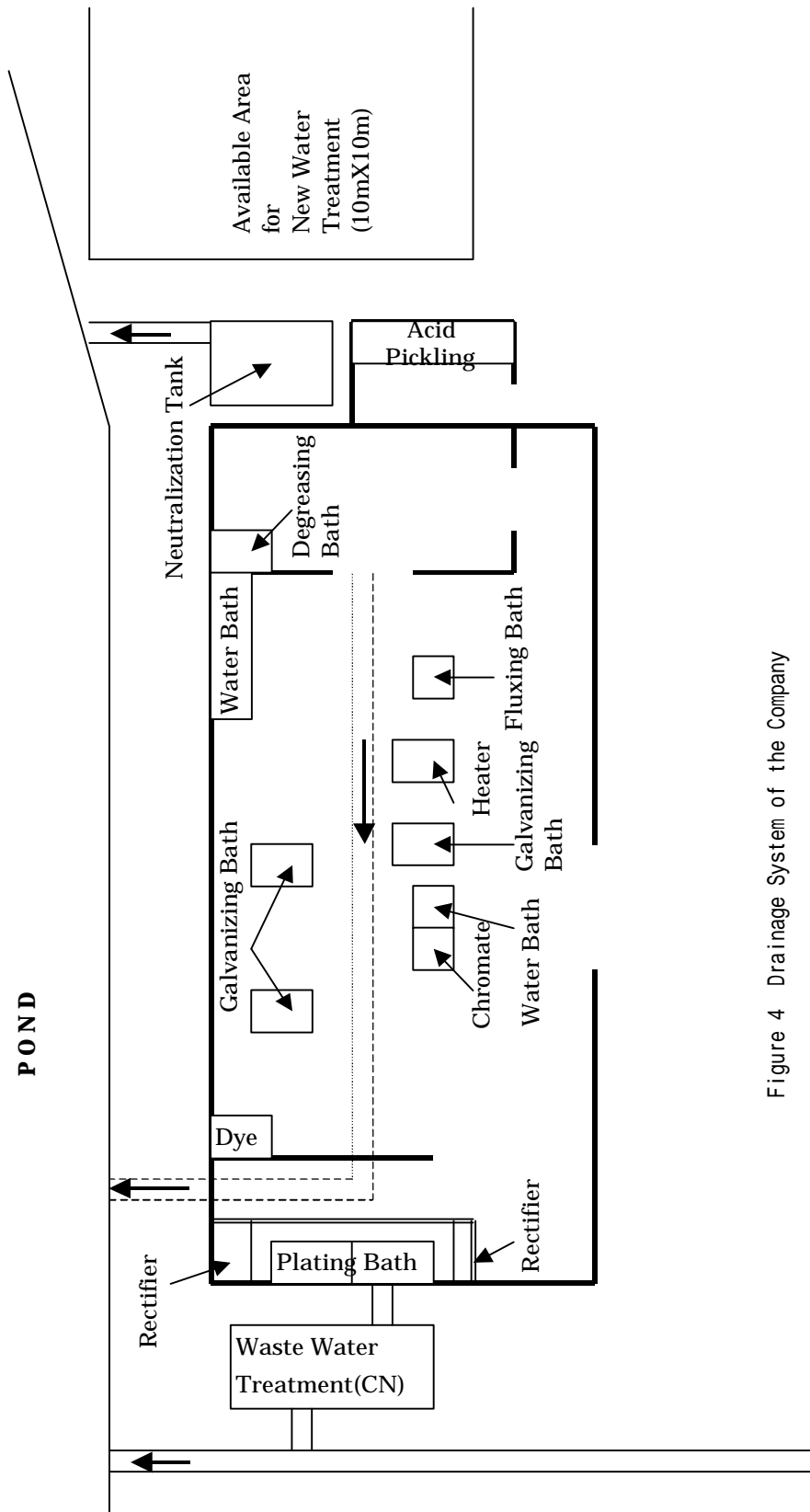


Figure 4 Drainage System of the Company

5. Countermeasures for Industrial Waste Water Pollution Prevention

5.1 Present Problems

At present, the main problems of the company are as follows:

- (1) Investigation for Future Direction
- (2) Operational Problems
 - 1) The working environment of the shops
 - 2) The rinsing process after plating
 - 3) Transportation of heavy goods
- (3) Water Treatment

5.2 Improvement Points for Production Technology

5.2.1 Investigation for Future Direction

The company is constructing a new plating shop. The company and the upper management are planning to make plating intensive shop in the company. It seems to be a very good improvement plan, so the plan should be completed. If possible, the new plating shop should be made into an independent plating company. This is because an independent plating company may have a higher possibility for development than a plating shop belonging to a mechanical manufacturer. The future direction of the company needs to be investigated and decided through full discussions with the concerned authorities.

5.2.2 Operational Improvement

The new plating shop needs to be operated under improved conditions. Main improvement points are as follows:

- (1) Improvement of the working environment through good shop floor arrangement and cleaning

Nothing should be placed directly on the floor. Various tanks which have been placed on the floor, need to be put on movable carts, so the layout can be arranged according to the job flow. Unnecessary materials in the shop need to be taken out. The walk way needs to be clearly painted. Making work easy brings about high productivity and high quality, which makes for increased business chances.

- (2) Application of the multi-rinsing method

Introduction of a multi- rinsing method can reduce a large amount of rinsing

water. High content electrolytes in the first rinsing tank can also be recycled to a plating bath. This means that the application of this method can reduce harmful effluent discharged from the plating process.

(3) Introduction of Transportation Machines

High productivity can be achieved by introducing transportation machines such as a hoist, a jib-crane, a spring balancer etc. This can also lead to future automation.

5.2.3 Investigation on Water Treatment Unit Installation

A water treatment unit is indispensable for the new plating shop. It is also important that the operating technology of the water treatment unit be transferred to company employees. A water treatment unit which meets the goals of the future direction of the company, needs to be investigated.

5.3 Waste Water Treatment

According to the results of waste water quality analysis, it is necessary to introduce a waste water treatment unit. The conceptual design of a waste water treatment unit was carried out in this Study and is summarized as follows:

5.3.1 Design Basis

(1) Amount of Waste Water

- CN contained waste water : 10 m³/day
- Other industrial waste water : 30 m³/day
- Total : 40 m³/day

(2) Waste Water Quality

Table 5 Waste Water Quality

Item	Unit	CN contained	Other waste	TCVN5945
pH		10.4	2.8	5.5-9
Oil	mg/l	0.18	0.24	1or10
BOD	mg/l	14.9	30.8	50
COD	mg/l	136.2	61.2	100
Cyanide	mg/l	0.213	0.02	0.1
Fe	mg/l	2.65	3.5	5.0
Zn	mg/l	2.35	1.02	2.0
Cr ⁺⁶	mg/l	0	0	0.1
Ni	mg/l	0	0	1.0
Pb	mg/l	trace	0.54	0.5

5.3.2 Conceptual Design

(1) Flow Sheet

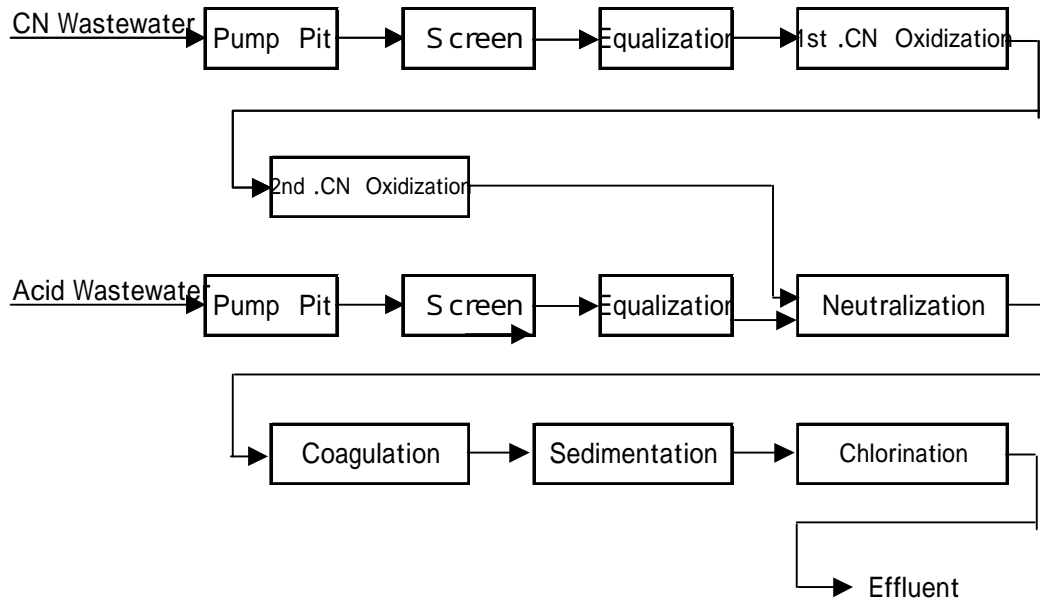


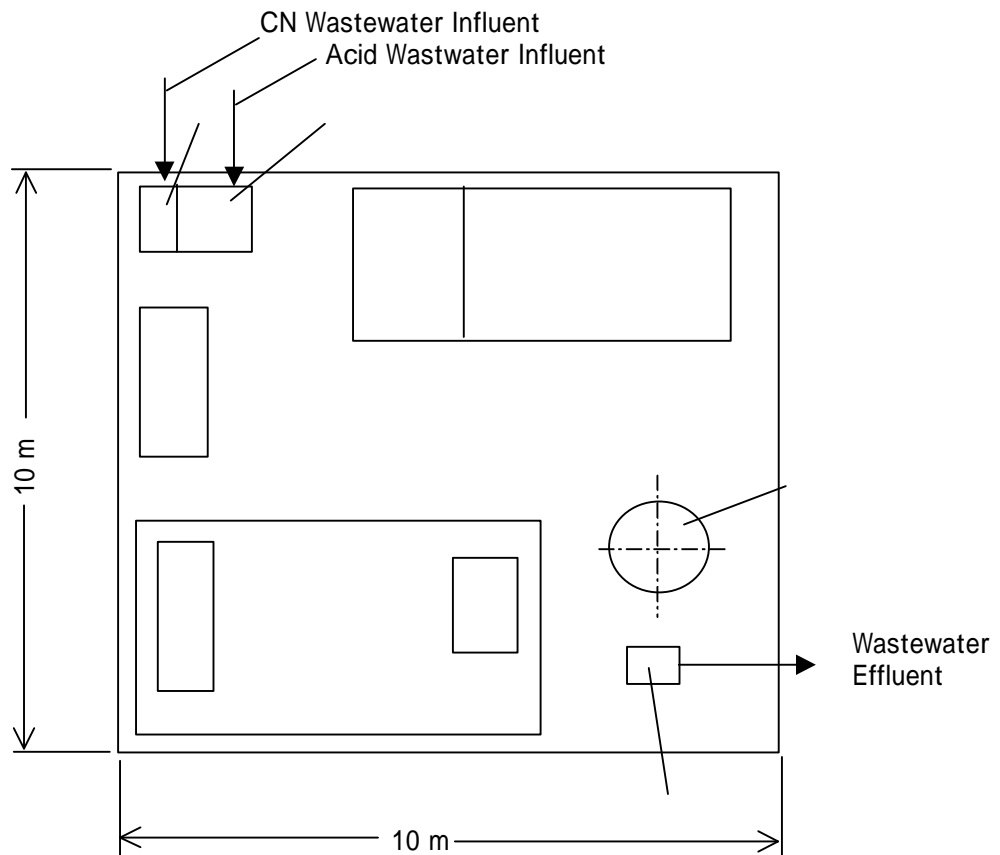
Figure 5 Flow Sheet

(2) Main Equipment List

Table 6 Main Equipment List

Name of Equipment	No. of Req'd	Remarks
Pump Pit for CN WW	1	0.4m ³ , RC
Pump Pit for Acid WW	1	1m ³ , RC
Wastewater Pump for Acid WW.	2	Submerged, 0.05 m ³ / min 0.4kw
Wastewater Pump for CN WW.	2	Submerged, 0.13 m ³ / min 0.75kw
Screen	2	1mm mesh
Equalization Tank for CN WW	1	7 m ³ RC, 8m dia 3.5m depth
Equalization Tank for Acid WW	1	20 m ³ RC, 8m dia 3.6m depth
Transfer Pump for CN WW	2	Volute, 0.007 m ³ / min 0.2kw
Transfer Pump for Acid WW	2	Volute, 0.022 m ³ / min 0.2kw
1st. CN Oxidation Tank	1	0.8m ³ , Steel (Resin Lining), Mixer
2st. CN Oxidation Tank	1	0.8m ³ , Steel (Resin Lining), Mixer
Neutralization Tank	1	1.74m ³ , Steel (Resin Lining), Mixer
Coagulation Tank	1	0.4m ³ , Steel (Resin Lining), Mixer
Sedimentation Tank	1	1.6m ³ , dia. 6m ³ , Corn Bottom, Steel
Chlorination Tank	1	0.4m ³ , Steel
Chlorinator	1	Hypochlorinator
Chemical Dosing	1set	Sulfuric Acid Tank and Feed Caustic Soda Tank and Feed PAC Tank and Feed Pumps Sodium Hypo. Tank and Feed
Control Building	1	4mw * 6mL Steel Slated

(3) Plot Plan



- Pump Pit for CN Wastewater
- Pump Pit for Acid Wastwater
- Equalization Tank for CN WW
- Equalization Tank for Acid WW
- Reaction Tanks
- CN Oxidation Tanks, Neutralization Tank
- Chemical Dosing Equipments
- Sedimentation Tank
- Chlorination Tank
- Electrical Pannel
- Control Building

Figure 6 Plot Plan

(4) Required Cost

The rough estimated cost is about 550 millionVND.

6 Recommendations for Improvement

6.1 Short Term Countermeasures

(1) Investigation for Future Direction

The company is constructing a new plating shop. If possible, the new plating shop should be made into an independent plating company. This is because an independent plating company may have a higher possibility for development than a plating shop belonging to a mechanical manufacturer.

(2) Operational Improvement

- 1) Improvement of the working environment through good shop floor arrangement and cleaning
- 2) Application of multi-rinsing method
- 3) Introduction of transportation machines

(3) Investigation on Water Treatment Unit Installation

6.2 Mid and Long Term Countermeasures

(1) Promotion of an Independent Plating Company

It is recommended that an independent plating company, which is consolidated from surrounding state-owned companies' plating shops and utilizes their employees, be established. Tu Son Standard Parts Factory must make it's living as a bolt and nut manufacturer.

(2) Profit Improvement by Scale Enlargement

Both companies must enlarge their businesses and profits by concerning on their specialities.

- 1) Application of a Break Even Point Chart
- 2) Promotion of Cleaner Production Activities

(3) Installation of a Water Treatment Unit

The new plating company must have a complete water treatment unit. If full utilization of the water treatment unit is necessary, waste water treatment should be performed at surrounding companies. For that purpose, the company must have sufficient technology on water treatment.

6.3 Implementation Schedule and Future Image

An implementation schedule plan is shown in Figure 7. The plan must be discussed and reviewed with the central government and local government.

Activity	2000-2001	2002-2005	Future Image
1. Investigation of Future Plans			Non-polluting company An independent, competitive company that specializes in plating A profitable company that performs Zn plating
2. Operational Improvements			
3. Investigation for Water treatment			
4. Establishment of Plating Company			
5. Perform Profit Improvement			
6. Installation of Water Treatment Unit			

Figure 7 Implementation Schedule Plan and Future Image

Export Mechanical Tools Company

Survey Date: 19 November 1999

1. General**1.1 Profile**

Export Mechanical Tools Company is a SOEs that was established in 1960 as a mechanical tools and parts manufacturing company. The company will be a publicly traded enterprise from the year 2000. The company profile is summarized in Table 1.

Table 1 Company Profile

Name of Company	Export Mechanical Tools Company
Ownership	State-owned
Address	229 Tay Son Street. Hanoi
Tel	8533017/8534135
Established	1960
Number of Employees	630
Area	24,660 m ²
Main Products	Hand held tools, Spare parts for motorcycles, Medical equipment

1.2 Business Status**1.2.1 Production**

Table 2 shows production and sales of the company in 1998.

Table 2 Production and Sales in 1998

No	Item	Unit	Production	Turnover(million VND)
1	Motorcycle Parts	set	219,975	10,321.70
2	Hand Held Tools	piece	685,075	5,353.40
3	Others			8,250.20
	Total			23,925.30

1.2.2 Debt

From the Bank of Investment: 500 million VND

From the State Bank of Vietnam: 400 million VND

2. Production Technology

2.1 Process

The overall block flow diagram is shown in Figure 1

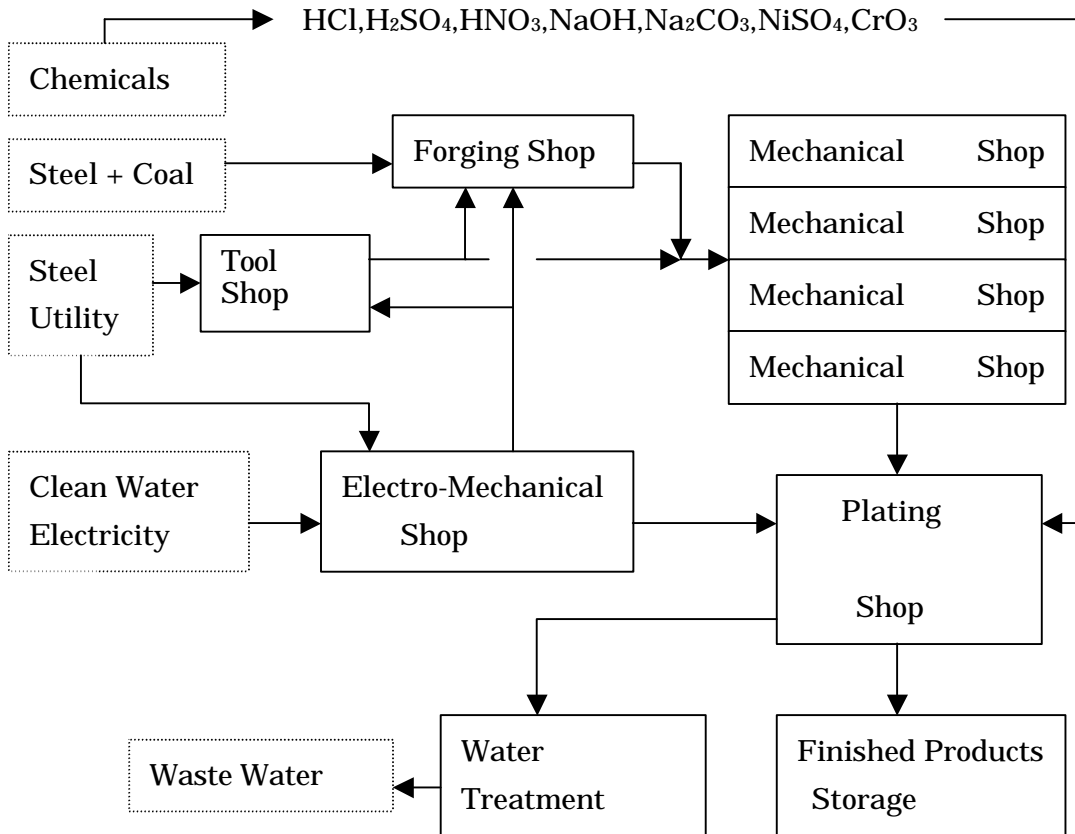


Figure - 1 Block Flow Diagram of The Company

2.2 Main Raw Materials and Utility Consumption

Table 3 Main Raw Materials and Utility Consumption

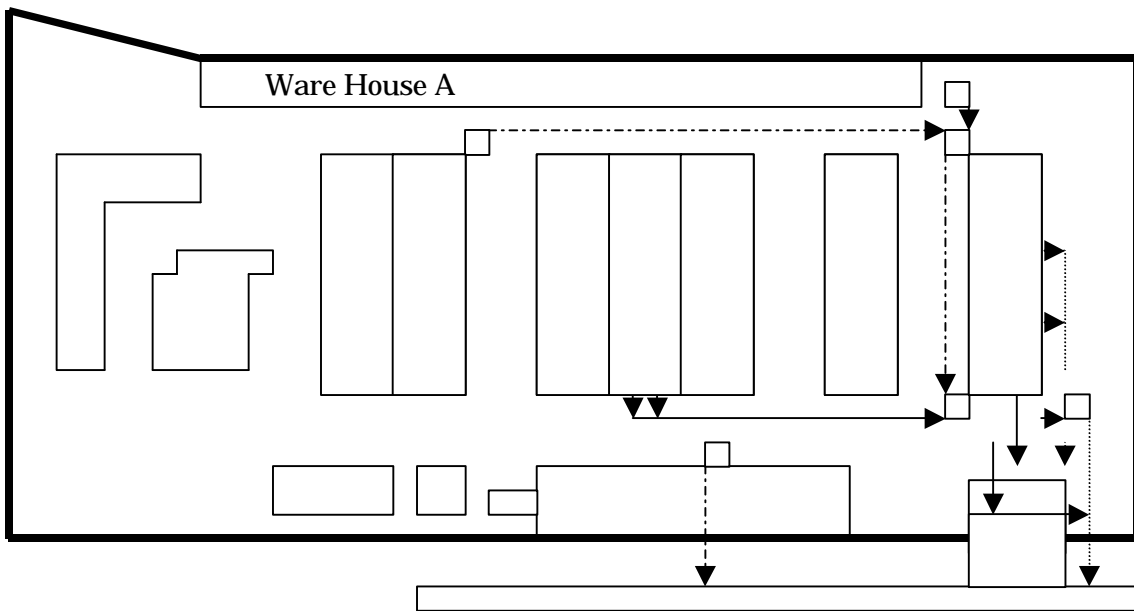
Material	Unit	Amount	Unit Price (VND)	Total Price (million VND)
Steel	kg	306,500		1,683.80
Alloy Steel	kg	27,500		804.00
Chemicals	kg	46,820		197.45
Coal	t	360	720	259.20
Electric Power	kWh	1,596,060	840	1,340.30
City Water	m ³	12,831	3,000	38.50
Well Water	m ³	74,800	450	33.70
Others				398.92
Total				4,755.87

3. Management Technology

The company maintains a good status for information control and shop management.

4. Industrial Waste Water

4.1 Drainage System of the Company



- Legend:
- Administration section
 - Heat Treatment Shop
 - Mechanical Shop No.1
 - Tool/ Electromechanical Shop
 - Mechanical Shop N0.2
 - Mechanical Shop No.3
 - Mechanical Shop No.4
 - Forging Shop
 - Plating Shop
 - Water Treatment Station
 - Waste water containing Cr
 - Waste water containing Ni
 - Waste water containing Acid

Figure 2 Drainage System of the Company

4.2 Waste Water System

There are 2 waste water systems.

4.2.1 Domestic use wastewater from Mechanical Shops + Forging Shop + Rain water :

Runs into the city drainage.

4.2.2 Wastewater from the Plating Shop :

Is divided into four sources and passes through a water treatment station which was installed by CEETIA in 1997.

- 1) Waste water containing Cr : Passes through the water treatment station.
- 2) Waste water containing Ni : Same as above 1).
- 3) Waste water containing Acid : Flows into a tank used in the water treatment system.
- 4) The remaining waste water from the Plating Shop : Flows into the common drainage system.

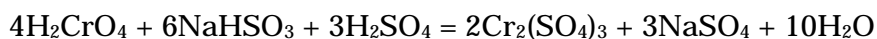
4.3 Water Treatment Station

4.3.1 Mode of Operation :

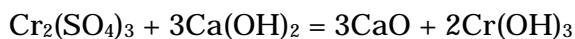
Continuous rate of treatment depending on operation of the two plating systems (Cr and Ni). The treatment rate is high if there are a lot of products being plated.

4.3.2 Treatment method :

The following reaction will happen when $\text{pH} < 2.5$



The following reaction will happen when $\text{pH} > 9.5$ (using Calcium powder)



The precipitated substance goes down to the bottom and is discharged into the mud tank.

Table 4 Previous Analysis Results of Waste Water (June 1999)

Item	Unit	TCVN-5945	Before	After	Company
pH		5.5-9	7.36	7.8	7.8
COD	mg/l	100	12.8	12.8	17.5
Fe ⁺³	mg/l	5	0.07	4.0	3.4
SS	mg/l	100	1.0	43	47
Total NG	mg/l	60	25	7.2	19.5
CN	mg/l	0.1	0.390	0.005	0.005
Cr ⁶⁺	mg/l	0.1	20.0	0.128	0.07
Cr ³⁺	mg/l	1.0	<0.002	0.005	0.005
Ni	mg/l	1.0	<0.001	0.21	1.05
Pb ⁺²	mg/l	0.5	<0.002	0.015	0.001
Zn	mg/l	2	0.092	0.32	0.25

4.4 The company's tentative methods for reducing industrial wastewater

- (1) Make a floating cover for the Ni-Cr plating tanks in order to limit the open surface of the solution and reduce it's rate of evaporation.
- (2) Reduce the amount of spilled plating solution that occurs when lifting parts out of the tank.
- (3) Regularly inspect the wastewater system in order to maintain a high level of prevention of environmental pollution.
- (4) Regularly analyze waste water of the treatment station in every 6 months to maintain the effectiveness of the station.

4.5 Waste Water Analysis Results of the Survey Team Sampled on Nov.19, 1999

Waste water analysis results which were analyzed from samples taken by the Survey Team , are shown in Table 5.

Table 5 Waste Water Analysis Results (Nov.19, 1999)

Sampling place	Unit	Cr waste water	After Treat.	Other Waste	Final Discharge	TCVN 5945
Flow Rate	m ³ /h				260	
Temperature	°C	24.3	23	23.7	23.1	
pH		5.85	5.77	8.1	6.9	5.5~9
Electric Conductivity	μS/cm	650	240	750	1850	
Turbidity	NTU	51	17	54	293	
Oil content	mg/l	0	0	trace	trace	1or10
BOD	mg/l	7.09	5.32	6.74	4.61	50
COD	mg/l	28	38.2	45.6	135	100
DO	mg/l	5.06	2.78	2.56	4.62	
SS	mg/l	52.1	18.9	59.3	312.5	100
Cyanide	mg/l	0.39	0.05	0.41	0.59	0.1
Cu	mg/l	1.29	2.27	0.27	2.16	1
Fe	mg/l	0.01	2.45	0.78	0.87	5
Zn	mg/l	0.41	0.05	0.09	0.21	2
Pb	mg/l	0.015	trace	trace	0.015	0.5
Cr-total	mg/l	2.62	0.045	0.632	0.231	1
Ni	mg/l	2.3	3.42	5.28	12.5	1

5. Improvement Proposals

Basically the company has a very good status. The company is operating a water treatment system, and waste water is systematically separated.

The company's tentative methods for reducing industrial wastewater which were described in section 4.4, are very important improvement items, so they must be proceeded with. There are some differences between the previous analysis results and the survey team's analysis results. The figures of the latter one are bad. This means that there may be some abnormal operating conditions in the water treatment system. So, the water treatment system must be operated under good management.

Hanoi Mechanical Company

Survey Date: 22 November, 1999

1. General**1.1 Profile**

Hanoi Mechanical Company is a state-owned company that was established in 1958 as a machine and mechanical parts manufacturing company. The company profile is summarized in Table 1.

Table 1 Company Profile

Name of Company	Hanoi Mechanical Company
Ownership	State-owned
Address	24 Nguyen Trai Street, Hanoi
Tel	8584475/8584416
Established	1958
Number of Employees	1150
Area	120,000 m ²
Main Products	Machine tools, Plant and factory use Machinery, Mechanical parts

1.2 Business Status**1.2.1 Production**

Table 2 shows production and sales of the company in 1998.

Table 2 Production and Sales in 1998

No.	Item	Unit	Production	Turnover(million VND)
1	Machine Tools & Accessories	Piece	170	5,399
2	Machinery & Industrial Accessories		-	47,956
3	Fabricated Steel	Ton	3,400	13,276
	Total			66,631

1.2.2 Debt

No information.

2. Production Technology

2.1 Process

They use a self-made technological flow for their mechanical products (machinery, equipment, machine parts). The flow goes from materials, casting, metal works, heat-treatment, assembling and finishing operations. The block flow sheet is shown in Figure 1.

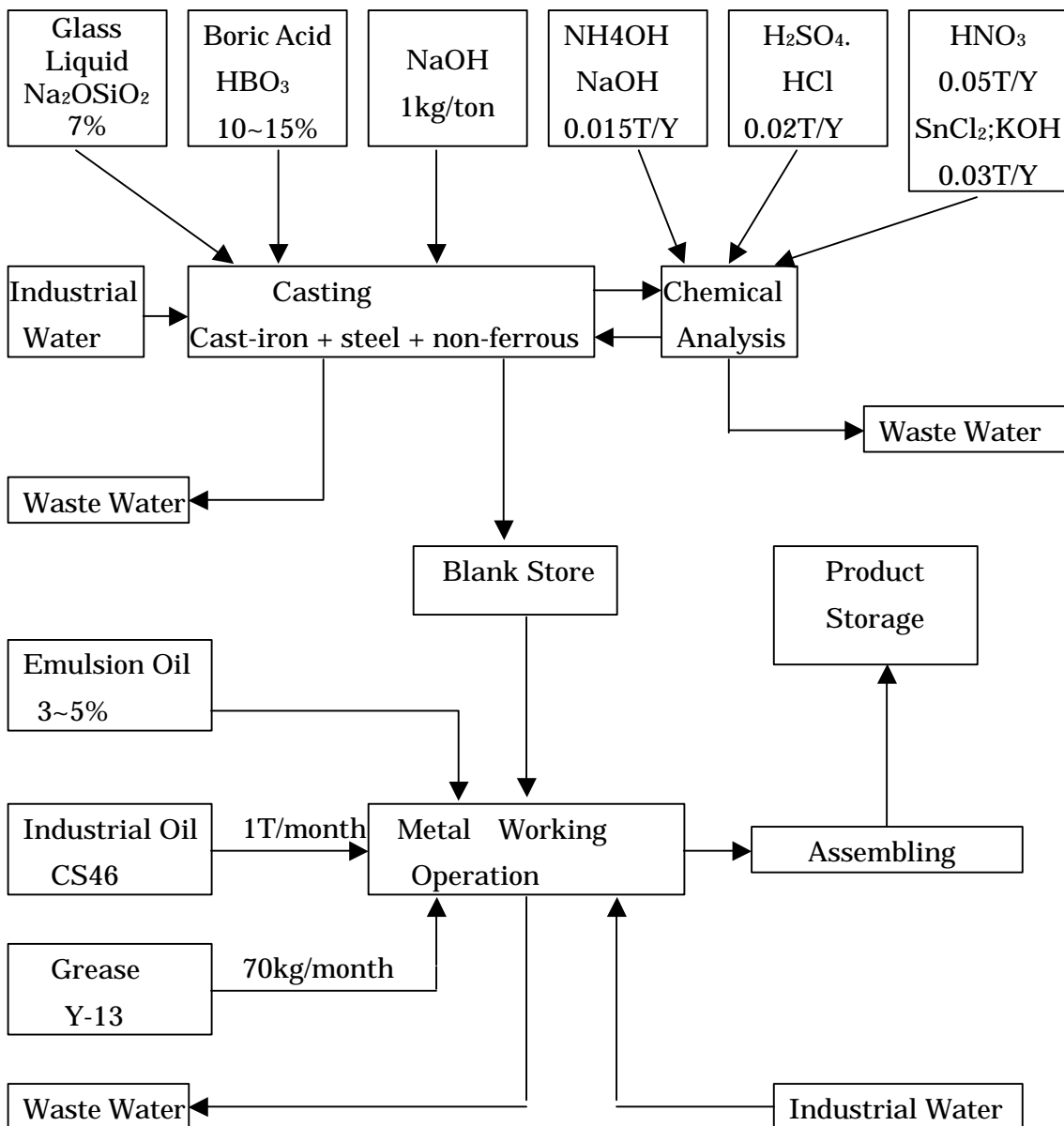


Figure 1 Block Flow

3. Management Technology

The company has a good management system which is based on ISO9000 and they also, apply the 5S activity. The shops are actually managed in good condition.

4. Industrial Waste Water

4.1 Drainage System of the Company

Industrial waste water is discharged from the iron-casting shop, the steel-casting shop, chemical analysis process and the machine shop. The wastewater is gathered and discharged into a river.

4.2 Waste Water Analysis Results

Waste water analysis results, which were analyzed using samples taken by the Survey Team, are shown in Table 3.

Table 3 Waste Water Analysis Results (Nov.22, 1999)

Sampling Place	Unit	Iron-casting waste water	Steel-casting waste water	Final discharge	TCVN
Flow Rate	m ³ /h			200	
Temperature	°C	25.1	21.8		
pH		7.61	7.55		5.5~9
Electric Conductivity	μS/cm	755	636		
Turbidity	NTU	113	43		
Oil content	mg/l	0.05	0.02		1or10
BOD	mg/l	137.8	106.6		50
COD	mg/l	181.2	178.1		100
SS	mg/l	126	52		100
Cyanide	mg/l	0.29	0.08		0.1
Cu	mg/l	0.03	0		1
Fe-total	mg/l	0.81	0.47		5
Zn	mg/l	0.81	0.47		2
Pb	mg/l	0.68	0.177		0.5

* Steel-casting waste water data indicates the quality of the river water which is used for cooling water in the process.

5. Improvement Proposals

According to the wastewater analysis result, improvement proposals are as

follows:

- 1) The cooling water source for the steel-casting process must be changed to another source such as city water or well water.
- 2) The reason for high BOD and COD levels need to be investigated.
- 3) Then, if high BOD and COD levels are unavoidable, it is recommended that a biological water treatment unit be installed.

Quang Trung Mechanical Company

Survey Date: 23 November, 1999

1. General**1.1 Profile**

Quang Trung Mechanical Company is a state-owned company that was established in 1962 as the first company in light industry in Viet Nam. The company profile is summarized in Table 1.

Table 1 Company Profile

Name of Company	Quang Trung Mechanical Company
Ownership	State-owned
Address	Gai Phong Road (6 th Km)
Tel	8642215
Established	1962
Number of Employees	230
Area	44,000 m ²
Main Products	Pressure vessels (Boiler, Tank etc), Steel shaping, Factory use machines (Paper, Dust treatment etc.)

1.2 Business Status**1.2.1 Production**

Table 2 shows production and sales of the company in 1998.

Table 2 Production and Sales in 1998

Item	Production	Turnover (million VND)
1. Mechanical products - Mechanical accessories - Pounder and paper rolling machines	350 Tons	7,031
2. Boilers - Vessels for pressurized gas - Dust filter and absorbing systems		
3. Steel structure products		

1.2.2 Debt

From the State Bank of Viet Nam: 176 million VND

2. Production Technology

2.1 Process

The overall block flow diagram is shown in Figure 1.

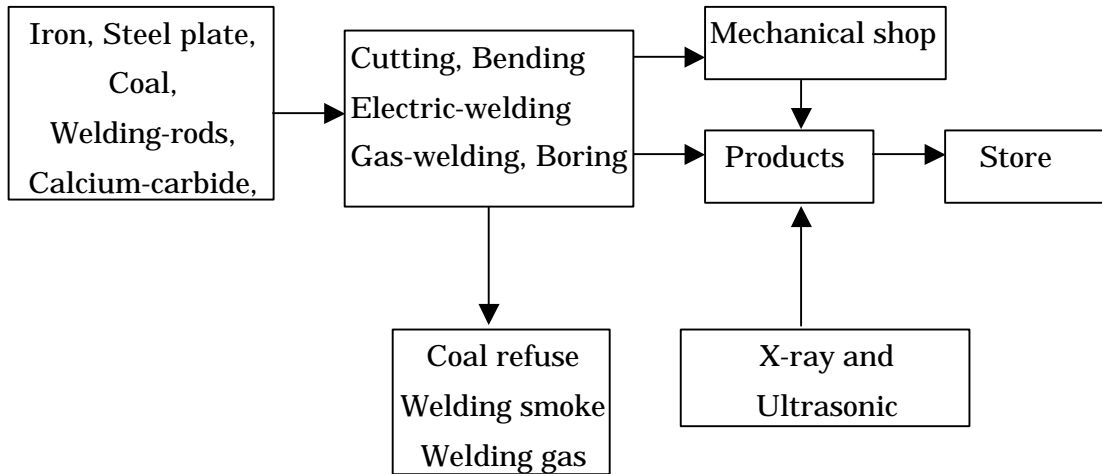


Figure 1 Block Flow Diagram of the Company

2.2 Utility Consumption

Table 3 Utility Consumption

Material	Unit	Consumption	Total Price (million VND)
Welding rod	Ton	3.5	35.0
Water	m ³	500	1.5
Lubricant	Ton	1.5	1.5
Coal	Ton	1.5	0.9
Electric power	Kwh	27,600	25.46

3. Management Technology

The management level is not so high. The first step that need to be taken is to arrange in a better working order of each shop.

4. Industrial Waste Water

4.1 Drainage System of the Company

Figure 2 shows the drainage system of the company.

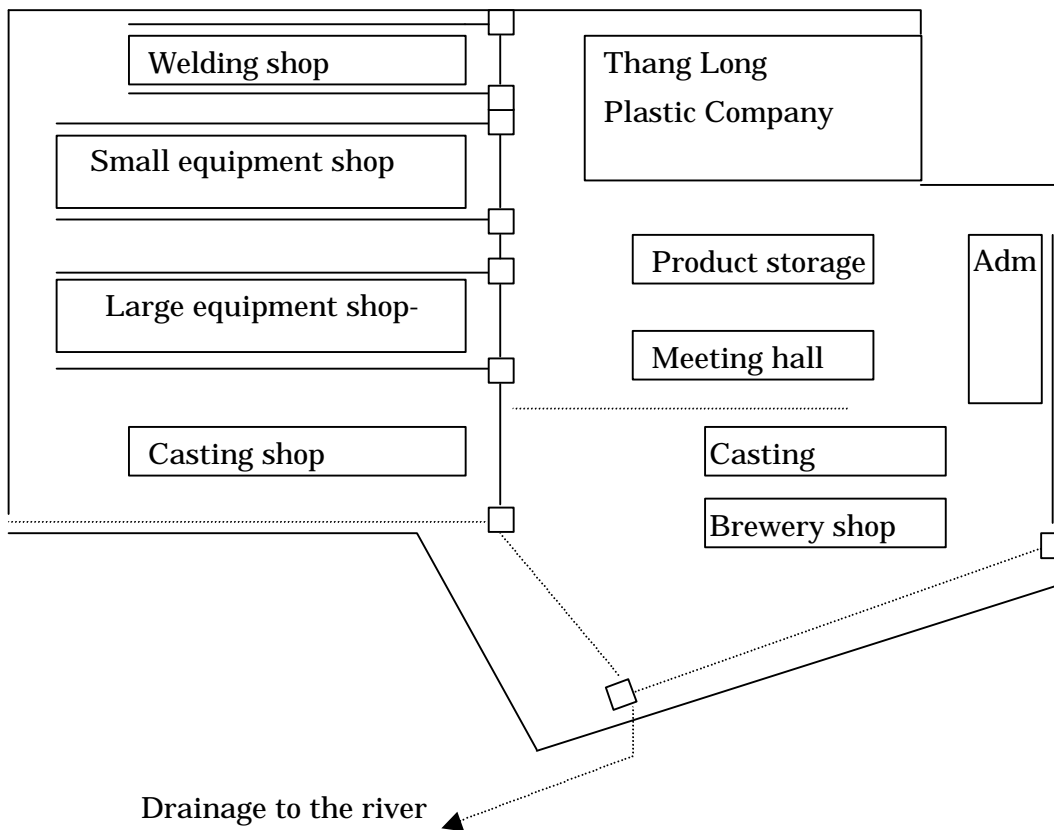


Figure 2 The Drainage System of the Company

4.2 Waste Water of the Company

The water consumption of the company was 500m³/year in 1998. This means that daily water consumption is 1~2 m³. During our survey, there was no waste water flow. So, no samples were taken.

5. Improvement Proposals

Basically, the amount of wastewater in the company is very small and the company has no plating shop. Therefore, there are no water pollution problem in the company at present.

Number One Accurate Mechanics Company

Survey Date: 24 November, 1999

1. General**1.1 Profile**

Number One Accurate Mechanics Company is a state-owned company that was established in 1967. The company was a self-made electric fan manufacturer up until 1995. However, after 1996, the company stopped plating. The company profile is summarized in Table 1.

Table 1 Company Profile

Name of Company	Number One Accurate Mechanics Company
Ownership	State-owned
Address	275 Nguyen Trai Road, Hanoi
Tel	8581694/8584387
Established	1967
Number of Employees	400
Area	20,000 m ²
Main Products	Fans, Small pumps for water and oil, Steel shelves and boxes

1.2 Business Status**1.2.1 Production**

Table 2 shows production and sales of the company.

Table 2 Production and Sales in 1998

Item	Unit	Production	Turnover(million VND)
Electric fans	Unit	44,000	
Hydraulic pumps	Piece	1,800	
Motor bike lifters	Piece	166	
Shelving for bike transportation	Piece	1,465	
Other products (metal box etc.)	X	X	400
Total			14,200

1.2.2 Debt

From the Bank of Trade: 316 million VND

From the Bank of Vietnam: 1,000 million VND

2. Production Technology

2.1 Process

2.1.1 Electric Fan

The block flow for electric fan manufacturing is shown in Figure 1.

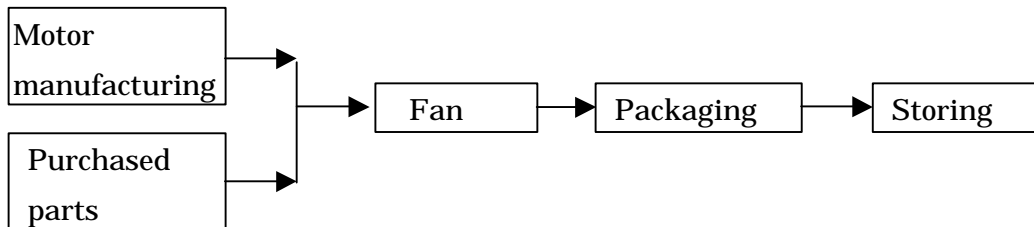


Figure 1 Block Flow for Electric Fan Manufacturing

2.1.2 Hydraulic Pump

The block flow for hydraulic pump manufacturing is shown in Figure 2.

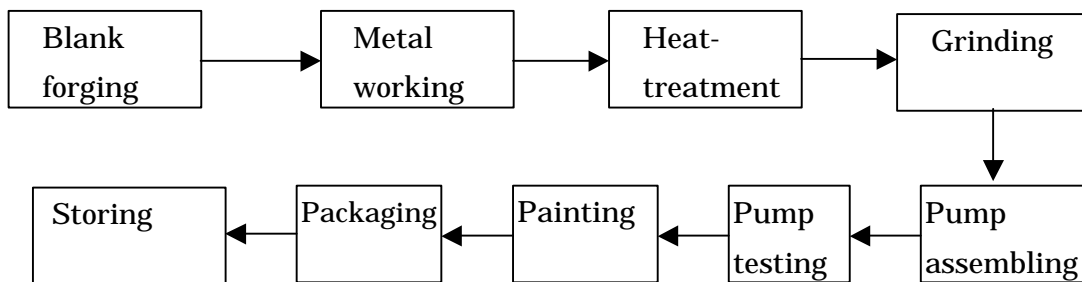


Figure 2 Block Flow for Hydraulic Pump Manufacturing

2.2 Main Raw Materials and Utility Consumption

Table 3 Main Raw Materials and Utility Consumption

Material	Unit	Amount	Unit Price	Total Price (million VND)
Copper Wire	kg	12,000	47,000	564
Steel	kg	90,000	6,000	540
Paint	kg	3,500	20,000	70
Water	m ³	7,200	3,000	21.6
Electric Power	kWh	150,000	810	121
Oil	kg	400	9,500	4
Fuel oil	l	7,200	4,300	30
Coal	kg	12,000	250	3
Grease	kg	150	12,000	1.8
Total				1,355.4

3. Management Technology

The management level of the company is good and the factory is well managed. The company has developed new products like a hydraulic pump.

4. Industrial Waste Water

The company discharges no industrial wastewater. The company only utilizes water for domestic use.

5. Other Information

The company has a new project for a fan assembling shop which has a 19.4 billion VND budget.

Cutting and Measuring Tools Company

Survey Date: 24 November, 1999

1. General**1.1 Profile**

Cutting and Measuring Tools Company is a state-owned company that was established in 1968 as a cutting and measuring tools manufacturing company. Until 1975, the company was manufacturing a very small amount of products. The company profile is summarized in Table 1.

Table 1 Company Profile

Name of Company	Cutting and Measuring Tools Company
Ownership	State-owned
Address	108 Nguyen Trai Road, Hanoi
Tel	8584337
Established	1968
Number of Employees	450
Area	17,000 m ²
Main Products	Cutting tools for machine tools, Measuring tools etc.

1.2 Business Status**1.2.1 Production**

Tabl-2 shows production and sales of the company.

Table 2 Production and Sales in 1998

Item	Unit	Production	Turnover(million VND)
Cutting tools for axle and hole threading, drilling, milling, boring, lathe, sampling machine, land saw, cutting metal plates	Piece	167,436	1,882.3
Export products - sliding bars, one kind of cam, hoist, jaw, grinding fixture, electric wrench, machine parts, thickness gauge	Piece	52,152	3,153.6
Set of equipment for candy processing and accessories	-	-	3,481.3
Products for gas and oil branch	-	-	2,137.5
Other products	-	-	1,422.5
Total			12,077.2

1.2.2 Debt

From the Bank of Trade: 5 billion VND.

2. Production Technology

2.1 Process

The overall block flow diagram is shown in Figure 1.

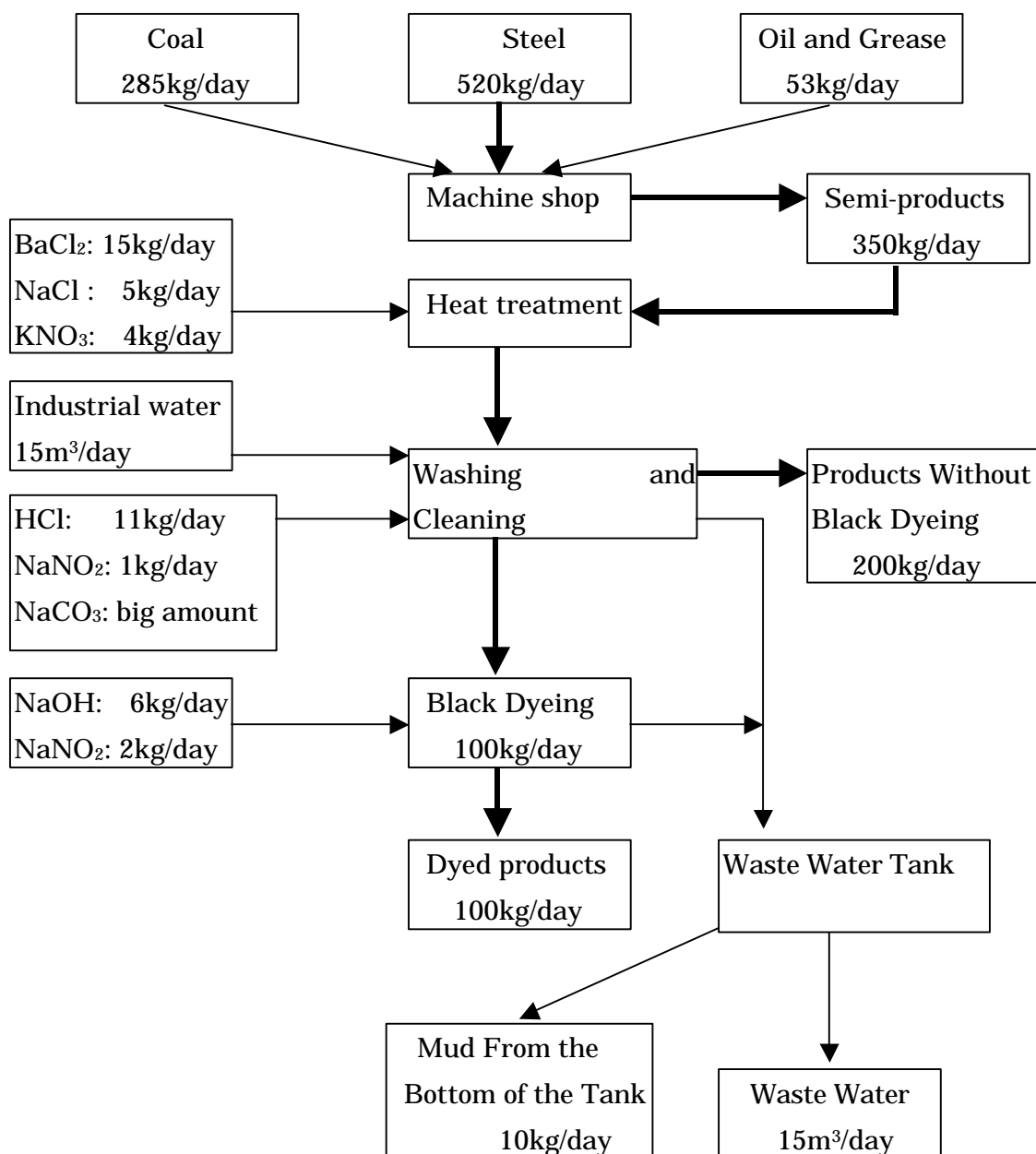


Figure 1 Block Flow Diagram of the Company

2.2 Materials and Utility Consumption

Table 3 Material and Utility Consumption

Material	Unit	Amount	Total Price (million VND)
1. Cutting tools			350
- Rapid steel	kg	10,000	350
- Oil and grease	kg	3,000	27
- Coal	kg	8,000	5.12
- BaCl ₂	kg	830	3.7
- NaCl	kg	250	0.3
- KNO ₃	kg	300	2.1
- HCl	kg	600	1.2
- NaOH	kg	350	1.925
- NaNO ₂	kg	200	0.9
- Industrial water	m ³	850	2.5
- Electric power	kWh	134,700	107.76
2. Export products			
-Carbon steel	kg	43,000	258
-Coal	kg	26,000	16.64
-Oil and grease	kg	4,500	40.5
-BaCl ₂	kg	1,245	5.602
-NaCl	kg	384	0.46
-HCl	kg	950	1.9
-NaOH	kg	500	2.97
-NaNO ₂	kg	300	1.35
-Industrial water	m ³	1,300	3.9
-Electric power	kWh	202,500	162
3. Equipment for candy processing			
-Carbon steel	kg	29,000	174
-Coal	kg	16,000	10.24
-Oil and grease	kg	3,000	27
-BaCl ₂	kg	830	3.7
-NaCl	kg	250	0.3
-HCl	kg	600	1.2
-NaOH	kg	350	1.925
-NaNO ₂	kg	200	0.9
-Industrial water	m ³	850	2.55
-Electric power	kWh	134,700	107.76
4. Products for oil and gas branch			
-Carbon steel	kg	29,000	174
-Coal	kg	16,000	10.24
-NaCl	kg	250	0.3
-HCl	kg	600	1.2
-NaOH	kg	350	1.925
-NaNO ₂	kg	200	0.9
-Industrial water	m ³	850	2.5
-Electric power	kWh	134,700	107.76
-Paint			
5. Other Product			
-Carbon steel	kg	15,000	90.00
-Coal	kg	8,000	5.12
-Oil & grease	kg	1,500	13.50
-BaCl ₂	kg	400	1.80
-NaCl	kg	100	0.12
-HCl	kg	300	0.60
-NaOH	kg	170	0.95
-NaNO ₂	kg	100	0.45
-Industrial water	m ³	420	1.26
-Electric power	kWh	67,700	54.00

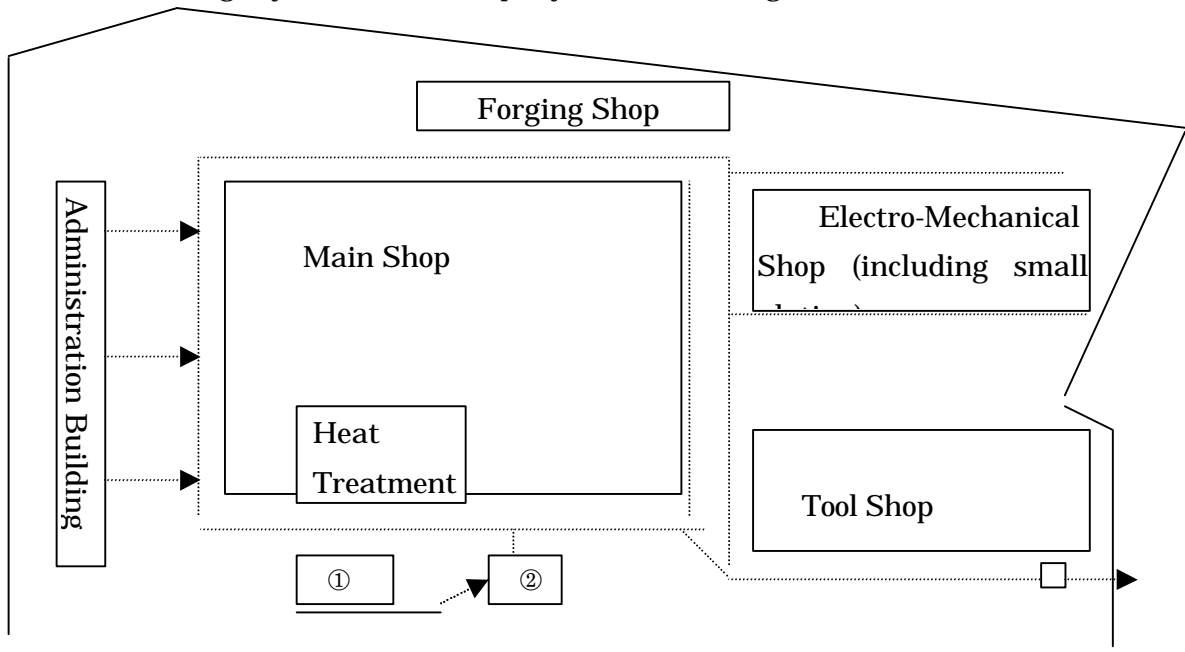
3. Management Technology

The management system should be improved.

4. Industrial Waste Water

4.1 Drainage System of the Company

The drainage system of the company is shown in Figure 2.



Remarks: ① Acid Cleaning and Black Color Dyeing Section

② Neutralization Tank ($V=48m^3$)

Figure 2 Drainage System of The Company

4.2 Waste Water System

The waste water discharged from the acid cleaning and black color dyeing sections flows into a neutralization tank and then mixes with other waste water. However, there is no pH meter at the neutralization tank.

4.3 Waste Water Analysis Results

Waste water analysis results are shown in Table 4.

Table 4 Waste Water Analysis Results (Nov.25,1999)

Sampling Place	Unit	Acid Washing Waste	Plating Waste	Final Pit	TCVN
Flow Rate	m ³ /h			15	
Temperature	°C	22.8	21.6	21.6	
pH		6.8	6.98	6.95	5.5-9
Electric Conductivity	µs/cm	770	550	743	
Turbidity	NTU	13	16	61	
Oil	mg/l	0.81	0.11	0.92	1or10
BOD	mg/l	14.2	12.1	127.1	50
COD	mg/l	63.2	51.4	184.6	100
SS	mg/l	17	19	79	100
Cyanide	mg/l	0.07	0.06	0.09	0.1
Cu	mg/l	0.19	1.27	1.05	1.0
Fe	mg/l	1.47	1	1.52	5.0

5. Improvement Proposals

- 1)For waste water, a pH meter need to be installed at the neutralization tank.
- 2)The factory's operation load is only 50%. Market research and development of new products are required.

5.1 Conceptual Design of a Water Treatment Unit

According to waste water analysis results, a conceptual design of a water treatment unit was carried out in this study and is summarized as follows. However, the company need to reconfirm the correct design basis, including the reason for high BOD and COD levels before starting into detail design work.

5.1.1 Design Basis

The data from the “ Final pit”, shown in Table 4, was used for the design base.

5.1.2 Conceptual Design

(1) Flow Sheet

The flow is based on an activated sludge system.

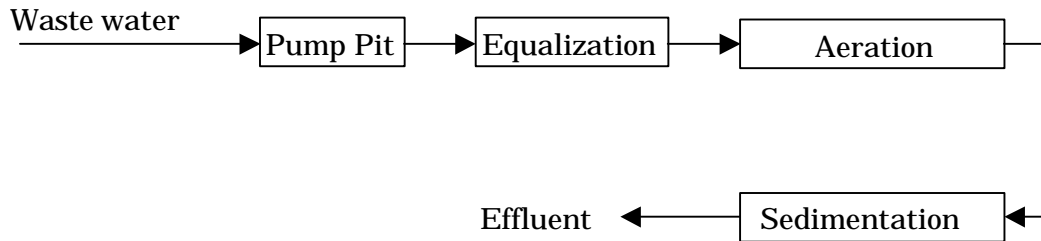


Figure 3 Flow Sheet

(2) Main Equipment List

Table 5 Main Equipment List

Name of Equipment	No. Req'd.	Remarks
Pump Pit	1	1m ³ , RC
Equalization Tank	1	10m ³ , RC
Aeration Tank	1	7.5m ³ , Steel
Aeration Blower	1	0.1m ³ /min, 0.1kw
Sedimentation Tank	1	3m ³ , Steel
Transfer Pump	2	Volute, 0.02m ³ /min, 0.2kw
Sludge Return Pump	2	Volute, 0.02m ³ /min, 0.2kw
Control Building	1	4mW x 6mL, Steel Slated

(3) Required Cost

The rough estimated cost is about 410 million VND.

ABB Transformer LTD.

Survey Date:26 November, 1999

1. General**1.1 Profile**

ABB Transformer LTD. is a joint venture company between CTBT and ABB. CTBT was established in 1963 and the J/V company was established in 1994 as a transformer manufacturing company. The company profile is summarized in Table 1.

Table 1 Company Profile

Name of Company	ABB Transformer LTD.
Ownership	Joint venture
Address	Milestone No.9, Hoang Liet, Thahn tri, Hanoi
Tel	8611010
Established	1963(as CTBT), 1994(as ABB)
Number of Employees	263
Area	
Main Products	Distribution transformers, Power transformers

1.2 Business status**1.2.1 Production**

Table 2 shows production and sales of the company in 1998.

Table 2 Production and Sales in 1998

Item	Unit	Production	Turnover(million VND)
Distribution Transformer	Unit	1610	100,545.539

1.2.2 Debt

No information.

2. Production Technology**2.1 Process**

The Distribution Transformer production flow chart is shown in Figure 1.

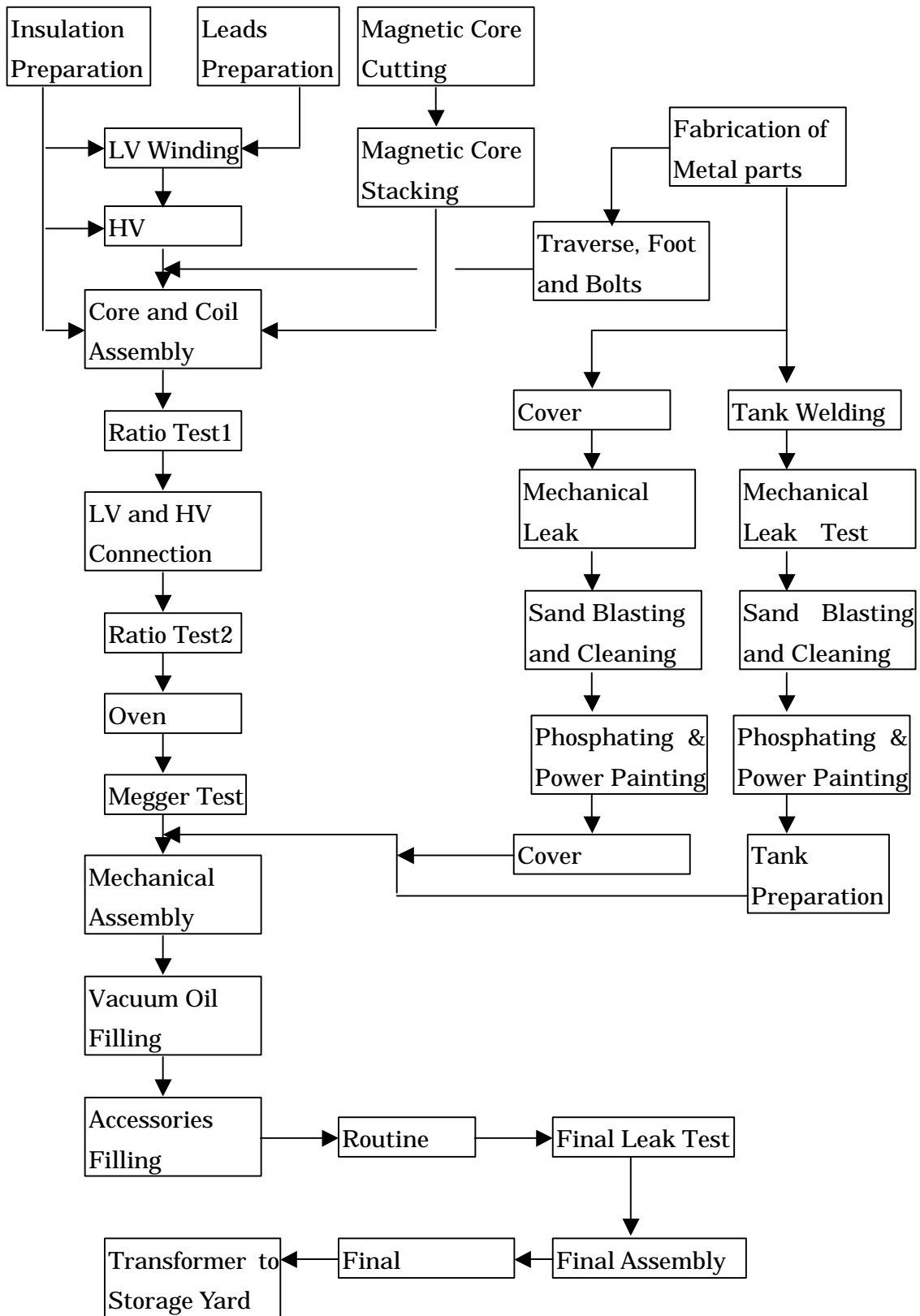


Figure 1 Distribution Transformer Production Flow Chart

2.2 Material Consumption

Table 3 Material Consumption

Material	Unit	Amount	Unit Price
Transformer Oil	Kg	621,237	0.525 USD
Silic Plate	Kg	683,577	1.55 USD
Copper Foil	Kg	107,915	3.34 USD
Round Copper Wire	Kg	130,928	2.89 USD
Rectangular Copper Wire	Kg	63,754	2.85 USD
Adjuster	Piece	1,979	134 FRF
Corrugated Parts	Set	1,274	187.03 USD
Steel	kg	308,313	

3. Management Technology

The company's management system is shown in Figure 2.

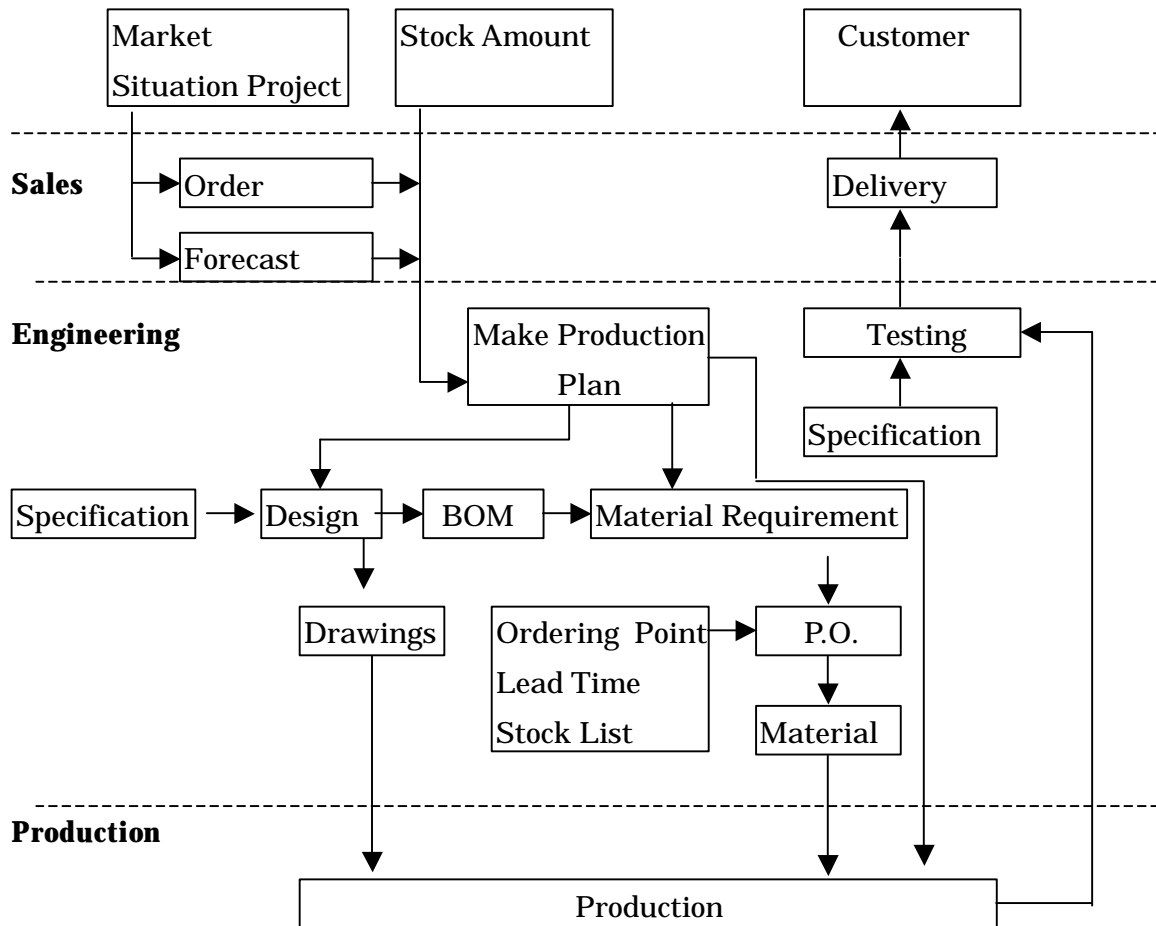


Figure 2 Production Management System

4. Industrial Waste Water

The company does not discharge industrial waste water.

5. Improvement Proposals

There are no special proposal items.

Song Cong Engine Company

Survey Date 29 November 1999

1. General**1.1 Profile**

Song Cong Engine Company is a state owned company that was established in 1980. The Company's basic technology and main equipment were supplied by the USSR. The company profile is summarized in Table 1

Table 1 Company Profile

Name of Company	Song Cong Engine Company
Ownership	State owned
Address	Song Cong Town- Thai nguyen Province
Tel	0280-862332
Established	1980
Number of Employees	1400
Area	
Main Products	Engines (6~80 Hp), spare parts and accessories

1.2 Business Status**1.2.1 Production**

Table 2 shows production and sales of the Company in 1998.

Table 2 Production and Sales in 1998

Product	Production	Turnover
Engine D50L	36 pieces	504 million VND
Marine Engine DT55	25 pieces	513
Marine Engine DT60	35 pieces	805
Engine TS 60	617 pieces	740
Engine TS 105	141 pieces	197
Engine TS 130	265 pieces	398
Engine spare parts and accessories	1,100 Tons	16,653
Marine gear boxes	27 pieces	122
Rolled steel	11,292 Tons	38,084
Casting products	9,434 Tons	5,480
Total		63,495 million VND

2. Production Technology**2.1 Process**

The overall block flow diagram is shown in Figure 1.

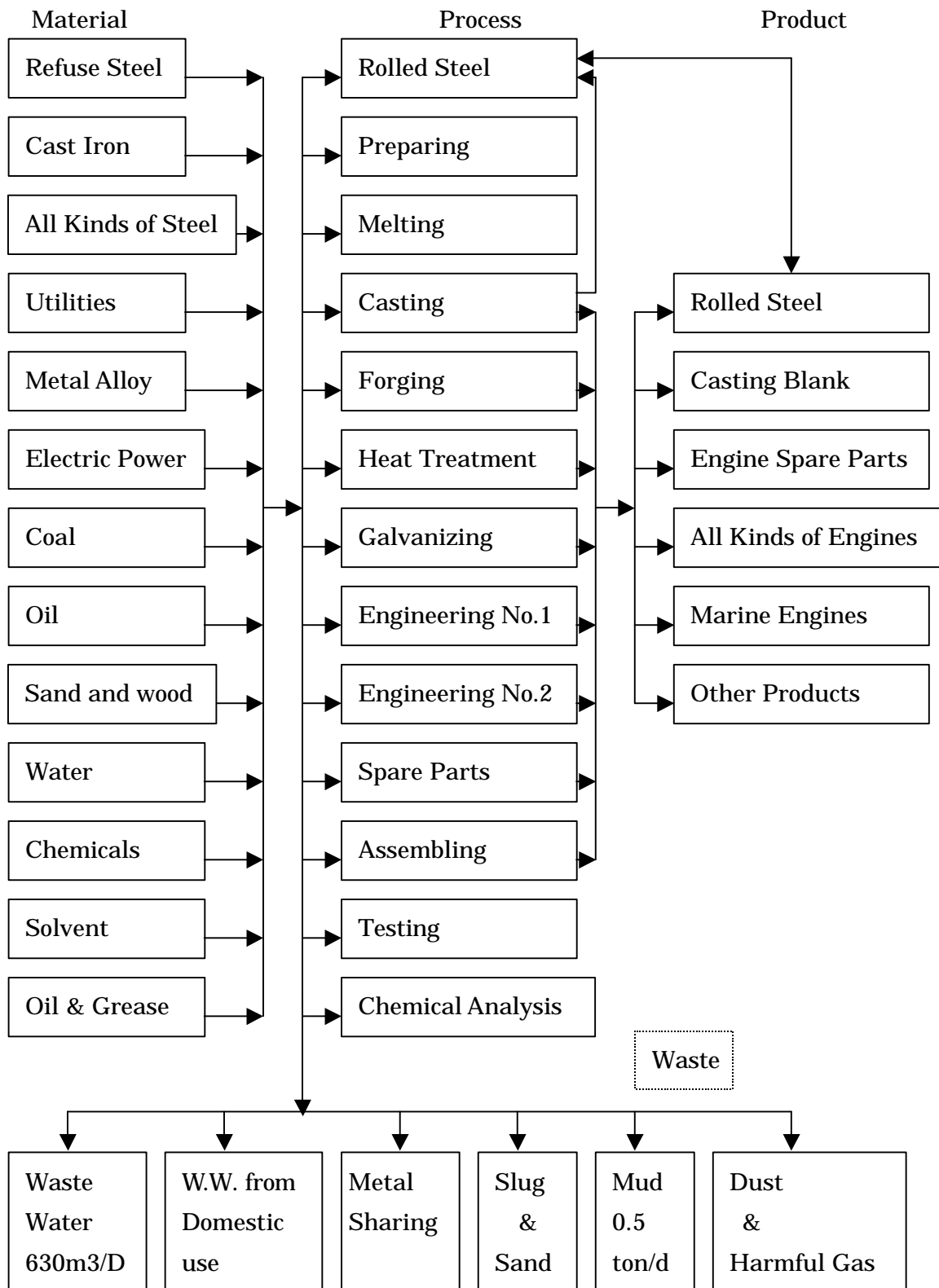


Figure 1 Overall Block Flow Diagram

2.2 Material Consumption

Table 3 Material Consumption

Material	Unit	Amount
All Kinds of Cast Iron	t/year	500
Fabricated Steel	t/year	2,300
Electrodes	t/year	60
Fire Proof Bricks	t/year	600
Refuse Steel	t/year	15,000
Electric Power	kWh/year	14,000,000
Coal	t/year	2,000
Wood	m ³ /year	50
Gas, Petrol and Oil	t/year	14
Chemicals	t/year	4

3. Management Technology

The company's management technology has not been updated, but the level is considered to be standard.

4. Industrial Waste Water

4.1 Waste Water System

The company has a plating shop. Originally, the plating shop was equipped with a complete waste water treatment unit, but it has never been used up to now. So, all industrial waste water is mixed and discharged without water treatment.

4.2 Waste Water Analysis Result

Waste water analysis results are shown in Table 4.

Table 4 Waste Water Analysis Results (Nov.29, 1999)

Sampli	Unit	Plating	Paintin	H.T.	Washin	Castin	Final	TCVN
Flow	m ³ /D						680	
Temp.	°C	26.1	24.9	25.1	26	25.2	25.1	
pH		9.3	7.4	7.52	7.48	7.61	7.64	5.5~9
Elec.con	us/c	220	150	100	240	130	280	
Turbidit	NTU	26.6	29	27	10.8	64.6	11.2	
Oil	mg/l	0.4		0.8	0.8	1.6	0.5	1or10
BOD	mg/l	68.64	106.7	81.8	92.4	95.6	125	50
COD	mg/l	163	174	169	154.5	112.8	156	100
DO	mg/l	2.5	1.8	1.9	1.2	1.5	1.6	
SS	mg/l	32	37	34	12	75	13	100
Cyanide	mg/l	0.01	0	trace	trace	0.01	trace	0.1
Cu	mg/l	0.27	0.23	0.22	0.31	0.45	0.16	1.0
Pb	mg/l	-	0.035	-	-	0.033	0.01	0.5
Zn	mg/l	0.7	0.41	0.44	0.47	0.64	0.4	2.0
Fe	mg/l	2.65	1.79	0.35	0.73	3.21	1.24	5.0

5. Improvement Proposals

- 1) It is recommended that an employee's idea proposal system and 5S activity be introduced.
- 2) There are two other companies which have plating shops near the company, so it is recommended that one combined water treatment unit be built.
- 3) If a combined water treatment unit can't be built, then it is recommended that the existing water treatment unit be operated.
- 4) Another solution would be to close the plating shop.

5.1 Conceptual Design of the Water Treatment Unit

According to the waste water analysis results, a conceptual design of the water treatment unit was carried out in this study and is summarized follows. However, the company need to reconfirm the correct design basis before starting detail design work.

5.1.1 Design Basis

The data "Final", shown in Table 4, was used for the design basis.

5.1.2 Conceptual Design

(1) Flow Sheet

The flow is based on an activated sludge system.

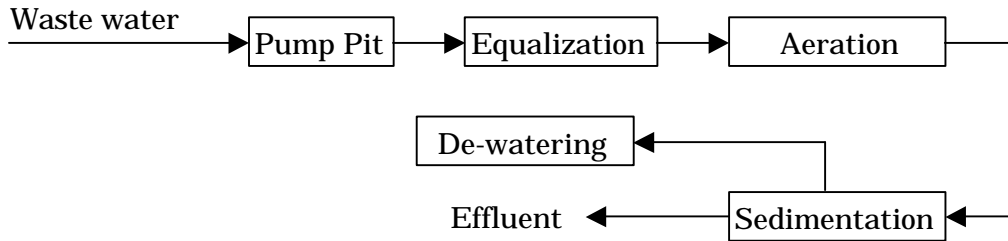


Figure 2 Flow Sheet

(2) Main Equipment List

Table 5 Main Equipment List

Name of Equipment	No. Req'd.	Remarks
Pump Pit	1	28m ³ , RC
Waste Water Pump	2	Submerged, 4m ³ /min, 10kw
Equalization Tank	1	453m ³ , RC
Equalization Blower	1	0.5m ³ /min, 1kw
Aeration Tank	1	340m ³ ,
Aeration Blower	1	3.5m ³ /min, 5.5kw
Transfer Pump	2	Volute, 0.5m ³ /min, 1kw
Sedimentation Tank	1	136m ³
Sludge Return Pump	2	Volute, 0.5m ³ /min, 1.1kw
Dewatering Facility	1set	Belt Filter 3.4mW
Control Building	1	8mW x 10mL

(3) Required Cost

The rough estimated cost is about 2,900 million VND.

Spare Parts Company Number One

Survey Date: 29 November, 1999

1. General**1.1 Profile**

Spare Parts Company Number One is a state-owned company that was established in 1968. The company profile is summarized in Table 1.

Table 1 Company Profile

Name of Company	Spare Parts Company Number One
Ownership	State-owned
Address	Song cong Town, Thai Nguyen
Tel	0280862396
Established	1968
Number of Employees	700
Area	300,000 m ²
Main Products	Automobile engine parts, Agricultural machines

1.2 Business Status**1.2.1 Production**

Table 2 shows production and sales of the company in 1998.

Table 2 Production and Sales in 1998

Item	Unit	Production	Weight(ton)	Turnover(mil VND)
Cylinder Liners	Piece	102,507	413.7	
Pistons	Piece	3,634	5.5	
Piston Rings	Piece	36,208	1.5	
Gears	Piece	4,841	3.6	
Shafts	Piece	5,737	10.2	
Piston pins	Piece	1,810	1.8	
Poppet valves	Piece	1,702	0.3	
Marine gear boxes	Box	8,295	396.9	
Sprocket wheels	Piece	137,305	64.5	
Hoes	Piece	50,135	60.2	
Agricultural machines	Piece	316	53.5	
Other products			19.3	815.5
Total				24,368.1

1.2.2 Debt

Long-term loan (for investment) : 702 million VND

2. Production Technology

2.1 Process

The block flow of the company is shown in Figure 1.

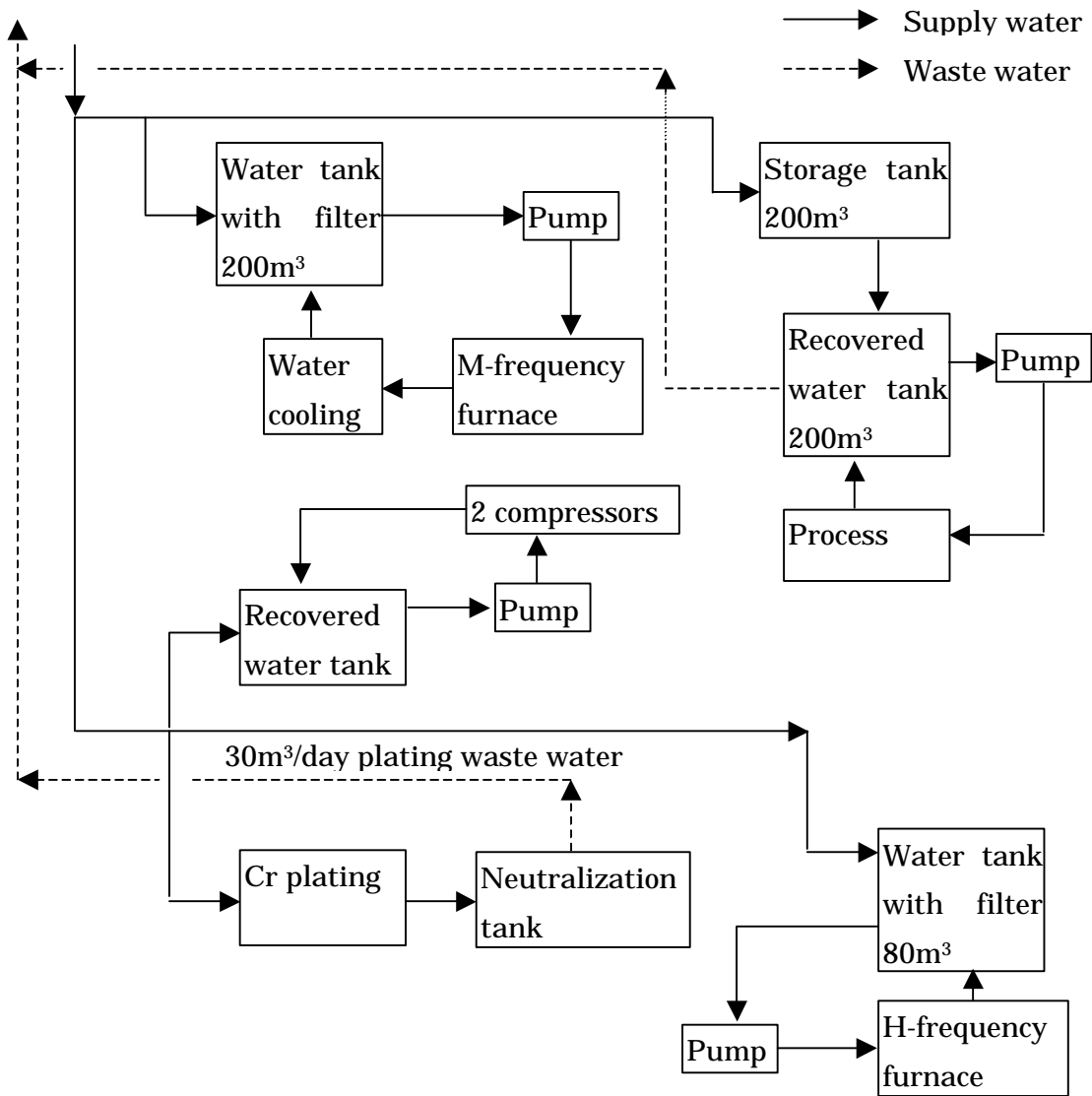


Figure 1 Block Flow Diagram of the Company Water System

2.2 Raw Materials and Utility Consumption

Table 3 Raw Materials and Utility Consumption

Material	Unit	Consumption
Electric Power	kWh/year	2,756,120
Coal	t/year	1,453.5
Oil	t/year	46.8
Wood	t/year	10.0
Cast-iron	t/year	1,414.8
Steel	t/year	500
Aluminum	t/year	7
Copper, Bronze	t/year	8
H ₂ SO ₄	kg/year	260
H ₃ PO ₄	kg/year	140
HCl	kg/year	169
KCl	kg/year	100
S	kg/year	35
NaCl	kg/year	130
NaNO ₂	kg/year	70
Cr ₂ O ₃	kg/year	130
O ₂	bottle	150
Paint	kg/year	1,635
Water	m ³ /year	96,000

3. Management Technology

The management level of the company is high. The company performs 5S activities and the factories are well managed.

4. Industrial Waste Water

4.1 Waste Water System

The company has a neutralization tank for plating waste water and other waste water is discharged from the company directly outside. The company has already planned to construct a water treatment unit, but the budget has not yet been authorized.

4.2 Waste Water Analysis Results

Waste water analysis results are shown in Table 4.

Table 4 Waste Water Analysis Results (Nov.29,1999)

Sampling place	Unit	Central Sewage	Plating Out	Plating Tank Out	Final Pit	TCVN 5945
Flow Rate	m ³ /day				350	
Temp.	°C	23	20	23	24	
pH		7.06	4.07	6.9	6.17	5.5~9
Elec.Cond.	μS/cm	340	640	160	150	
Turbidity	NTU	22.4	93.6	20.8	48	
Oil	mg/l	2	trace	trace	2.2	1or10
BOD	mg/l	98.2	102.4	59.1	98.5	50
COD	mg/l	213.6	121	98.2	223.2	100
DO	mg/l	1.25	1.05	2.3	1.16	
SS	mg/l	28	102	24	55	100
Cyanide	mg/l	0.01	trace	trace	Trace	0.1
Cu	mg/l	0.32	1.24	0.27	0.24	1.0
Pb	mg/l	0.08	0.271	0.039		0.5
Zn	mg/l	0.69	1	0.89	0.71	2.0
Fe	mg/l	1.072	6.3	1.26	2.31	5.0

5. Improvement Proposals

Construction plans for a waste water treatment unit need to be designed. At the detail design stage, it is recommended that a separate treatment for plating waste water be planned for.

5.1 Conceptual Design of a Water Treatment Unit

According to the waste water analysis results, the conceptual design of a water treatment unit was carried out in this study and is summarized as follows. However, the company need to reconfirm the correct design basis before starting detailed design work.

5.1.1 Design Basis

The data from the “Final pit”, shown in Table 4, was used for the design basis.

5.1.2 Conceptual Design

(1) Flow Sheet

The flow is based on an activated sludge system.

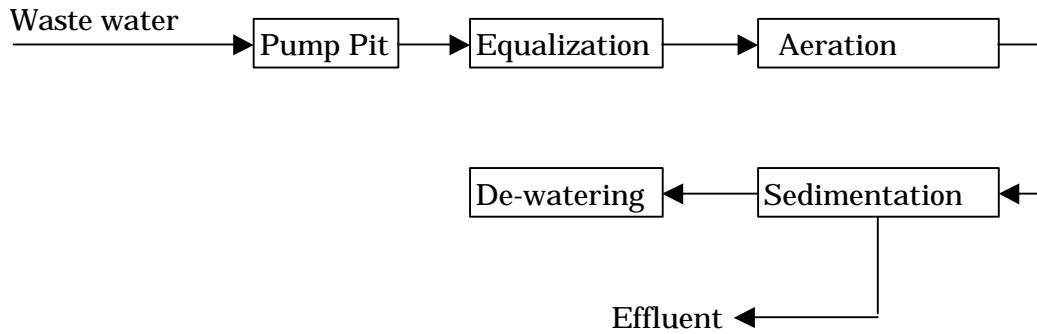


Figure 2 Flow Sheet

(2) Main Equipment List

Table 5 Main Equipment List

Name of Equipment	No. Req'd.	Remarks
Pump Pit	1	15m ³ , RC
Waste Water Pump	2	Submerged, 2m ³ /min, 5kw
Equalization Tank	1	233m ³ , RC
Transfer Pump	2	Volute, 0.25m ³ /min, 0.5kw
Equalization Blower	1	0.3m ³ /min, 0.4kw
Aeration Tank	1	175m ³ ,
Aeration Blower	1	1.4m ³ /min, 2kw
Sedimentation Tank	1	70m ³
Sludge Return Pump	2	Volute, 0.25m ³ /min, 0.55kw
De-watering Facility	1set	Belt Filter, 2.7mW
Control Building	1	6mW x 10mL

(3) Required Cost

The rough estimated cost is about 2,000 million VND.

Hon Gai Mechanical Company

Survey Date: December 01, 1999

1. General**1.1 Profile**

Hon Gai Mechanical Company is a state-owned company that was established in 1930 as the largest mechanical company in the VINA COAL group. The company profile is summarized in Table 1.

Table 1 Company Profile

Name of Company	Hon Gai Mechanical Company
Ownership	State-owned
Address	Le Thanh Tong Road, Ha Long City, Quang Ninh
Tel	033-825591/825002
Established	1930
Number of Employees	480
Area	10,000m ²
Main Products	Spare parts for the coal industry, Steel structures, Repairing mining equipment

1.2 Business Status**1.2.1 Production**

Table 2 shows production and sales of the company in 1998.

1.2.2 Debt

From the Quang Ninh COMBANK : 20 billion VND.

Table 2 Production and Sales in 1998

Item	Unit	Production	Turnover (million VND)
1.Mechanical repairing			3,971.84
-repairing cars	piece	7	(700.0)
-repairing bulldozers	piece	8	(2,400.0)
-repairing bottom of TY	set	2	(240.0)
-repairing motors	set	10	(450.0)
-repairing air compressors	piece	80	(181.84)
2.Spare parts			7,096.051
-parts of excavator	piece	1,500	(2,590.5)
-arm-boom of excavator	set	8	(101.816)
-gear of excavator	piece	130	(618.2)
-bush of excavator	ton	20	(1,363.64)
-chain of bulldozer	set	2	(400.0)
-gear of bulldozer	piece	15	(150.0)
-front roller of bulldozer	piece	10	(54.545)
-shovel of D85A	set	30	(136.35)
-rotary drill	piece	100	(181.0)
-spare parts for screener	ton	20	(360.0)
-spare parts for pumps	ton	3	(240.0)
-other casting products	ton	50	(900.0)
3.Steel structure			4,484.448
-screener	set	2	(136.264)
-screen SR3-850	unit	2	(81.818)
-skip car	unit	25	(136.364)
-bucket	set	6	(280.002)
-screens	m ²	200	(100.0)
-stone crusher	unit	2	(250.0)
-other steel structure			(3,500.0)
Total			15,552.339

2. Production Technology

2.1 Process

The block flow diagram for the mechanical repairing process is shown in Figure 1.

The block flow diagram for steel structure manufacturing is shown in Figure 2.

The block flow diagram for spare parts manufacturing is shown in Figure 3.

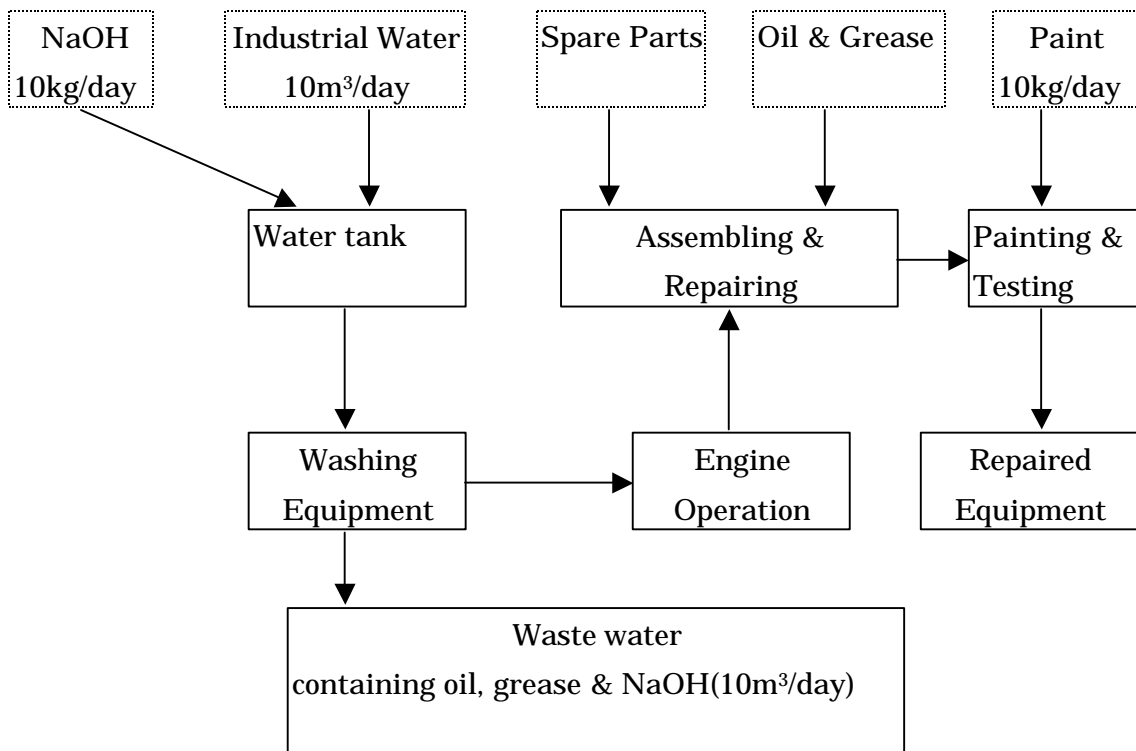


Figure 1 Block Flow Diagram for the Repairing Process

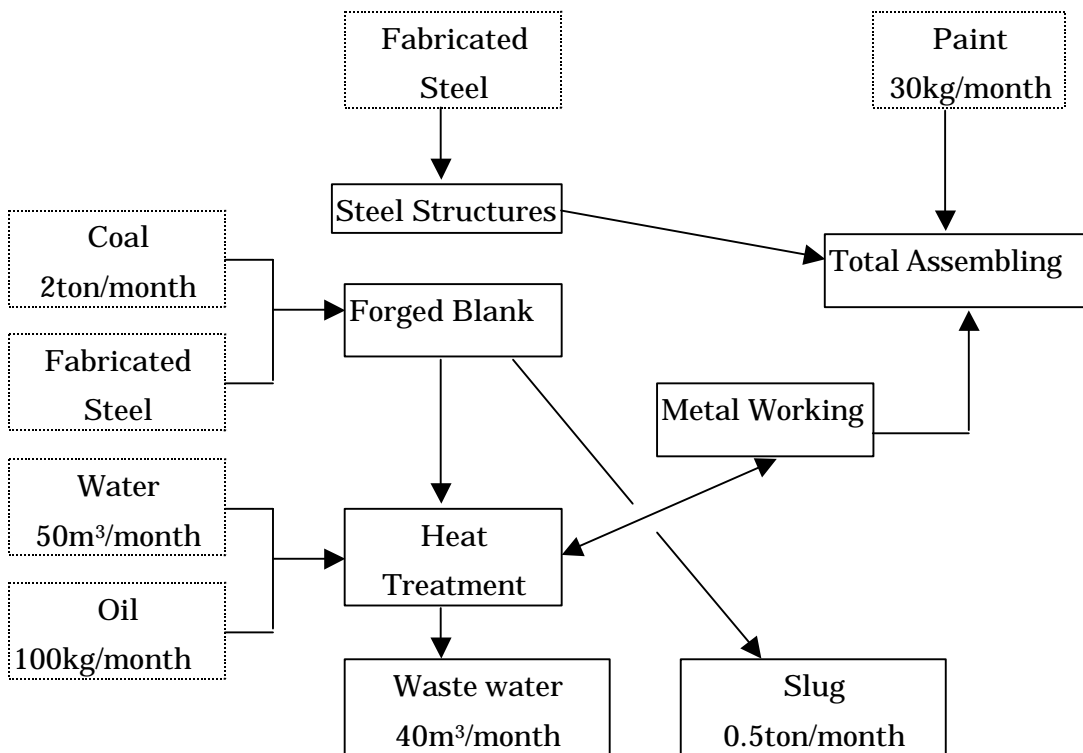


Figure 2 Block Flow Diagram for Steel Structure Manufacturing

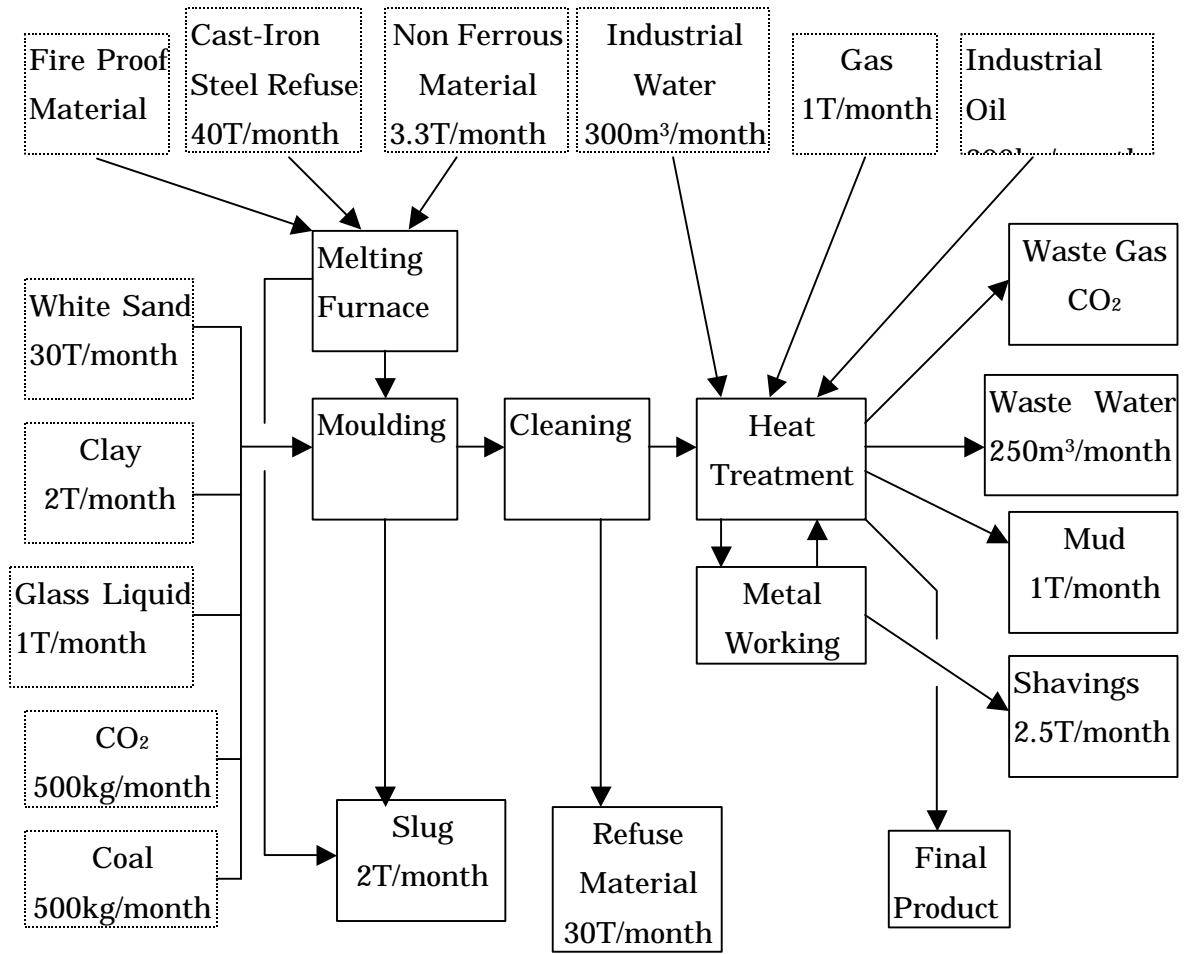


Figure 3 Block Flow Diagram for Spare Parts Manufacturing

2.2 Materials and Utility Consumption

Table 3 Material and Utility Consumption

Materials	Unit	Amount	Total Price (million VND)
1.Mechanical repairing			
-spare part of cars			2,200
-paint	t	1	15
-welding electrode	t	3	21
-fabricated steel	t	10	45
-oxygen	t	1	7
-lubricant, grease	t	10	100
2.Spare parts			
-steel refuse	t	450	720
-cast-iron	t	50	100
-bronze- copper alloy	t	30	600
-non ferrous alloy	t	10	350
-FeMn, FeSi, FeCr	t	25	500
-fire proof material	t	25	100
-white sand	t	350	56
-glass liquid	t	15	16.5
-plastic	t	4	120
-CO ₂ gas	t	6	38
-welding electrode	t	1	7
-oxygen	t	0.5	3.5
3.Steel structures			
-fabricated steel	t	400	1,800
-oxygen	t	4	28
-paint	t	4	60
-welding sticks	t	12	84
4.Water and energy			
-Industrial water	m ³	5,000	15
-coal	t	150	82.5
-gas	t	25	163.75
-oil	t	12	42
-electric power	kWh	1,100,000	880

3. Management Technology

The management level of the company is considered to be standard.

4. Industrial Waste Water

4.1 Waste Water System

The waste water of the company is discharged from the car washing pit, engine washing tank and also, the heat treatment tank occasionally. The waste

water is passing through the company sewage and is directly discharged to Ha Long Bay without treatment.

4.2 Waste Water Analysis Result

Waste water analysis results are shown in Table 4. The samples were taken by the company one day before the survey date. At the time of the survey, there was no waste water flow.

Table 4 Waste Water Analysis Result (Nov.30, 1999)

Sampling place	Unit	Heat treat. out	Car washing out	Engine washing out	TCVN 5945
Flow Rate	m ³ /d	(6.5)	(6.5)	(7)	
Temperature	°C				
pH		8.5	11.2	12.2	5.5-9
Elec. Conductivity	μS/cm	340	5.1	350,000	
Turbidity	NTU	4.2	321	4,812	
Oil	mg/l	Trace	38.2	41.1	1or10
BOD	mg/l	26.2	71.8	63.1	50
COD	mg/l	55.2	89.6	92.2	100
DO	mg/l	3.51	2.1	2.18	
SS	mg/l	5.2	348.5	4,900	100
Cyanide	mg/l	0	0	0	0.1
Zn	Mg/l	0.17	3.45	3.55	2.0
Fe	Mg/l	0.85	1.6	19.6	5.0

() shows assumption.

5. Improvement Proposals

- 1) The company has a plan to install sand filters at the final discharge point of the company. This plan should be implemented.
- 2) A better arrangement of the working shops is recommended to achieve more effective work.
- 3) It is recommended that heat treatment water be recycled.
- 4) If possible, steam should be used for car and engine washing instead of NaOH.

5.1 Conceptual Design of the Water Treatment Unit

According to the waste water analysis results, a conceptual design of the water treatment unit was carried out in this study and is summarized as follows. However, the company need to reconfirm the correct design basis (especially the amount of waste water) before starting detailed design work.

5.1.1 Design Basis

(1) Amount of Waste Water: 20 m³/day

(2) Waste Water Quality

Table 5 Waste Water Quality

Item	Unit	Base Data	TCVN5945
pH		11	5.5-9
Oil	mg/l	26.4	1or10
BOD	mg/l	53.7	50
COD	mg/l	79	100
SS	mg/l	1,750	100
Cyanide	mg/l	0	0.1
Fe	mg/l	7.4	5.0
Zn	mg/l	2.39	2.0

5.1.2 Conceptual Design

(1) Flow Sheet

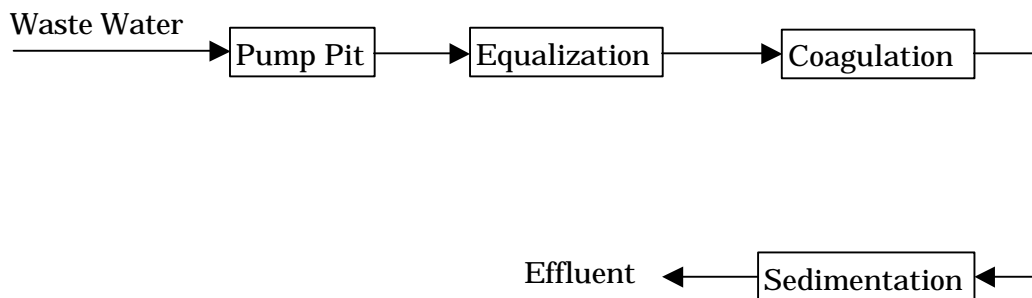


Figure 4 Flow Sheet

(2) Main Equipment List

Table 6 Main Equipment List

Name of Equipment	No. Req'd.	Remarks
Pump Pit	1	1m ³ , RC
Waste Water Pump	2	Submerged, 0.15m ³ /min
Equalization Tank	1	13m ³ , RC
Transfer Pump	2	Volute, 0.015m ³ /min
Coagulation Tank	1	0.2m ³ , Steel(Lining)
Sedimentation Tank	1	3m ³ , RC

(3) Required Cost

The rough estimated cost is about 140 million VND.

Hai Duong Pump Manufacturing Company

Survey Date: 02 December, 1999

1. General**1.1 Profile**

Hai Duong Pump Manufacturing Company is a joint venture company with Ebara and was established in 1960 as a state-owned pump manufacturing company. The company profile is summarized in Table 1.

Table 1 Company Profile

Name of Company	Hai Duong Pump Manufacturing Company
Ownership	Joint-venture
Address	37-Ho Chi Minh Road, Hai Duong city
Tel	0320-853594
Established	1960(as a state-owned), 1996 (as a J/V)
Number of Employees	850
Area	25,000 m ²
Main Products	Pumps (mainly agricultural use)

1.2 Business Status**1.2.1 Production**

Table 2 shows production of the company in 1998.

Table 2 Production in 1998

Item	Unit	Production
Industrial pumps	Set	796
Agricultural pumps	Set	747
Industrial fans	Set	64
Valves	Piece	381

1.2.2 Debt

No information.

2. Production Technology

2.1 Process

The block flow diagram is shown in Figure 1.

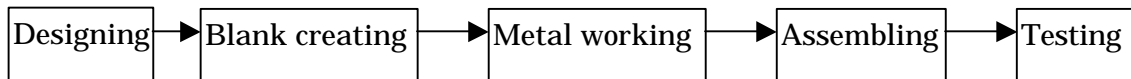


Figure 1 Block Flow Diagram

2.2 Material Consumption

Table 3 Material Consumption

Material	Type	Unit	Amount
Cast-iron	Ingot and refuse	Ton/year	10,000
Steel	Rolled and plate	Ton/year	5,000
Copper, Bronze	Ingot and plate	Ton/year	200
Coal		Ton/year	100
Sand, Clay		Ton/year	200
CO ₂		bottles	180

3. Management Technology

The management technology level of the company is high. The company is introducing advanced foreign technology. It's factories are well managed.

4. Industrial Waste Water

The company does not discharge industrial waste water.

The company only discharges domestic use waste water and rain water.

5. Improvement Proposals

There are no specific proposals.

Hai Duong Grindstone Company

Survey Date: 02 December, 1999

1. General**1.1 Profile**

Hai Duong Grindstone Company is a state-owned company that was established in 1966 as a grindstone manufacturing company. The company profile is summarized in Table 1.

Table 1 Company Profile

Name of Company	Hai Duong Grindstone Company
Ownership	State-owned
Address	Dien Bien Phu Road, Hai Duong City
Tel	0320-853790
Established	1996
Number of Employees	407
Area	
Main Products	Industrial grindstone

1.2 Business Status**1.2.1. Production**

Table 2 shows production and sales of the company in 1998.

Table 2 Production and Sales in 1998

Item	Unit	Amount	Turnover(million VND)
Industrial grind stones	Ton	312.7	
Grindstone for knives	Piece	466,400	
Grind-grits	Ton	622.9	
Total			10,987

1.2.2. Debt

From the Hai Duong COMBANK : more than 1,000 million VND.

2. Production Technology

2.1. Process

The overall block flow diagram is shown in Figure 1.

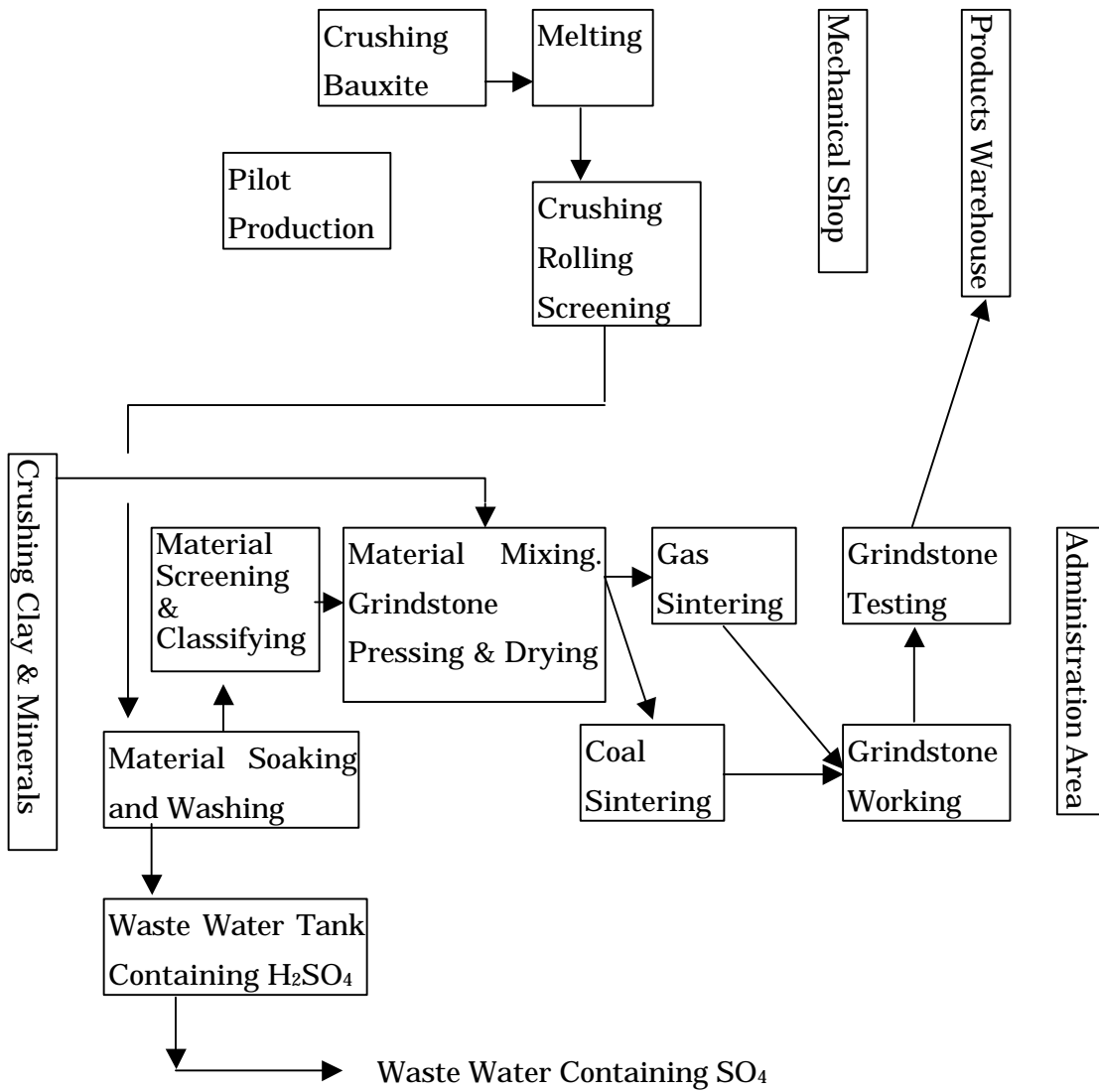


Figure 1 Overall Block Flow Diagram

2.2 Materials and Utility Consumption

Table 3 Materials and Utility Consumption

Materials	Purpose	Amount
Bauxite	Produce corundum	300ton/year
Coal	Burning, sintering	1,400ton/year
Clay	Making grindstone	800ton/year
Minerals	Making grindstone	928ton/year
White Sand	Sintering	43ton/year
H ₂ SO ₄ (96%)	Washing material	5ton/year
Graphite Electrode	Melting	24ton/year
S	Making grindstone	8ton/year
Chemicals	Making grindstone	4.8ton/year
Coke (coal)	Producing material	18ton/year
Clean Water	Washing material	25,000ton/year
Glass Liquid	Making grindstone	43ton/year
Sticky Rice Powder	Making grindstone	2.7ton/year
Electric Power	Melting, lighting	4,980,996 kwh
White Cast-Iron Grit	Grindstone working	6.6ton/year
Gas	Sintering	30ton/year
Graphite Powder	Making grindstone	1ton/year

3. Management Technology

The company has a high mind for improving the company management. The company management understands what need to be done. The company has modernization plans with a budget of 4 million US\$.

4. Industrial Waste Water

Industrial waste water is discharged from the material soaking and washing processes. A high content of sulfuric acid is used as a washing agent in the process. Diluted sulfuric acid is also, discharged to the waste water tank where solid materials settle.

4.1 Waste Water Quality

Analysis results of waste water are shown in Table 4.

Table 4 Waste Water Analysis Results (2 December 1999)

Item	Unit	After Polishing	Acid Washing	Final Pit	TCVN
Flow Rate	m ³ /day			24	
PH		8.08	2.74	7.65	5.5-9
Oil	mg/l	trace	Trace	0.4	1or10
BOD	mg/l	24.6	23.2	82.1	50
COD	mg/l	55.6	53.2	112.8	100
SS	mg/l	280	68	14	100
Cyanide	mg/l	trace	Trace	Trace	0.1
Al	mg/l	0.01	0.9	0.24	

5. Improvement Proposals

- (1) Industrial waste water need to be neutralized before discharging outside.
- (2) The working environment need to be improved by developing better tools to reduce the man power load.
- (3) The modernization plan need to be implemented.
- (4) A quality control system need to be established to ensure good quality.

5.1 Conceptual Design for Water Treatment Unit

According to the waste water analysis results, a conceptual design of a water treatment unit was carried out in this study and summarized as follows. However, the company need to reconfirm the correct design basis before starting detail design work.

5.1.1 Design Basis

The data of the “Final Pit”, shown in Table 4, was used for the design basis.

5.1.2 Conceptual design

- (1) Flow Sheet

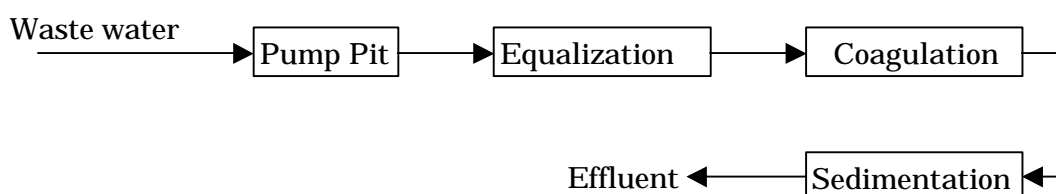


Figure 2 Flow Sheet

(2) Main Equipment List

Table 5 Main Equipment List

Name of Equipment	No. Req'd.	Remarks
Pump Pit	1	1m ³ , RC
Waste Water Pump	2	Submerged, 0.2m ³ /min
Equalization Tank	1	16m ³ , RC
Transfer Pump	2	Volute, 0.02m ³ /min
Coagulation Tank	1	0.3m ³ , Steel(lining)
Sedimentation Tank	1	3.6m ³ , Steel(lining)
Control Building	1	4mW x 6mL

(3) Required Cost

The rough estimated cost is about 400 million VND.

Chemical Machine and Equipment Company

Survey Date: 06 December, 1999

1. General**1.1. Profile**

Chemical Machine and Equipment Company is a state-owned company that was established in 1976 as a chemical equipment manufacturer. The company profile is shown in Table 1.

Table 1 Company Profile

Name of Company	Chemical Machine and Equipment Company
Ownership	State-owned
Address	Hiep Phu Ward, Dist. 9, Ho Chi Minh City
Tel	08-8966920
Established	1972
Number of Employees	350
Area	25,000 m ²
Main Products	Chemical equipment (Boilers, Vessels, Structures etc.) Granite plates (new products)

1.2. Business Status**1.2.1. Production**

The volume of mechanical production of the company is around 1,000 ton/year. We were not informed of any further details.

1.2.2. Debt

From the Bank : 520 million VND.

2. Production Technology

2.1. Process

The overall block flow diagram is shown in Figure-1.

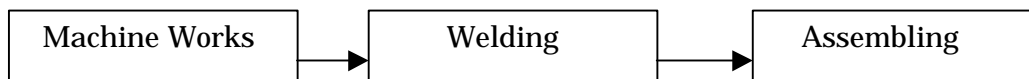


Figure 1 Overall Block Flow Diagram of The Company

2.2. Utility Consumption

Table 2 Utility Consumption

Material	Consumption
Water	60 m ³ /day (recycle water)
DO oil	24 ton/year
Coal	4,000 kg/year
Electric capacity	250 KVA

3. Management Technology

The management level of the company is considered to be at a standard level. The company developed a new product and has a back-up diesel generator.

4. Industrial Waste Water

The company does not discharge industrial waste water. The granite plate manufacturing shop uses a lot of water, but water is filtrated and recycled.

5. Improvement Proposals

There are no specific proposals, because the company has no industrial waste water.

Electrical Equipment Company

Survey Date: 07 December, 1999

1. General**1.1. Profile**

Electrical Equipment Company is a state-owned company that was established in 1977 as an electrical equipment manufacturer. The company profile is shown in Table 1.

Table 1 Company Profile

Name of Company	Electrical Equipment Company
Ownership	State-owned
Address	Khu Cong Nghiep Bien Hoa 1, Dong Nai
Tel	061-836139
Established	1977
Number of Employees	500
Area	41,000 m ²
Main Products	Distribution transformers, Motors, Capacitors

1.2. Business Status**1.2.1. Production**

Table 2 shows production and sales of the company in 1998.

Table 2 Production and Sales in 1998

Item	Unit	Production	Turnover (million VND)
Single phase transformers	Set	3430	
Three phase transformers	Set	1274	
Motors	Set	1230	
Other products	Set	3532	
Total			120,000

1.2.2. Debt

No information.

2. Production Technology

2.1. Process

The overall block flow is shown in Figure 1. 80% of the work is done manually and the remaining 20% is done semi-automatically.

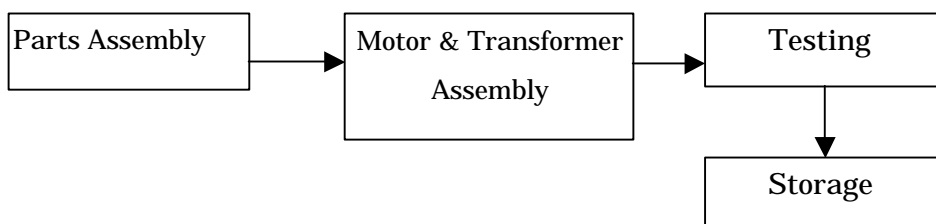


Figure 1 Overall Block Flow of The Company

2.2. Materials and Utility Consumption

Table 3 Materials and Utility Consumption

Materials	Unit	Consumption
Core of Transformer	t/year	1,100
Steel	t/year	662.726
Copper Wire	t/year	191.413
Insulation Paper	t/year	78
Lubricant	l/year	1,000,000
Gas	l/year	1,600
FO Oil	l/year	36,000
DO Oil	l/year	2,000
Lubricant	l/year	6,000

3. Management Technology

The management level of the company is good. The factory is well managed. The company is competitive in small and medium size electrical equipment.

4. Industrial Waste Water

4.1. Waste Water System

The company discharges the following three kind of waste water :

- 1) Domestic use waste water is sent separately to a local environmental service company.
- 2) Waste water discharged from the painting pretreatment process which is collected to a special waste water tank and sent to a treatment company by a tank truck. (Waste Water Sample No.2)
- 3) The remaining industrial waste water (including rain water) is discharged to a common industrial sewage system directly. (Waste Water Sample No.1)

4.2. Waste Water Analysis Results (07 November, 1999)

Waste water analysis results are shown in Table 4.

Table 4 Waste Water Analysis Results (7 November 1999)

Sample No.	Unit	1. Final pit	2. 10% Tank
Flow rate	m ³ /day	14	2
Temperature	° C	26.8	28.5
pH		1.97	5.1
Electric conductivity	μ S/cm	390	80
Turbidity	NTU	319	570
Oil content	mg/l	11	156
BOD	mg/l	1	43
COD	mg/l	3	471
DO	mg/l	1	2.8
Cyanide	mg/l	0.11	0.06
Fe	mg/l	18.6	13.2
Zn	mg/l	0.53	0.01
Pb	mg/l	0.194	0.147
Cr ⁺⁶	mg/l	0.012	0.016
Ni	mg/l	0.083	0.067
Salt	mg/l	0.02	0.03

5. Improvement Proposals

The factory is well managed and the volume of waste water of the company is small. Although the polluted waste water is treated separately, the remaining 70% of the waste water is directly discharged to public sewage, and is still exceeding TCVN limitation. So, it is recommended that a waste water treatment unit be

installed.

5.1 Conceptual Design of the Water Treatment Unit

According to the waste water analysis results, a conceptual design of a water treatment unit was carried out in this study and is summarized as follows. However, the company need to reconfirm the correct design basis before starting detailed design work.

5.1.1 Design Basis

The data from “1, Final pit”, is shown in Table 4 and was used for the design basis.

5.1.2 Conceptual Design

(1) Flow Sheet

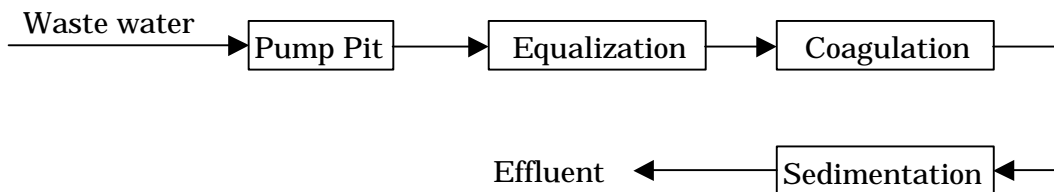


Figure 2 Flow Sheet

(2) Main Equipment List

Table 5 Main Equipment List

Name of Equipment	No. Req'd.	Remarks
Pump Pit	1	1m ³ , RC
Waste Water Pump	2	Submerged, 0.15m ³ /min
Equalization Tank	1	13m ³ , RC
Transfer Pump	2	Volute, 0.015m ³ /min
Coagulation Tank	1	0.2m ³ , Steel(lining)
Sedimentation Tank	1	3m ³ , Steel(lining)
Control Building	1	4mW x 6mL

(3) Required Cost

The rough estimated cost is about 400 million VND.

VINAPPRO

Survey Date: 07 December, 1999

1. General**1.1 Profile**

VINAPPRO is a state-owned company that was established in 1969 as an engine manufacturing company. The company profile is shown in Table 1.

Table 1 Company Profile

Name of Company	VINAPPRO
Ownership	State-owned
Address	Bien Hoa Industrial Zone, Dong Nai Province
Tel	613-36163/36155
Established	1969
Number of Employees	500
Area	50,000 m ²
Main Products	Diesel engines, Equipment for agriculture

1.2 Business Status**1.2.1 Production**

Table 2 shows production and sales of the company in 1998.

Table 2 Production and Sales in 1998

Item	Unit	Production	Turnover (million VND)
Internal combustion engines	Piece	2,275	10,826
Husk grinding machines	Piece	13,806	24,804
Rubber rolls	Pair	93,915	11,812
Water pumps	Piece	3,257	1,082
Total			48,524

1.2.2 Debt

From the Bank : 31,113.7 million VND

2. Production Technology

2.1 Process

The overall block flow is shown in Figure 1.

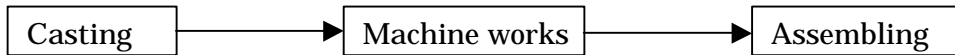


Figure 1 Overall Block Flow

2.2 Material and Utility Consumption

Table 3 Material and Utility Consumption

Material	Unit	Annual Consumption
Cast-iron ingot	Ton	1,200
Ferrous	Ton	12
Steel	Ton	250
Copper	Ton	1.2
Al ingot	Ton	20.5
Zinc ingot	Ton	0.6
Synthetic rubber	Ton	103
M.B.T.	Ton	5
Stearin	Ton	4.2
Sulfur powder	Ton	24
Coke	Ton	222
Diesel oil	Ton	5.2
Electric power	Kwh	1,500,000
Water	m ³	2,400

3. Management Technology

The management level of the company is high. The company has a quality control section and also has plans to obtain ISO certification. The company has a technical tie-up with Yanmer.

4. Industrial Waste Water

4.1. Industrial Waste Water System

Industrial waste water is discharged from the degreasing process, saponification process and painting process. Domestic use waste water and rain water are discharged separately.

4.2. Waste Water Analysis Results

Waste water analysis results are shown in Table 4.

Table 4 Waste Water Analysis Results (Dec.07, 1999)

Sampling place	Unit	Painting Out	Final Exit	TCVN5945
Flow Rate	m ³ /day		5	
Temperature		28	28.4	
pH		7.08	7.2	5.5-9
Elec. Conductivity	μ S/cm	10	1500	
Turbidity	NTU	215		
Oil	mg/l	228	5.9	1or10
BOD	mg/l	37	2	50
COD	mg/l	339	24	100
DO	mg/l	1	3.9	
Cyanide	mg/l	0.08	0.03	0.1
Salt	%	0.01	0	

5. Improvement Proposals

- 1) An oil separator is required at the discharge point of the painting shop.
- 2) The company need to apply for ISO certification because of their large amount of exports.

Viet Nam Wire and Cable Company (CADIVI)

Survey Date: 08 December, 1999

1. General**1.1 Profile**

Viet Nam Wire and Cable Company is a state-owned company that was established in 1972 as a cable and wire manufacturing company. The company has a head office and seven factories. The Survey Team visited the head office and one factory named VIDICO. Table 1 shows the company profile.

Table 1 Company Profile

Company Name	Viet Nam Wire and Cable Company (CADIVI)
Ownership	State-owned
Address: Head office VIDICO	70-72 Nam Ky Khoi Nghia St., Ho Chi Minh City Khu Cong Nghiep Bien Hoa 1, Dong Nai
Tel : Head office VIDICO	08-8299443 061-836200
Established	1972
Number of Employees	Total: 1,200 (VIDICO 145)
Area	VIDICO: 20,000 m ²
Main Products	Wire and cables for electric power, Magnetic wire for transformers and motors

1.2 Business Status of VIDICO**1.2.1 Production**

Table 2 shows production and sales of the company in 1998.

Table 2 Production and Sales in 1998

Item	Unit	Production	Turnover (million VND)
Many kinds of wire	Km	29,328	
Many kinds of cable	Km	546	
Control cable	Km	1,225	
Total			55,661

Total turnover of Viet Nam Wire and Cable Company in 1998 was around 25 to 30 million US\$.

1.2.2 Debt

CADIVI borrows money from the Bank and distributes it separately to each company. So,VIDICO is unaware of their total debt.

2. Production Technology

2.1. Process

1) Process of Copper-Aluminum Wire

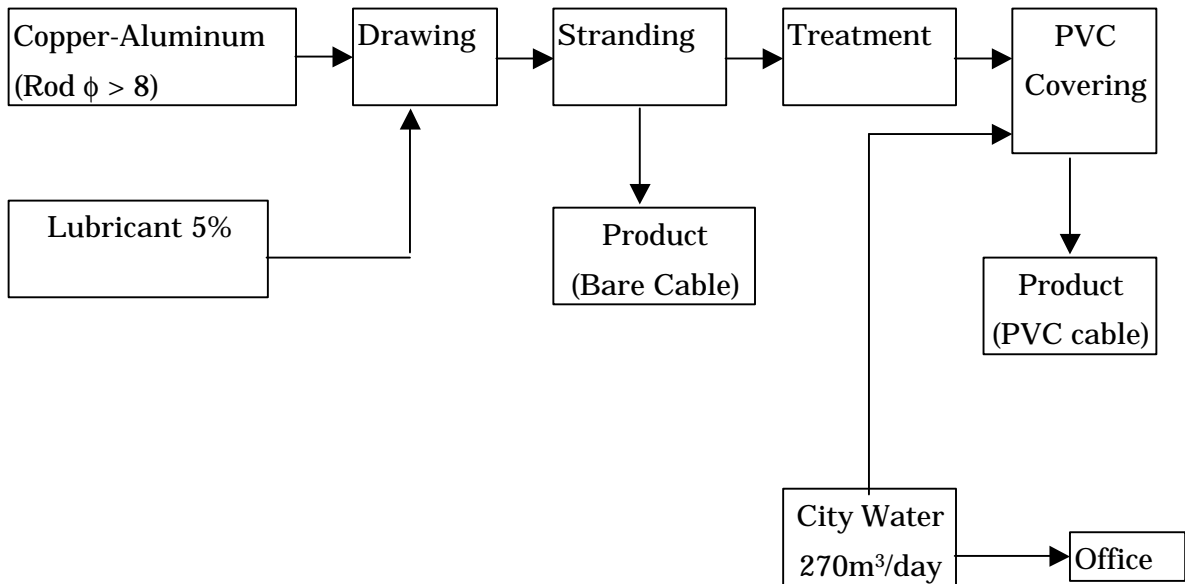


Figure 1 Process Flow Sheet (1)

2) Process of Power Magnet Wire

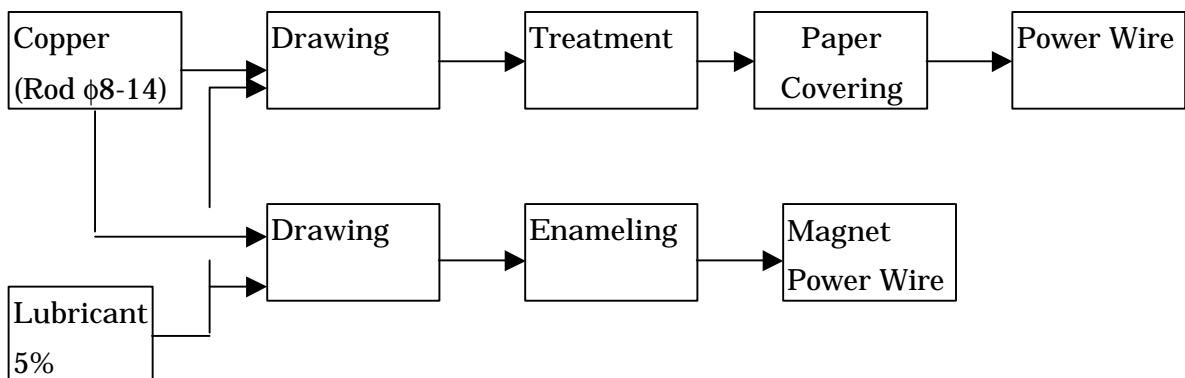


Figure 2 Process Flow Sheet (2)

2.2. Material Consumption and Cost

Table 3 Material Consumption and Cost

Materials	Unit Price	Consumption/year	Cost/year (million VND)
1.Copper Wire(bare)			
(1) Copper $\phi 8$	29,542 d/kg	166,958 kg	4,932.3
(2) Water	2,500 d/m ³	727 m ³	1.8
(3) Electric Power	840 d/kWh	22,204 kWh	18.7
2.Copper Wire (covered)			
(1) Copper $\phi 8$	29,731 d/kg	569,212 kg	16,923.2
(2) PVC	10,800 d/kg	285,054 kg	3,078.6
(3) Water	2,500 d/m ³	21,586 m ³	54.0
(4) Electric Power	840 d/kwh	345,936 kwh	290.6
3.Magnet Wire			
(1) Copper $\phi 8$	29,542 d/kg	461,197 kg	13,625.1
(2) Polyester	28,000 d/kg	19,580 kg	548.2
(3) Insulation Paper	32,884 d/kg	5,482 kg	180.3
(4) Water	2,500 d/kg	12,415 m3	31.0
(5) Electric Power	840 d/kwh	566,736 kwh	476.1
4.Alminum Wire (bare)			
(1) Aluminum $\phi 8$	24,500 d/kg	208,249 kg	5,102.1
(2) Steel	11,500 d/kg	92,159 kg	1,059.8
(3) Water	2,500 d/m ³	4,797 m ³	12.7
(4) Electric Power	840 d/kWh	78,490 kWh	65.9
5.Alminum Wire (covered)			
(1) Aluminum $\phi 8$	24,500 d/kg	5,256 kg	128.8
(2) Steel	11,500 d/kg	619 kg	7.1
(3) PVC	10,800 d/kg	3,959 kg	42.8
(4) Water	2,500 d/m ³	280 m ³	0.7
(5) Electric Power	840 d/kWh	5,798 kWh	4.9
6.Steel Work			
(1) Steel	11,500 d/kg	10,666 kg	122.7
(2) Water	2,500 d/m ³	174 m ³	0.4
(3) Electric Power	840 d/kWh	661 kWh	0.6
Total			46,708.4

● Average monthly consumption

- Electric Power: 108,000kwh
- Water : 8,000m³
- PVC : 23.7ton
- PEW : 4.6ton
- Copper : 48 ton
- Aluminum : 19 ton
- Steel : 8.4ton
- Lubricant : 80 L

3. Management Technology

The company management has a firm policy of achieving high quality and high productivity. The company has been obtained ISO 9002 certification. The seven factories have a firm job allocation to achieve high productivity. In addition, ISO certification is required for exporting the company products.

4. Industrial Waste Water of VIDICO

4.1 Sewage System of VIDICO

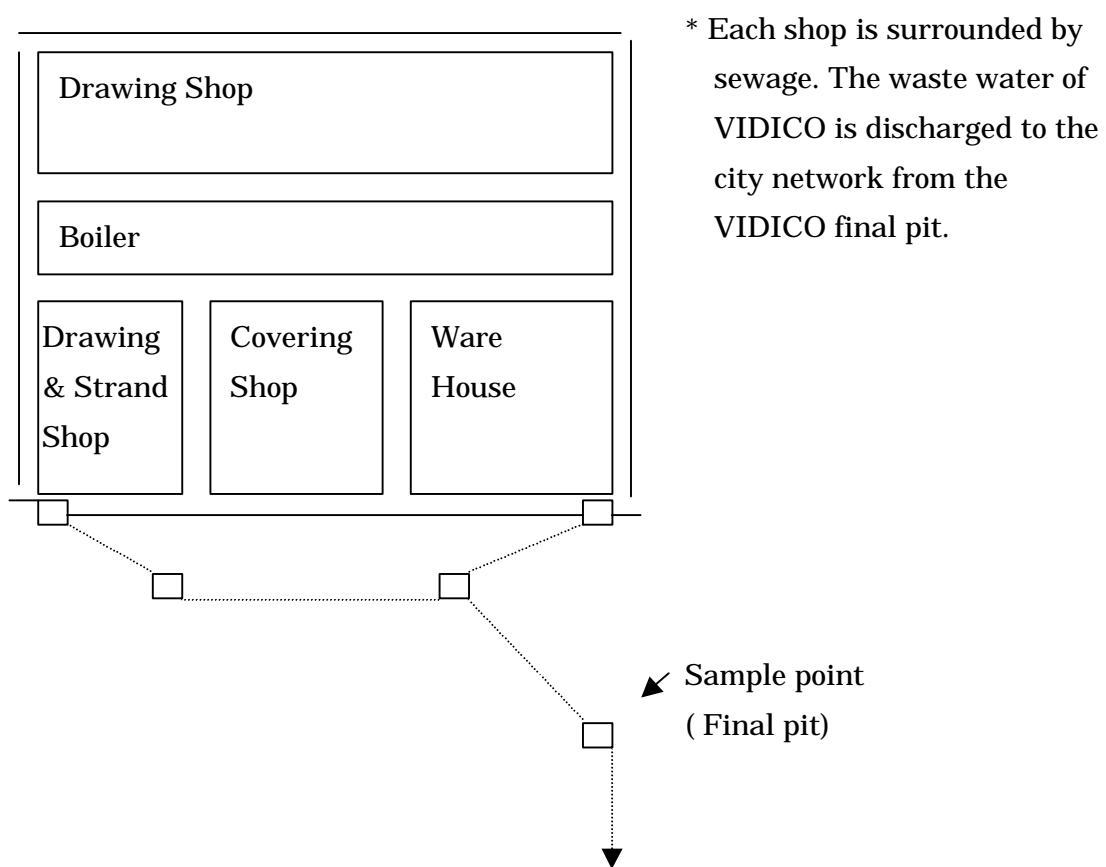


Figure 3 Sewage System

4.2 Waste Water Analysis Results (for VIDICO)

Waste water analysis results are shown in Table 4.

Table 4 Waste Water Analysis Results (Dec.08, 1999)

Sample Place	Unit	Final Pit	TCVN5945
Flow Rate	m ³ /day	< 10	
Temperature	°C	28.2	
pH		6.73	5.5-9
Elec. Conductivity	μS/cm	20	
Turbidity	NTU	152	
Oil content	mg/l	10.8	1or10
BOD	mg/l	20	50
COD	mg/l	48	100
DO	mg/l	16	
Cyanide	mg/l	0.03	0.1
Cu	mg/l	0.03	1.0
Fe	mg/l	0.49	5.0
Ni	mg/l	0.98	1.0

5. Improvement Proposals

According to the waste water analysis results, oil content of VIDICO waste water exceeds TCVN. So, it is recommended that a small oil separator be installed, around the final pit of VIDICO.

VINASTAR Motor Corporation

Survey Date: 10 December 1999

1. General**1.1. Profile**

VINASTAR Motor Corporation is a joint venture company that was established in 1995 as an automobile manufacturer. The share holders of the company are Tracimexco from Viet Nam, Mitsubishi Motors Corporation from Japan, Proton from Malaysia and Mitsubishi Corporation from Japan. The company profile is shown in Table 1.

Table 1 Company Profile

Name of Company	VINASTAR Motor Corporation
Ownership	Joint venture
Address	243 Truong Son Road, Thu Duc District, Ho Chi Minh
Tel	08-8962181
Established	1995
Number of Employees	140
Area	85,983 m ²
Main Products	Automobile (knock-down)

1.2. Business Status**1.2.1 Production**

700 automobiles were produced and sold in 1998 and 500 automobiles are expected to be produced and sold in 1999. Other details are not known.

1.2.2 Debt

No information.

2. Production Technology

2.1. Process

The block flow of the company is shown in Figure 1. The most important process is the surface treatment process before painting.

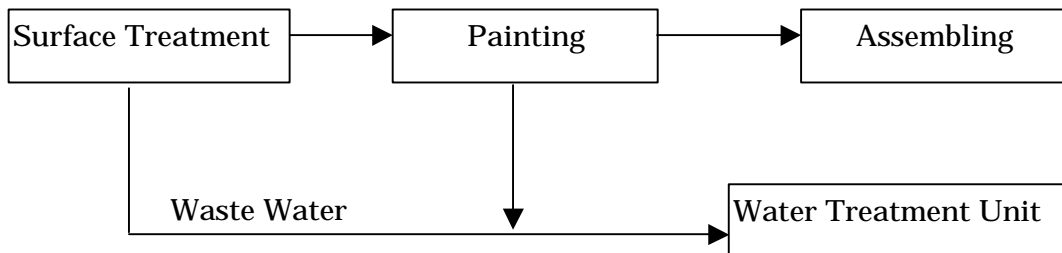


Figure 1 Block Flow of The Company

2.2. Material Consumption

Not informed.

3. Management Technology

The factory is very clean and documents are well controlled. The company has an activated sludge system water treatment unit. Their only major problem is that the company can not develop the sales market. There are more than ten (10) automobile companies in Viet Nam. The company ranks 4th among them.

4. Industrial Waste Water

4.1. Drainage System of the Company

The company has two drainage systems, one is for industrial waste water which is discharged from the surface treatment and painting processes, and the other is for domestic use water and rain water. The industrial waste water is treated by the activated sludge system water treatment unit .

4.2. Water Treatment Unit of the Company

The water treatment unit of the company applies an activated sludge system. The system configuration is shown in Figure 2.

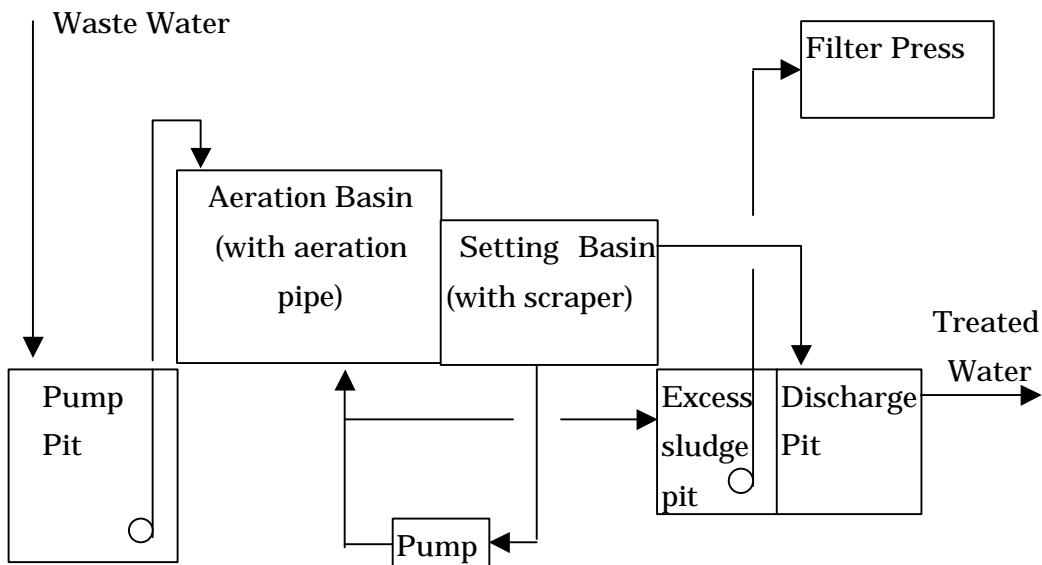


Figure 2 Water Treatment Unit of The Company

4.3 Waste Water Analysis Results

The analysis results of waste water are shown in Table 2

Table 2 Waste Water Analysis Results (Dec.10,1999)

Sampling Place	Unit	Final Pit	Before Treat.	TCVN5945
Flow Rate	m ³ /day		160	
Temperature	°C	26	26	
pH		7	7.5	5.5-9
Elec. Conductivity	μS/cm	170	260	
Turbidity	NTU	50	120	
Oil	mg/l	9	28	1or10
BOD	mg/l	63	28	50
COD	mg/l	150	370	100
DO	mg/l	4.7	7.5	
Cyanide	mg/l	0.03	0.09	0.1
Zn	mg/l	0.303	0.812	2.0
Pb	mg/l	0.093	0.238	0.5
Cr ⁺⁶	mg/l	0.081	0.107	0.1(1)

5. Improvement Proposals

Basically, there are no recommendations.

According to the analysis results, BOD and COD values exceed TCVN at the final pit. The domestic use waste water may affect BOD and COD levels.

Mechanics and Weapon Center

Survey Date: 14 December 1999

1. General**1.1. Profile**

Mechanics and Weapon Center is a state-owned company that was established in 1981 as a mechanics and weapon center belonging to the Ministry of Public Security. The company profile is shown in Table 1.

Table 1 Company Profile

Name of Company	Mechanics and Weapon Center
Ownership	State-owned
Address	808 Lac Long Quan Road, Bui Ward-Tay Ho Dist., Ha Noi
Tel.	8-353490
Established	1981
Number of Employees	120
Area	8,500 m ²
Main Products	Medals and Badges for Police, Steel Cabinets

1.2. Business Status

The turnover of the company in 1998 was 8 billion VND. We were not informed of other details.

2. Production Technology

Company activities only include manufacturing steel cabinets and plating. For plating, Cu-plating, Cr-plating, Ni-plating and Au-plating are performed. The plating technology is based on USSR technology. Rotary plating is applied for small pieces. Electrolyte contained cyanide is used for Cu-plating and Au-plating.

3. Management Technology

They have a large demand, but have only small capacity. The necessity of a

water treatment unit is recognized by management. However, no mention was made of any new project plans.

4. Industrial Waste Water

4.1. Drainage System of the Company

All waste water is gathered and directly discharged to the city drainage system. In the plating shop, the floor is tiled. Cr-plating, Ni-plating and Au-plating rooms are completely separated.

4.2. Waste Water Analysis Results

The waste water analysis results are shown in Table 2.

Table 2 Waste Water Analysis Results (Dec.14, 1999)

Sampling Place	Unit	Final Pit	Au,Ni mix Pit	Au Pit	Well Water	TCVN 5945
Flow Rate	m ³ /day	3				
Temperature	°C	24.8	24.5	23.9	23.1	
pH		2.04	3.4	1.75	6.74	5.5-9
Elec. Conductivity	μS/cm	488	172	1870	310	
Turbidity	NTU	16.4	71.3	19.2	6.1	
Oil	mg/l	0.11	0.15	0.13	0	1or10
BOD	mg/l	5.12	0.59	9.45	0.77	50
COD	mg/l	41.2	4.6	46.2	7.8	100
DO	mg/l	2.65	2.32	2.51	3.04	
Cyanide	mg/l	0.02	trace	trace	0	0.1
Cu	mg/l	6.65	2.34	5.69	0.02	1.0
Ni	mg/l	0.304	0.215	0.03	0	1.0
Cd	mg/l	0.612	0.006	0.01	trace	0.02
Cr ⁺⁶	mg/l	0.613	0.012	0.08	0	0.1
Zn	mg/l	0.41	0.39	0.35	0.03	2.0
Fe	mg/l	3.13	2.85	4.2	0.2	5.0

5. Improvement Proposals

(1) A highly efficient rinsing system which has a multi-rinsing tank is

recommended for reducing waste water.

- (2) The waste water volume is very small, but a proper water treatment unit need to be installed.

5.1 Conceptual Design of a Water Treatment Unit

According to the results of waste water analysis , a water treatment unit must be introduced. The conceptual design of a water treatment unit was carried out in this study and is summarized as follows:

5.1.1 Design Basis

The data from the “Final Pit” is shown in Table 2 and was used for the design basis.

5.1.2 Conceptual Design

- (1) Flow Sheet

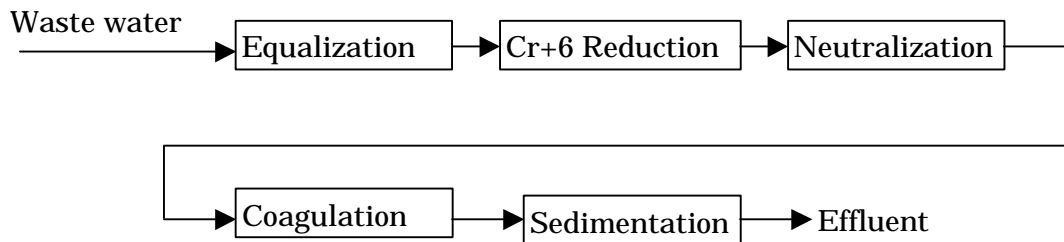


Figure 1 Flow Sheet

- (2) Main Equipment List

Table 3 Main Equipment List

Name of Equipment	No. Req'd.	Remarks
Equalization Tank	1	2m ³ , RC
Waste Water Pump	2	Submerged, 0.02m ³ /min
Cr ⁺⁶ Reduction Tank	1	0.3m ³ . Steel(lining), Mixer
Neutralization Tank	1	0.1m ³ , Steel(lining), Mixer
Coagulation Tank	1	0.03m ³ , Steel(lining), Mixer
Transfer Pump	2	Volute, 0.002m ³ /min
Sedimentation Tank	1	0.5m ³ , Steel
Control Building	1	4mW x 6mL

(3) Required Cost

The rough estimated cost is about 400 million VND.

Thanh Binh Corporation

Survey Date: 16 December 1999

1. General

1.1. Profile

Thanh Binh Corporation is a private company that was established in 1983 as a plating company. The company profile is summarized in Table 1.

Table 1 Company Profile

Name of Company	Thanh Binh Corporation
Ownership	Private
Address	2b Hao Nam, Ngo Quan Tho 1, Hanoi
Tel	8-516475
Established	1983
Number of employees	10
Area	120 m ²
Main Products	Small plated parts, such as bicycle accessories, motorbike accessories and bolts and nuts, etc.

1.2. Business Status

The company had 40 employees and a 180 m² area for plating previously, but now the company only has 10 employees and a 120 m² area for plating. The reason for this is that smuggled plating goods are invading the market. The turnover of the company in 1998 was 500 million VND.

2. Production Technology

2.1. Process

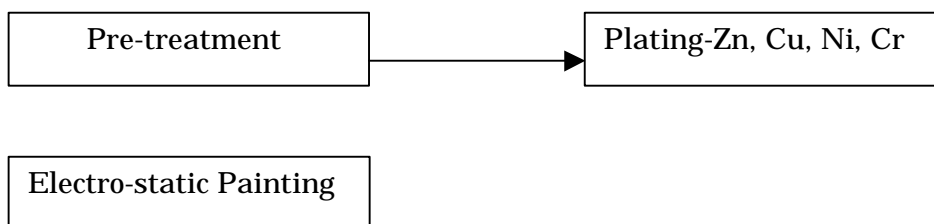


Figure 1 Process Flow

2.2. Material Consumption

No quantitative information was provided to us. However, Director informed us that the price of chemicals was becoming more and more expensive, and Ni and Cd anodes were becoming difficult to buy.

3. Management Technology

The company had been plating small goods such as hair clips, watch bands etc. However, such small plated goods are now being smuggled into the country, so the company has changed their plating goods to bigger ones, such as bicycle accessories, motorbike accessories etc.

4. Industrial Waste Water

4.1 Drainage System

10 m³/day industrial waste water is discharged to the city network directly without treatment.

4.2. Industrial Waste Water Analysis Results

The waste water analysis results are shown in Table 2.

Table 2 Waste Water Analysis Results (16 December 1999)

Sampling Place	Unit	Cu Plating Out	TCVN5945
Flow Rate	m ³ /day	(10)	
pH		2.97	5.5-9
Oil	mg/l	Trace	1or10
BOD	mg/l	71.6	50
COD	mg/l	125.8	100
SS	mg/l	180	100
Cyanide	mg/l	0.322	0.1
Cu	mg/l	2.76	1.0
Cr ⁺⁶	mg/l	0.095	0.1

() shows assumption.

5. Improvement Proposals

There are many similar plating companies in Hanoi, so the local government has instructed them to move to industrial zones. Of course, there are many difficulties with this proposal, such as a lack of funds, transportation etc. However, it is the only way to improve industrial waste water pollution for small plating companies.

5.1 Conceptual Design of Water Treatment Unit

According to the waste water analysis results, a water treatment unit must be introduced. The conceptual design of a water treatment unit was carried out in this study. However, the company need to investigate a more accurate design basis before starting detailed design work.

5.1.1 Design Basis

The data shown in Table 2 was used for the design basis.

5.1.2 Conceptual Design

(1) Flow Sheet

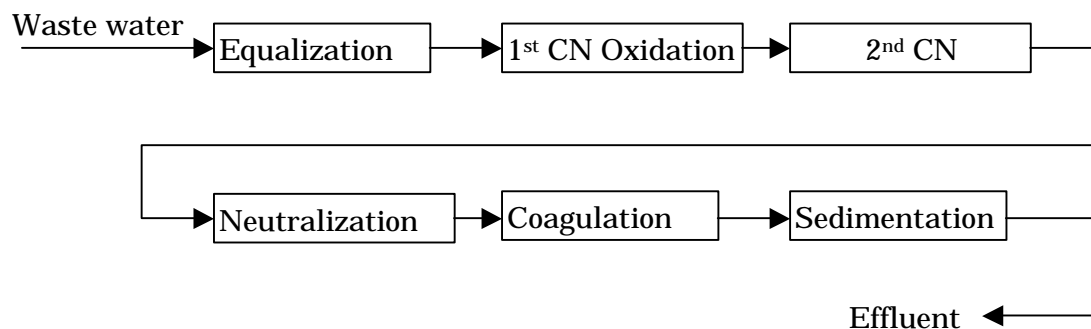


Figure 2 Flow Sheet

(2) Main Equipment List

Table 3 Main Equipment List

Name of Equipment	No. Req'd.	Remarks
Equalization Tank	1	7m ³ , RC
Waste Water Pump	2	Submerged, 0.06m ³ /min
1 st CN Oxidation Tank	1	1m ³ , Steel(lining), Mixer
2 nd CN Oxidation Tank	1	1m ³ , Steel(lining), Mixer
Transfer Pump	2	Volute, 0.007m ³ /min
Neutralization Tank	1	0.4m ³ , Steel(lining), Mixer
Coagulation Tank	1	0.1m ³ , Steel(lining), Mixer
Sedimentation Tank	1	1.5m ³ , RC
Control Building	1	4mW x 6mL

(3) Required Cost

The rough estimated cost is about 450 million VND.