Chapter 4 Food Processing Sub-sector

4.1 Detailed Enterprise Study

4.2 Simplified Enterprise Study

CASE STUDY F-01

Ha Noi Liquor Company

Survey Date: 22 November 1999
9, 10 & 16 March 2000

1. General

1.1 Profile

Ha Noi Liquor Company (HALICO) is a state-owned company which belongs to VINABECO (Viet Nam Alcohol Beverage and Beer Corporation). The company profile of HALICO is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Cong ty ruou Ha Noi (Ha Noi Liquor Company)
Ownership:	State-owned
Address:	94 Lo Duc Street., Hai Ba Trung District, Ha Noi
Tel/Fax:	(04)9713249 – 8213157 – 9781341/(04)8212662
Director:	Mr. Nguyen Thuong Chat
Established:	1898
Corporate Capital:	
Number of Employees:	660
Main Products:	Alcohol, Liquor, Wine

HALICO (former name: Hanoi Liquor Factory) was established in 1898 and belonged to a French company, Phong Ten Liquor Company. This company was in business for more than 100 years.

After several years of suspended operations, the GOV allowed the Factory to be rebuilt and put into working condition in 1954. The main tasks and duties of the factory are the production of ethanol, liquor for local consumption and export in the amounts requested by the GOV.

In accordance with the decision of the GOV 388/CP regarding the renovation of factories, the Factory was improved and renamed the Hanoi Liquor Company as decided by the Ministry of Light Industry on 7 May 1993.

1.2 Organization

Figure 1 shows the organization of the Company.

The Quality Control and Technical Department is responsible for environmental protection, as well as the improvement of production technologies.

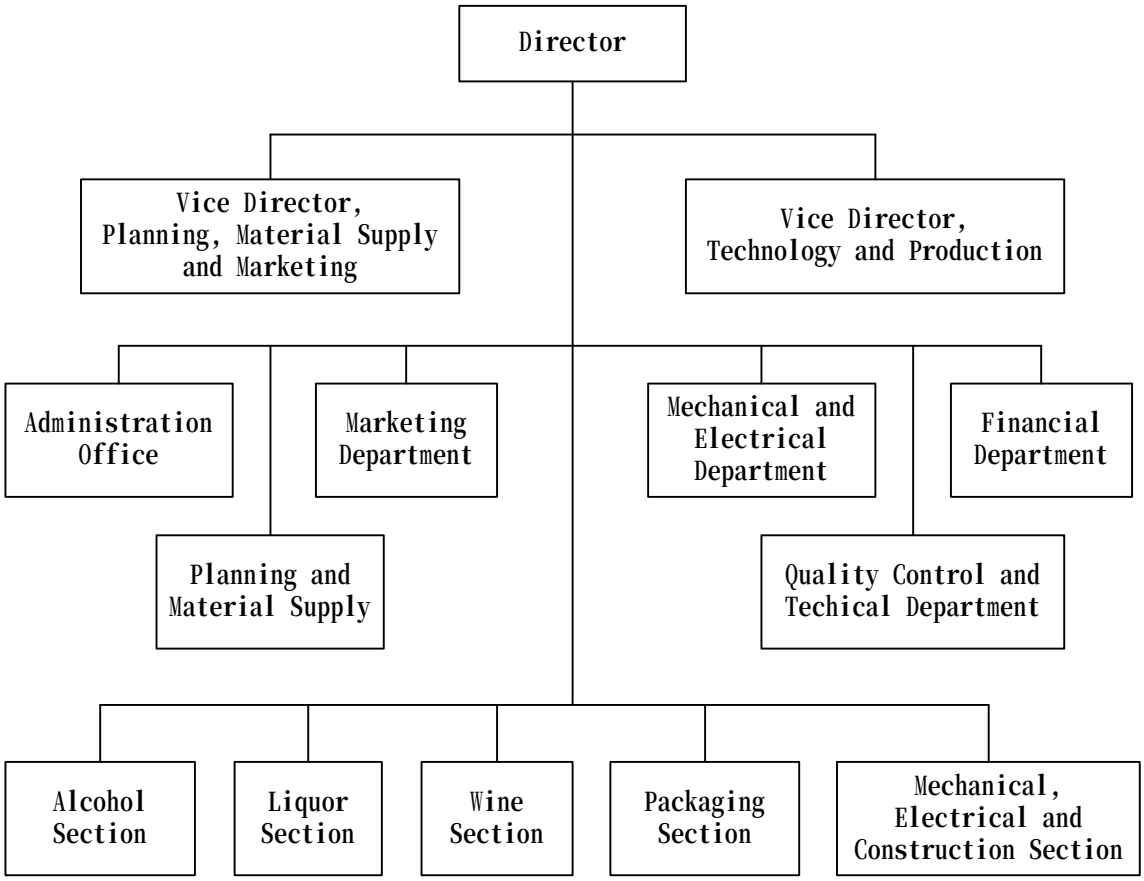

Figure 1 Organization of HALICO

1.3 Business Status

Before 1990, HALICO contributed quite a large amount of financing for protecting and building up the country through the sale of its products in local markets and export to other countries: their highest production total ever recorded was 6.5 million l-ethanol/year and 9 million l-liquor/year.

Since 1990, due to the loss of export markets, such as that of the former Soviet Union and other East European countries, the market situation has changed dramatically. Now, imported liquor is not taxed, individuals are allowed to make alcohol by themselves, and many private companies are permitted to produce ethanol of low quality. Consequently, the alcohol business became more and more competitive. HALICO, however, has guided itself into a favorable business position through good leadership and the efforts of hard-working employees.

Table 2 shows production and sales of HALICO.

Table 2 Production and Sales

Product	Production (l)		
	1997	1998	1999
Ethanol	1,075,542	1,753,029	2,139,516
Liquor		4,120,996	
CO_2 Liquid		30,928	
Wine		75,000	
Turnover (million VND)		54,343.1	

2. Production Technology

2.1 Process

Figure 2 shows a block flow diagram of the whole factory.

City water is used as process water, including for washing and domestic use. Every production unit is provided with a city water flow measuring meter.

Well water is used only for cooling purposes in the Ethanol section. No flow measuring meter is provided for well water.

2.1.1 Ethanol Section

Three units, Saccharification, Fermentation and Distillation in the Ethanol Section are operated batch-wise. The washing of equipment after batch production creates wastewater. Over the last several years, HALICO has made efforts to improve its production process as follows:

1) It was decided that enzymes, instead of acid and fungi, should be used for liquefaction and saccharification;
2) Hanoi Liquor has been recovering CO_2 from the Fermentation section and selling it as liquid CO_2.

2.1.2 Liquor Section

In the liquor section various kinds of liquor are produced batch-wise by adding specified ingredients to alcohol in mixing tanks. Tanks are washed after batch production and this creates wash wastewater.

2.1.3 Wine Section

Fruit wine is produced using grapes, apricots, strawberries and the like.

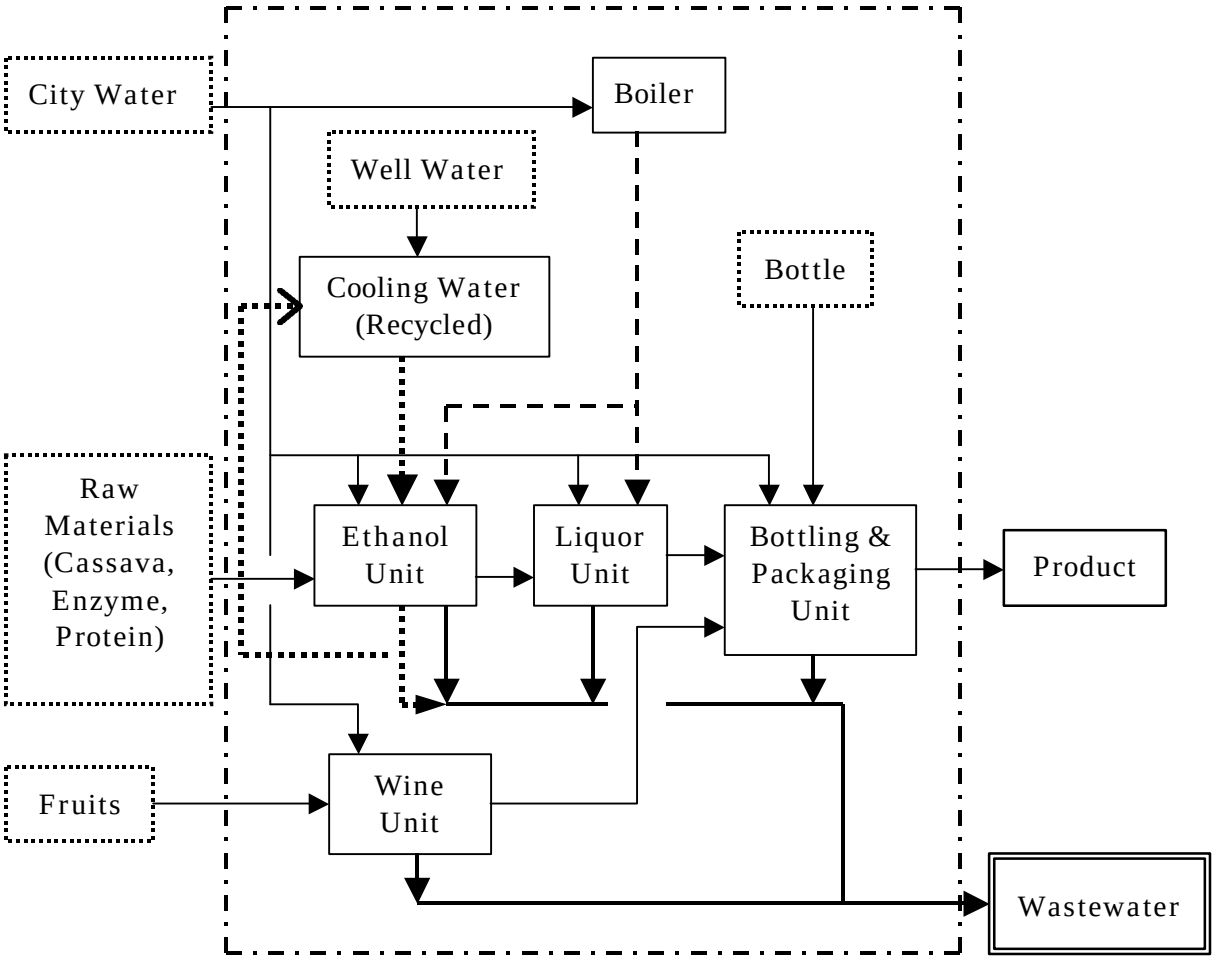

Figure 2 Block Flow Diagram of the Factory

2.1.4 Bottling and Packaging Section

The bottling section has been provided with a filling machine and a capping machine. Adjustment in the quantity of individual bottles and the inspection of caps are manually carried out by operators. Wastewater is created continuously from the bottle-washing unit.

2.2 Future Plans for Improvement

HALICO has the following future plans for process improvement:

1) Well water treatment for process use;
2) Renewal of bottling equipment;
3) In order to preserve underground water resources, a cooling water system that follows MOI policy is scheduled to be installed;

4) Wastewater treatment using biological technology;
5) Improvement of the quality of wine products;
6) Solid waste separation from the fermentor.

3. Management Technology

3.1 Production Losses

Production loss is calculated at approximately 3 % in the bottling section.

In order to reduce production loss, a filtration technology and distillation technology have been introduced respectively, from Germany and France.

3.2 Unit Consumption and Cost

Material balance and unit consumption are calculated for every purchase lot of cassava. Table 3 shows consumption and costs of raw materials and utilities in 1998.

Table 3 Unit Consumption and Cost in 1998

Material	Unit	Amount	Unit Consumption		Unit Price (VND)	Total Cost (1,000 VND)	Production Cost (VND/l)
1. Ethanol							
Cassava	kg	4,580,837	2.61	kg/l	1,610	7,375,148	4,207.0
Enzyme	kg	500	0.285	kg/l	127,000	63,500	36.2
Well Water	m^3	100,000	57	l/l			
City Water	m^3	87,680	50	l/l	3,000	263,040	150
Coal	t	3,384.8			350,000	1,184,680	675.8
Fuel Oil	t	133.245			1,813,000	241,573	137.8
Electricity	kWh	629,027			810	509,552	290.7
2. Liquor & Wine							
Ethanol	l	1,442,348			8,428.5	12,142,407	
Sugar	kg	115,000			6,500	747,500	
Fruits	t	36			6,000,000	216,000	
Bottle		5,085,444			1,700	8,645,266	
Cap		5,085,444			280	1,423,924	
Label		5,085,444			170	864,525	
Container		339,029			5,000	1,695,148	
Water	m^3	101,345			3,000	304,035	
Electricity	kWh	161,605			810	130,900	

HALICO has made efforts to improve unit consumption of raw materials and

utilities compared with the international standard that was published in 1980. Main unit consumption has been steadily improving in the three years since 1997 as shown in Table 4 and Figure 3.

Table 4 Trend of Unit Consumption

Materials	Unit	1997	1998	1999			
				1-4	8-9	11-12	Total
Cassava	kg/l-Ethanol	2.67	2.61	2.58	2.51	2.50	2.54
Electricity	kWh/l-Ethanol	0.375	0.324	0.302	0.298	0.170	0.267
Water	m^3/l-Ethanol	0.059	0.032	0.017	0.023	0.033	0.023
Coal	kg/l-Ethanol	1.822	1.16	0.905	0.739	0.781	0.85

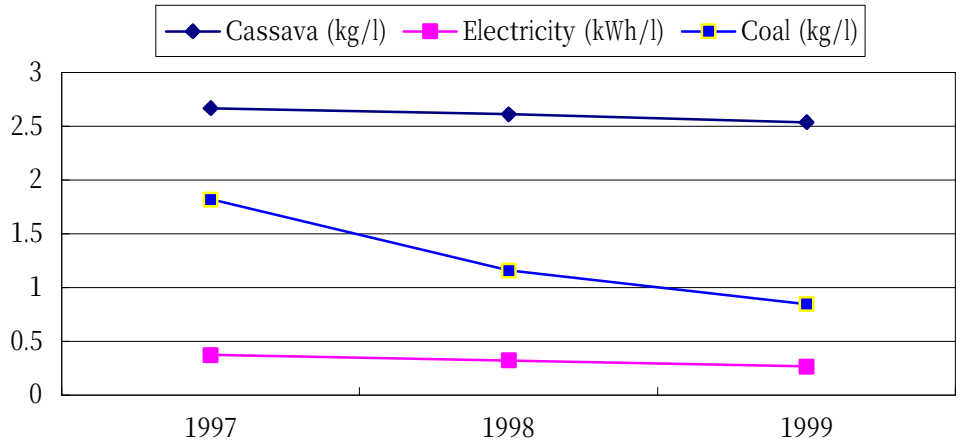

Figure 3 Unit Consumption of Materials per Liter-Ethanol

4. Industrial Wastewater Treatment and Discharge

Wastewater from the factory is classified as follows;

1) Cooling wastewater from the Ethanol section:
   (a) cooling wastewater from the liquefaction vessels and the saccharification vessels (80 m^3/h);
   (b) cooling wastewater from the distiller overhead condensers (80 m^3/h).
2) Wash wastewater from every production section;
3) Blow down wastewater from the primary distiller bottom (144 m^3/day).

Wastewater from each production unit is collected and discharged into the city sewer without treatment. The outline of the wastewater line is shown in Figure 4. Wastewater samples were taken at the spots shown in Figure 4 in this study.

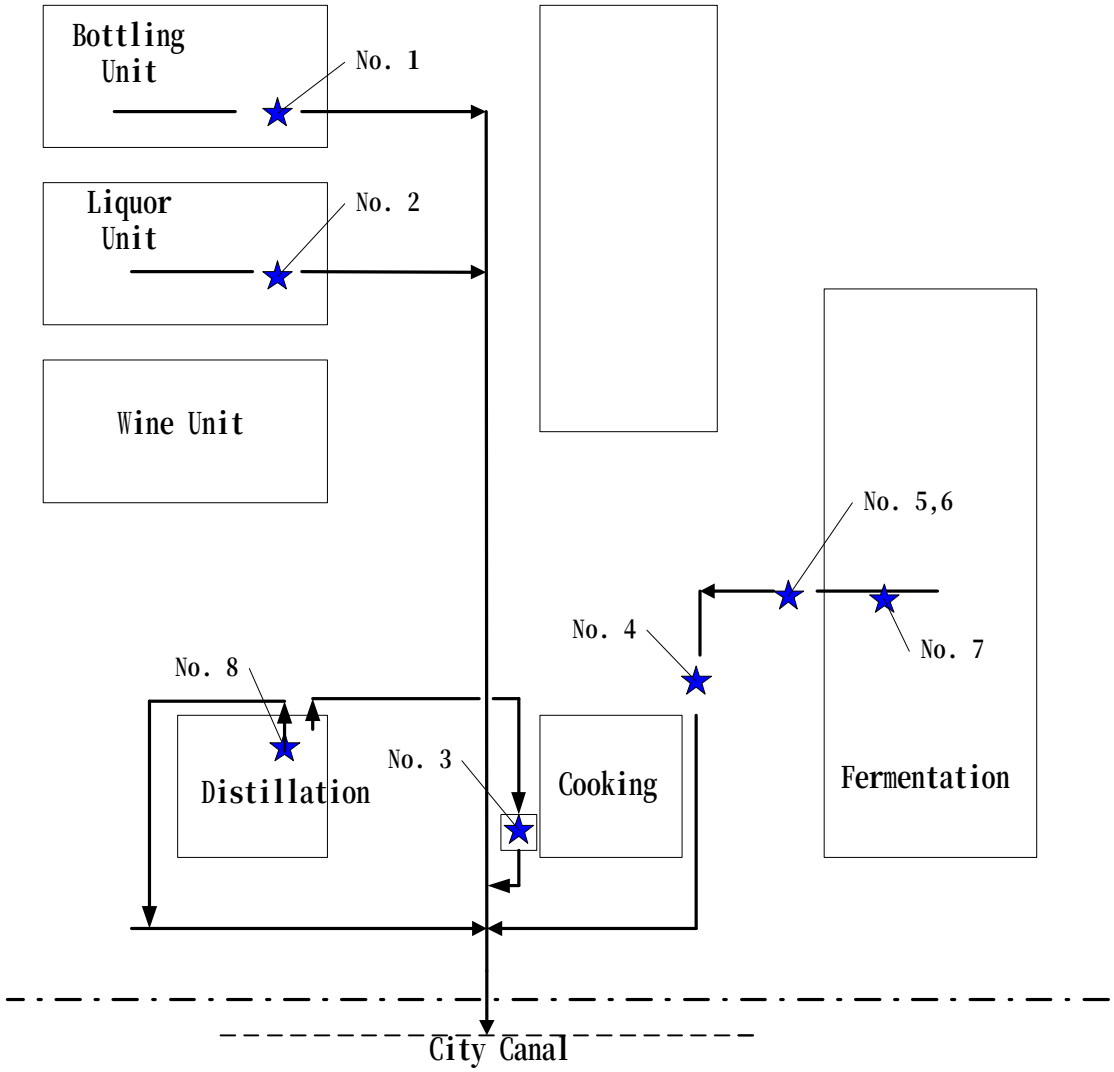

Figure 4 Outline of the Wastewater Route in HALICO

(1) Wastewater Samples Taken in November 1999

Samples were taken on 22 and 23 November 1999 as follows:

1. Bottle washing wastewater at sampling point No. 1;
2. Wastewater from the Liquor section at sampling point No. 2;
3. Distiller cooling wastewater at sampling point No. 3;
4. Cooker cooling wastewater at sampling point No. 4;
5. Fermentor washing wastewater at sampling point No. 5;
6. Fermentor washing wastewater at sampling point No. 6;
7. Distiller bottom blow down water at sampling point No. 8;
8. Distiller cooling wastewater at sampling point No. 3.

Tables 5 and 6 show the analysis results of the samples mentioned above.

Table 5 Wastewater Quality (22 November 1999)

Item	Unit	Sample number and sampling time				
		1 (11:40)	2 (12:00)	3 (12:10)	4 (12:20)	5 (12:26)
Temperature	℃	25.0	24.1	48.2	33.2	29.0
pH	-	7.97	7.49	7.8	7.59	7.67
Electric Conductivity	μS/cm	220	278	595	618	616
Turbidity	NTU	9	15	10	9	9
Oil & Grease	mg/l	0.22	0.38	1.3	0.4	0.11
DO	mg/l	7.3	4.45	5.05	6.0	6.3
SS	mg/l	8	14	26	6	12
COD	mg/l	64	44.8	68.8	88	55.2
BOD	mg/l	30	28	54	70	40
Total Nitrogen	mg/l	4.8	4.64	8.4	7.6	5.97
Residual Chlorine	mg/l	0.02	0.05	0.04	0.02	0.02
Phenol	mg/l	0.000	0.001	0.003	0.004	0.001

Table 6 Wastewater Quality (23 November 1999)

Item	Unit	Sample number and sampling time			TCVN 5945 (1995)
		6 (11:40)	7 (11:50)	8 (12:00)	
Temperature	℃	31.5	97.3	43	40
pH	-	6.56	3.5	7.72	5.5-9
Electric Conductivity	μS/cm	697	423	518	
Turbidity	NTU	820	4,629	45	
Oil & Grease	mg/l	0.34	0.81	1.57	10
DO	mg/l	4.8	1.3	6.2	
SS	mg/l	3,440	4,028	37	100
COD	mg/l	10,400	18,000	800	100
BOD	mg/l	7,530	15,440	640	50
Total Nitrogen	mg/l	48	69	22	60
Residual Chlorine	mg/l	0.02	0.01	0.02	2
Phenol	mg/l	0.003	0.001	0.002	0.05

(2) Wastewater Samples Taken in March 2000

Samples were taken on 16 March 2000 as follows:

1. Fermentor washing wastewater at sampling point No. 7;
2. Saccharification vessel wash wastewater at sampling point No. 4;
3. Distiller drain at sampling point No. 8;
4. Bottle washing wastewater at sampling point No. 1.

Table 7 shows the analysis results of the wastewater samples taken.

Table 7 Wastewater Quality (16 March 2000)

Item	Unit	Sample number and sampling time				TCVN 5945 (1995)
		1 9:05	2 9:15	3 9:30	4 9:45	
Temperature	℃	25.0	25.7	90	24.6	40
pH	-	5.9	7.2	4.49	7.4	5.5-9
Electric Conductivity	μS/cm	1140	710	2950	230	
Turbidity	NTU	616	135	2423	13	
Oil & Grease	mg/l	0.74	0.65	0.87	0.19	10
DO	mg/l	4.2	5.9	0.7	6.42	
SS	mg/l	1725	347	10650	5	100
COD	mg/l	11200	3920	27200	72	100
BOD	mg/l	7840	2733	19040	31	50
Total Nitrogen	mg/l	52	12	71	3.9	60
Residual Chlorine	mg/l	3.46	0.52	6.7	0.01	2
Phenol	mg/l	0.04	0.007	0.002	0.001	0.05

Based on the analysis results, HALICO's wastewater is characterized as follows:

1) The temperature, SS, COD and BOD of the blow down wastewater from the distiller bottom is extremely high;
2) Wastewater generated during the washing operation contains high concentrations of organic pollutants;
3) It seems that wastewater generated during ordinary operations, other than that at the distillation unit, has little environmental impact except in the case of a few parameters.

5. Countermeasures for Industrial Pollution Prevention

5.1 Current Problems

Current issues in HALICO concerning wastewater are summarized as follows:

(1) Contaminated and hot wastewater are discharged into the city sewer without treatment;
(2) Clean wastewater is mixed with dirty wastewater resulting in a high volume of wastewater;
(3) Solid waste from fermentors is washed into wash wastewater;
(4) It is difficult to take a wastewater sample at the final discharge point because the wastewater pit has been closed off with concrete.

5.2 Production Technology Improvement

5.2.1 Wastewater Classification

It is possible to reduce the amount of contaminated wastewater by classifying and recycling clean wastewater as follows:

(a) Bottle washing wastewater can be discharged to the city canal without treatment;

(b) Cooling wastewater from the distillers and the cookers can be recovered for reuse after re-cooling;

5.2.2 Installation of a Cooling Tower

In order to reuse cooling wastewater as mentioned above, it is necessary to install a cooling tower. The company should carry out the existing plan for a cooling tower according to their prearranged program.

5.2.3 Recovery of Fermented Solid Waste

Solid waste remaining in fermentors after a batch operation can be recovered by installing a centrifugal separator and reused as animal feed or fertilizer. It is expected that this measure will reduce the environmental impact of the blow down wastewater from the primary distiller.

5.3 Wastewater Treatment

5.3.1 Design Basis

The total volume of wastewater to be treated is set at 230 m^3/day, and is incorporated in future improvement plans for wastewater classification. The qualities of wastewater to be treated are calculated based on analysis results and each flow rate at major discharge points, estimated by factory staff, are shown in Table 8.

5.3.2 Conceptual Design

Based on the above data, a conceptual design of a wastewater treatment system was constructed by the study team.

Summarizing the results of the conceptual design, the block flow diagram and the basic dimensions of major equipment for the wastewater treatment system are shown respectively, in Figure 6 and Table 9. The schematic process flow sheet is

shown in Figure 7.

5.3.3 Factory Layout

The site plan for the wastewater treatment system is shown in Figure 8. An area of approximately 600 m^2 can be allocated for a cooling tower nearby the planned area. Figure 5 shows a picture of the planned site for the wastewater treatment system.

Figure 5 Wastewater Treatment System Site

5.3.4 Required Cost

The required construction cost of the wastewater treatment system, based on conceptual design, is estimated at 4.6 billion VND.

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6. Recommendations

6.1 Short Term Basis Recommendations

On a short term basis, it is recommended that the company take the following preparatory actions which will be the basis for mid-term countermeasures:

1) Work out implementation plans for:
   (a) The cooling tower project;
   (b) The wastewater treatment project.
2) Prepare wastewater sampling measures for final discharge wastewater (It is important to get hold of the quality of discharged wastewater).

6.2 Mid-Term Basis Recommendations

On a mid-term basis, it is recommended that a wastewater treatment system be installed as discussed in Section 5.3. The cooling tower project should be implemented parallelly with the wastewater treatment project.

It is also recommended that wastewater treatment operation experts be invited to the company in order to establish and optimize operating conditions, especially for the biological treatment system.

6.3 Long Term Basis Recommendations

On a long term basis, it is recommended that a solid waste recovery project be implemented for solid waste in the fermentors. This measure includes switching current fermenters in use to fermentors made of SUS.

In addition, it is most important to maintain stable operation of the wastewater treatment system.

6.4 Implementation Schedule

An implementation schedule is for the countermeasures for industrial pollution prevention has been planned and, is shown in Figure 9. The cooling tower should be put into operation before the test operation of the wastewater treatment system, which is expected to commence operations in the middle of 2003.

Table 8 Design Basis of Wastewater Volume and Quality (Ha Noi Liquor Company)

Wastewater Source	Volume	Temp.	pH	Wastewater Quality COD	BOD	SS	Oil	Total-N	Note
	(m3／day)	℃		(mg／l)	(mg／l)	(mg／l)	(mg／l)	(mg／l)	
1) Distillation Column Bottom Drain	144	90		27200	19040	10650	0.87	71	sample 3
2) Fermentation Section Washing	30	25		11200	7840	1725	0.74	52	sample 1
3) Cooking Section Washing	9	25.7		3920	2733	347	0.65	12	sample 2
4) Wine Production Section	30	25		11200	7840	1725	0.74	52	same as sample 1
5) Floor Washing	17	25		11200	7840	1725	0.74	52	same as sample 1
Sub Total	230	65.7		20933	14652	7258.9	0.8	62.3	
Contaminants discharged per day	m3/Day	℃		kg/Day	kg/Day	kg/Day	kg/Day	kg/Day	
	230	65.7		4814.5	3370.0	1669.5	0.2	14.3	
Cooling Water Volume for Distillation bottom Drain (Drain temperture should be cooled down to 45℃)									
	393	(30-45)		0	0	0	0	0	

Calculation Base of Wastewater Volume & Quality per Day

1) All Data has been adopted in accordance to the result of discussions on 9th March.

2) To clear the wastewater temperature standard, cooling water for the distiller bottom drain is necessary.

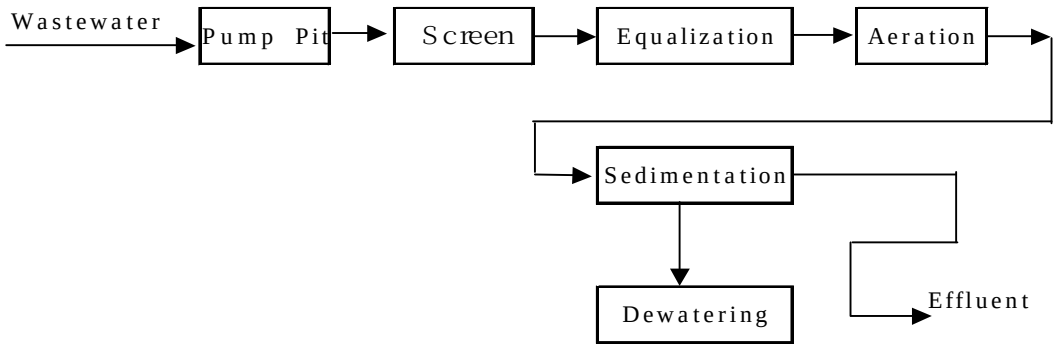
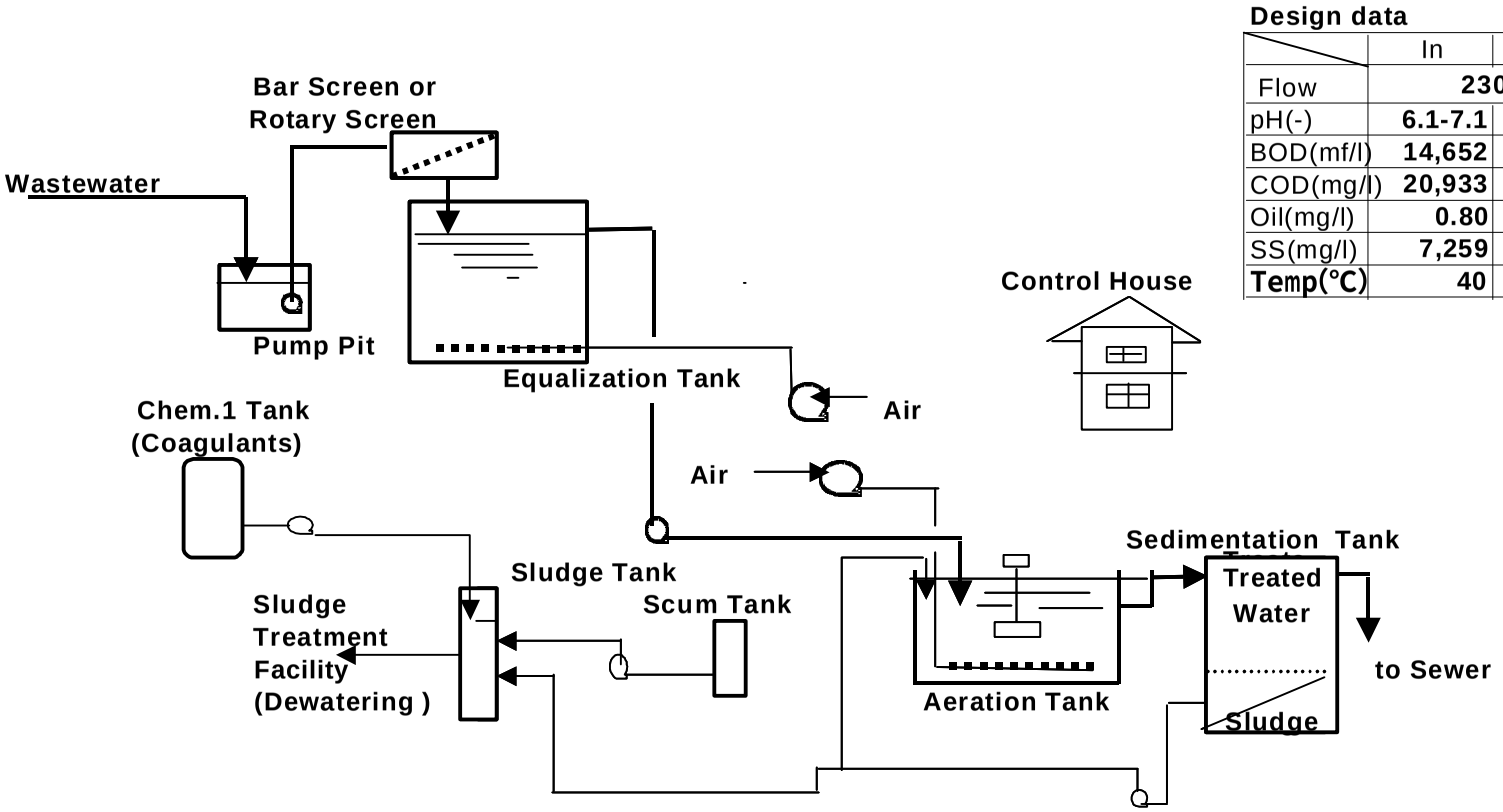


Figure 6 Block Flow sheet of the Wastewater Treatment system (Ha Noi Liquor Company)

Table 9 Basic Dimensions of Major Equipment

Name of Equipment	No. of Unit Required	Remarks
Pump Pit	1	$10m^3$ RC
Wastewater Pump	2	Submerged, $0.8m^3$/min 3.4kW
Screen	1	1mm mesh
Equalization Tank	1	$153m^3$ RC, 7m dia. 4.5m d
Blower for the Equalization Tan	2	Rotary $1.5m^3$/.min 1.9kW
Equipment for the Equal.Tank	1	Diffuser Type
Transfer Pump	2	Volute, $0.2m^3$/min 0.4kW
Aeration Tank	1	$345m^3$ RC, 5mw*4.5mD*16mL
Blower for the Aeration Tank	3	Rotary $50m^3$/.m 56kW*3sets
Equipment for the Aeration.Tank	1	Diffuser Type
Sedimentation Tank	1	61m3, 4m dia. 4m d RC
Return Sludge Pump	2	Volute, $0.2m^3$/m 0.2kW
Sludge Collector	1	Mechanical Rake
Dewatering Facilities	5	Belt Filter, 3m Width*5 sets
Chemical Dosing	1	Cation Polymer Tanks and Pumps
Control Building	1	8mW*18mL Steel Slated, 2 Stories



Design data

	In	Out	VN.Std
Flow	230m^3/D		
pH(-)	6.1-7.1	5-9	5.5-9.0
BOD(mf/l)	14,652	50	50
COD(mg/l)	20,933	100	100
Oil(mg/l)	0.80	10	10
SS(mg/l)	7,259	100	100
Temp(℃)	40		≦40

Figure 7 Schematic Flow of the Wastewater Treatment System
(Ha Noi Liquor Company)

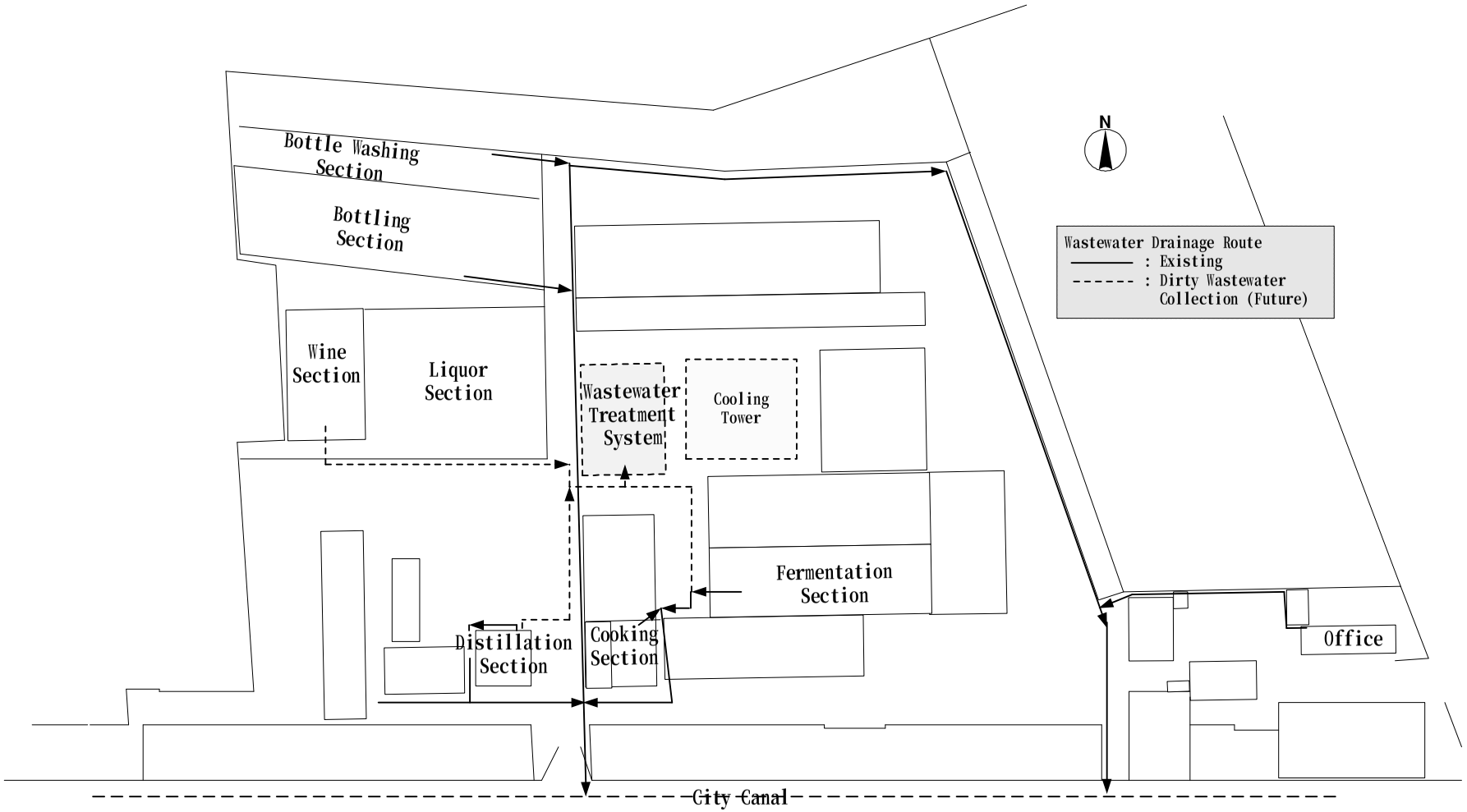


Figure 8 Factory Layout and Wastewater Drainage Route
(Ha Noi Liquor Company)

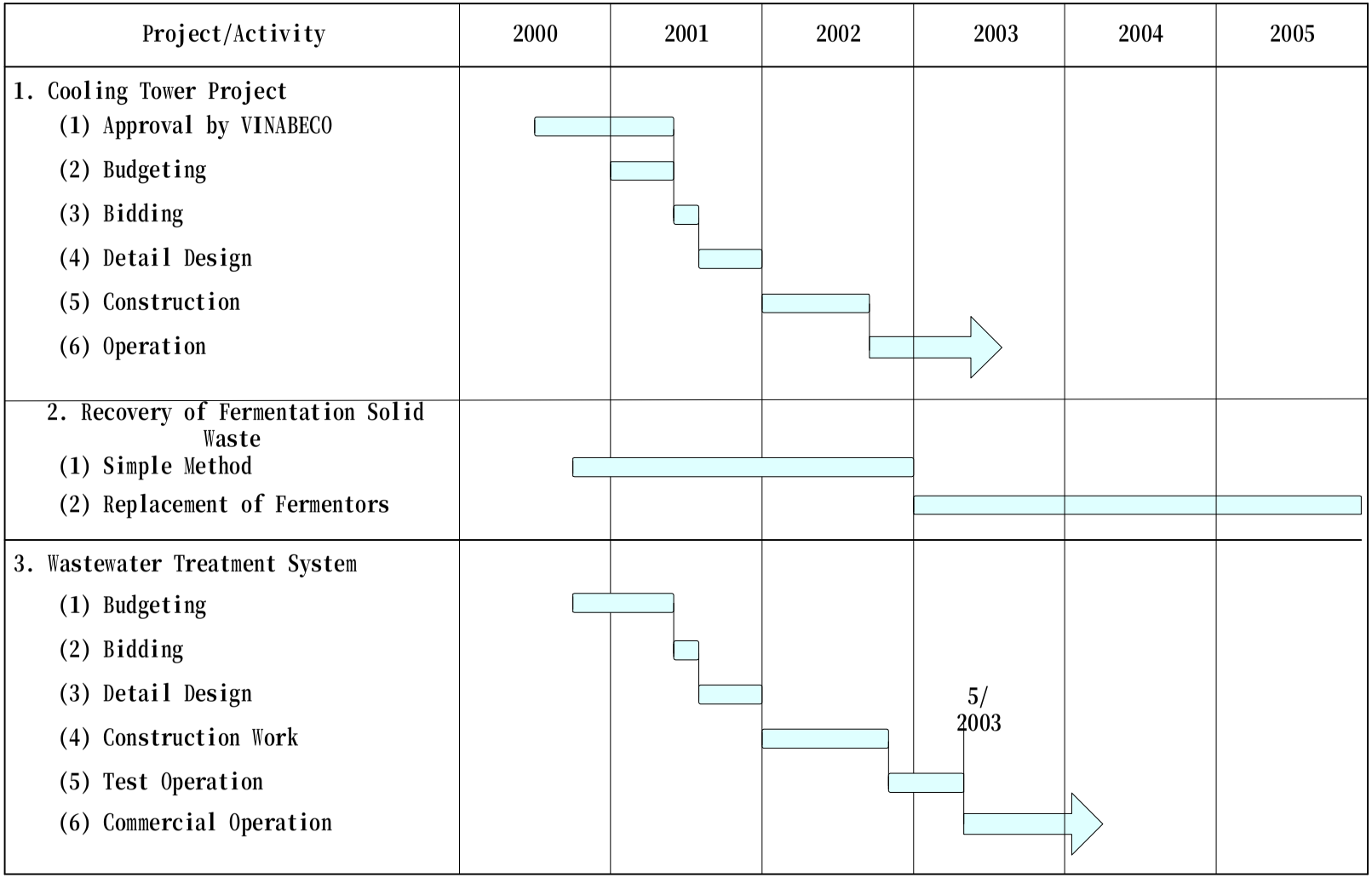


Figure 9 Proposed Implementation Schedule for Industrial Pollution Prevention Countermeasures (Ha Noi Liquor Company)

CASE STUDY F-02

Hai Ha Confectionery Company

Survey Date: 29 November 1999
13-15 March 2000

1. General

1.1 Profile

Hai Ha Confectionery Company, a state-owned company that was established in 1960, is the biggest confectionery maker in Viet Nam. The profile and organization of Hai Ha Confectionery Company are shown respectively, in Table 1 and Figure 1. The Company has two subsidiary companies, one in Viet Tri and one in Nam Dinh, and owns a 29 % share in a joint venture with "Kotobuki," a Japanese company that was established in 1994. The assets of the Company have reached 70 billion VND.

Table 1 Enterprise Profile

Name of Company:	Hai Ha Confectionery Company
Ownership:	State owned
Address:	25 Truong Dinh Str., Hai Ba Trung, Ha Noi
Tel/Fax	844－8632956, 844－8631683
Director:	Mr. Nguyen Tien Dung
Established	1960
Corporate Capital	
Number of Employees:	1,100
Main Products:	Confectionery

1.2 Business Status

1.2.1 Production

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

Table 2 Production and Sales in 1998

Product	Production (t/year)	Turnover
Soft Candy	6,000	
Hard Candy	2,000	
Biscuits	2,034	
Crackers	1,400	
Total	11,434	171.5 billion VND

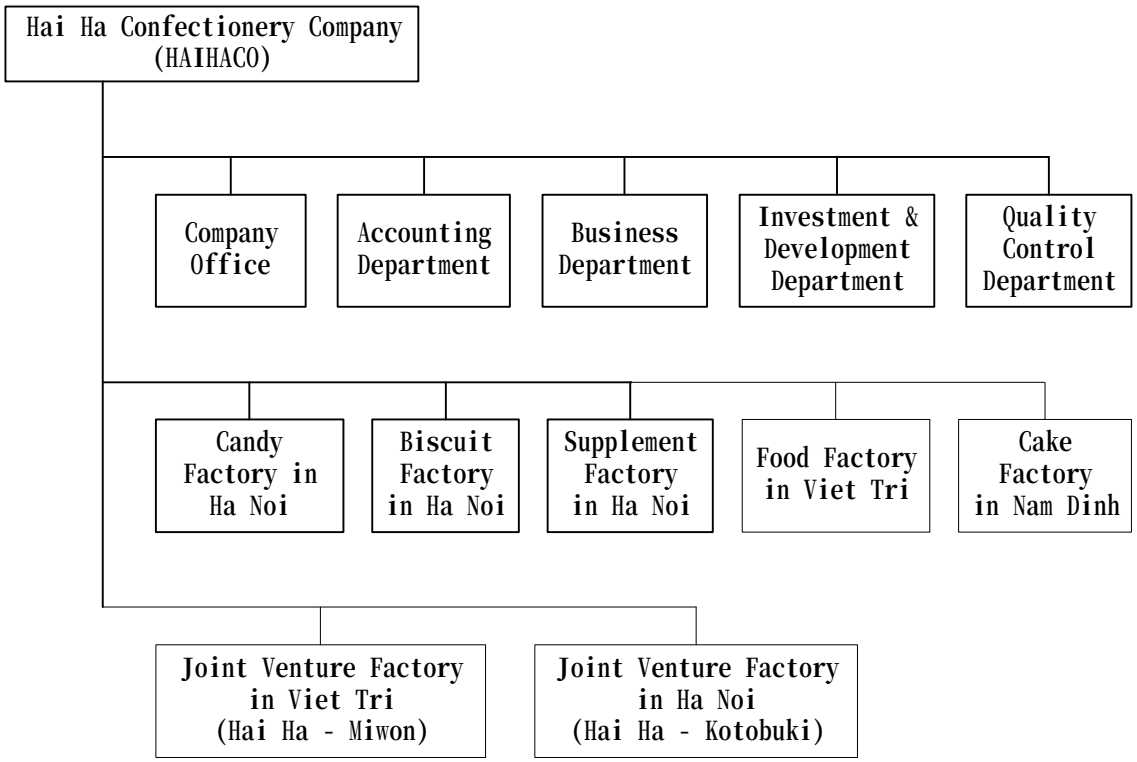


Figure 1 Organization of the Hai Ha Confectionery Company

Maximum production capacity is estimated as 15,000 t/year.

3.1.1. Debt

The Company carries debt of 34,246 million VND with a Trade Bank.

4. Production Technology

2.1 Process

The overall block flow diagram is shown in Figure 2. Well-water is treated by an iron removal unit and sand filtration before being sent to production sections. The boiler section uses an ion exchange resin to get boiler water.

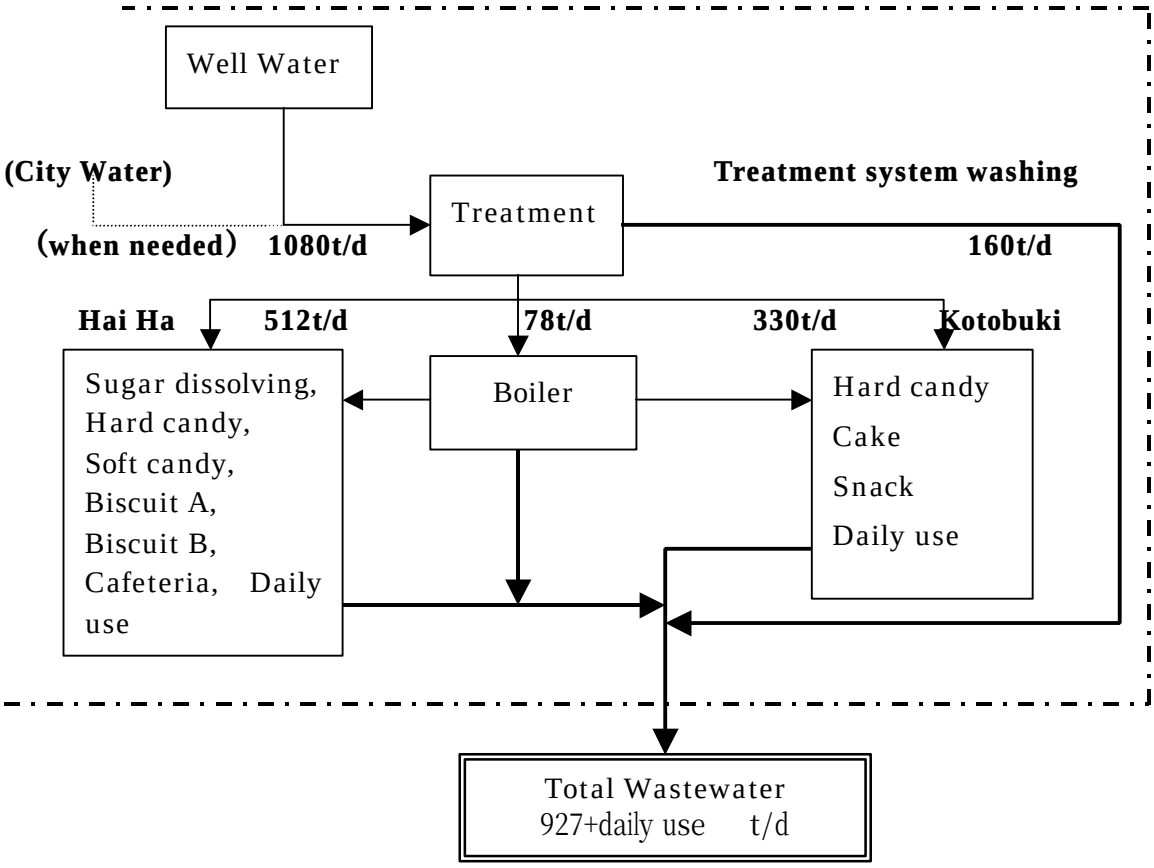


Figure 2 Block Flow Diagram

Equipment of the Biscuit A and B sections was imported from Denmark and Italy, respectively.

Wastewater discharged from each production section is identified as follows:

1) Equipment washing water (dirty);
2) Cooling water for vacuum systems (clean);
3) Hard candy cooling water (clean).

2.2 Material and Utility Consumption

Table 3 shows annual consumption of raw materials and energy for products.

Table 3 Raw Materials and Energy Consumption in 1998

Section	Materials	Amount (/year)	Payment (VND/kg)
1) Soft Candy	Sugar	2,172 t	5,000
	Glucose syrup	3,000 t	3,700
	Milk	318 t	25,000
	Shortening	300 t	8,000
	Essential	12 t	200,000
	Color	0.6 t	500,000
2) Hard Candy	Sugar	1,300 t	
	Glucose syrup	780 t	
	Essential	4.4 t	
	Color	0.4 t	
	Acid	12 t	30,000
3) Biscuit	Wheat flour	1,370 t	
	Sugar	430 t	
	Fat	320 t	
	Essential	4,4 t	
	Color	0.2 t	
4) Cracker	Wheat flour	966 t	5,000
	Sugar	217 t	
	Fat	210 t	8,000
	Milk	7 t	
	Glucose syrup	27 t	
	Palm oil	71 t	9,500
	Chemicals	40 t	4,000
5) Utilities	Water	290,600 m^3	1,800 D/m^3
	Fuel oil	674.2 t	1,500,000 D/t
	Electricity	2,912,896 kWh	800 D/kWh

2.3 Future Plan

The Company has the following future plans for process improvement:

1) Improvement in product quality;
2) Remodeling and renovation of equipment in order to improve productivity;
3) Recycling cooling wastewater, which is, at present discharged to a city canal;
4) Installing wastewater treatment systems to prevent industrial pollution.

3. Management Technology

In the same factory area, the Company and a Japanese enterprise established

a joint venture named KOTOBUKI in 1994. Their products are sold domestically in Viet Nam..

4. Industrial Wastewater Treatment and Discharge

4.1 Wastewater Volume

The washing of equipment after each shift operation and vacuum pump cooling in the candy production section create wastewater. Wastewater is collected from each production section, including Kotobuki, and directly discharged to a city canal without any treatment.

Table 4 summarizes the volume of wastewater discharged from the company and Kotobuki.

Table 4 Wastewater Volume in HAIHACO (m^3/day)

	Factory	Section	Usage	As of March 2000	Future
Daily	Hai Ha	1) Sugar Solution	Washing	44	44
		2) Hard Candy	Vacuum	60	6
			Cooling	20	
			Washing	20	20
		3) Soft Candy	Vacuum	180	18
			Cooling	30	
			Washing	10	10
		4) Biscuits Crackers	Washing	16	16
		Sub-total		380	114
		5) Others			
		Supply Water Treatment		160	80
		Cafeteria		120	120
		Total		660	314
	Kotobuki	1) Sugar Solution	Process		
		2) Hard Candy	Vacuum	41	4
			Cooling	11	
			Washing	29	29
		3) Snack		30	30
		4) Cake		52	52
		Sub-total		163	115
		5) Cafeteria		13	13
		Total		176	128
	Grand Total			836	442
Weekly		All equipment washing		289	289

As of March 2000, the volume of wastewater discharged daily is 836 m^3/day. This will be reduced to 442 m^3/day after the completion of the cooling water recycling project mentioned in Section 2.3.

Weekly washing of all equipment every Saturday creates 283 m^3/day of wastewater.

Wastewater Quality

In 1998, wastewater qualities, as well as the estimated amount of wastewater from each section during normal operations and during washing operations, was analyzed and reported in detail by RIB (Research Institute of Bewaring).

The company surveyed basic technologies for wastewater treatment in 1998. The investment cost necessary to introduce a wastewater treatment system has not yet been estimated. It is difficult for the Company to implement a wastewater treatment project due to a shortage of finances.

In this study, wastewater samples were collected and analyzed by CECE.

(1) Wastewater Sampling in November 1999

Wastewater samples were collected at the following spots on 29 and 30 November 1999:

1) North side wastewater pit of the washing process and at the vacuum pump cooling for candy;
2) Vacuum pump cooling for candy;
3) Wastewater pit of the Kotobuki factory;
4) Southern side wastewater pit of the candy production section;
5) Domestic wastewater pit;
6) The candy, Kotobuki, and domestic wastewater collection pits;
7) The final pit just before discharge to the city canal;
8) Washing waste from the Sugar Mixer on 30 November 1999;
9) Washing waste from the Hard Candy section on 30 November 1999;
10) Washing Waste from the Soft Candy Section on 30 November 1999.

Tables 5 and 6 show qualities of the wastewater samples mentioned above.

Table 5 Wastewater Quality (29 November 1999)

Item	Unit	Sampling number and sampling time							TCVN 5945
		1) 11:25	2) 11:35	3) 11:45	4) 12:00	5) 12:15	6) 12:25	7) 12:35	
Flow Rate	m^3/h								
Temperature	℃	29.3	31.2	37.0	25.6	24.0	27.8	26.9	40
PH	-	7.08	6.78	6.83	7.17	7.8	6.7	6.6	5.5-9
Electric Conductivity	μS/cm	550	560	620	590	830	610	620	
Turbidity	mg/l	7	19	327	46	196	33	35	
Oil & Grease	mg/l	2.2	3.5	.6	0.91	1.28	0.67	0.32	10
DO	mg/l	4.6	1.7	2.19	3.05	1.18	1.41	1.33	
SS	mg/l	6	38	488	98	654	63	44	100
COD	mg/l	180	1760	4640	520	1480	680	360	100
BOD	mg/l	106	620	3090	380	1140	490	310	50
Total Nitrogen	mg/l	12.48	14.04	17.16	12.54	36.35	14.66	20.3	60
Residual Chlorine	mg/l	0.25	0.05	0.05	0.03	0.02	0.02	0.03	2

Table 6 Wastewater Quality (30 November 1999)

Item	Unit	Sample number and sampling time			TCVN 5945
		8) 11:30	9) 12:05	10) 12:20	
Flow Rate	m^3/h				
Temperature	℃	33.5	28.5	31.5	40
PH	-	6.58	7.2	7.2	5.5-9
Electric Conductivity	μS/cm	730	490	690	
Turbidity	mg/l	90	79	60	
Oil & Grease	mg/l	1.05	0.2	0.42	10
DO	mg/l	5.3	4.8	3.87	
SS	mg/l	918	173	226	100
COD	mg/l	6240	1280	3840	100
BOD	mg/l	4760	8690	2670	50
Total Nitrogen	mg/l	12.48	10.97	13.45	60
Residual Chlorine	mg/l	0.15	0.21	0.15	2

(2) Wastewater Sampling in March 2000

Wastewater samples were collected at the spots shown in Figure 6 on 14 March 2000:

① Sugar dissolving section washing wastewater;

② Vacuum pump outlet wastewater;

③ Vacuum pump inlet water;

④ KOTOBUKI candy section washing wastewater;

⑤ Soft candy section washing wastewater;

⑥ Biscuit section container washing wastewater;

⑦ KOTOBUKI cake section washing wastewater;

⑧ Supply water system back washing wastewater;

⑨ Hard candy section washing wastewater.

Tables 7 and 8 show qualities of the samples.

Table 7 Wastewater Quality (14 March 2000)

Item	Unit	Sampling number and sampling time					TCVN 5945
		① 9:00	② 9:25	③ 9:30	④ 9:45	⑤ 10:25	
Flow Rate	m^3/h						
Temperature	℃	32.2	32.3	24.6	37	28.1	40
pH	-	6.6	8.3	7.0	7.2	6.2	5.5-9
Electric conductivity	μS/cm	920	490	560	640	670	
Turbidity	mg/l	208	2	2	128	96	
Oil & Grease	mg/l	0.45	0.01	0.01	2.1	0.31	10
DO	mg/l	1.4	6.3	5.2	1.8	2.7	
SS	mg/l	1450	0	0	638	484	100
COD	mg/l	17600	6.4	9.6	9760	600	100
BOD	mg/l	12320	3	4	6832	421	50
Total Nitrogen	mg/l	9.7	1.7	2.2	21.7	11.3	60
Sugar	mg/l		0.51	0.75			
Residual Chlorine	mg/l	1.11	0.05	0.06	0.63	0.66	2

Based on the analysis results, wastewater from HAIHACO is characterized as follows:

1) Wastewater from the hard candy section contains organic contaminants as indicated by high COD and BOD values;
2) Wastewater from the soft candy section, biscuit section and Kotobuki cake section contains organic contaminants, the concentration of which, however, is rather low compared with hard candy;
3) Wastewater from the vacuum evaporator is clean as mentioned in Section 2.1;
4) Back washing water from the water supply system contains high SS and Fe.

Table 8 Wastewater Quality (14 March 2000)

Item	Unit	Sampling number and sampling time				TCVN 5945
		⑥ 10:45	⑦ 10:55	⑧ 11:15	⑨ 16:15	
Flow Rate	m^3/h					
Temperature	℃	22.8	27.7	25.4	46.6	40
PH	-	8.0	6.7	7.2	7.6	5.5-9
Electric conductivity	μS/cm	43440	660	590	650	
Turbidity	mg/l	85	142	316	42	
Oil & Grease	mg/l	0.31	0.39	0.05	0.32	10
DO	mg/l	1.1	4.7	4.45	2.62	
SS	mg/l	228	1634	3280	238	100
COD	mg/l	400	640	560	7480	100
BOD	mg/l	265	420	373	5236	50
Total Nitrogen	mg/l	27.5	12.5	9.5	15.4	60
Residual Chlorine	mg/l	0.3	0.75	0.08	0.28	2
Total Fe	mg/l			255		5

5. Countermeasures for Improvement

5.1 Current Problems

Current issues in HAIHACO concerning wastewater are summarized as follows:

(1) Contaminated wastewater is discharged into the city canal without treatment;

(2) Clean wastewater is mixed with contaminated wastewater resulting in a high volume of wastewater;

(3) Steam condensate is discharged instead of being recovered.

5.2 Countermeasures for the Production Technology Improvement

5.2.1 Cooling Wastewater Recovery

In order to decrease the amount of wastewater, it is effective to recover and recycle clean wastewater. As mentioned in Section 2.3, projects for cooling water recovery are underway in the company as follows:

(1) Vacuum Evaporator Wastewater Recovery

Wastewater from the vacuum system in the candy section can be recovered and recycled as shown in Figure 3. In order to avoid the excessive accumulation of sugar, approximately 10 % of the recycling water should be blown down.

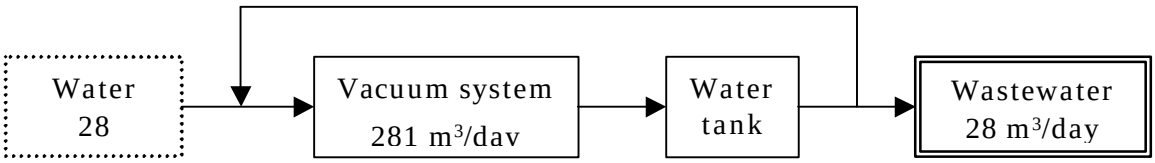


Figure 3 Recovery of Vacuum System Wastewater

(2) Candy Cooling Water Recovery

Cooling water in the candy section can be recovered and reused by installing water cooling units as shown in Figure 4. No wastewater is created from the recycling system. This measure can decrease the amount of wastewater by 61 m3/day compared with the current state.

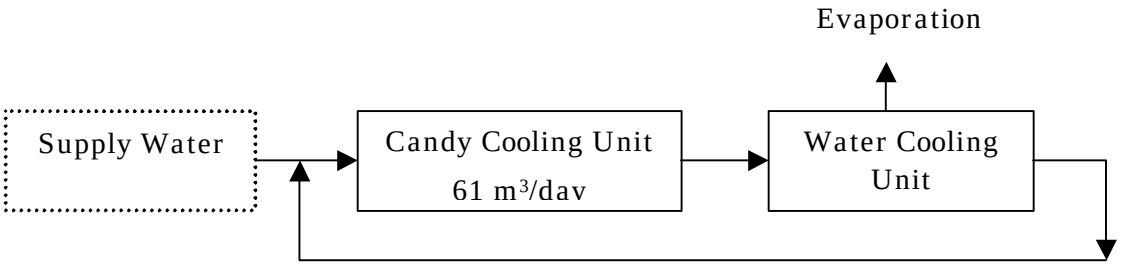


Figure 4 Recovery of Cooling Water

5.2.2 Waste Heat Recovery

The factory uses 59 t/day of 6.6-6.8 kg/cm2G steam, condensate of which is not currently recovered. Recycling steam condensate has the following benefits:

1) Conservation of energy: reduction of fuel oil 507 kg/day

In case of 80% recovery of steam condensate;

59*0.8*（100-25）*1,000/（10500*0.95*0.7）= 507 kg/day

507 kg/day * 1500 VND/kg = 760,000 VND/day（228 million VND/year）

Where as; Burning efficiency = 95 %

Boiler heat loss = 30%

2) Reduction of the amount of supply water. 47.2 t/day

47.2 t/day * 1800 VND = 85,000 VND/day（25.5 million VND/year）

5.3 Countermeasures for Wastewater Treatment

5.3.1 Design Basis

Total amount of wastewater to be treated is set at 449 m3/day, incorporating future improvement plans on wastewater classification and cooling water recycle

use. And also wastewater quality of the factory total is summarized from the analysis results by CECE and each flow rate at major discharge point, estimated by the factory staff. This is shown in Table 9.

5.3.2 Conceptual Design

Based on the above data, conceptual design work was done by the study team. As a result, the block flow and basic dimensions of major equipment for a wastewater treatment system is shown respectively in Figure 6 and Table 10, and also a schematic process flow sheet is shown in Figure 7.

5.3.3 Site Plan

The site planned for the installation of a wastewater treatment system is shown in Figure 5.

Figure 5 Site for a Wastewater Treatment System

5.3.4 Required Cost

The required construction cost of a wastewater treatment system based on

conceptual design is estimated at 3.4 billion VND.

6 Recommendations

6.1 Short Term Basis Recommendations

The following activities are recommended as short-term countermeasures:

1) Implementation of the cooling water recycling project mentioned in 5.2.1(2);
2) Meticulous improvement activities such as:
   (a) Periodical cleaning of the wastewater pits;
   (b) Sealing up of windows so as to prevent possible invasion of insects or dust into the production area;
   (c) Giving a slope to the floor in the production sections with a slight gradient so as to prevent floor washing water from accumulating.

6.2 Mid and Long Term Basis Recommendations

On a mid-term basis, the implementation of projects mentioned in the previous sections is recommended:

1) Recovery of vacuum system wastewater as mentioned in 5.2.1(1);
2) Energy conservation, including the recovery of steam condensate as mentioned in 5.2.2;
3) Installation of a wastewater treatment system as mentioned in 5.3. It is also recommended to invite an expert on wastewater treatment operation for the test operation of the system in order to establish and optimize the operating conditions.

On a long-term basis, it is most important to maintain stable operation of the wastewater treatment system.

6.3 Implementation Schedule

An implementation schedule has been planned for the countermeasures for industrial pollution prevention and is shown in Figure 8. It is expected that HAIHACO will commence test operations of the wastewater treatment system in the middle of 2002.

Table 9 Design Basis of Wastewater Volume and Quality

(Hai Ha Confectionery Company)

Wastewater Source	Volume	Wastewater Quality							Note
		Temp.	pH	COD	BOD	SS	Oil	Total-N	Total-Fe	
	(m3／day)	℃		(mg／l)	(mg／l)	(mg／l)	(mg／l)	(mg／l)	(mg／l)	
1) Sugar Section Washing	44	32		17600	12320	1450	0.45	9.7		composit sample
2) Kotobuki Candy Section Washing	29	37		9760	6832	638	2.1	21.7		composit sample
3) Kotobuki Cake Section Washing	52	28		640	420	1630	0.39	12.5		composit sample
4) Kotobuki Snack Section Washing	30	28		640	420	1630	0.39	12.5		same as cake
5) Soft Candy Section Washing	10	28		600	421	484	0.31	11.3		composit sample
6) Biscuit Section Washing	10	23		400	265	228	0.31	27.5		composit sample
7) Hard Candy Section Washing	20	47		748	5236	238	0.32	15.4		composit sample
8)Supply Water Back Washing	80	25		560	373	3280	0	9.5	255	composit sample
9) Cafeteria(daily domestic)	133	24.0		1480	1140	654	1.28	36.4		
Daily total Wastewater	408	28.0		3373.8	2616.9	1414.8	0.7	20.5	50.0	
10) Weekly equipment washing (289m3/w)	41	28.0		3373.8	2616.9	1414.8	0.7	20.5	50.0	
Factory Total Wastewater	449	28.0		3373.8	266.9	1414.8	0.7	20.5	50.0	
Contaminants discharged per day										
	m3/Day			kg/Day	kg/Day	kg/Day	kg/Day	kg/Day	kg/Day	
	449	25.9		1514.8	119.8	635.2	0.3	9.2	22.5	

Calculation Base of Wastewater Volume & Quality per Day

1) Wastewater V0lume of each section has been adopted in accordance to the results of discussions between the study team and factory staff.
2) Analysis results by CECE are adopted as wastewater qualities.
3) Weekly equipment washing water qualities are estimated to be the same as daily total wastewater.

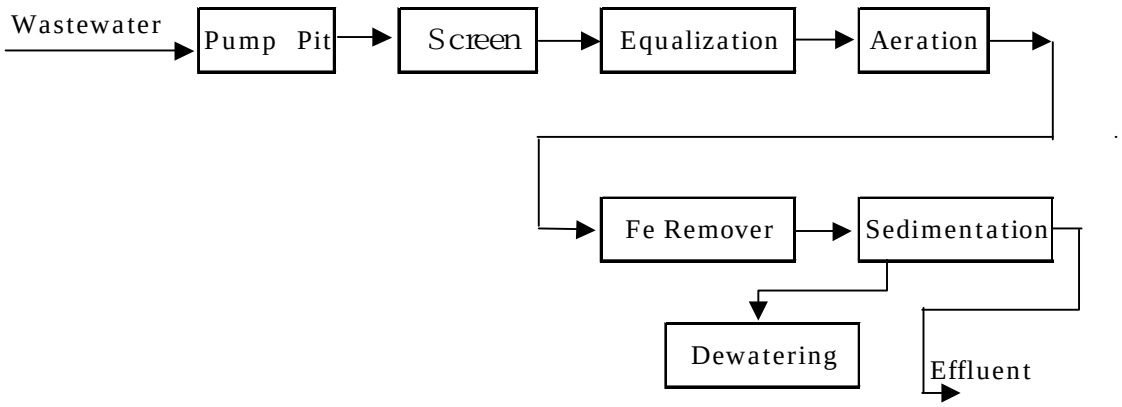


Figure 6 Block Flow sheet of the Wastewater Treatment System
(Hai Ha Confectionery Company)

Table 10 Basic Dimensions of Major Equipment

Name of Equipment	No. of Unit Required	Remarks
Pump Pit	1	19m^3 RC
Wastewater Pump	2	Submerged, 1.5m^3/min 6.7kW
Screen	1	1mm mesh
Equalization Tank	1	300m^3 RC, 10m dia. 4.5m d
Blower for Equalization the Tank	2	Rotary 3.0m^3/.min 3.7kW
Aeration Equip. for the Equal.Tank	1	Diffuser Type
Transfer Pump	2	Volute, 0.3m^3/min 0.7kW
Aeration Tank	1	449m^3 RC, 5mw*4.5mD*20mL
Blower for the Aeration Tank	2	Rotary 48m^3/.m 58kW
Equipment for the Aeration Tank	1	Diffuser Type
Sedimentation Tank	1	120m3, 6m dia. 4m d RC
Return Sludge Pump	2	Volute, 0.3m^3/m 0.4kW
Sludge Collector	1	Mechanical Rake
Fe Remover Tank	1	60m3, 4 mdia, 4md, RC
Chemical Dosing	1	NaOH Solution Tank and Pumps
Dewatering Facilities	2	Belt Filter, 3m Width*2 sets
Chemical Dosing	1	Cation Polymer Tanks and Pumps
Control Building	1	6mW*8mL Steel Slated, 2 Stories

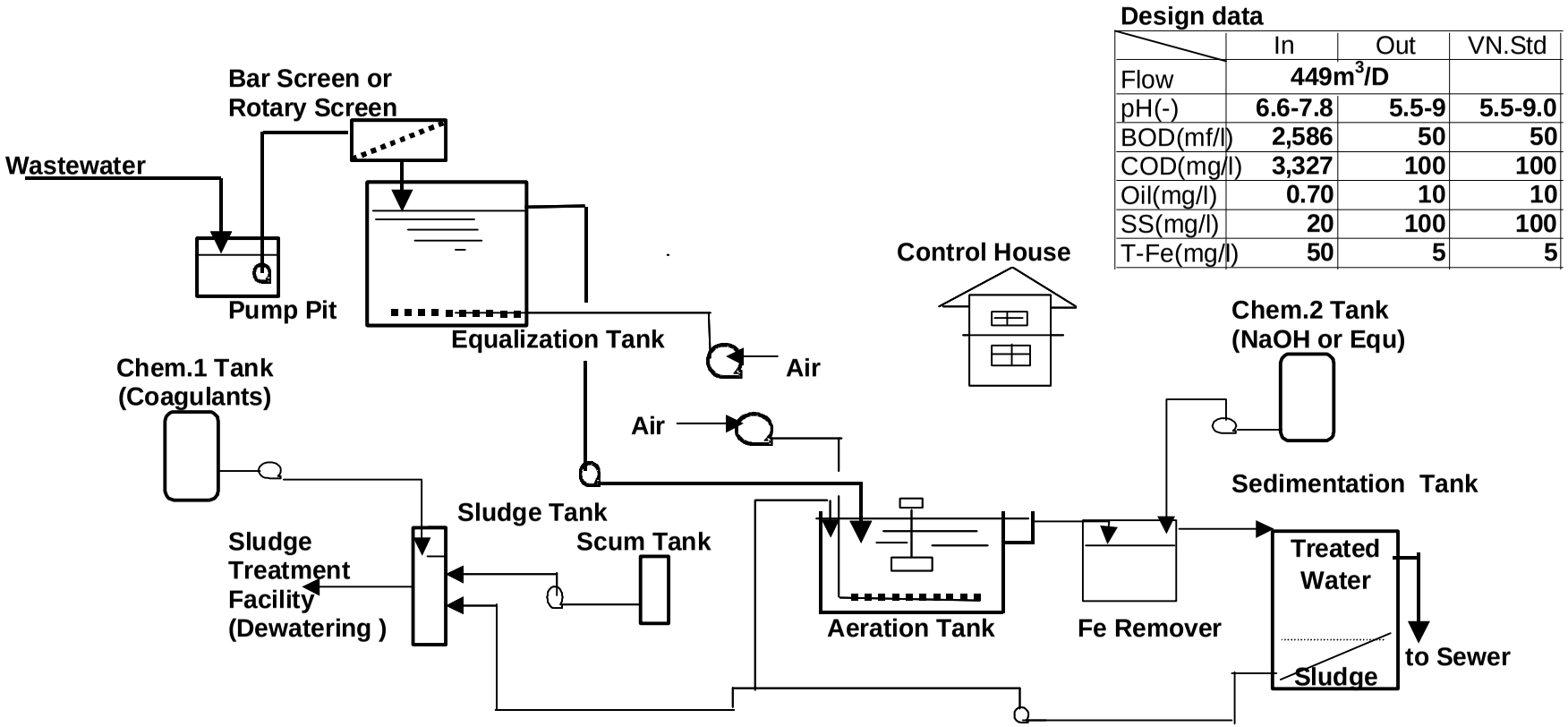


Figure 7 Schematic Flow of the Wastewater Treatment System
(Hai Ha Confectionery Company)

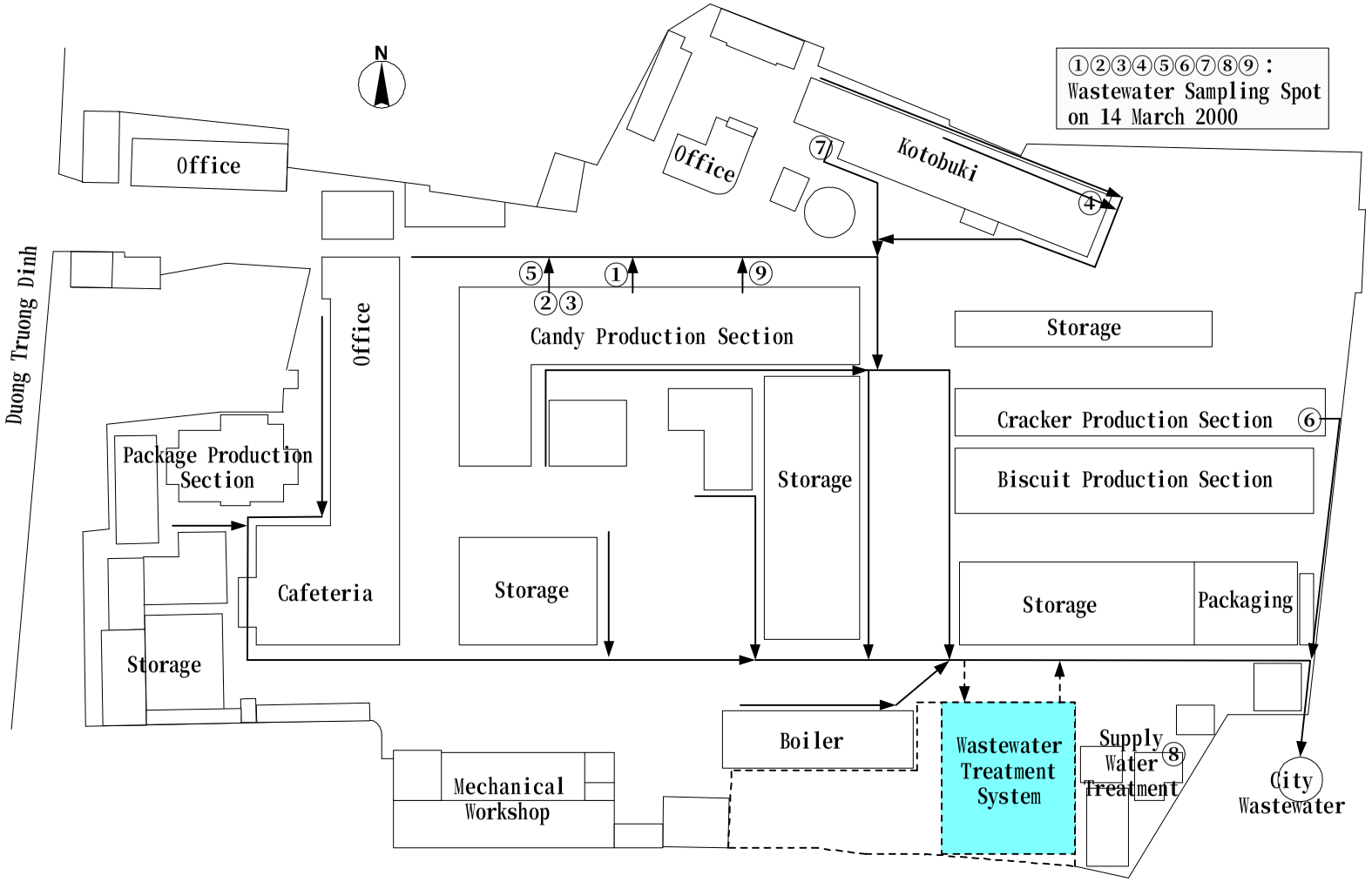


Figure 8 Factory Layout and Wastewater Drainage Route
(Hai Ha Confectionery Company)

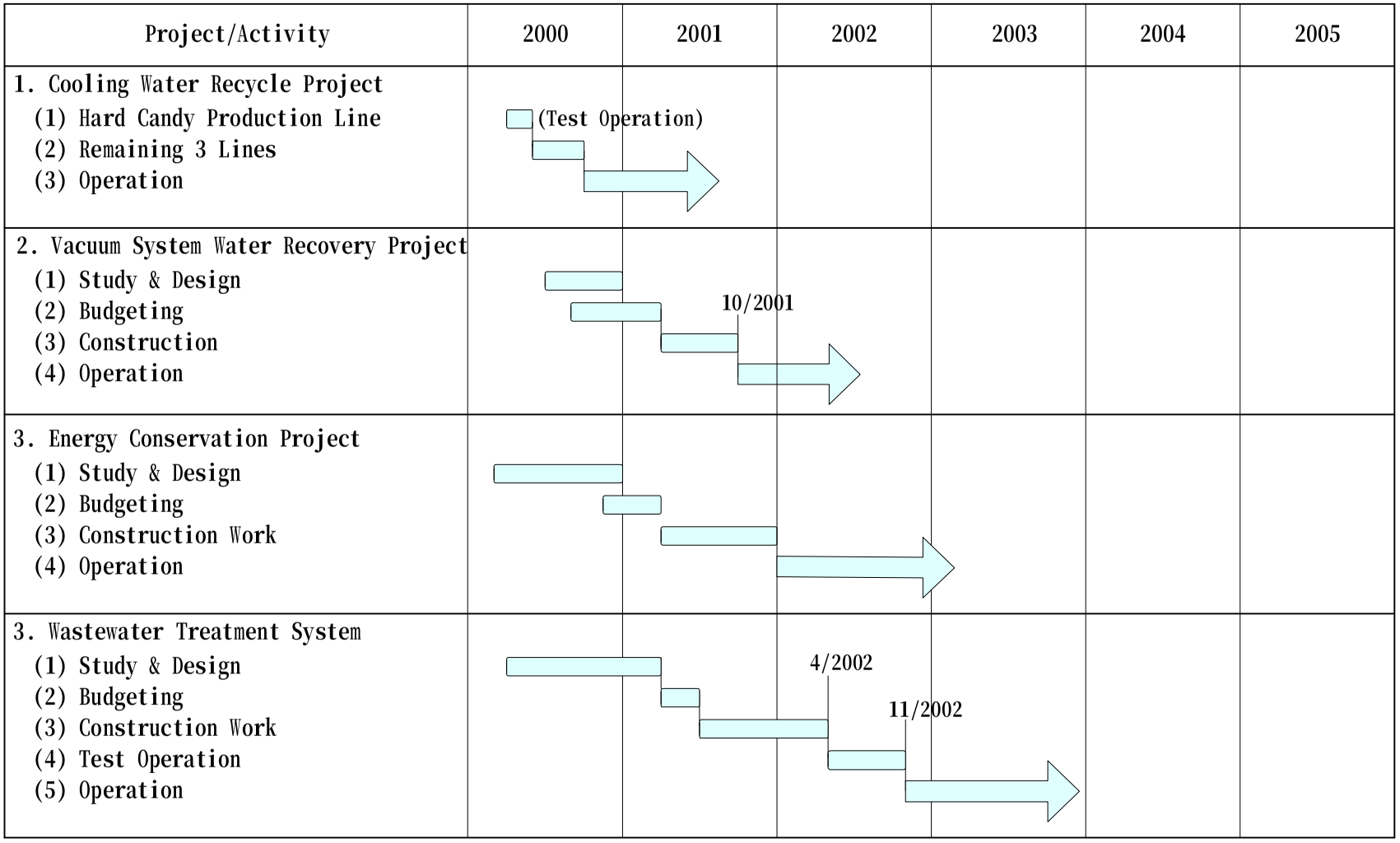


Figure 9 Proposed Implementation Schedule for Industrial Pollution Prevention Countermeasures (Hai Ha Confectionery Company)

CASE STUDY F-03

Cau Tre Export Goods Processing Enterprise

Survey Date: 06 December 1999
25, 28-29 February 2000

1. General

1.1 Profile

The company profile of Cau Tre Export Goods Processing Enterprise is summarized in Table 1.

The Enterprise operates many projects in cooperation with foreign partners to refine many kinds of products for texport. One joint venture company is to be converted to a private company owned by the Enterprise in 2000. The Factory is located in an area of 80,000 m^2.

Table 1 Company Profile

Company Name:	Cau Tre Export Goods Processing Enterprise
Ownership:	State-owned
Address:	Road 14, Tan Binh Distr., HCM City
Tel/Fax:	848-8552007 / 848-8550057
Director:	Mrs. Nguyen Thi Thu Ba
Established:	1982
Corporate Capital:	
Number of Employees:	2,200
Main Products:	Processed Sea Food, Meat, Tea

1.2 Organization

Figure 1 shows the organization of the enterprise. The Electrical and Mechanical Workshop is responsible for wastewater treatment as well as the wastewater drainage system.

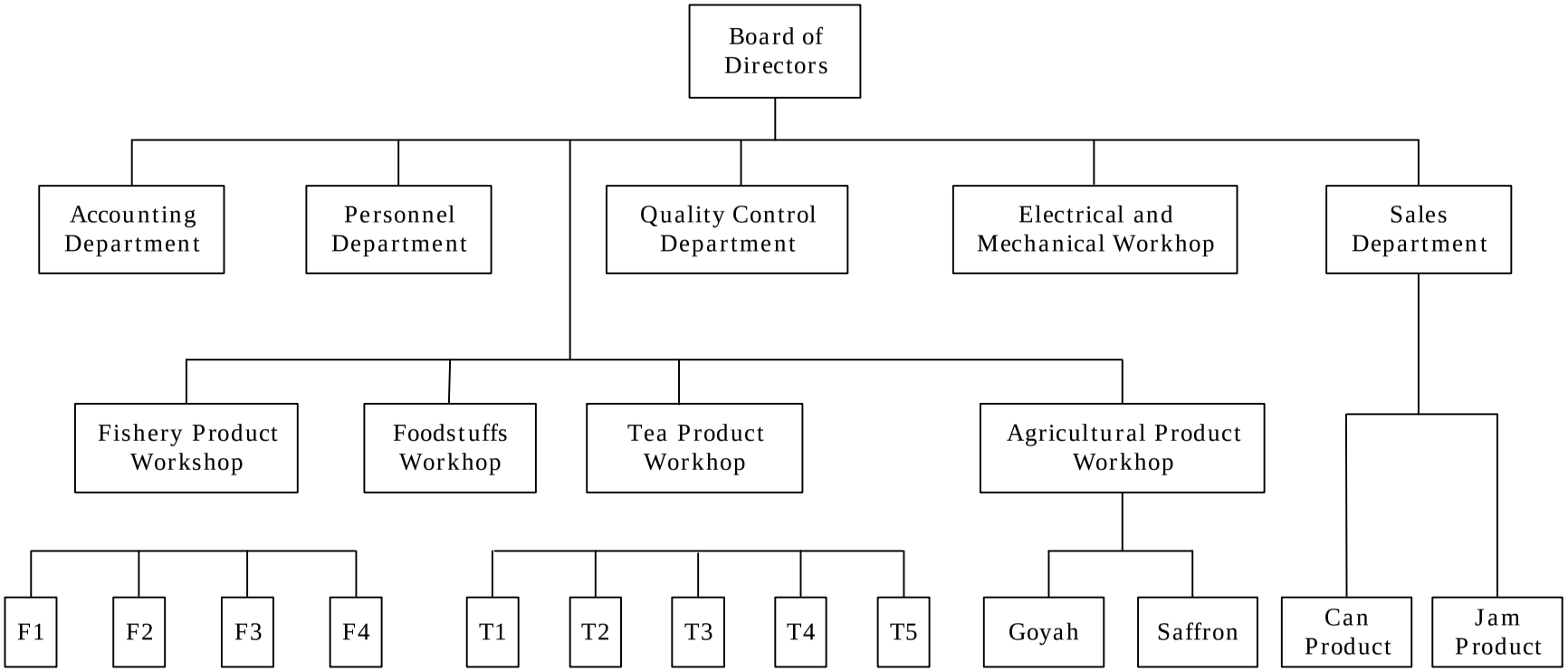


Figure 1 Organization of Cau Tre Export Goods Processing Enterprise

1.3 Business Status

1.3.1 Production

Table 2 shows the production amount of the enterprise in 1998.
The enterprise produces varieties of aquatic products, agricultural products and foodstuffs. 80% of products are exported to many countries and 20% of products are supplied to the domestic market. Especially, 60% of products are exported to Japan.

The factory is running at a full load, and operates continuously 24 hours a day with a 2 shift work system.

Table 2 Production Amount in 1998

NO	Product	Production Amount (t/y)
1	Fish	316.0
2	Octopus	271.0
3	Clam	285.2
4	Crab	108.2
5	Scallop	18.0
6	Fan shell	40.3
7	Tea products / Other Processing goods	1026.4 (Tea Products 500 t)
	Total	2065.0

1.3.2 Debt

The Enterprise is in debt of 21.6 billion VND to Viet Com Bank in Ho Chi Minh City as of the end of 1999.

2 Production Technology

2.1 Process

Figure 2 shows a block flow diagram of the whole factory and water usage for each section. Well water is used as process water, including washing use and domestic use. Supply water is treated by coagulation and sand filtration. Flow meters are provided to measure well water supply and consumption at each production section. Residue of raw material from each processing section is recovered as livestock feed.

2.2 Unit Consumption

Unit consumption of utilities and additives is shown in Table 3, and material consumption for main products is shown in Table 4.

Table 3 Utility and Additives Consumption in 1998

No.	Raw materials	Unit	Consumption	Unit Price (VND / Unit)	Cost (Million VND)
1.	Water	m^3	450,000	1,300	585.0
2.	Electricity	kWh	7,200,000	780	5,608.4
3.	Ice	t	19,560	149,600	2,926.2
4.	Fleon	kg	600	41,250	24.8
5.	Chlorine	kg	121,958	1,650	201.2

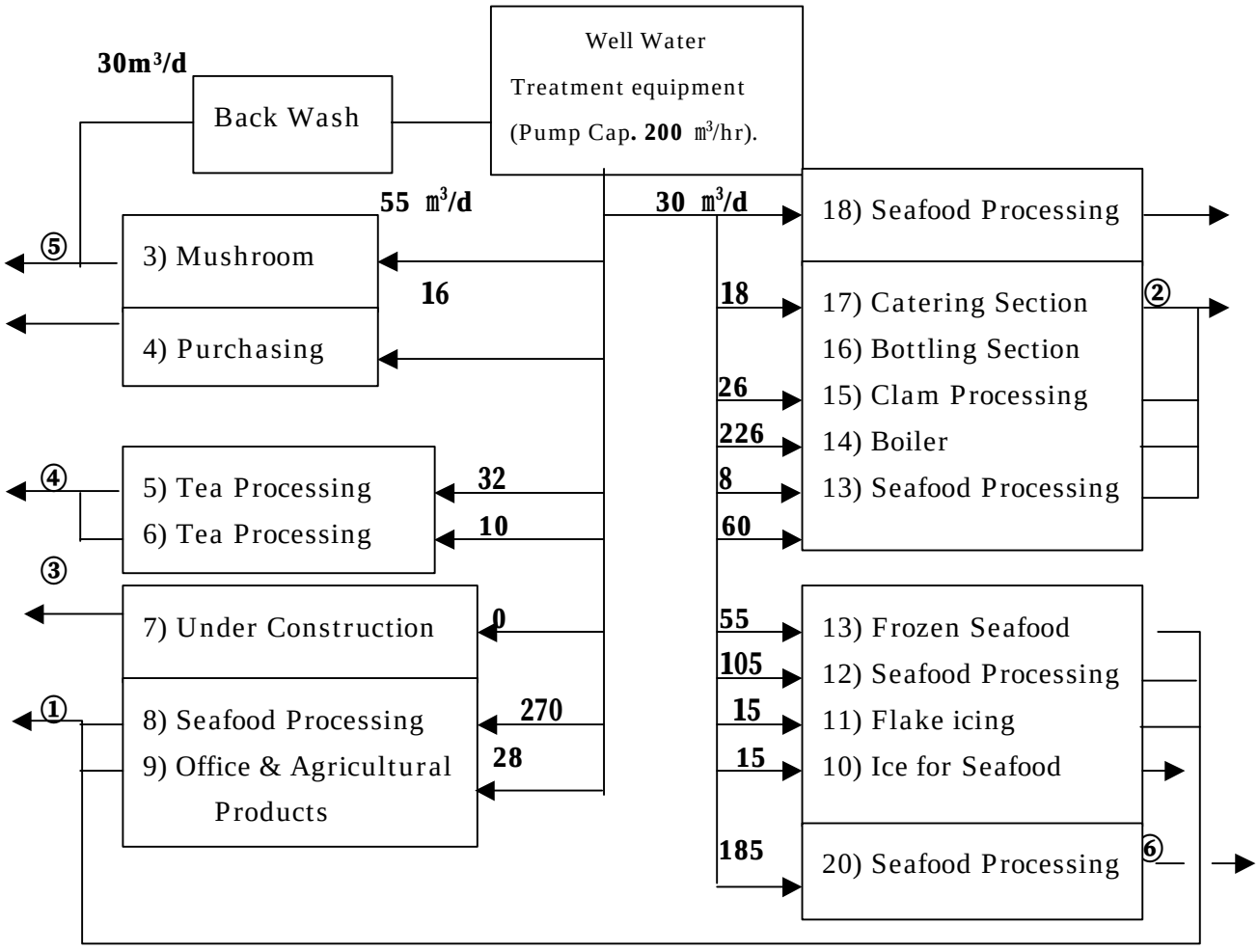


Figure 2 Block Flow Diagram of the Factory and Water Usage

Table 4 Raw Materials Consumption in 1998

No.	Product	Unit	Consumption Amount
1.	Frozen Fish		
	—Raw material Fish	t	660
	—Water	m^3	36,974
	—Electricity	kWh	410,822
	—Ice	t	951
2.	Frozen Octopus		
	—Raw material Octopus	t	848
	—Water	m^3	25,741
	—Electricity	kWh	325,150
	—Ice	t	373
3.	Processed Crab		
	—Raw material Crab	t	307
	—Water	m^3	10,924
	—Electricity	kWh	135,199
	—Ice	t	190

2.3 Future Plan

The company has future plans for productivity improvement and environmental pollution prevention as follows:

1) Installing modernized equipment and facilities to improve the product quality and to expand the production capacity by 20 % per year;
2) Installing a new water drainage system to separate process wastewater from rain water;
3) Installing a wastewater treatment system to satisfy the environmental requirement.

3 Management Technology

3.1 General

As a food processing company, the company studied and introduced HACCP (Hazard Analysis Critical Control Point), based on which several actions have been taken so far as follows:

1) Renewal of the steamer in 1997;
2) Fuel change to diesel oil;
3) Installation of silencers for the generator shop;
4) Collection of solid waste from the processing shop;
5) Installation of screens for drainage in order to prevent insects from

entering into the processing shop;

6) Cleaning up the canal every three (3) months.

The company operates cooperation projects with foreign partners to refine production technologies and product qualities. Many experts from foreign partners have visited the factory and cooperated to improve production technology.

Two power generators were installed as hot standby in preparation for electric power supply failures which happen frequently.

Water flow meters are provided for each production section to check and control water consumption.

3.2 ISO 9002 Certification

The company started to prepare for applying for the certification of ISO9002 in November 1999. Based on the proposal made by an outside expert, the company is pursuing the following procedure:

1) Prepare working procedure for each production section (5 % finished as of February 2000);
2) Arrange training;
3) Internal cross auditing scheduled from June through September 2000;
4) Acquire the certificate in December 2000.

4 Industrial Wastewater Treatment and Discharge

4.1 Sources of Wastewater

Washing feedstock and equipment mainly create wastewater. The amount of wastewater per day is estimated at around 1,000t. Wastewater is directly discharged to a city canal through several points of the factory without any treatment. EPC (Environmental Protection Center) under MOSTE once took and analyzed a wastewater sample in 1996.

4.2 Wastewater Quality

Wastewater samples were collected for analysis in this study at the points shown in Figure 7.

(1) Samples Taken in December 1999

Eight wastewater samples were taken on 6 December 1999 as follows:

① Convergence pit from buildings No.8, 9, 10, 11, 12 and 13;

② Convergence pit from buildings No.13, 14, 15 and 16;

③ Wastewater from No.8 building;

④ Convergence pit from buildings No.5 and 6;

⑤ Wastewater from No.3 building;

⑥ Wastewater from No.20 building;

⑨ The Upstream of a city canal surrounding the factory;

⑩ The Downstream of the city canal discharged factory wastewater.

Sampling points of No.① to ⑥ are shown in figure 2.

Table 5 shows qualities of wastewater samples mentioned above.

Table 5 Wastewater Quality (6 December 1999)

Item	Unit	Sample number and sampling time								TCVN 5945
		① 13:22	② 13:33	③ 13:45	④ 13:55	⑤ 14:05	⑥ 14:15	⑨ 14:35	⑩ 14:55	
Flow Rate	m^3/h									
Temperature	℃	28.5	26.1	20.5	27	26	26.8	31.8	30	40
PH		7.8	8.2	8.4	7.27	6.8	8.4	6.6	6.6	5.5～9
Electric Conductivity	µS/㎝	1310	630	1040	790	234	1060	850	880	
Turbidity	NTU	72	21	23	49	19	129	168	115	
Oil & Grease	mg/l	0.22	0.22	0.17	0.22	0.35	0.3	0.28	0.25	10
DO	mg/l	3.9	5.5	6.5	7.17	3.2	4.2	0.55	0.33	
SS	mg/l	158	87	129	137	82	223	530	376	100
COD	mg/l	748	224	640	280	2800	452	465	435	100
BOD	mg/l	427	162	396	182	1772	252	326	261	50
Total N	mg/l	32.76	6.24	25	9.75	8.58	37.44	14.6	18.41	60
Residual Chlorine	mg/l	0.34	0.17	0.36	0.23	0.31	0.5	0.9	0.98	2

(2) Samples Taken in February 2000

Eight wastewater samples were taken on 28 February 2000 at the spots shown in Figure 4 as follows:

①-1 Sampling spot No. 1 (wastewater from the Seafood section, the freezer room and the office);

⑦-1 Sampling spot No. 7 (wastewater from the Seafood section);

⑧-1 Sampling spot No. 8 (wastewater from the clam section, the Bottling section and the canteen);

⑥-1 Sampling spot No. 6 (wastewater from the Seafood section);

①-2 Sampling spot No. 1;

⑦-2 Sampling spot No. 7;

⑧-2 Sampling spot No. 8; and

⑥-2 Sampling spot No. 6.

Table 6 shows qualities of wastewater samples mentioned above.

Table 6 Wastewater Quality (28 February 2000)

Item	Unit	Sample number and sampling time								TCVN 5945
		①-1 09:30	①-2 10:35	⑥-1 10:15	⑥-2 11:20	⑦-1 09:45	⑦-2 10:50	⑧-1 10:00	⑧-2 11:05	
Flow Rate	m^3/h									
Temperature	℃	26.2	26.0	26.0	26	26.6	26.9	26.6	26.4	40
PH		7.3	7.4	7.7	6.3	7.6	7.7	7.0	7.0	5.5～9
Electric Conductivity	μS/cm	1560	1780	1090	690	1352	820	2450	4110	
Turbidity	NTU	27	39	67	60	82	85	19	30	
Oil & Grease	mg/l	0.37	0.32	0.35	0.29	0.29	0.24	0.25	0.21	10
DO	mg/l	4.3	5.6	5.4	5.1	5.6	3.7	5.7	3.8	
SS	mg/l	148	223	215	256	159	164	87	85	100
COD	mg/l	244	276	288	296	224	232	160	168	100
BOD	mg/l	146	165	172	162	132	139	82	96	50
Total N	mg/l	35.4	34.3	71.0	55.0	14.5	21.1	13.0	9.30	60
Residual Chlorine	mg/l	0.01	0.09	0.12	0.15	0.38	0.47	0.13	0.18	2

Based on the analysis results, wastewater from the enterprise is characterized as follows:

(1) Wastewater is not seriously contaminated, although BOD and COD exceeded the Vietnamese Standard at every point;

(2) The content of SS exceeds the Standard at most points.

5 Countermeasures for Improvement

5.1 Current Problems

Current issues in the enterprise are summarized as follows:

(1) Wastewater is discharged to the city canal without treatment, although the contamination level of the wastewater is not very serious;

(2) Rainwater is not being separated from process wastewater.

5.2 Countermeasures for Production Technology Improvement

5.2.1 Separation of Rainwater from Process Wastewater

In order to minimize the dimensions of a wastewater treatment system in order to reduce the construction cost, it is necessary to prevent rainwater from being mixed into process wastewater. The construction of a new underground drainage line for process wastewater is being planned in the company. The required cost for the said drainage line is estimated at 50,000 US$.

5.3 Countermeasures for Wastewater Treatment

5.3.1 Design Basis

The total volume of wastewater to be treated is set at 1189 m3/day, incorporating future production expansion plans and separation of rain water from process wastewater. And also wastewater quality of the total factory is summarized from the analysis result by CECE and each flow rate at major discharge point, estimated by the factory staff. This is shown in Table 7.

5.3.2 Conceptual Design

Based on the above data, conceptual design work was done by the study team. As the result, block flow and basic dimension of major equipment for wastewater treatment system is shown respectively in Figure 5 and Table 8 , and also schematic process flow sheet is shown in Figure 6.

5.3.3 Site and layout Plan

Figure 3 shows a layout plan for the wastewater treatment system. An area of approximately 1,250 m^2 can be allocated close to the canteen as shown in Figure 7.

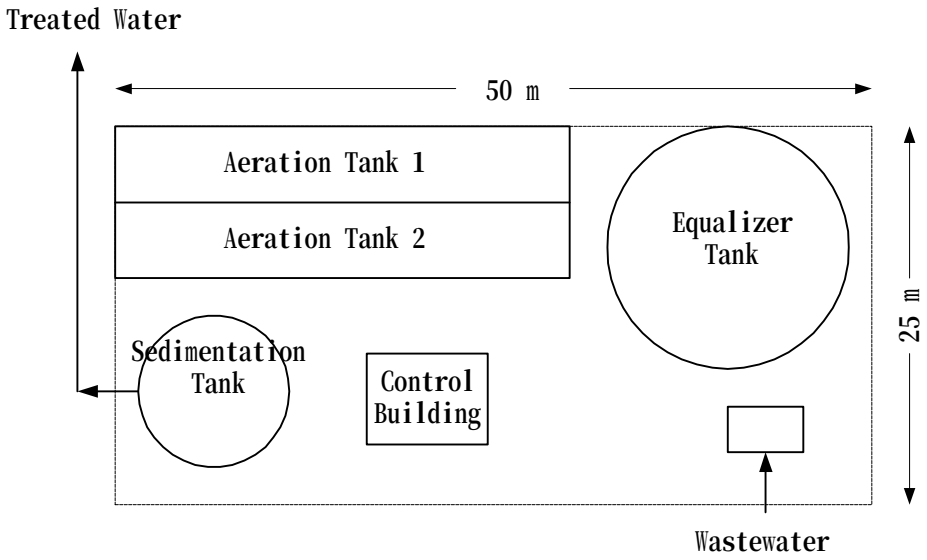


Figure 3 Layout Plan for the Wastewater Treatment System

A picture of the site planned for a wastewater treatment system is shown in Figure 4.

Figure 4 Site Planned for the Wastewater Treatment System

5.3.4 Required Cost

The required construction cost of a wastewater treatment system based on conceptual design is estimated at 6.4 billion VND.

6 Recommendations

6.1 Short Term Basis Recommendations

It is understood that the enterprise is making every effort to keep customer satisfaction in line with the buyer's advice. On a short-term basis, it is recommended that the enterprise concentrate on the acquisition of ISO9002 certification according to the prearranged program. Although the acquisition of ISO9002 certification might be intended to appeal to customers, especially foreign clients, secondary effects will help improve the management level of the enterprise.

6.2 Mid and Long Term Basis Recommendations

On a mid-term basis, it is recommended to install a wastewater treatment system as discussed in Section 5.3. It is also recommended to invite an expert in biological treatment operation for the test operation of the treatment system in order to establish and optimize operating conditions.

On a long-term basis, it is important to maintain stable operation of the wastewater treatment system. It is also important to continue to follow the procedures based on ISO9002.

6.3 Implementation Schedule

Figure 8 shows a proposed implementation schedule for industrial pollution prevention countermeasures. It is expected that the enterprise commence the test operation of the wastewater treatment system in the middle of 2002.

Table 7 Design Basis of Wastewater Volume and Quality (Cau Tre Export Goods Processing Enterprise)

Wastewater Source	Volume	Wastewater Quality							Note
		Temp.	pH	COD	BOD	SS	Oil	Total-N	
	(m3/day)	℃		(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	
1) Continuous Process Wastewater (Sea food processing and Freezing)	298	26.1	7.4	260	156	186	0.35	3.49	sample 1
2) Continuous Processing Wastewater (Sea food processing)	135	26.8	7.7	228	136	162	0.42	17.8	sample 7
3) Continuous Processing Wastewater (Clam, Bottling, Canteen)	373	26.5	7	164	89	86	0.23	10.7	sample 8
4) Continuous Processing Wastewater (Crab meat processing)	185	26.0	7	292	167	236	0.32	63.0	sample 6
Factory total	991	26.3		225	143	154	0.31	19.3	
Contaminants discharged per day	m3/Day			kg/Day	kg/Day	kg/Day	kg/Day	kg/Day	
	991	26.3		223.5	141.4	153.0	0.3	19.1	
in Case of 20% Production Capacity expansion in future;									
	1189			268	170	184	0	23	

Calculation Base of Wastewater Volume & Quality per Day

1) Wastewater volume of each section has been adopted in accordance to the results of discussions between the study team and factory staff.
2) The mean value of 2 samples for each section analyzed by CECE has been adopted
3) Wastewater from Mitsui section, Tea processing section, Well water filter back washing, and one sea food processing section currently not in operation, is directly discharged to the city canal.
4) Wastewater volume for the W.W.T.S Design is considered taking into account future expansion(A 20% capacity increase).

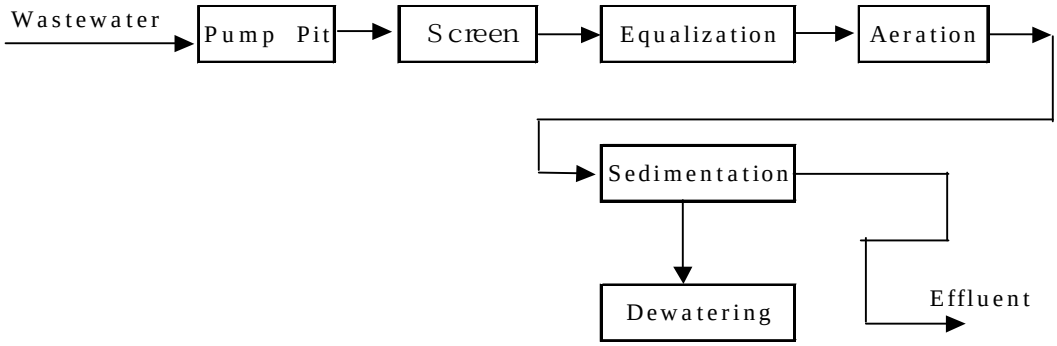
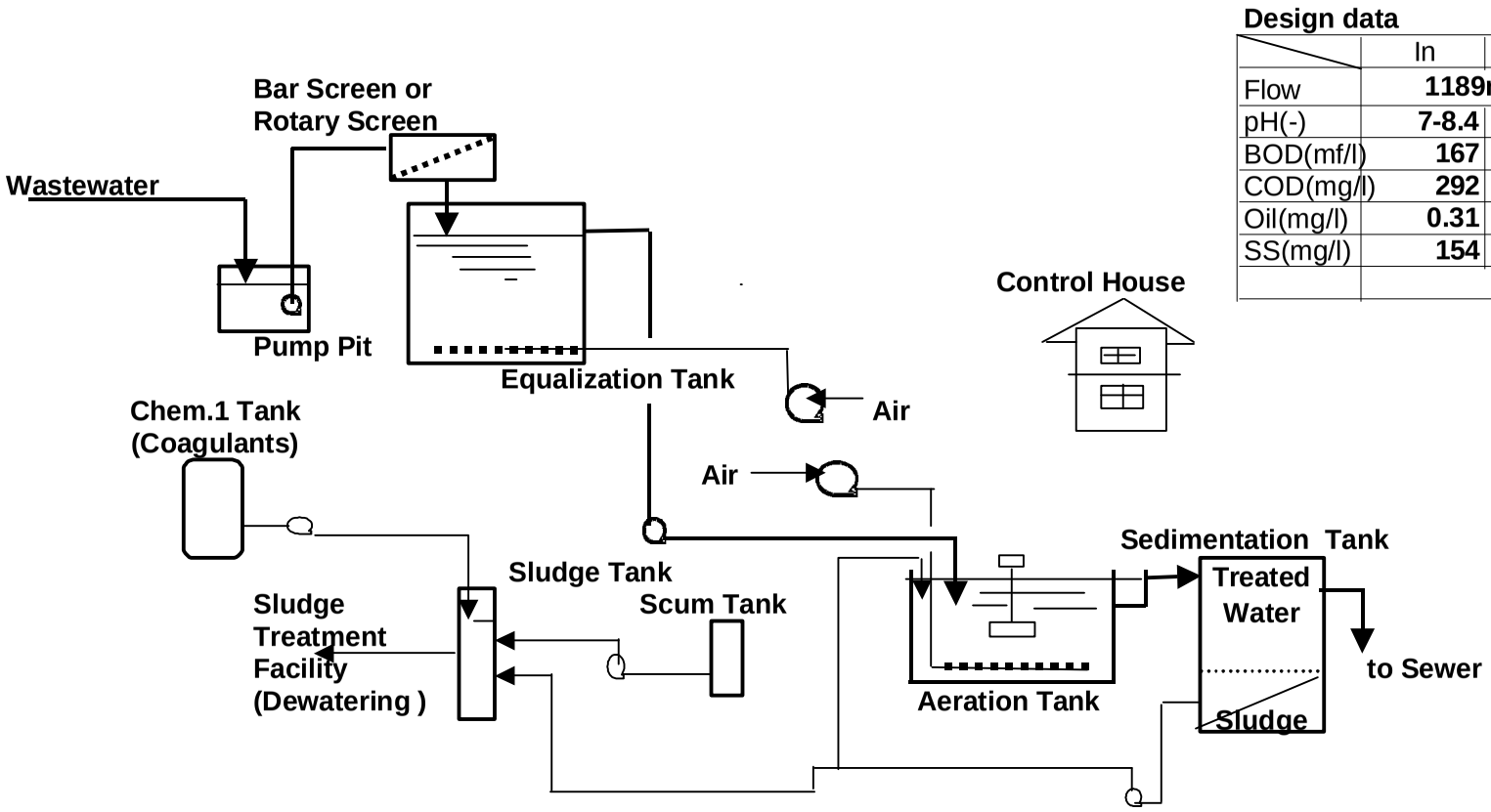


Figure 5 Block Flow sheet of the Wastewater Treatment System
(Cau Tre Export Goods Processing Enterprise)

Table 8 Basic Dimensions of Major Equipment

Name of Equipment	No. of Unit Required	Remarks
Pump Pit	1	50m^3 RC
Wastewater Pump	2	Submerged, 4.0m^3/min 17.6kW
Screen	1	1mm mesh
Equalization Tank	1	800m^3 RC, 15m dia. 4.5m d RC
Blower for Equalization Tank	2	Rotary 9.0m^3/.min 11kW
Aeration Equip. for Equal.Tank	1	Diffuser Type
Transfer Pump	2	Volute, 0.8m^3/min 1.8kW
Aeration Tank	1	1189m^3 RC, 5mw*4.5mD*27mL * 2sets
Blower for Aeration Tank	2	Rotary 7m^3/.m 8kW
Equipment for Aeration.Tank	1	Diffuser Type
Sedimentation Tank	1	317m3, 10m dia. 4m d RC
Return Sludge Pump	2	Volute, 0.8m^3/m 1.1kW
Sludge Collector	1	Mechanical Rake
Dewaterring Facilities	1	Belt Filter, 1m Width
Chemical Dosing	1	Cation Polymer Tanks and Pumps
Control Building	1	6mW*8mL Steel Slated, 2 Stories



Design data

	In	Out	VN.Std
Flow	**1189m^3/D**		
pH(-)	**7-8.4**	**5-9**	**5.5-9.0**
BOD(mf/l)	**167**	**50**	**50**
COD(mg/l)	**292**	**100**	**100**
Oil(mg/l)	**0.31**	**10**	**10**
SS(mg/l)	**154**	**100**	**100**

Figure 6 Schematic Flow of the Wastewater Treatment System
(Cau Tre Export Goods Processing Enterprise)

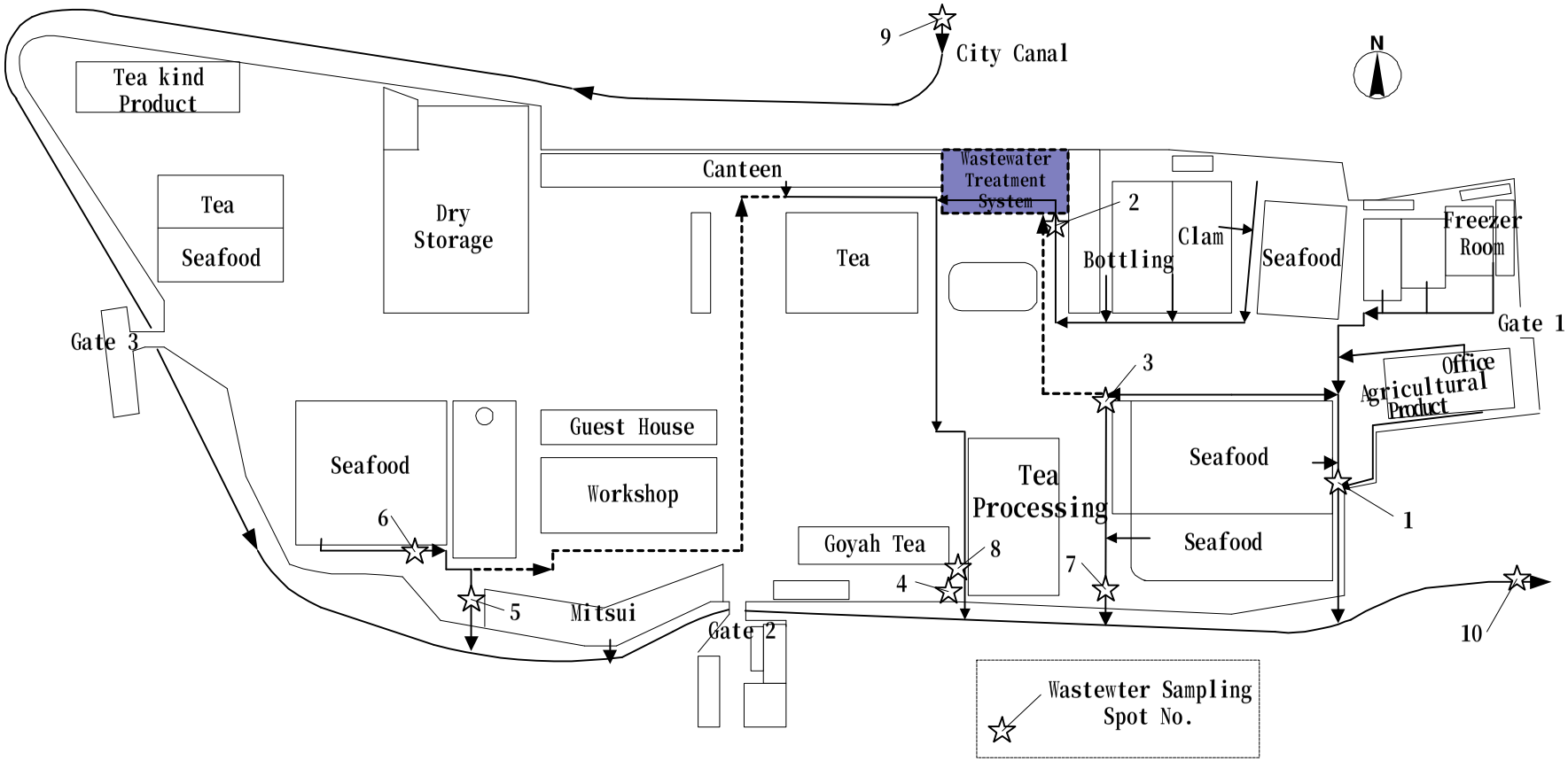


Figure 7 Factory Layout and Wastewater Drainage Route of Cau Tre Export Goods Processing Enterprise

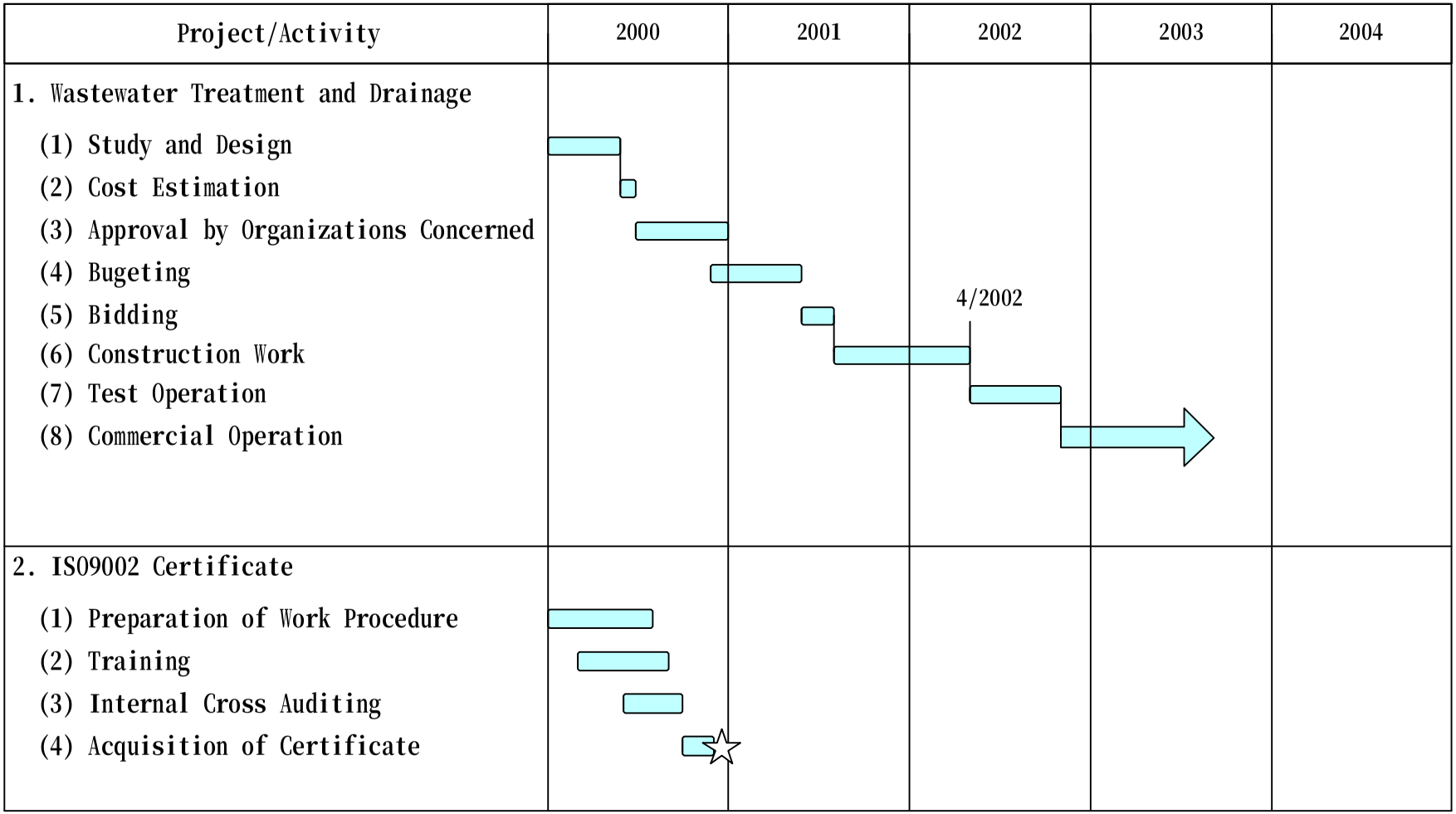


Figure 8 Proposed Schedule for Implementation of Industrial Pollution Prevention Countermeasures (Cau Tre Export Goods Processing Company)

CASE STUDY F-04

Tan Binh Vegetable Oil Factory

Survey Date: 13 December 1999
1-3 March 2000

1. General

1.1 Profile

Tan Binh Vegetable Oil Factory was established in 1973 and was turned into a state-owned company belonging to VOCARIMEX (Vegetable Oil-Cosmetics-Aromas Company of Viet Nam) in 1975. The company profile is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Tan Binh Vegetable Oil Factory
Ownership:	State-owned
Address:	6 CMTT Street, Tan Binh District, HCM City
Director:	Mr. Nguyen Van Be (Vice-Director)
Established:	1973
Corporate Capital:	
Company Territory:	3.5 ha
Number of Employees:	250
Main Products:	Refined Oil with the brand name of “NAKYDACO”

The designed production capacity was 12 t/day in the beginning of 1973 and reached 45 t/day in 1999. An expansion project is underway to introduce new equipment into the refining section in 2000. The projected investment is 3 million US$.

1.2 Business Status

1.2.1 Production

Production and sales amounts in 1998 are summarized in Table 2. Two products, cooking oil and shortening, bring about the most turnover. Refined sesame oil and roasted sesame oil are exported to Japan.

Table 2 Production and Sales in 1998

Product	Production (t)	Turnover (1,000 VND)
Refined Coconut Oil	545.085	
Refined Sesame Oil	613.909	
Roasted Sesame Oil	147.357	
Refined Soybean Oil	1,114.514	
Cooking Oil	8,830.379	
Shortening	6,790.036	
Margarine	52.582	
Crude Coconut Oil for Export	525.943	
Total Oil Product	18,610.81	239,103,109

1.2.2 Debt

Corporate capital has been stable since 1995 and the company carries no debt with the bank in 1999.

2 Production Technology

2.1. Process

Figure 1 shows the overall block flow diagram of the Factory.

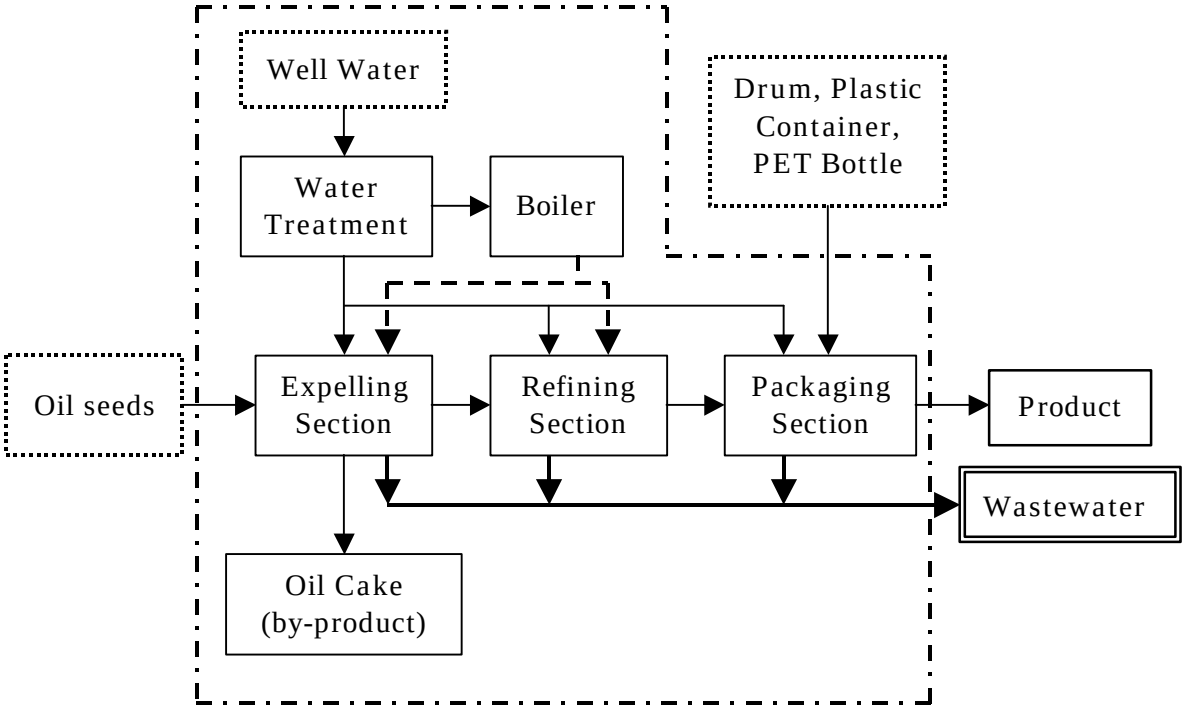


Figure 1 Block Flow Diagram

2.1.1. Expelling Section

Oil seeds are crushed, dried and cooked with saturated steam in the expelling section. After that, crude oil is extracted with screw presses. Three presses are dedicated to coconuts, sesame and soybeans respectively.

2.1.2. Refining Section

The refining section consists of the following units:

1) Neutralization of crude oil with sodium ash;
2) Decolorization with activated clay and activated carbon at high temperature through heating with saturated steam;
3) Deodorization by heating and vacuum evaporation. A small amount of fatty acid is absorbed in wastewater, which is recovered and sent to a supply water pool. Recovery rate reaches 20-40 %.

Both a batch refining line and a continuous refining line are in operation.

2.1.3. Packaging Section

All of the packaging work is manually carried out by 100 employees:

1) The product is filled into drums or plastic containers for industrial use;
2) The product is filled into PET bottles, labeling is applied, and then packed in a carton box.

2.2. Equipment

Major equipment is listed in Table 3.

Table 3 Major Equipment List

Name	Manufacturer	Year of Manufacture	Year of Installation	Process Capacity
Screw Press EP & ETP	East Germany	EP: 1976 ETP: 1980	EP: 1976 ETP: 1980	EP: 15 t/d ETP: 40 t/d
Batch Refining Line	Japan	1972	1973	20 t/d
Continuous Refining Line	USA	1973	1995	27 t/d

2.3. Unit Consumption

2.3.1. Raw Material

Unit consumption of main raw materials is calculated based on the

consumption in 1998 and summarized in Table 4.

Table 4 Unit Consumption of Raw Material

Material Name	Product	Consumption (kg)	Unit Consumption (kg/kg)
Sodium Ash	Refined Coconut Oil	1,215	2.229
	Refined Sesame Oil	3,928	6.398
	Refined Soybean Oil	2,421	2.172
	Cooking Oil	12,206	1.382
	Shortening	5,082	0.748
	Margarine	46	0.875
	Total	24,898	1.337
Activated Carbon	Refined Coconut Oil	150	0.275
	Refined Sesame Oil	3,085	5.025
	Refined Soybean Oil	22.48	0.020
	Cooking Oil	1,072	0.121
	Shortening	229	0.034
	Margarine	3.31	0.063
	Total	4561.79	0.245
Activated Clay	Refined Coconut Oil	1,910	3.504
	Refined Sesame Oil	16,339	26.615
	Refined Soybean Oil	10,122	9.082
	Cooking Oil	57,654	6.529
	Shortening	6,727	0.991
	Margarine	46	0.875
	Total	92,798	4.984
Citric Acid	Refined Coconut Oil	46	0.084
	Refined Sesame Oil	49	0.080
	Refined Soybean Oil	92	0.083
	Cooking Oil	715	0.010
	Shortening	98	0.014
	Total	1,000	0.054
NaCl	Refined Coconut Oil	1,446	3.653
	Refined Sesame Oil	3,070	5.001
	Margarine	207	3.937
	Total	4,723	0.254
Nickel	Shortening	2,125	0.313
	Total	2,125	0.313

2.3.2. Utilities

Utilities consumption in 1998 was as follows:

1) Water: 45 m depth well water;

   Quality: pH 4.46, Hardness 75 ppm as $CaCO_3$, Total Fe 0.3 ppm

   Capacity: 60 m^3/h Domestic & fire fighting use: 10 m^3/h

   Process use: 50 m^3/h

2) Electricity: 2,742,892 kWh

3) Fuel Oil (heavy oil): 2,448,652 kg

2.4. Future Plans

An expansion project is underway in the Company aiming at a production capacity increase to 150 t/day, i.e. 45,000 t/year. The first stage of the project started in 1996 and was completed at the end of 1999 when new neutralization equipment was introduced as follows:

1) A steam boiler from USA;

2) A separator from Germany.

In the next stage of the project, new equipment with the most modern technology is to be introduced from the EU for the Refining section. The projected budget for the Refining section expansion is 3 million US$.

3. Management Technology

The factory is recovering waste oil from the existing oil separators. Approximately 50 kg-oil/day is being recovered and sold to a soap producer at 3,000 VND/kg.

4. Industrial Wastewater Treatment and Discharge

Figure 2 shows water and wastewater balance.

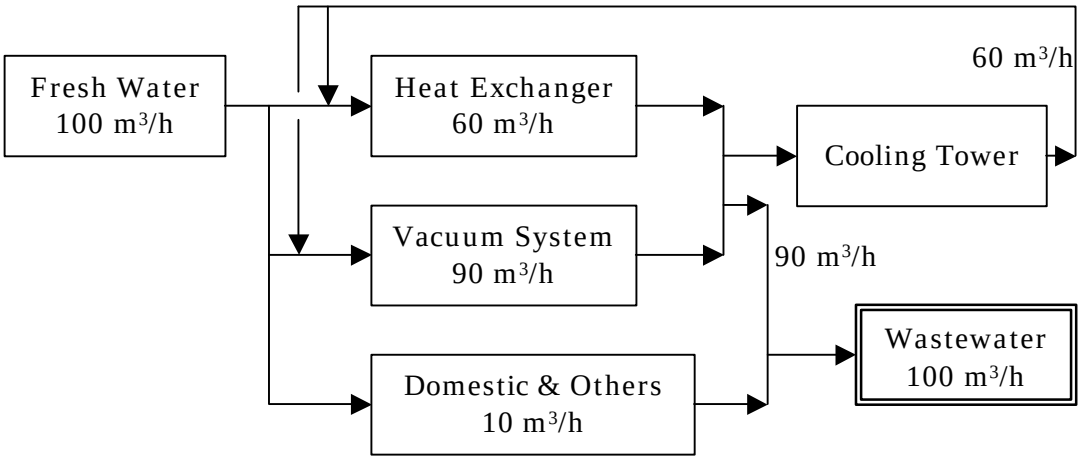


Figure 2 Current Water and Wastewater Balance

Wastewater is mostly created from the Refining section, especially from the

Decolorization and Deodorization unit. In Figure 2, water for the Heat Exchanger means cooling water for the Decolorization and Deodorization units. Also, water for the Vacuum System means water for the Decolorization and Deodorization unit vacuum evaporators. A small amount of oil migrates into vacuum system wastewater, while the heat exchanger wastewater is clean. The Neutralization section is equipped with two 2-stage oil separators.

Figure 3 shows a conceptual diagram of the existing wastewater system. All wastewater is collected to a one-stage oil separator and discharged into a city sewer without treatment.

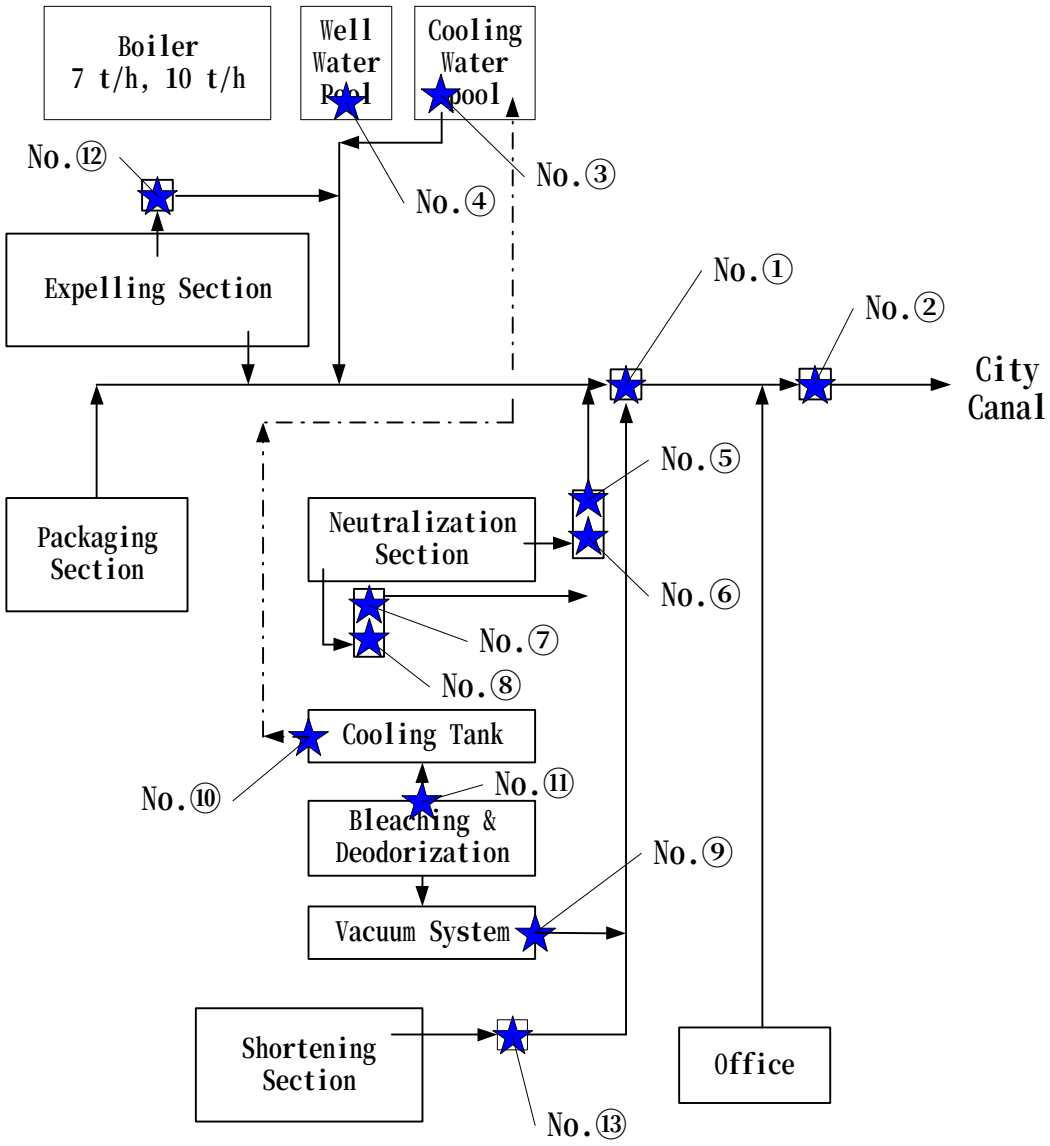


Figure 3 Conceptual Diagram of the Existing Wastewater System

Some difficulties remain in introducing a wastewater treatment system. They are as follows:

1) Construction work should be implemented without stopping the production lines.;
2) A lack of adequate technologies;
3) A shortage of financing.

Wastewater samples were collected at the spots shown in the Figure 3 and analyzed by CECE in this study.

(1) Samples Taken in December 1999

Seven wastewater samples were taken on 13 December 1999 at the following points:

① Primary wastewater pit;
② Final oil separator outlet:
③ Cooling water pool blow down;
⑫ Expelling section dust collector;
⑬ Shortening process wastewater (stagnant water);
⑤ Neutralization section wastewater (oil separator outlet);
⑥ Neutralization section wastewater (oil separator inlet).

Table 5 shows the results of quality analysis of the samples.

Table 5 Wastewater Quality (13 December 1999)

Item	Unit	Sample number and sampling time							TCVN 5945
		① 13:25	② 13:31	③ 13:40	⑫ 13:50	⑬ 14:00	⑤ 14:08	⑥ 14:14	
Temperature	℃	37.9	37.5	36.9	30.3	28.9	33.3	337.5	40
pH	-	7.12	6.88	6.58	6.12	6.11	6.35	6.1	5.5-9
Electric Conductivity	μS/cm	220	250	140	180	250	230	210	
Turbidity	NTU	75	70	37	5	66	36	10	
Oil & Grease	mg/l	0.16	0.12	0.12	0.01	0.22	0.17	0.3	10
DO	mg/l	2.65	2.61	3.98	4.72	2.24	3.68	3.87	
SS	mg/l	156	129	79	18	130	132	36	100
COD	mg/l	300	360	220	240	280	185	160	100
BOD	mg/l	210	225	127	127	170	111	96	50
Total Nitrogen	mg/l	6.5	7.8	6.5	6.8	9.5	6.9	6.2	60
Residual Chlorine	mg/l	0.47	0.58	0.26	0.06	0.41	0.02	0.09	2

(2) Wastewater Samples Taken in March 2000

Eleven wastewater samples were taken on 2 March 2000 at the following points:

①②③⑤⑥: same points as on 13 December 1999;

④ Well water pond;

⑦ Neutralization section wastewater (No. 2 oil separator outlet);

⑧ Neutralization section wastewater (No. 2 oil separator inlet);

⑨ Vacuum evaporator wastewater;

⑩ Decolorization and Deodorization cooling water recycled;

⑪ Deodorization cooling water.

Figure 4 Oil Separator at the final discharge point for wastewater

Table 6 shows the results of quality analysis of the wastewater samples.

The separation efficiency of the existing oil separators is in sufficient as is indicated by the high oil content in the outlet stream. It is understood that, when diluted with clean cooling wastewater, COD and BOD of the final discharge water is rather low compared with vacuum system wastewater and oil separator outlet water.

Table 6 (1) Wastewater Quality (2 March 2000)

Item	Unit	Sample number and sampling time					
		④ 9:54	③ 10:03	⑩ 10:12	⑪ 10:26	⑨ 10:41	① 10:50
Temperature	℃	30	36.2	35.9	37.1	38.8	37.7
pH	-	5.1	5.8	5.9	5.4	5.9	7.5
Electric Conductivity	μS/cm	360	310	168	188	169	350
Turbidity	NTU	0	39	10	6	66	281
Oil & Grease	mg/l	0.008	0.2	0.23	0.32	0.34	0.28
DO	mg/l	6.5	3.1	4.5	4.8	3.9	2.41
SS	mg/l	0	45	20	2	96	289
COD	mg/l	8	320	48	40	640	320
BOD	mg/l	3.5	144	22	18	254	155
Total Nitrogen	mg/l	0.52	6.5	16.0	6.3	7.4	1.6
Residual Chlorine	mg/l	0	0.26	0.14	0.08	0.49	1.79

Table 6 (2) Wastewater Quality (2 March 2000)

Item	Unit	Sample number and sampling time					TCVN 5945
		② 11:02	⑦ 11:17	⑧ 11:30	⑤ 11:40	⑥ 11:55	
Temperature	℃	37.7	49.9	49.9	33.7	32.8	40
pH	-	6.6	7.9	9.5	7.1	7.1	5.5-9
Electric Conductivity	μS/cm	1450	1040	740	307	365	
Turbidity	NTU	132	1712	1404	73	44	
Oil & Grease	mg/l	2.6	164.9	201.6	158.6	258.2	10
DO	mg/l	2.8	1.7	1.8	3.2	2.6	
SS	mg/l	107	2712	3656	49	62	100
COD	mg/l	280	4690	5760	5520	4080	100
BOD	mg/l	126	2552	3200	3250	2355	50
Total Nitrogen	mg/l	8.1	21.0	14.5	6.0	19.5	60
Residual Chlorine	mg/l	0.63	8.52	13.28	0.48	0.32	2

5. Countermeasures for Improvement

5.1. Current Problems

Current issues in Tan Binh Oil Factory concerning wastewater are summarized as follows:

(1) Contaminated wastewater is discharged to a city canal;

(2) Oil separators: existing oil separators seems too small to remove oil from wastewater effectively;

(3) The capacity of the existing cooling tower is too low to efficiently

recover and reuse cooling water. Therefore, clean cooling wastewater is mixed with dirty wastewater and discharged to a city canal resulting in a high volume of wastewater.

5.2. Improvement of Production Technologies

5.2.1. Recycle and Reuse of Cooling Wastewater

In order to minimize the dimensions of the wastewater treatment system so as to reduce the construction costs, it is necessary to reduce the volume of wastewater. At present, 100 m^3 of wastewater is discharged per day as shown in Figure 2.

By improving the water supply and wastewater system as shown in Figure 5, the volume of wastewater treated could be reduced to 70 m^3/h, which includes 30 m^3/h from a new production line. In order to achieve this, it is necessary to install two sets of cooling towers for the heat exchanger cooling water and the vacuum system water. The required cost is estimated at 380 million VND.

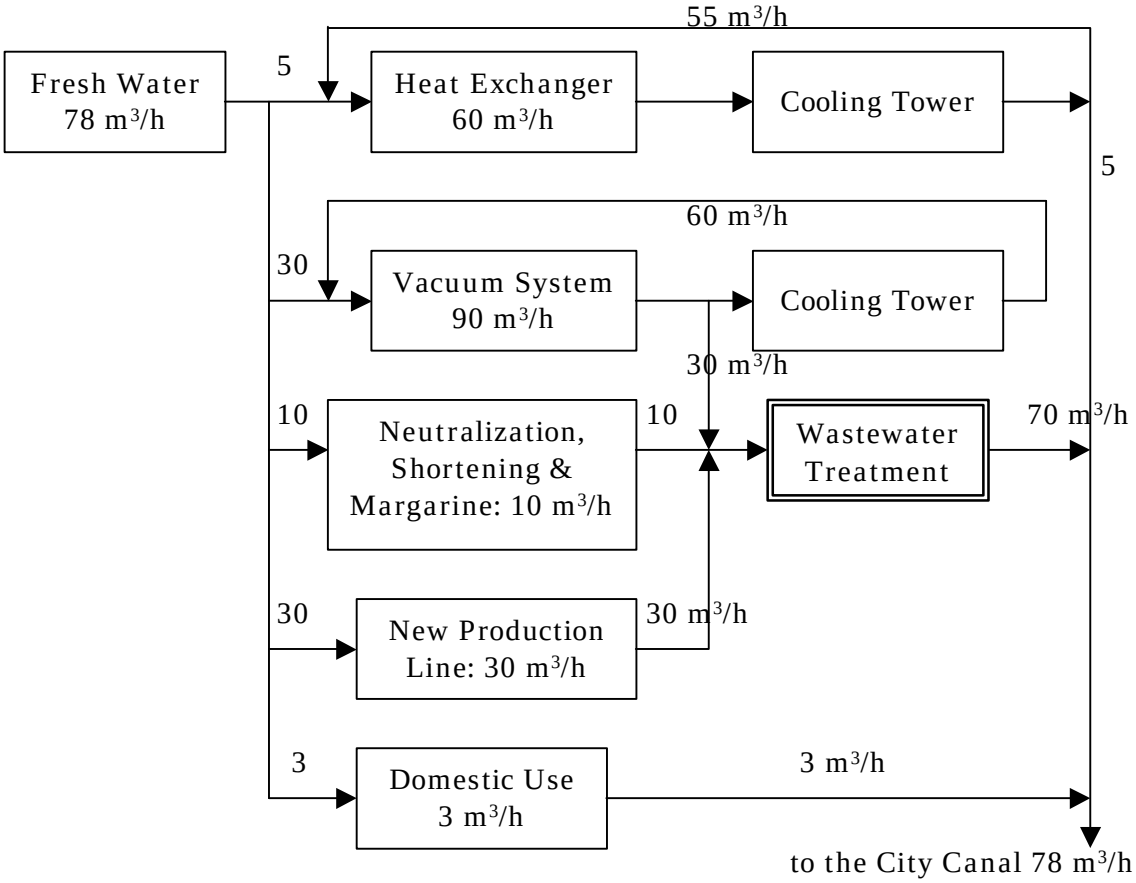


Figure 5 Improved Water Supply and Recycling System

5.2.2. Improvement of Oil Separators

The amount of COD being discharged to the city canal at present is roughly calculated as follows:

Neutralization wastewater: 10 m^3/h x 5,000 mg/l = 500 kg/h

Vacuum system wastewater: 30 m^3/h x 600 mg/l = 18 kg/h

Final discharge wastewater: 100 m^3/h x 300 mg/l = 30 kg/h

Judging from the fact that:

1) The current oil separators are not efficiently working;
2) The environmental impact of oil separator outlet wastewater is quite high, although there is discrepancy in overall COD balance.

It is necessary to improve the efficiency of the oil separators. It is suggested that the factory enlarge the oil separators to keep a retention time of as long as 1 minute and an average horizontal velocity inside of as low as 0.9 m/min. By implementing this countermeasure, waste oil can effectively be removed and recovered and used as another resource.

5.3. Improvement of Wastewater Treatment

5.3.1. Design Basis

Incorporating future improvement plans for wastewater classification and production capacity expansion plan, total volume of wastewater to be treated is set at 1680 m3/day. And also wastewater quality of the entire factory total is summarized from the analysis results by CECE and the flow rate at major discharge point, estimated by the factory staff. This is shown in Table 7.

5.3.2. Conceptual Design

Based on the above data, conceptual design work was done by the study team. As a result, a block flow diagram and basic dimensions of major equipment for the wastewater treatment system are shown respectively in Figure 7 and Table 8, and also the schematic process flow sheet is shown in Figure 8.

5.3.3. Site Plan

The site for the installation of a wastewater treatment system is shown in Figure 9. An area of approximately 1,200 m^2 can be allocated by clearing away

the existing old warehouse. Figure 6 shows the present state of the site proposed.

Figure 6 Proposed Site for the Wastewater Treatment System

5.3.4. Required Cost

The required construction cost of the wastewater treatment system, based on the above conceptual design, is estimated at 8.5 billion VND.

6. Recommendations

6.1. Short Term Recommendations

It is understood that the company is giving the expansion project the highest priority among Factory activities. Continuous and meticulous efforts, however, will be required to maintain GMP as a food production factory.

Parallel to the construction work of a new production line, the following measures are recommended on a short term basis:

(1) To get hold of an accurate material balance, especially materials

discharged into the wastewater. Based on an accurate material balance, the factory should work out measures to reduce losses;

(2) To prepare for the implementation of a wastewater treatment project.

6.2. Mid and Long Term Countermeasures

On a mid-term basis, it is recommended that a wastewater treatment system be installed as mentioned in Section 5.3. Parallel to the wastewater treatment project, it is recommended to enlarge the existing oil sparators as mentioned in 5.1.2. It is also recommended tat an outside expert of wastewater treatment operation be invited for the test operation of the treatment system in order to establish an optimal operating condition.

On a long term basis, it is important to maintain stable operation of the wastewater treatment system as well as the production facilities.

6.3. Implementation Schedule

An implementation schedule has been planned for the countermeasures for industrial pollution prevention and is shown in Figure 10. It is expected that the factory commence the test operation of the wastewater treatment system in the middle of 2002.

Table 7 Design Basis of Wastewater Volume and Quality

(Tan Binh Vegetable Oil Company)

Wastewater Source	Volume	Wastewater Quality						Note
		Temp.	pH	COD	BOD	SS	Oil	Total-N	
	(m3／day)	℃		(mg／l)	(mg／l)	(mg／l)	(mg／l)	(mg／l)	
1) Neutralization section (inc. Shortening section)	240	41.7		5012	2840	1620	196	15.3	aberage of sample⑤⑥⑦⑧
2) Vacuum system of Breaching and Deodorization section									
	720	38.8		1706	678	256	0.91	20	sample⑨*2．67 (condensed by recycle use)
3) Future expansion of the Purification unit									
	720	38.8		1706	678	256	0.91	20	same as present system
Factory total	1680	39.2		2178.3	986.9	450.9	28.8	19.3	
Contaminants discharged per day									
	m3/Day			kg/Day	kg/Day	kg/Day	kg/Day	kg/Day	
	1680	39.2		3659.52	1657.92	757.44	48.35	32.47	

Calculation Base of Wastewater Volume & Quality per Day

1) Wastewater volume of each section is adopted in accordance to the discussion results between the study team and factory staff.
2) Wastewater volume of the vacuum unit is roughly estimated as 80 m3/Hr by visually checking flow speed in the wastewater pit.
3) Wastewater volume increased by future production capacity expansion is estimated at 30m3/Hr.
And the quality is also estimated to be the same as the present situation. This is necessary to review at the detail design stage.

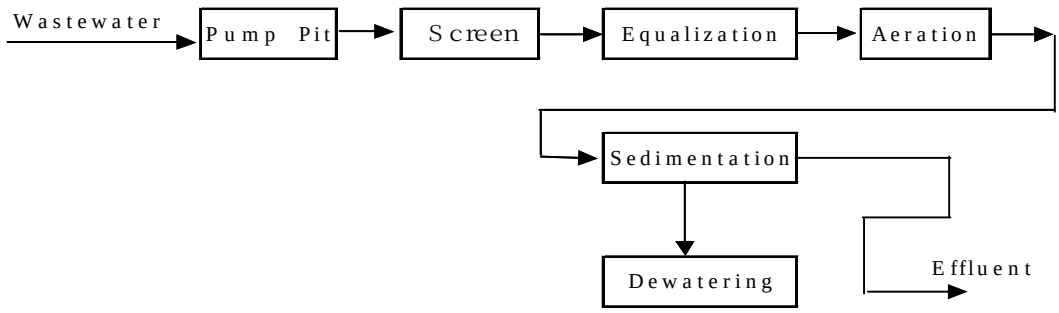


Figure 7 Block Flow sheet of the Wastewater Treatment System
(Tan Binh Vegetable Oil Company)

Table 8 Basic Dimensions of Major Equipment

Name of Equipment	No. of Unit Required	Remarks
Pump Pit	1	70m^3 RC
Wastewater Pump	2	Submerged, 5.6m^3/min 25kW
Screen	1	1mm mesh
Equalization Tank	1	1120m^3 RC, 18m dia. 4.5m d
Blower for the Equalization Tank	2	Rotary 13m^3/.min 16kW
Equipment for the Equal.Tank	1	Diffuser Type
Transfer Pump	2	Volute, 1.2m^3/min 2.6kW
Aeration Tank	1	1680m^3 RC, 5mw*4.5mD*25mL *3sets
Blower for the Aeration Tank	2	Rotary 69m^3/.m 83kW
Equipment for the Aeration.Tank	1	Diffuser Type
Sedimentation Tank	1	448m3, 12.m dia. 4m d RC
Return Sludge Pump	2	Volute, 1.2m^3/m 1.6kW
Sludge Collector	1	Mechanical Rake
Dewaterring Facilities	3	Belt Filter, 3m Width*3 sets
Chemical Dosing	1	Cation Polymer Tanks and Pumps
Control Building	1	4mW*8mL Steel Slated, 2 Stories

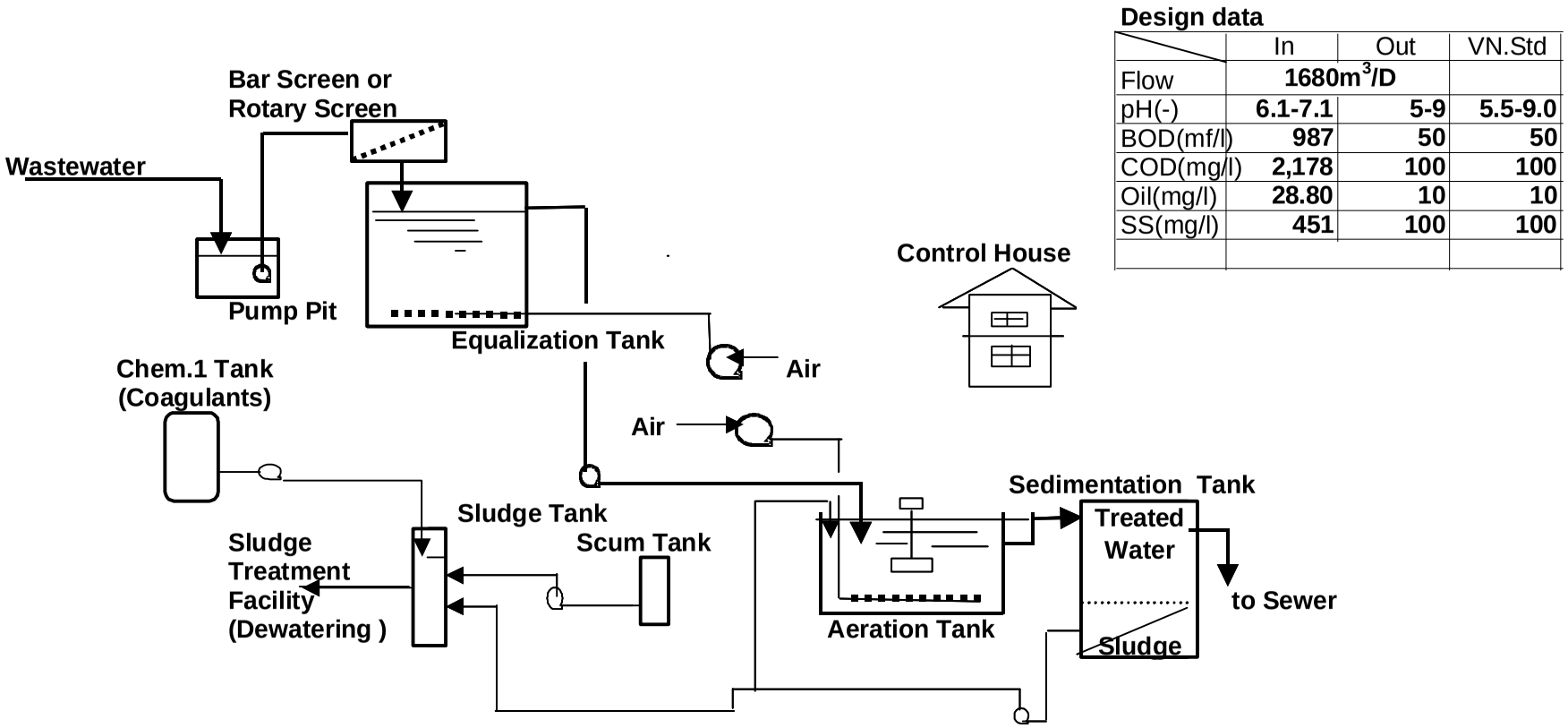


Figure 8 Schematic Flow of the Wastewater Treatment System

(Tan Binh Vegetable Oil Factory)

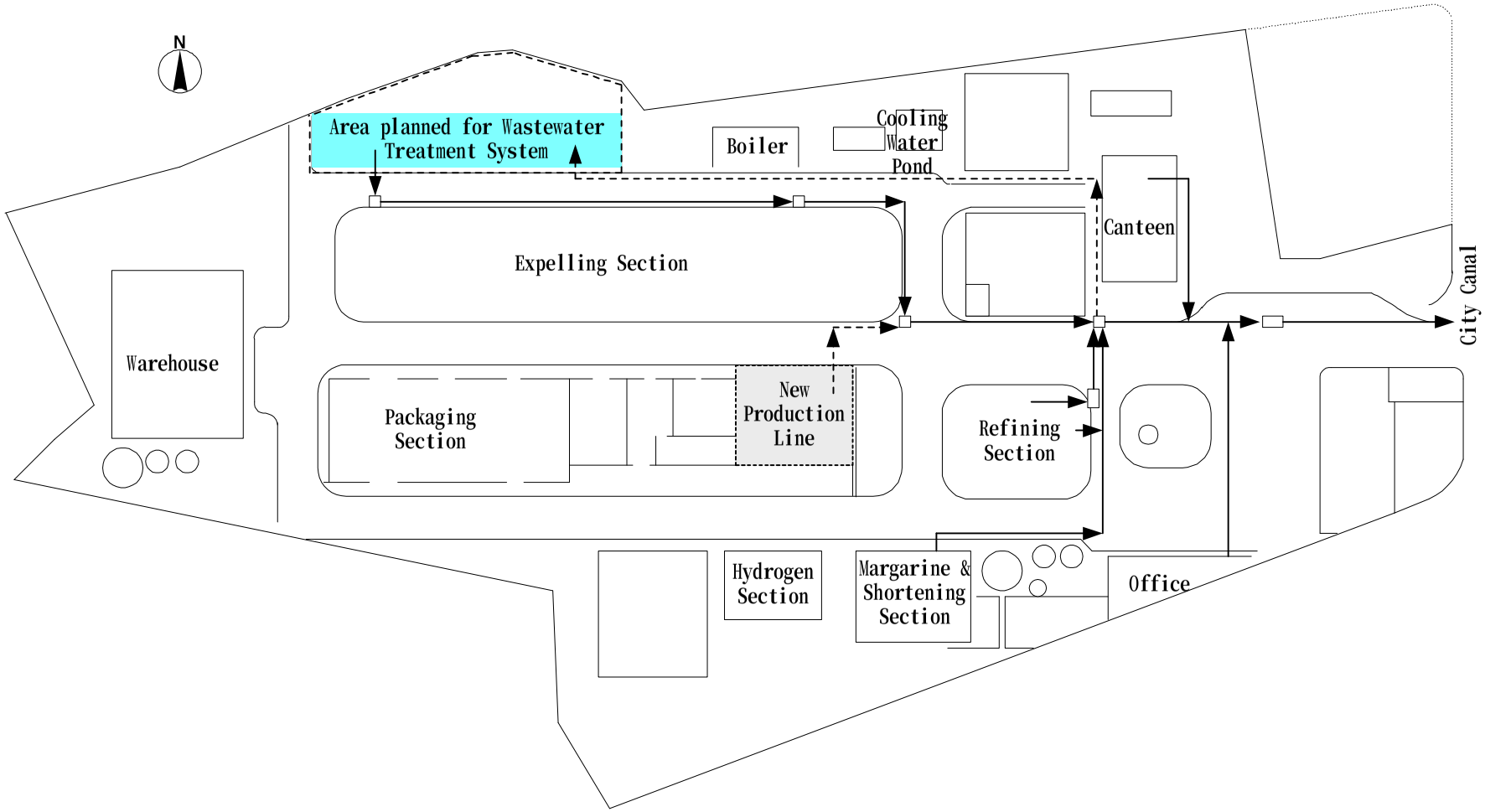


Figure 9 Factory Layout and Wastewater Drainage Route of Tan Binh Vegetable Oil Factory

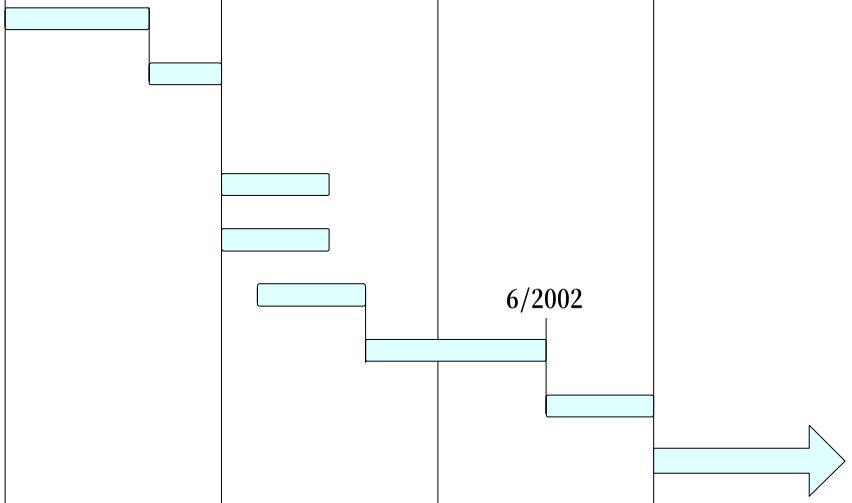
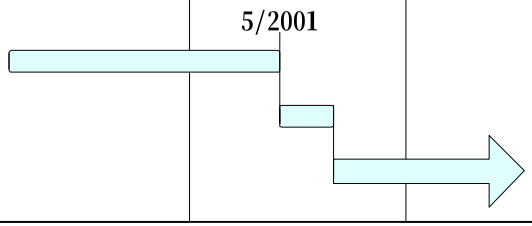
Project	2000	2001	2002	2003	2004
1. Wastewater Treatment System (1) Feasibility Study of the Project (2) Design (Engineering & Cost Estimation) (3) Approval by MOI and HCMC (4) Budgeting (5) Bidding (6) Construction Work (7) Test Operation (8) Commercial Operation			6/2002		
2. New Production Line (1) Construction Work (2) Test Operation (3) Commercial Operation		5/2001			

Table 10 Proposed Implmentation Schedule for Industrial Pollution Prevention Countermeasures (Tan Binh Vegetable Oil Factory)

CASE STUDY F-05

Da Nang Beer Company

Survey Date:15 & 16 December 1999
6-8 March 2000

1. General

1.1 Profile

Da Nang Beer Company was established in 1947 during the French colonization. The company produced beverages in it's early stages and later changed to beer production based on Czech technology. The company profile is summarized in Table 1. Figure 1 shows the organization of the company. A project team composed of members of the Planning department, the Q.A and Technical department and the Facilities Management department has been established to implement several projects for production technology improvement, including wastewater treatment.

Table 1 Enterprise Profile

Name of Company:	Da Nang Beer Company
Ownership:	State-owned
Address:	No. 6 Nguyen Du Str. Da Nang City
Director:	Mr. Tran Van Linh
Established:	1947
Corporate Capital:	
Number of Employees:	270
Main Products:	Beer, Soft drinks

1.2 Business Status

1.2.1 Production

The Company recorded its record maximum production level of 15 million liter beer/year in 1996. After 1996, however, its production declined to 5 million l/year due to severe competition in the market. Table 2 shows production and sales in 1998.At present, Da Nang Beer Company is considered a local beer producing company.

1.2.2 Debt

The Company has no debt as of the end of 1999.

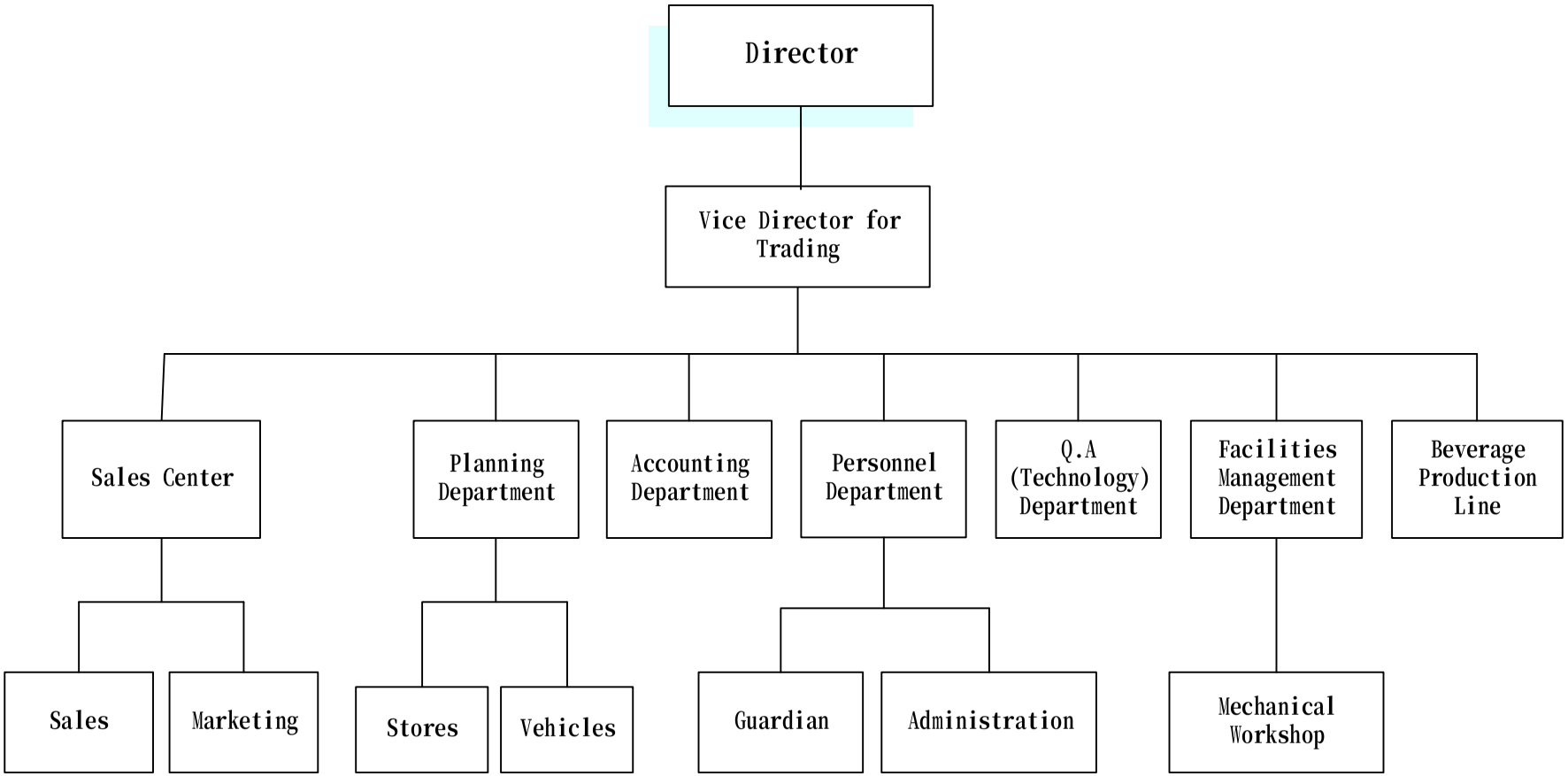


Figure 1 Organization of Da Nang Beer Company

Table 2 Production and Sales in 1998.

Items	Production (l)	Turnover (million VND)
Bottle Beer	3,025,000	22,182
Da Nang Draught Beer	622,000	3,110
Draught Beer	1,123,000	3,144
Beer Total	4,770,000	
Soft Drinks	232,000	829
Total		29,265

2. Production Technology

2.1 Process

Figures 2 shows a simplified block flow diagram of the Factory. Well water supplied by a 10 m^3/h pump is used to make up for city water shortage.

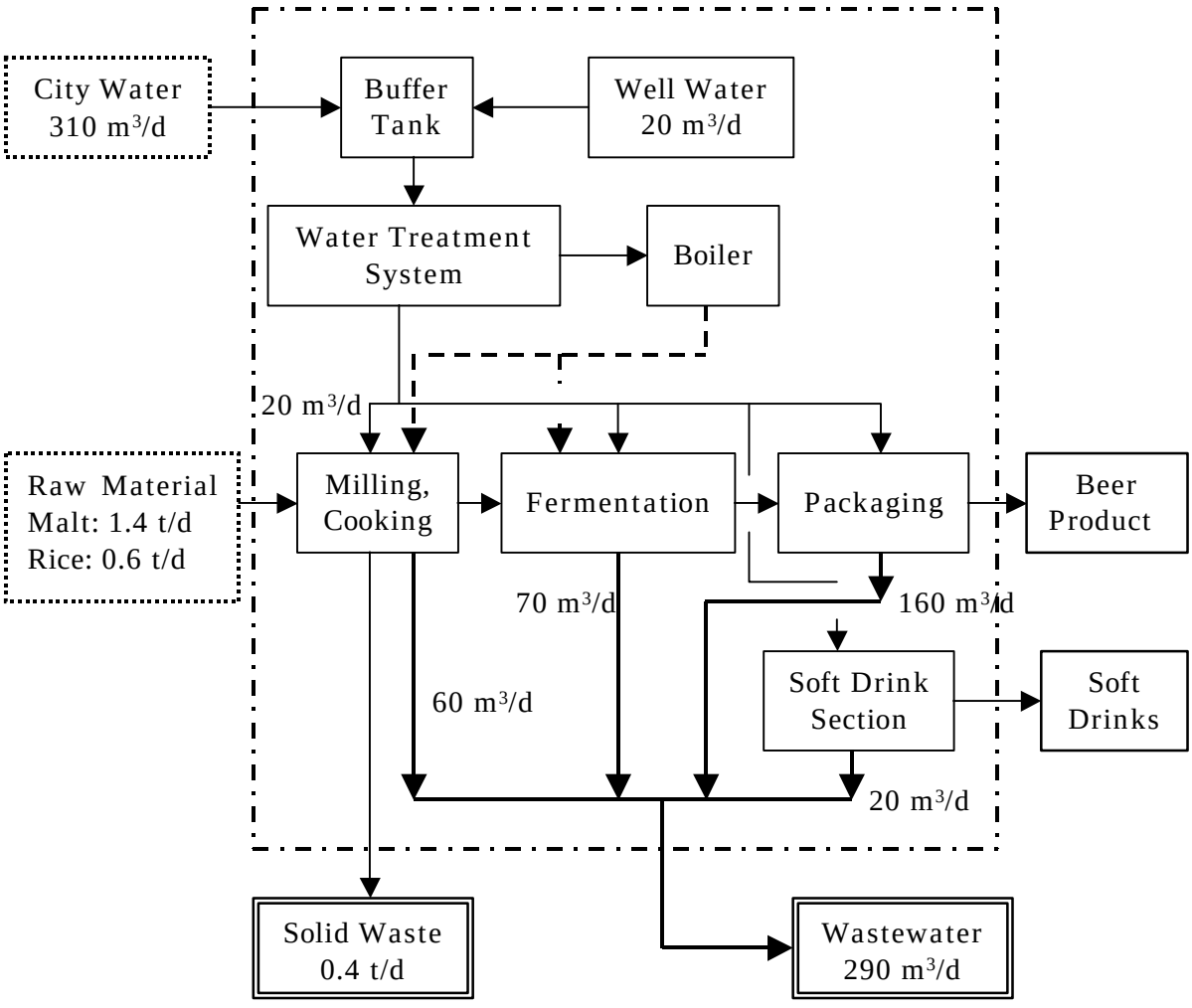


Figure 2 Simplified Block Flow Diagram of the Factory

Figure 3 shows a simplified block flow diagram of the beer producing line.

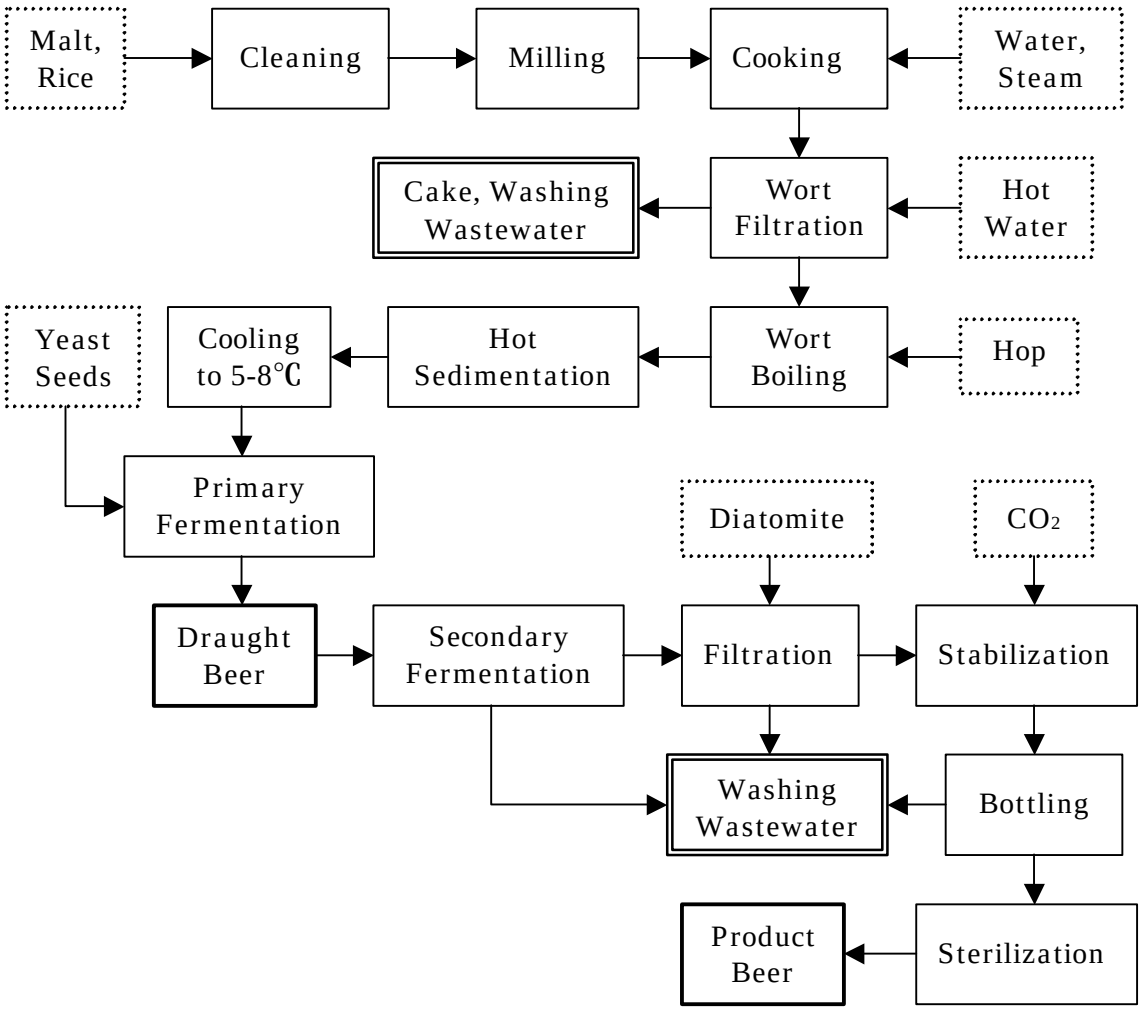


Figure 3 Block Flow Diagram of Beer Production Process

The cooking section, composed of a liquefaction unit and a sacchrafication unit creates 0.4 t/day of solid waste, which is sold as animal feed to a contractor located 30 km away from the company.

Draught beer is filled into drums. The drum filling section is equipped with a CIP system that has an automatic sequence controller.

2.2 Sources of Wastewater

Wastewater is created by washing equipment and piping in each processing unit and bottles and drums as follows:

(1) Cooker Washing
(2) Wort Filter Washing
(3) Secondary Fermentor Washing
(4) CIP System Washing
(5) Bottle Washing
(6) Beverage Section Washing

2.3 Process Improvement

Process improvement is being implemented by the project team mentioned in Section 1.1. Undergoing projects are as follows:

1) Relocation of the secondary fermentors and introduction of a single stage fermentation process;
2) Installation of a new water treatment system;
3) Installation of flow meters for each production unit;
4) Optimization of energy consumption;
5) Expansion of the production capacity.

The highest priority of the Da Nang Beer Company is their aim of increasing beer production capacity to 20 million liter/year in 3 or 4 years.

3. Management Technology

3.1 Material Consumption

One of the most important issues for a factory in the process industry is to gain a grasp of material balance and to control unit consumption of raw materials and utilities. Table 3 shows raw material consumption calculated by using figures in 1998.

3.2 Unit Consumption of Water

The unit consumption of water to produce beer is approximately 10 m^3/m^3-beer in ordinary beer producing factories and 5 m^3/m^3-beer in advanced factories. Compared with these figures, the figure of 21.8 m^3/m^3-beer in Da Nang Beer Company is too high.

Figure 4 shows unit consumption of water calculated by using monthly data in 1999. Figures are not only large, but also fluctuate by month. The reason for this high water consumption is not clear, although the Factory explained that there is a lot of leakage from the piping at present. After the completion of the

aforementioned projects for process improvement, it is expected that water consumption will be greatly reduced to the international standard level after the company takes hold of the problem and controls it.

Table 3 Raw Material Consumption.

Material	Quantity	Unit Consumption	Unit Cost (VND)	Payment (1,000 VND)
1. Beer				
Malt	594,500 kg	0.125 kg/l	5,611 /kg	3,335,740
Rice	260,000 kg	0.055 kg/l	3,411 /kg	886,860
Hop extract	500 kg	0.105 g/l	210,000 /kg	105,000
Hop pellet	870 kg	0.182 g/l	87,047 /kg	75,731
H_3PO_4 acid	85 l	0.018 l/m^3	7,000 /l	595
Formaldehyde	150 l	0.031 l/m^3	4,200 /l	630
$CaCl_2$	470 kg	0.099 g/l	9,700 /kg	4,559
NaOH	22,200 kg	4.654 g/l	4,100 /kg	91,020
NaClO	320 l	0.067 l/m^3	1,350 /l	432
Diatomite	6,000 kg	1.258 g/l	8,610 /kg	51,660
Silica gel	800 kg	0.168 g/l	305,260 /kg	244,208
Gelatin glue	2,500 kg	0.524 g/l	32,426 /kg	81,065
Soap	330 kg	0.069 g/l	4,400 /kg	1,452
Cleaning agent	1,500 kg	0.314 g/l	48,764 /kg	73,146
Lime	550 kg	0.115 g/l	800 /kg	440
$Al_2(SO_4)_3$	1,650 kg	0.346 g/l	3,450 /kg	5,693
Water	104,125 m^3	21.8 m^3/m^3	2,410 /m^3	250,941
Fuel oil	593,501 l	0.124 l/l	1,720 /l	1,020,822
Electricity	1,545,460 kWh	0.324 kWh/l	950 /kWh	1,458,687
Total				
2. Soft Drinks				
Refined sugar	31,000 kg	134 g/l	6,343 /kg	196,633
Essential oil	325 kg	1.4 g/l	122,000 /kg	39,650
Total				236,283

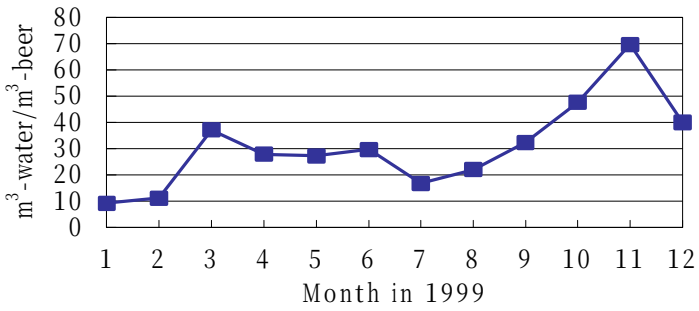


Figure 4 Unit Consumption of Water in 1999

4. Industrial Wastewater Treatment and Discharge

4.1 Wastewater volume

Wastewater is created from each production and packaging section and finally, discharged into a city canal without treatment.

The volume of wastewater discharged at present is estimated at 290 m^3/day as shown in Figure 2. It is expected that this figure will be reduced by 90 m^3/day through the following measures after the completion of the expansion and technology improvement projects.

1) Reduction of wastewater from the fermentation section by applying a new technology;
2) Improvement of the washing procedure of the cooking section;
3) Separation of clean wastewater from dirty wastewater.

4.2 Wastewater Quality

Wastewater samples were taken for analysis by CECE in this study at the spots shown in Figure 7.

(1) Sampling in December 1999

Five samples were collected as follows:

① Floor washing wastewater in the cooking section;
② Bottle washing wastewater;
③ Secondary fermentation wastewater;
④ Drum cleaning wastewater;
⑤ Final discharge to the city canal.

Wastewater samples might have been diluted with rainwater due to the heavy seasonal rains.

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

Table 4 Wastewater Quality (17 December 1999)

Item	Unit	Sample number					TCVN 5945
		① 14:55	② 15:06	③ 15:16	④ 15:35	⑤ 15:45	
Flow Rate	m^3/h						
Temperature	℃	26.5	26.3	20.1	35.8	23.5	40
pH	-	7.88	11.07	7.54	10.61	10.65	5.5-9
Electric Conductivity	μS/cm	132	530	120	647	620	
Turbidity	NTU	74	51	18	36	25	
Oil & Grease	mg/l	0.12	0.25	0.22	0.0	0.15	10
DO	mg/l	4.85	5.12	4.98	5.01	5.41	
SS	mg/l	135	91	36	67	63	100
COD	mg/l	920	160	280	240	200	100
BOD	mg/l	520	93	172	165	121	50
Total Nitrogen	mg/l	18.2	14.8	10.8	9.4	6.8	60
Residual Chlorine	mg/l	0.0	0.0	0.75	0.0	0.03	2

(2) Sampling in March 2000

One sample was collected by company employees on 6 March 2000 to the production schedule:

⑥Secondary fermentation filter washing wastewater.

Seven samples were collected on 7 March as follows:

①Cooker washing wastewater;

②Bottle washing wastewater;

③Secondary fermentation wastewater;

③Secondary fermentation wastewater;

⑦CIP solution tank washing wastewater;

⑤Final discharge to the city canal;

①Wort filter washing wastewater.

The results of quality analysis on the samples are summarized in Tables 5 and 6.

Table 5 Wastewater Quality (7 March 2000)

Item	Unit	Sample number and sampling time					TCVN 5945
		① 07:35	①- 2 12:36	② 7:50	③ 8:17	③-2 8:30	
Flow Rate	m^3/h						
Temperature	℃	27.6	28.4	38.4	21.3	20.8	40
pH	-	6.2	6.7	10.7	10.6	10.9	5.5-9
Electric Conductivity	μS/cm	230	117	1200	687	1117	
Turbidity	NTU	50	42	18	176	62	
Oil & Grease	mg/l	0.4	0.45	0.33	0.44	0.48	10
DO	mg/l	5.5	6.3	4.2	6.6	5.6	
SS	mg/l	256	152	95	362	389	100
COD	mg/l	572	362	200	224	236	100
BOD	mg/l	330	231	120	175	145	50
Total Nitrogen	mg/l	4.6	6.5	13.2	12.5	18.6	60
Residual Chlorine	mg/l	0.24	0.17	0.09	0.92	0.29	2

Table 6 Wastewater Quality (6 & 7 March 2000)

Item	Unit	Sample number and sampling time			TCVN 5945
		⑤ 09:00	⑥ 6 Mar.	⑦ 08:45	
Flow Rate	m^3/h				
Temperature	℃	50.8		58.5	40
pH	-	9.7	6.4	9.2	5.5-9
Electric Conductivity	μS/cm	563	276	340	
Turbidity	NTU	24	90	33	
Oil & Grease	mg/l	0.35	0.38	0.45	10
DO	mg/l	3.17	3.20	3.34	
SS	mg/l	27	73	50	100
COD	mg/l	204	232	432	100
BOD	mg/l	121	150	300	50
Total Nitrogen	mg/l	7.3	12.3	16.7	60
Residual Chlorine	mg/l	0.06	0.03	0.01	2

5. Countermeasures for Improvement

5.1 Current Problems

Current issues in the company concerning wastewater are summarized as follows:

(1) Wastewater is discharged to the city canal without treatment;

(2) Causes of the water balance problem remain unclear. Unit

consumption of water per beer production is high compared with that of other companies;

(3) Clean wastewater is mixed with dirty wastewater;

(4) Rainwater is mixed with wastewater.

5.2 Countermeasures for Production Technology Improvement

5.2.1 Process Improvement

Process improvement projects described in Section 2.3 should be implemented. Required investment is estimated at 1,700,000 US$ or 23.8 billion VND.

5.2.2 Separation of Clean Wastewater and Rainwater from Dirty Wastewater

In the case a wastewater treatment system is introduced, it is necessary to reduce the volume of wastewater to be treated so as to minimize the dimensions of the treatment system. It is necessary to install a drainage line dedicated for dirty wastewater.

5.2.3 Management of Unit Consumption

After installing flow meters for each production unit, it is suggested that the company get a grasp of material balance, and calculate and control unit consumption.

5.3 Countermeasures for Wastewater Treatment

In addition to countermeasures for improvement of production technology and management technology, the introduction of a wastewater treatment system is necessary. The conceptual design of a wastewater treatment system was carried out in this study and summarized hereafter:

5.3.1 Design Basis

(1) Wastewater Volume

Incorporating the future plan, the volume of wastewater to be treated is set at 200 m^3/day.

(2) Water Quality

Total wastewater quality of the factory, which should be treated by the wastewater treatment system, is summarized from the analysis results of CECE, and the flow rate is estimated at each major discharge point. This is shown in Table 7.

5.3.2 Conceptual Design

Based on the above data, conceptual design work was done by the study team. As a result, a block flow diagram and the basic dimensions of major equipment for the wastewater treatment system are shown respectively, in Figure 5 and Table 8, and also the schematic process flow sheet is shown in Figure 6.

5.3.3 Layout Plan

A layout plan for the wastewater treatment system has been planned and is shown in Figure 7. The wastewater treatment system can be constructed by clearing the existing secondary fermentation tanks and providing a new access corridor from the gate facing Duong Nguyen Street.

5.3.4 Required Cost

The required construction cost of the wastewater treatment system, based on the conceptual design is estimated at 3.5 billion VND.

6 Recommendations for Industrial Pollution Prevention

6.1 Short Term Basis Recommendations

Parallel to the implementation of the expansion project, it is recommended that production costs of the existing production line be analyzed because the current unit consumption of water seems high as mentioned in 5.2.3.

6.2 Mid and Long Term Basis Recommendations

On a mid-term basis, it is recommended that the company introduce a wastewater treatment system referring to the conceptual design described in Section 5.3. It is also recommended that an expert on biological treatment be invited for the test operation of the system in order to establish an optimal operating condition. On a long-term basis, it is important to maintain stable operation of the wastewater treatment system, as well as the production facilities.

6.3 Implementation Schedule

An implementation schedule has been planned for the countermeasures for industrial pollution prevention and is shown in Figure 7. It is expected that the Factory will commence the test operation of the wastewater treatment system in the middle of 2002.

Table 7 Design Basis of Wastewater Volume and Quality
(Da Nang Beer Company)

Wastewater Source	Volume	Wastewater Quality						Note
		Temp.	pH	COD	BOD	SS	Oil	Total-N	
	(m3／day)	℃		(mg／l)	(mg／l)	(mg／l)	(mg／l)	(mg／l)	
1) Cooker Washing Wastewater	46	28	7.9	572	330	256	0.4	4.6	sample 1
2) Filter Washing at Cooking Section	5	28		362	231	152	0.34	6.5	sample1-2
3) Bottle Washing Wastewater	58	38		200	120	95	0.33	13.2	sample2
4) Second Fermentatin Tank washing Water	38	21		230	160	377	0.46	16.5	aberage of smple3-1&2
5) Draught Beer Container Washing	24	36		240	165	67	0	9.4	smple5
6) Product beer Filter Washing Water	8	25		232	150	73	0.38	12.3	sample6
TotalWastewater	179	30.7		313.3	192.9	193.1	0.3	11.0	
Contaminants discharged per day	m3/Day			kg/Day	kg/Day	kg/Day	kg/Day	kg/Day	
	200	30.7		62.7	38.6	38.6	0.1	2.2	

Calculation Base of Wastewater Volume & quality per Day
1) Wastewater volume of each section has been adopted in accordance to the results of discussions between the study team and company staff.:
2) Leak water from piping is excluding from total volume of supply water for WWT conceptual design.
3) Wstewater volume of 200m3/day is estimated at design base included for future expansion plan.

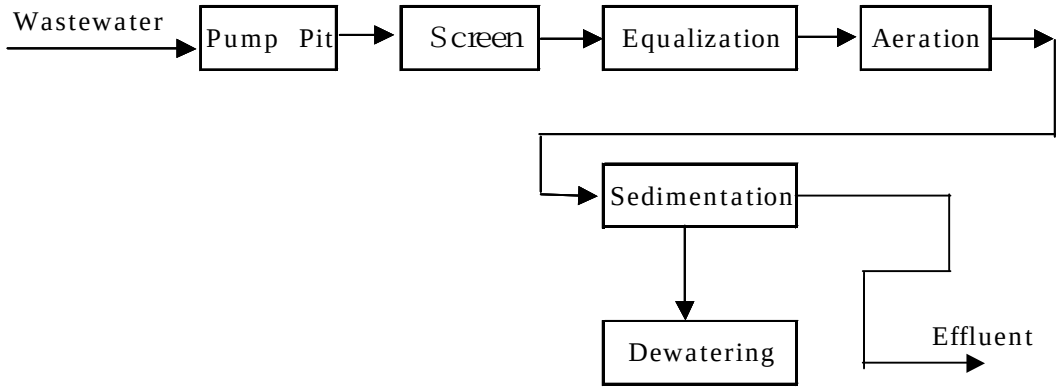
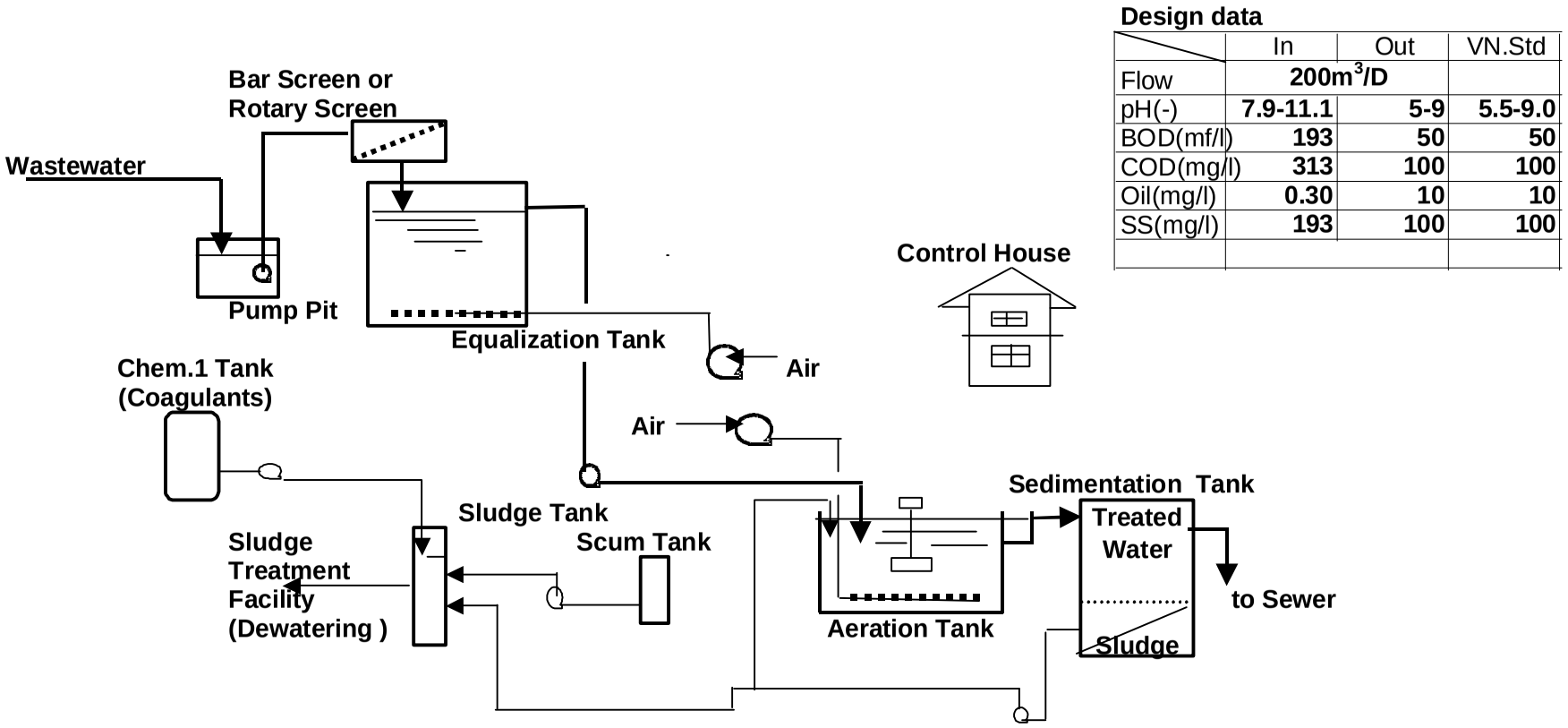


Figure 5 Block Flow sheet of the Wastewater Treatment System

(Da Nang Beer Company)

Table 8 Basic Dimensions of Major Equipment

Name of Equipment	No. of Unit Required	Remarks
Pump Pit	1	$8m^3$ RC
Wastewater Pump	2	Submerged, $0.7m^3$/min 3.0kW
Screen	1	1mm mesh
Equalization Tank	1	$135m^3$ RC, 6.5m dia. 4.5m d
Blower for the Equalization Tank	2	Rotary $1.5m^3$/.min 1.7kW
Equipment for the Equal.Tank	1	Diffuser Type
Transfer Pump	2	Volute, $0.1m^3$/min 0.3kW
Aeration Tank	1	$200m^3$ RC, 5mw*4.5mD*9mL
Blower for the Aeration Tank	2	Rotary $2m^3$/.m 2kW
Equipment for the Aeration.Tank	1	Diffuser Type
Sedimentation Tank	1	53m3, 4m dia. 4m d RC
Return Sludge Pump	2	Volute, $0.1m^3$/m 0.2kW
Sludge Collector	1	Mechanical Rake
Dewaterring Facilities	1	Belt Filter, 0.2m Width
Chemical Dosing	1	Cation Polymer Tanks and Pumps
Control Building	1	4mW*6mL Steel Slated, 2 Stories



Design data

	In	Out	VN.Std
Flow	**200m^3/D**		
pH(-)	**7.9-11.1**	**5-9**	**5.5-9.0**
BOD(mf/l)	**193**	**50**	**50**
COD(mg/l)	**313**	**100**	**100**
Oil(mg/l)	**0.30**	**10**	**10**
SS(mg/l)	**193**	**100**	**100**

Figure 6 Schematic Flow of the Wastewater Treatment System

(Da Nang Beer Company)

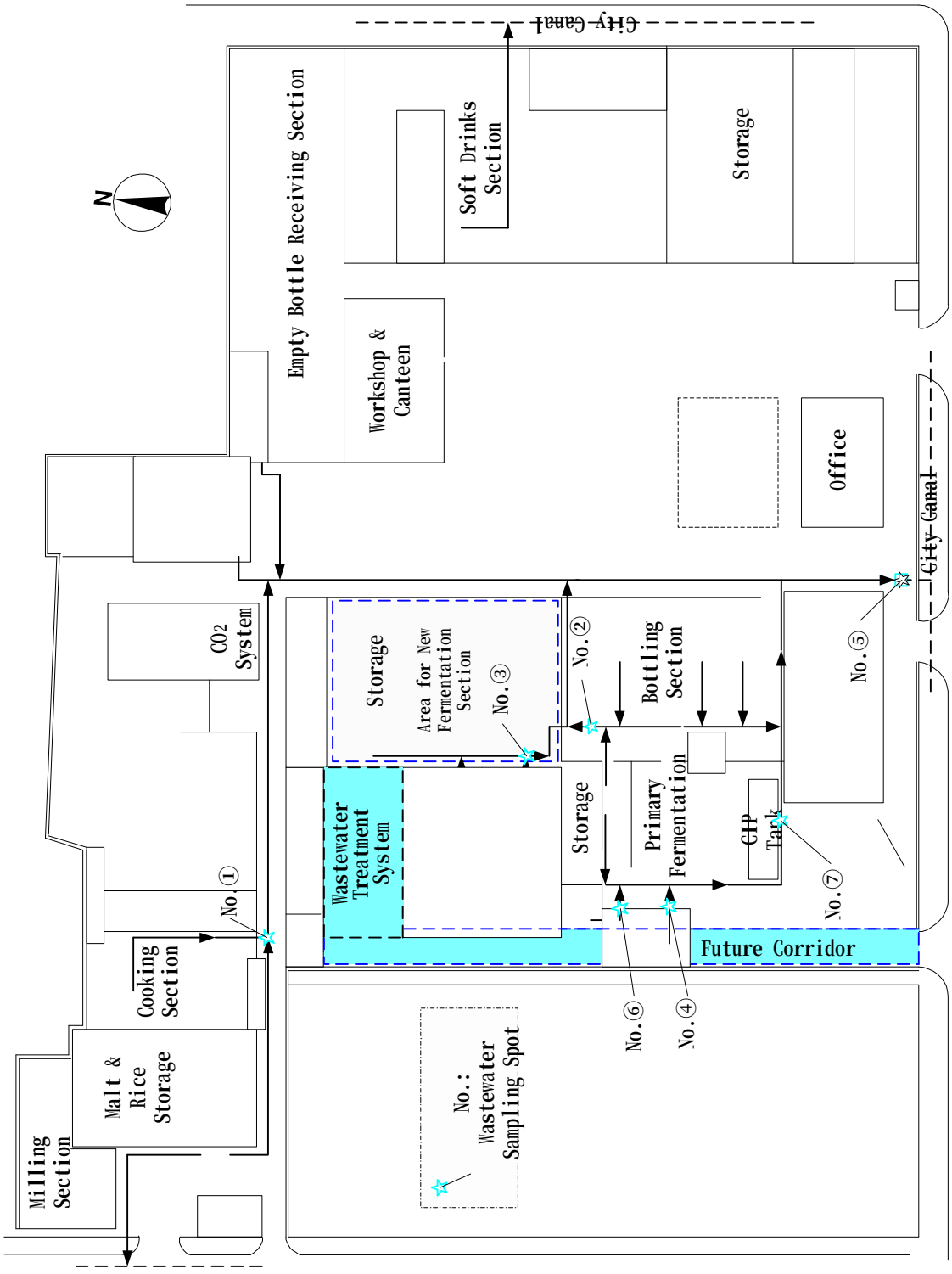


Figure 7 Factory Layout and Wastewater Drainage Route of Da Nang Beer Company

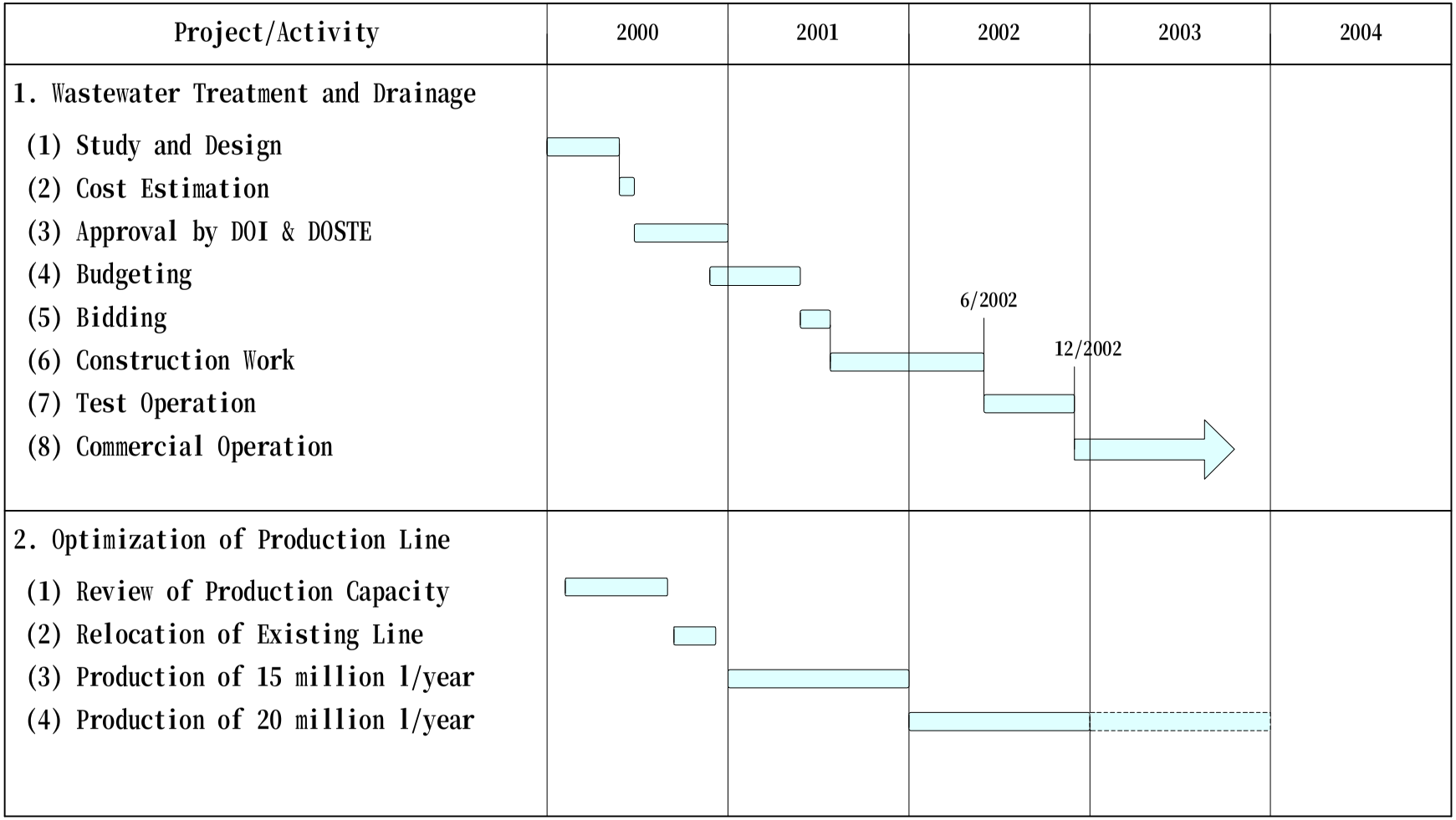


Figure 8 Proposed Implementation Schedule for Industrial Pollution Prevention Countermeasures (Da Nang Beer Company)

CASE STUDY F-06

Ha Noi Milk Factory

Survey Date: 19 November 1999

1. General

1.1 Profile

The Ha Noi Milk Factory belongs to VINAMILK (Viet Nam National Milk Company) whose headquarters are located in HCMC. The Factory profile is summarized in Table 1.

Table 1 Company Profile

Company Name:	Ha Noi Milk Factory
Ownership:	State-owned
Address:	Duong Xa-Gia Lam-Ha Noi
Tel/Fax:	8276418 – 8766218 / 8276966
Director:	Ms. Hoang Thi Bich Chau
Established:	1995
Corporate Capital:	
Number of Employees:	242
Main Products:	Condensed and Fresh milk, Ice cream, Soybean milk

1.2 Business Status

1.2.1 Production

Production capacities and annual production in 1998 are shown in Table 2. Operation capacity remained at under 70 % in 1998 due to poor market conditions.

Table 2 Production Capacity and Annual Production

Product	Production Capacity	Production in 1998	
		Quantity	Load
Condensed Milk	70 million cans/year	30 million cans	43 %
Fresh Milk	10 million l	7 million l	70 %
Yogurt	4 million l	2.5 million l	62 %
Ice Cream	3 million l	0.7 million l	23 %

Table 3 shows unit consumption of raw materials for each product calculated using annual production and consumption data.

Table 3 Unit Consumption in 1998

Product	Material	Consumption	Unit Consumption
Condensed Milk	Milk	2,500 t	83.3 g/can
	Sugar	5,300 t	176.7 g/can
	Butter	550 t	18.3 g/can
UHT Milk	Raw Milk	3,000 t	428.6 g/l
	Sugar	250 t	35.7 g/l
	Butter	1,500 t	214.2 g/l
Ice Cream	Raw Milk	50 t	71.4 g/l
	Sugar	45 t	64.3 g/l
	Butter	10 t	14.3 g/l
Yogurt	Milk	260 t	104 g/l
	Sugar	370 t	148 g/l
	Butter	30 t	12 g/l

1.2.2 Debt

Data and information related to company management, including sales and debt status, are subject to headquarters control.

2. Production Technology

2.1 Process

Figure 1 shows a simplified block flow diagram of the Factory.

The Factory introduced a modern production process, including a CIP (Cleaning in Place) system with automated sequence controllers.

2.2 Operation

The Factory utilizes a three-shift working system. All the production processes are operated batch-wise.

Under normal conditions, no wastewater is discharged from each process. The main sources of wastewater are the washing equipment and floor in each process. The cleaning procedures of the production processes are as follows:

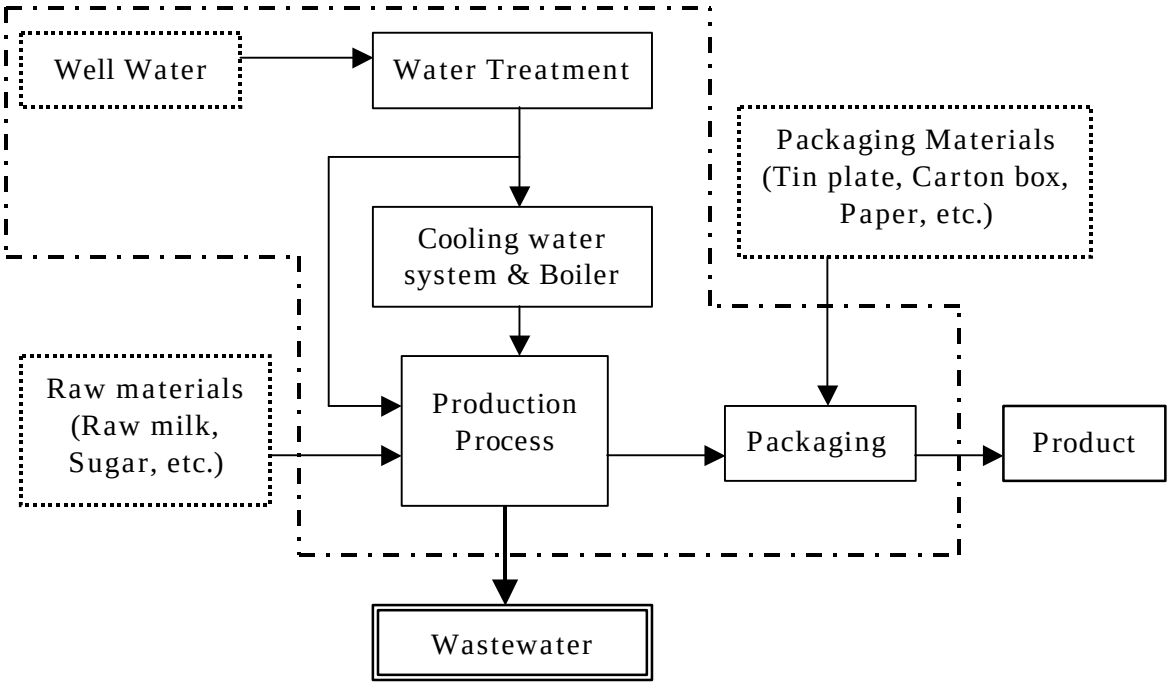


Figure 1 Block Flow Diagram of the Factory

1) Daily sterilization by steaming in the morning
2) Everyday cleaning after production
   a) 30 minutes of rinsing with water;
   b) Chemical cleaning with 2 % sodium hydroxide solution;
   c) 30 minutes of rinsing with hot water;
   d) Steaming.
3) Every three (3) days cleaning is done after production
   a) 30 minutes of rinsing with water;
   b) Chemical cleaning with 2 % sodium hydroxide solution;
   c) Chemical cleaning with a Nitric acid solution;
   d) 30 minutes of rinsing with hot water;
   e) Steaming.

3. Management Technology

The factory is going to apply for the ISO9002 certificate in 2000. Countermeasures for productivity improvement, including the “5S” movement, are underway.

4. Industrial Wastewater Treatment and Discharge

A wastewater treatment system with aeration was installed in the past. The system is not used at present because the treatment performance was not as good as expected. The current wastewater treatment system is shown in Figure 2.

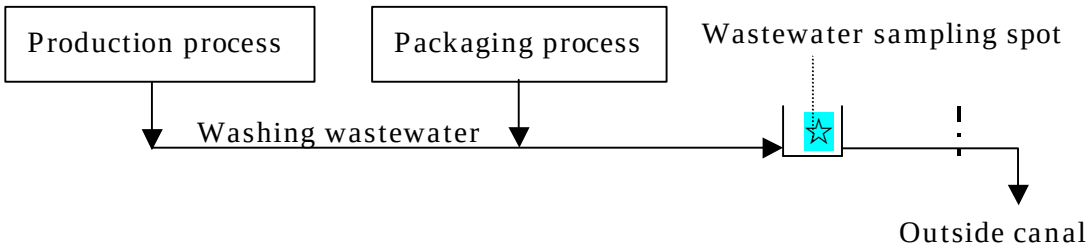


Figure 2 The Wastewater Treatment System of Ha Noi Milk Factory

All the wastewater is collected, flows through an underground pipe and is finally discharged into a small canal, which supplies irrigation water to fields nearby.

Five wastewater samples were taken at the same spot shown in Figure 2 at different times. Table 4 shows the results of wastewater analysis by CECE.

Table 4 Wastewater Quality

Item	Unit	Sample number and sampling time					TCVN 5945 (1995)
		1 (11:30)	2 (13:50)	3 (14:10)	4 (21:30)	5 (23:55)	
Temperature	℃	36	34.2	30.5	28.7	27.2	40
pH	-	11.52	11.79	11.9	11.6	9.8	5.5-9
Electric Conductivity	μS/cm	1,920	7,680	1,620	1.87	2.64	
Turbidity		144	522	169	139	121	
Oil & Grease	mg/l	7.95	35.8	7.3	6.5	7.4	10
DO	mg/l	6.5	2.4	7.34	5.84	5.4	
SS	mg/l	211	577	311	197	312	100
COD	mg/l	560	2,240	440	360	1920	100
BOD	mg/l	472	1,970	390	215	1120	50
Total Nitrogen	mg/l	10.7	47.97	9.73	12.4	11.5	60
Residual Chlorine	mg/l	0.07	1	0.99	0.08	0.06	2
Phenol	mg/l	0.001	0.001	0.002	0.002	0.001	0.05

The factory is undertaking a project for the construction of a new wastewater treatment system with an activated sludge unit in consultation with MOI. Costs

required for the new project are estimated at 700,000 US$.

5. Recommended Countermeasures for Improvement

5.1 Short Term Countermeasures

There is little to be recommended in this study because the factory is well organized and managed.

(1) Proposed Measures

1) To introduce the concept of UNIT CONSUMPTION
    a. In order to confirm what the losses are compared with theoretical unit consumption
    b In order to compare the unit consumption of main materials regularly (e.g. Monthly)
    c. In order to investigate how to minimize losses
2) To educate key personnel in charge of cost management
3) To collect and record information on abnormal conditions
4) To prepare material balances of raw materials, chemicals and utilities

(2) Anticipated Effect of Improvement

1) Cost reduction on materials and utilities,
2) Maintain worker morale at a high level,
3) Improve the potential for cost competitiveness..

5.2 Mid and Long Term Countermeasures

The factory is undertaking a project for a wastewater treatment system as mentioned in Section 4. By implementing the project, it is expected that the wastewater from the factory will be sufficiently improved. And also, in order to comply with wastewater regulation standards, it is recommended that a wastewater treatment system composed of an activated sludge unit, and a coagulation sedimentation unit be installed. A conceptual design of the required system was made in this study as follows:

(1) Design Basis

Total volume and quality of industrial wastewater to be treated are summarized and shown in Table 5. This data was estimated using the water consumption balance issued by the enterprise and the analysis results of wastewater samples taken by CECE at major discharge points.

Table 5 Base Data for W.W.T.S Conceptual Design

	IN	OUT	TCVN 5945 (B)
Flow Amount	600 m3/day		
PH	～12	5 ～ 9	5.5 ～ 9.0
BOD (mg/l)	460	50	50
COD (mg/l)	590	100	100
S S (mg/l)	260	100	100
Oil (mg/l)	8.5		10
Total – N(mg/l)	12.5	60	60

(2) Conceptual Design

Based on the above data, conceptual design work was done by the study team. As a result, a block flow diagram and the basic dimensions of major equipment for the wastewater treatment system is shown respectively in Figure 3 and Table 6.

(3) Required Cost

The required construction cost of the wastewater treatment system, based on the above conceptual design, is estimated at 9.8 billion VND by the factory project team.

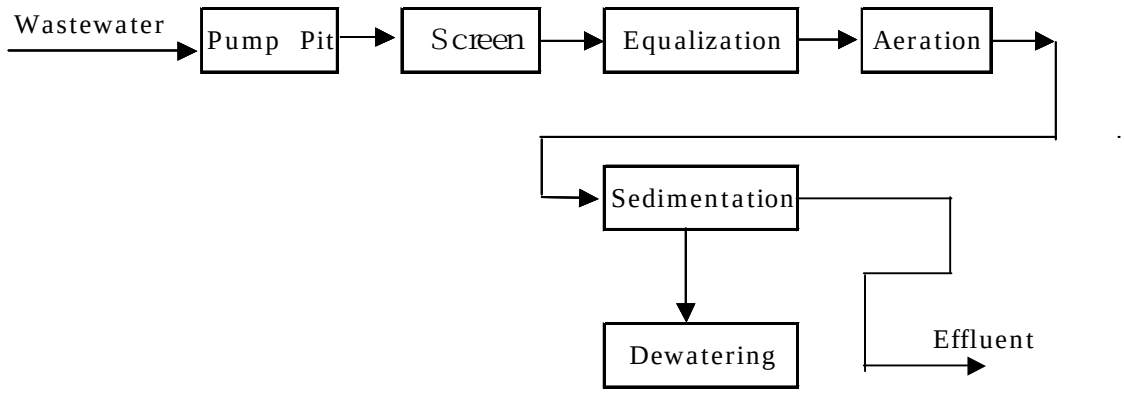


Figure 3 Block Flow Diagram of the Wastewater Treatment System (Ha Noi Milk Factory)

Table 6 Basic Dimensions of Major Equipment

Name of Equipment	No. of Unit Required	Remarks
Pump Pit	1	25m^3 RC
Wastewater Pump	2	Submerged, 2.0m^3/min 8.9kW
Screen	1	1mm mesh
Equalization Tank	1	400m^3 RC, 11m dia. 4.5m d
Blower for Equalization Tank	2	Rotary 4.5m^3/.min 5.5kW
Aeration Equip. for Equal.Tank	1	Diffuser Type
Transfer Pump	2	Volute, 0.4m^3/min 0.9kW
Aeration Tank	1	600m^3 RC, 5mw*4.5mD*13.5mL*2sets
Blower for Aeration Tank	2	Rotary 11m^3/.m 14kW
Equipment for Aeration.Tank	1	Diffuser Type
Sedimentation Tank	1	160m3, 7m dia. 4m d RC
Return Sludge Pump	2	Volute, 0.4m^3/m 0.6kW
Sludge Collector	1	Mechanical Rake
Dewaterring Facilities	1	Belt Filter, 1.1m Width
Chemical Dosing	1	Cation Polymer Tanks and Pumps
Control Building	1	4mW*6mL Steel Slated, 2 Stories

CASE STUDY F-07

Tam Hiep Sugar-Paper-Alcohol Enterprise

Survey Date: 23 November 1999

1. General

1.1 Profile

Tam Hiep Sugar-Paper-Alcohol Enterprise is a state-owned enterprise established in 1960. Currently, the Enterprise does not produce sugar. The Enterprise profile is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Tam Hiep Sugar-Paper-Alcohol Enterprise
Ownership:	State-owned
Address:	Tam Hiep, Phuc Tho, Ha Tay Prov
Tel/Fax:	034-648868/ 034-648867
Director:	Mr. Sy Cuong Thinh
Established:	1960
Corporate Capital:	
Number of Employees:	143
Main Products:	Paper, Beer, Liquor

1.2 Business Status

1.2.1 Production

Average annual production over the last 10 Years is shown in Table 2. Operation factors depend on market conditions.

Table 2 Annual Productions and Sales Amounts

Name of Product	Production Amount	Unit	Sales Amount (1,000 VND)
96% ethanol	529,989	l	2,524,097
Liquid CO_2	207,643	kg	623,4383
Paper	364,497	kg	1,305,953
Beer	19,060	l	24,780
Total			4,478,313

Table 3 shows raw materials and utilities consumption of each product calculated based on average annual production over the last 10 years.

Table 3 Average Unit Consumption over the last 10 years

Name of Materials	Consumption	Unit Consumption	Total Payment (1,000-VND)
96% Ethanol			1,369,157
Molasses	2,172 t	9.76 kg/l	1,086,026
H_2SO_4	17 t	0.032 kg/l	39,758
Protein	5 t	9.4 g/l	8,918
Coal	530 t	1 kg/l	234,455
Paper			574,989
Waste Paper	432.3 t	1.186 kg/kg	406,924
Blue color	2.1 t	5.7 g/kg	154,665
Chemical	6.7 t	18.3 g/kg	13,400
Beer			17,395
Malt	2.552 t	133.9 kg/l	12,760
Rice	1.012 t	53.1 kg/l	2,631
Sugar	0.092 t	4.83 g/l	552
Hop	0.011 t	0.577 g/l	924
Diatomite	0.044 t	2.3 g/l	528
Utilities			
Electricity	547,400 kWh		430,272
Water	m^3		
			2,391,813

The production estimate for 96% Ethanol in 1999 is projected at 1,200,000 l/year.

1.2.2. Financial situation

Debt: The Enterprise has debt of 280 million VND with the Agricultural Bank in Dan Phuong, and 1,000 million VND with the State Bank and others.

2. Production Technology

2.1 Operation

Figure 1 shows a simplified block flow diagram of the Factory.

The factory has adopted a three-shift working system. All the production processes are basically operated batch-wise.

Three distiller units are used for alcohol purification. Two pressure control systems (tower top pressure and reboiler pressure) are manually operated for product quality control. Heavier residue is drained out continuously from a distiller to a wastewater pit together with steam condensate. The three distillers

are opened and cleaned once every one or two months of operation.

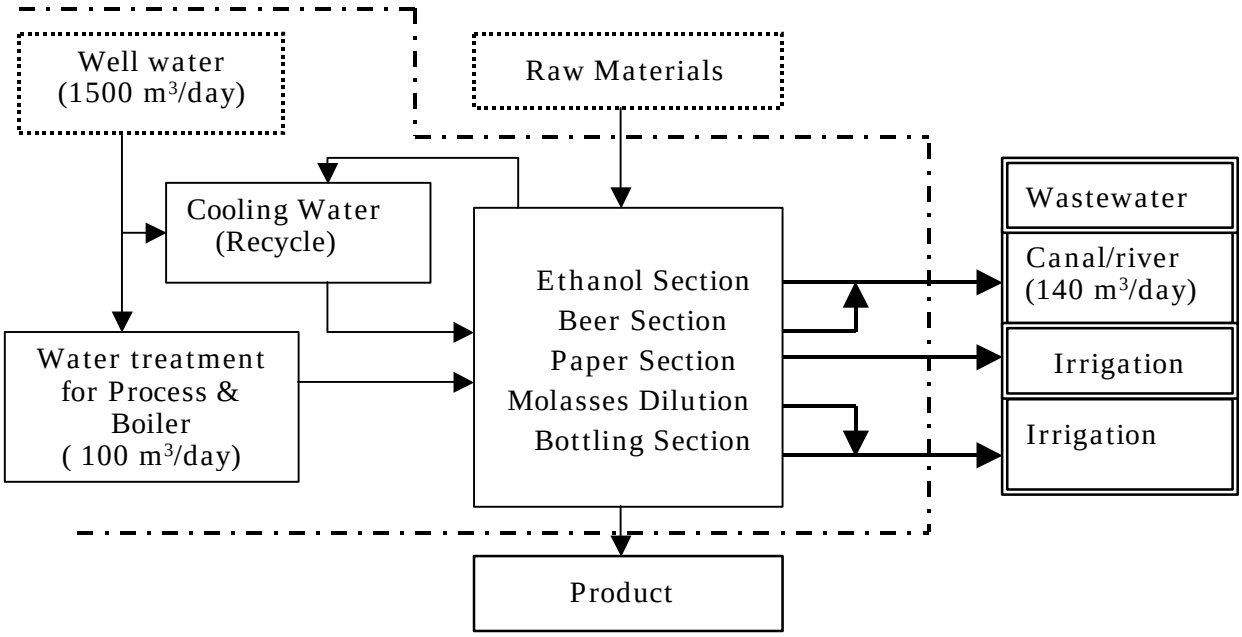


Figure 1 Block Flow Diagram of the Factory

The Paper section uses recycled paper as a raw material. The Paper section was not in operation at the study period due to market conditions.

2.2 Future Plans

The company has the following future plans:. (Details, however, have not yet been finalized because of financial limitations)

① Installation of wastewater piping that runs from the Factory to outside the town limits as a countermeasure against odor complaints. (required cost is estimated at 300 million VND);

② Installation of a wastewater treatment system for distiller drainage;

③ Improvement of the Fermentation section washing system;

④ Improvement of the Bottling section.

3. Management Technology

4. Industrial Wastewater Treatment and Discharge

Wastewater is discharged to a canal and field without any treatment. The surrounding residents have raised complaints about wastewater odor.

Four wastewater samples were taken at different spots shown in Figure 2 at different times on 23 November 1999.

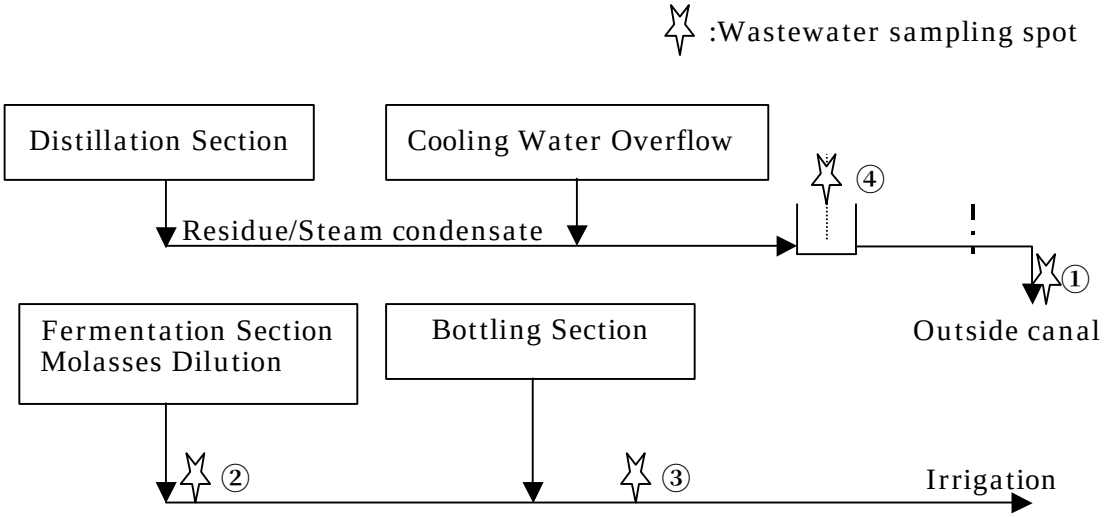


Figure 2 Wastewater System of the Factory

Figure 3 Sampling State at Canal (Sampling Point No.1)

Table 4 shows the results of wastewater analysis by CECE.

Table 4 Wastewater Quality

Item	Unit	Sample number and sampling time				TCVN 5945 (1995)
		1 (11:30)	2 (11:45)	3 (11:55)	4 (13:40)	
Temperature	℃	25.6	31.7	31.2	66	40
PH	-	5.3	4.87	6.2	4.35	5.5-9
Electric conductivity	mS/cm	4.61	0.75	0.97	7.04	
Turbidity	NTU	890	720	372	2,450	
Oil & Grease	mg/l	0.55	0.4	0.46	0.65	10
DO	mg/l	0.28	3.2	2.1	0.22	
SS	mg/l	2,648	970	1,320	1,300	100
COD	mg/l	6,400	4,800	5,200	16,000	100
BOD	mg/l	4,200	2,900	3,300	11,200	50
Total Nitrogen	mg/l	145.6	5.28	9.44	2,413	60
Residual Chlorine	mg/l	0.15	0.07	0.03	0.01	2
Phenol	mg/l	＜0.001	0.002	0.03	0.01	0.05
Fe	mg/l	30.88	9.12	7.36	31.92	5

It is understood that the wastewater from the Factory contains high concentrations of organic contaminants resulting in high turbidity, SS, COD or BOD. The low pH might be caused by the low pH level of the supply well water.

5. Recommended Countermeasures for Improvement

5.1 Short Term Countermeasures

The following short-term countermeasures should be implemented:

1) Recover organic matter from the bottom of the distillers so as to prevent it from mixing into wastewater. This recovered organic matter can be used as fuel.

5.2 Mid and Long Term Countermeasures

5.2.1 Prevention of Corrosion of Equipment and Piping

On a mid and long-term basis, it is recommended to implement the following countermeasures in order to prevent corrosion of equipment and piping:

(a) Changing material from carbon-steel to SUS;

(b) Controlling and preventing air from getting mixed into steam or hot water lines.

5.2.2 Wastewater Treatment System

In order to comply with wastewater regulation standards, it is recommended that a wastewater treatment system composed of an activated sludge unit, a de-nitrogen unit, and a coagulation sedimentation unit be installed. A conceptual design of the required system was made in this study as follows:

(1) Design Basis

Total amount and quality of industrial wastewater to be treated are summarized and shown in Table 5. This data was estimated using water consumption balance issued by the enterprise and the analysis results of wastewater samples taken by CECE at major discharge points.

Table 5 Base Data for W.W.T Conceptual Design

	IN	OUT	TCVN 5945 (B)
Flow Amount	260 m3/day	*520 m3/day	
PH	4.4 ～	5 ～ 9	5.5 ～ 9.0
BOD (mg/l)	7500	50	50
COD (mg/l)	10950	100	100
S S (mg/l)	1230	100	100
Oil (mg/l)	0.6		10
Total – N(mg/l)	1300	60	60
Fe (mg/l)	30	5	5
Temperature (℃)	50	40	40≧

*due to cool down with dilution water

(2) Conceptual Design

Based on the above data, conceptual design work was done by the study team. As a result, block flow diagram and basic dimension of major equipment for wastewater treatment system are shown respectively in Figure 4 and Table 6.

In this design work, Nitrogen remover was eliminated because of technical difficulty and cost reasons. And also, it is expected that nitrogen concentration will be dramatically reduced by removing organic solid matter from fermenter or the bottom drain of the distiller.

(3) Required Cost

Required construction cost of the wastewater treatment system based on the

above conceptual design, is estimated at 6.7 billion VND.

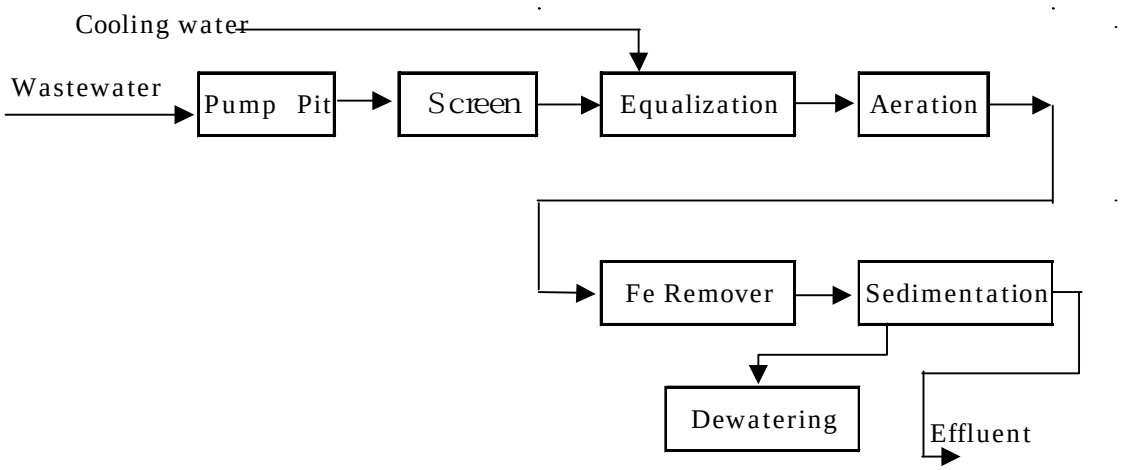


Figure 4 Block Flow Diagram of Wastewater Treatment system

(Tam Hiep Sugar-Paper-Alcohol Enterprise)

Table 6 Basic Dimension of Major Equipment

Name of Equipment	No. of Unit Required	Remarks
Pump Pit	1	22m^3 RC
Wastewater Pump	2	Submerged, 1.7m^3/min 7.79kW
Screen	1	1mm mesh
Equalization Tank	1	347m^3 RC, 10m dia. 4.5m d
Blower for Equalization Tank	2	Rotary 3.5m^3/.min 4.5kW
Aeration Equip. for Equal.Tank	1	Diffuser Type
Transfer Pump	2	Volute, 0.4m^3/min 0.8kW
Aeration Tank	1	780m^3 RC, 5mw*4.5mD*18mL * 2sets
Blower for Aeration Tank	2	Rotary 81m^3/.m 100kW
Aeration Equip. for Aeration.Tan	1	Diffuser Type
Fe Remover Tank	1	69m3, 5 m dia, 4m d
Chemical Dosing	1	NaOH tankand Pumps
Sedimentation Tank	1	139m3, 5m dia. 4m d RC
Return Sludge Pump	2	Volute, 0.4m^3/m 0.5kW
Sludge Collector	1	Mechanical Rake
Spray Pump	1	Volute, 0.1m^3/m 0.1kW
Dewaterring Facilities	3	Belt Filter, 3m Width
Chemical Dosing	1	Cation Polymer Tanks and Pumps
Control Building	1	8mW*18mL Steel Slated, 2 Stories

CASE STUDY F-08

Ha Tay Food Processing Company

Survey Date: 24 November 1999

1. General

1.1 Profile

Ha Tay Food Processing Company is a state-owned company that was established in 1987 as a rice-processing company. The company began producing beer called "Kim Bai Bia" in 1990. The company profile of Ha Tay Food Processing Company is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Ha Tay Food Processing Company
Ownership:	State-owned
Address:	Thi Tran Kim Bai, Thanh Oai, Ha Tay Province.
Tel:	034-873036
Director:	
Established:	1987
Corporate Capital:	
Number of Employees:	180
Main Products:	Beer (Brand Name: Kim Bai Bia)

1.2 Business Status

1.2.1 Production

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

The company's local market is limited to the village it belongs to. Sales amounts drop largely in winter.

Table 2 Production and Sales in 1998

Product	Production	Turnover
Beer	3.6 million l	12 million VND

1.2.2 Debt

Ha Tay Food Processing Company carries no debt with the state because the Company is raising funds by selling stock and by taking out loans from a private company.

2. Production Technology

2.1 Process

The beer production process is based on technology for cold fermentation supported by the Food Industries Research Institute (FIRI) of the Research Planning and International Cooperation Department, MOI.

The overall block flow diagram is shown in Figure 1.

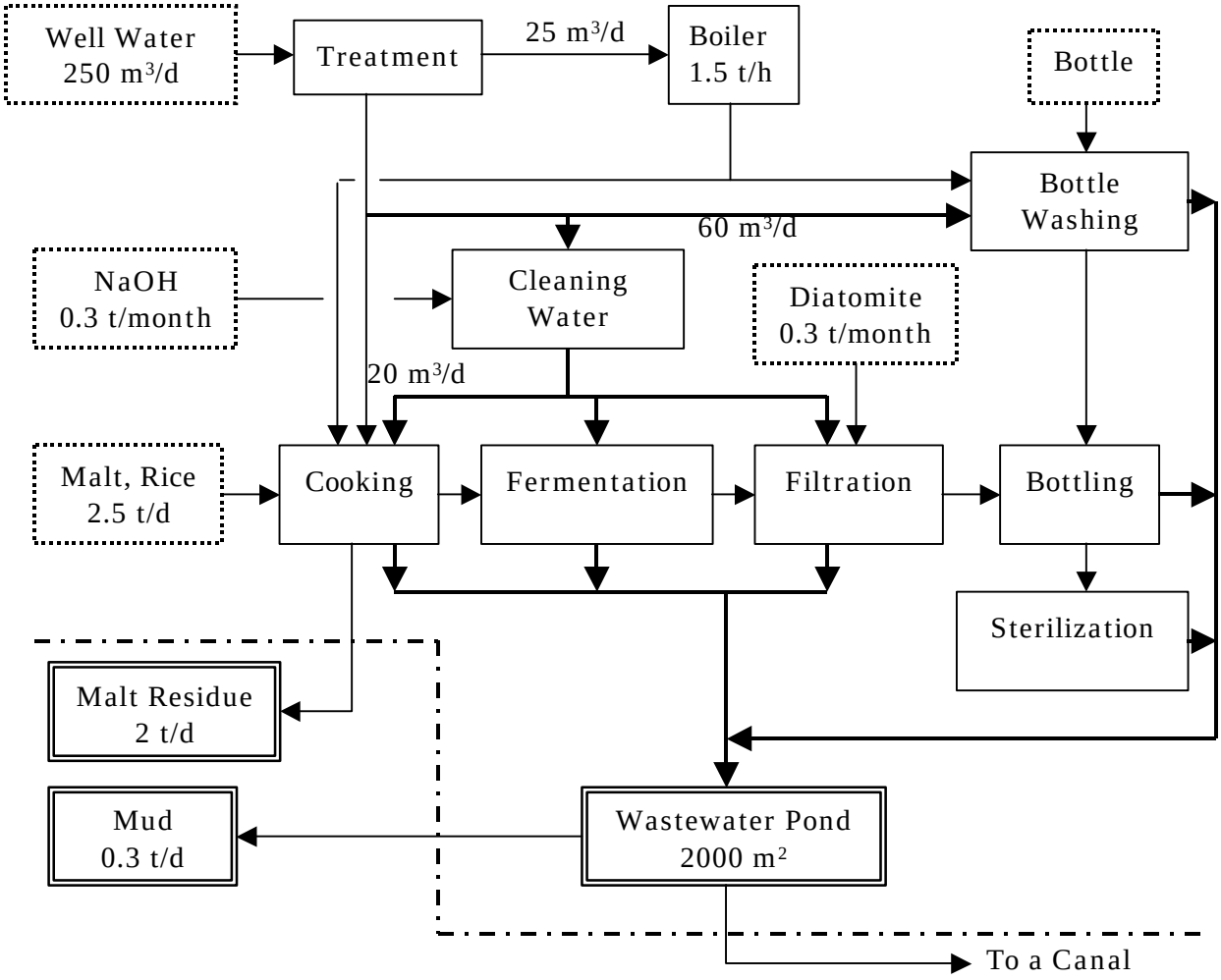


Figure 1 Block Flow Diagram of the Entire Factory

Well water is treated with ion exchange resin before being sent to a boiler and to the processes. Malt residue from the cooking unit is recovered as livestock feed.

Every production unit including product bottling is manually operated. Equipment is washed with a sodium hydroxide solution after the completion of

every batch operation and this creates wastewater.

2.2 Unit Consumption

Unit consumption of main materials and utilities is summarized in Table 3. Water consumption is calculated using the pump capacity. The cost of water includes fixed costs such as depreciation, labor costs and repair costs.

Table 3 Unit Consumption of Raw Materials and Utilities

Material	Unit Consumption (per 1 million liter)	Payment (VND/l)
Malt	110 t	638
Rice	70 t	245
Hops	1.5 t	90
Additives (Diatomite)	0.4 t	120
Sodium Hydroxide	2.0 t	15
Coal	250 t	102.5
Electricity	250,000 kWh	228.2
Water	26,000 m^3	26

2.3 Future plan

The company has future plans for process improvement as follows:

1) Improvement of fermentation technology in consultation with FIRI;
2) Recycling water from the sterilization unit.

3. Management Technology

The amount of beer produced is measured at the product vessels. Production losses are calculated monthly. Production loss in the fermentation unit could be reduced by installing a refrigerator, which would require a large investment.

4. Industrial Wastewater Treatment and Discharge

Washing the equipment after batch production and the floors in each production section creates wastewater. Wastewater is collected and sent to a pond located outside the factory. After settlement in the pond, wastewater is discharged to a canal and finally used for irrigation.

DOSTE of Ha Tay Province takes and analyzes wastewater samples once a year. The company was informed by DOSTE that only NH_4^+ exceeded wastewater regulation standards in 1999. It is said that some where between a 500 million

and 1 billion VND investment is necessary to install a wastewater treatment system in this sized factory. Figure 2 shows the general layout, wastewater routing of the factory and wastewater sampling spots.

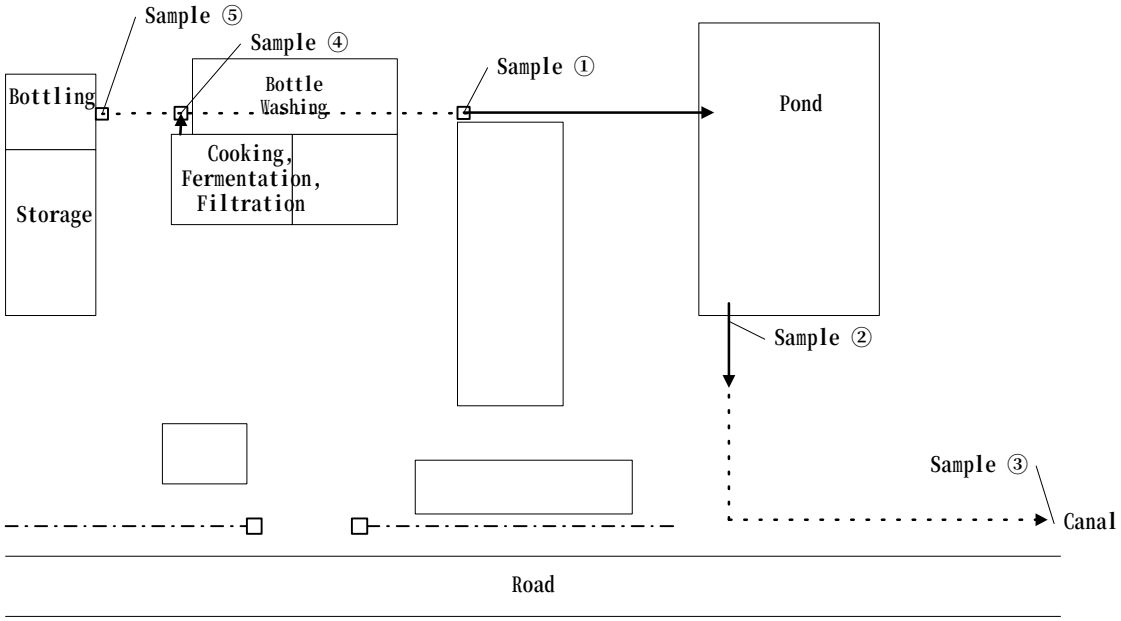


Figure 2 Layout and Wastewater System

Figure 3 Sampling state of Sample point No.1

Wastewater samples were collected at the following spots on 24 November 1999, and analyzed for this study:

① Gathered wastewater before being sent to the wastewater pond;
② At the outlet of the pond;
③ At the outlet of a culvert (domestic waste from local residents);
④ Wastewater created by washing the fermentation tank;
⑤ Wastewater from the bottling & sterilization section.

Table 4 shows qualities of the wastewater samples mentioned above.

Table 4 Wastewater Quality

Item	Unit	Sample number and sampling time					TCVN 5945
		① 11:30	② 11:45	③ 12:00	④ 13:30	⑤ 13:40	
Flow Rate	m^3/h	4	20				
Temperature	℃	26.5	25.5	25.0	27.3	26.3	40
pH	-	8.0	6.7	6.7	10.2	7.49	5.5-9
Electric Conductivity	μS/cm	700	980	970	710	710	
Turbidity		222	100	96	1,068	74	
Oil & Grease	mg/l	0.4	0.45	0.28	0.45	0.33	10
DO	mg/l	4.4	0.97	1.62	4.3	3.56	
SS	mg/l	253	70	84	1,216	145	100
COD	mg/l	960	880	412	6,040	72	100
BOD	mg/l	690	580	325	4,570	48	50
Total Nitrogen	mg/l	12	24	13.6	47	9	60
Residual Chlorine	mg/l	0.12	0.07	0.004	0.09	0.05	2

5. Recommended Countermeasures for Improvement

5.1 Short Term Countermeasures

Recommendations for short term countermeasures are as follows:

1) Meticulous management and control of production losses:
Production losses are calculated monthly in the Company. In addition, the implementation of activities for productivity improvement with the participation of all employees is recommended.

5.2 Middle and Long Term Countermeasures

Improvement of wastewater quality by treatment using biological technologies

is recommended. A conceptual design of the required system was made in this study as follows:

(1) Design Basis

Total amount and quality of industrial wastewater to be treated are summarized and shown in Table 5. This data was estimated using the water consumption balance issued by enterprise and the analysis results of wastewater samples taken by CECE at major discharge points.

Table 5 Base Data used for the W.W.T.S Conceptual Design

	IN	OUT	TCVN 5945 (B)
Flow Amount	240 m3/day		
PH	～12	5 ～ 9	5.5 ～ 9.0
BOD (mg/l)	460	50	50
COD (mg/l)	590	100	100
S S (mg/l)	260	100	100
Oil (mg/l)	8.5		10
Total – N(mg/l)	12.5	60	60

(2) Conceptual Design

Based on the above data, conceptual design work was done by the study team. As a result, a block flow diagram and the basic dimensions of major equipment for the wastewater treatment system are shown respectively in Figure 4 and Table 6.

(3) Required Cost

The required construction cost of the wastewater treatment system, based on the above conceptual design, is estimated at 2.3 billion VND by the factory project team.

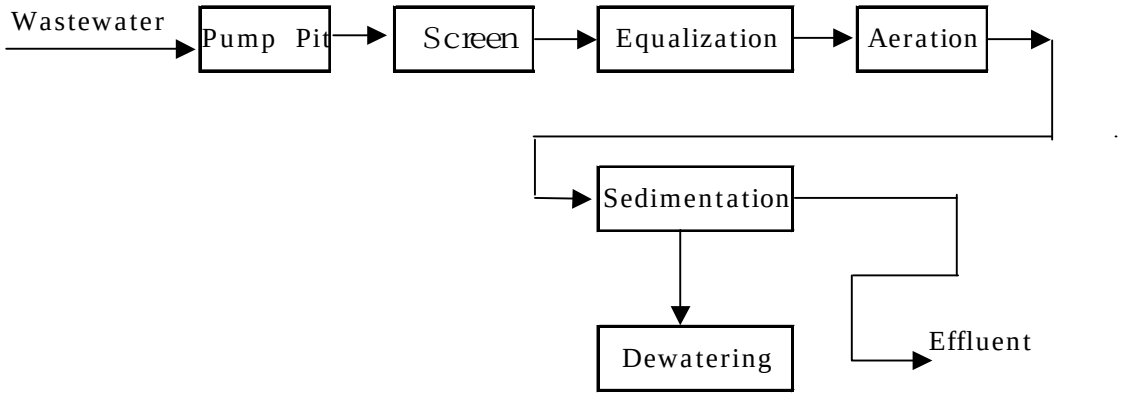


Figure 4 Block Flow sheet of the Wastewater Treatment System
(Ha Tay Food Processing Company)

Table 6 Basic Dimensions of Major Equipment

Name of Equipment	No. of Units Required	Remarks
Pump Pit	1	$10m^3$ RC
Wastewater Pump	2	Submerged, $0.8m^3$/min 3.6kW
Screen	1	1mm mesh
Equalization Tank	1	$160m^3$ RC, 7m dia. 4.5m d
Blower for the Equalization Tank	2	Rotary $1.6m^3$/.min 1.9kW
Aeration Equip. for the Equal.Tank	1	Diffuser Type
Transfer Pump	2	Volute, $0.2m^3$/min 0.4kW
Aeration Tank	1	$360m^3$ RC, 5mw*4.5mD*16mL
Blower for the Aeration Tank	2	Rotary $13m^3$/.m 16kW
Equipment for the Aeration.Tank	1	Diffuser Type
Sedimentation Tank	1	64m3, 5m dia. 4m d RC
Return Sludge Pump	2	Volute, $0.2m^3$/m 0.2kW
Sludge Collector	1	Mechanical Rake
Dewaterring Facilities	1	Belt Filter, 1.3m Width
Chemical Dosing	1	Cation Polymer Tanks and Pumps
Control Building	1	4mW*8mL Steel Slated, 2 Stories

CASE STUDY F-09

Ha Tay Foodstuff Processing Company

Survey Date: 25 November 1999

1. General

1.1 Profile

Ha Tay Foodstuff Processing Company is the biggest food processing company in Ha Tay Province. The Company profile is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Ha Tay Foodstuff Processing Company
Ownership:	State owned
Address:	Quang Trung Road, Ha Dong Town, Ha Tay Prov.
Tel/Fax:	034-824230, 034-827836
Director:	Ms. Vu Thi Phoung Duyen
Established:	
Corporate Capital:	
Number of Employees:	230
Main Products:	Beer, Juice, Confectioneries

1.2 Business Status

1.2.1 Production

Production and sales amounts in 1998 are shown in Table 2.

Table 2 Production Capacity and Annual Production

Product	Productivity	Unit	Sales Amount (million VND)
Beer	5,821	m^3	18,051
Beverage	414	m^3	667
Confectionary	81	t	104
Biscuits and Others	458	t	463

Table 3 shows annual consumption of raw materials and utilities for production in 1998.

Table 3 Raw Materials and Energies Consumption in 1998

Material	User Production Section	Consumption (t/year)	Remarks
Malt (imported)	Beer	600 t	
Rice	Beer	300 t	
Sugar	Beer, Beverage, Conf.	300 t	
Glucose syrup	Confectionary	120 t	
Milk	Confectionary	15 t	
Butter, Fat	Confectionary	15 t	
Wheat Flour	Confectionary	300—350 t	
Cassava starch	Confectionary	50 t	
Preservative	Confectionary	5—2 t	
Cleaning Additives	Beer	-------	NaOH, HNO_3
Coal	Boiler	1,200 t	
Water	Washing, Cooling, and in-process	70,000—80,000t	

1.2.2 Debt

At Present, the Company carries no debt.

2. Production Technology

2.1 Process

Figure 1 shows a simplified block flow diagram of the factory.

Beer production technology was licensed by FIRI (Food Industries Research Institute) of MOI.

The factory introduced a CIP (Cleaning in Place) system in the Fermentation section.

2.2 Future Plans

The company has future plans for process improvement as follows:

1) Improvement of work conditions in the Cooking section;
2) Improvement of beer quality;
3) Improvement of the wastewater treatment system. The company is looking for a suitable and practical wastewater treatment system.

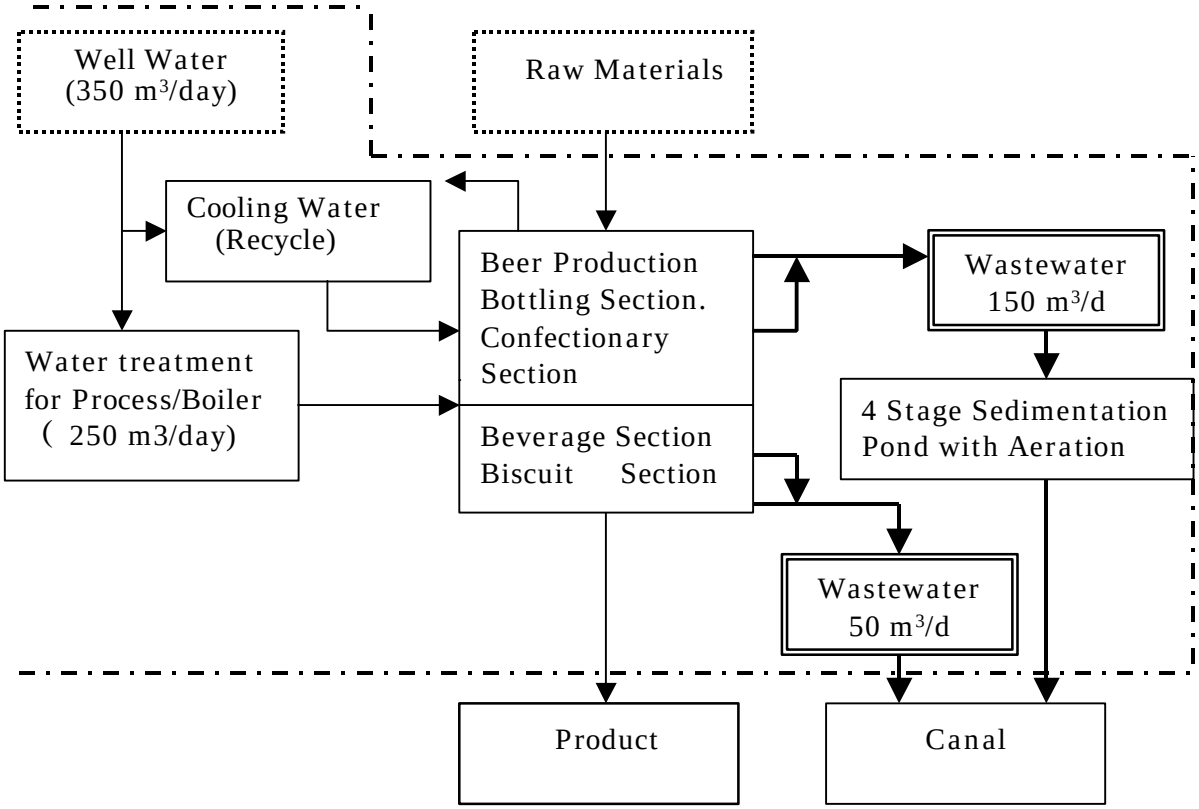


Figure 1 Block Flow Diagram of the Factory

3. Management Technology

The management calculates productivity by checking material losses every month. Based on consideration of the results, suitable countermeasures are implemented in order to improve productivity.

4. Industrial Wastewater Treatment and Discharge

A wastewater treatment system (4 stage sedimentation pond with aeration) was installed to treat wastewater from the Beer production section, the Confectionary section and for domestic use wastewater. Sludge is removed from the sedimentation pond about once a year.

Normally, water quality is not precisely checked. Wastewater analysis is done by the MOH (Ministry of Health) once per year. For analysis in this study, wastewater samples were collected at the following spots on 25 November 1999.

① Cooling water overflow and mineral water section;

② Wastewater from the Biscuit section;

③ First stage outlet of the wastewater treatment tank (after aeration);

④ Final discharge from the Factory (after sedimentation);

⑤ Beer cooking section wastewater (before filter washing);

⑥ Beer cooking section wastewater (during filter washing).

Table 4 shows qualities of wastewater samples mentioned above.

Table 4 Wastewater Quality

Item	Unit	Sample number and sampling time						TCVN 5945
		① (11:30)	② (11:50)	③ (12:05)	④ (12:15)	⑤ (13:30)	⑥ (13:45)	
Temperature	℃	28.9	26.6	29.4	28.7	31.6	32.8	40
pH	-	8.02	8.0	5.93	6.21	7.32	6.92	5.5-9
Electric Conductivity	µS/cm	365	517	276	584	541	586	
Turbidity	NTU	2	5	166	402	262	136	
Oil & Grease	mg/l	0.22	0.45	0.53	0.32	0.34	0.42	10
DO	mg/l	5.0	4.6	0.82	0.68	4.5	3.74	
SS	mg/l	3	15	245	526	430	160	100
COD	mg/l	60	280	400	440	1,600	640	100
BOD	mg/l	47	195	297	325	1,250	435	50
Total Nitrogen	mg/l	4.1	8.2	7.6	7.2	4.8	12.3	60
Residual Chlorine	mg/l	0.03	0.01	0.02	0.06	0.03	0.05	2
Fe	mg/l	0.13	0.07	0.25	0.63	0.25	0.21	5

5. Recommended Countermeasures for Improvement

5.1 Short Term Countermeasures

The following activities are recommended as short-term countermeasures:

1) Meticulous control for recycling of the cooling water;
2) Promote employee improvement movements to reduce production losses;
3) Introduce sensor(s) into the existing wastewater system that enable early detection of abnormal process conditions.

5.2 Mid and Long Term Countermeasures

On a mid and long-term basis, it is recommended that the wastewater treatment system be improved by introducing a biological treatment unit. A

conceptual design of the required system was made in this study as follows:

(1) Design Basis

The total amount and quality of industrial wastewater to be treated are summarized as shown in Table 5. This data was estimated using the water consumption balance issued by the enterprise and the analysis results of wastewater samples taken by CECE at major discharge points.

Table 5 Base Data for W.W.T.S Conceptual Design

	IN	OUT	TCVN 5945 (B)
Flow Amount	300 m^3/day		
PH	6 ～8	5 ～ 9	5.5 ～ 9.0
BOD (mg/l)	425	50	50
COD (mg/l)	560	100	100
S S (mg/l)	330	100	100
Oil (mg/l)	0.4		10
Total – N(mg/l)	64	60	60

(2) Conceptual Design

Based on the above data, conceptual design work was done by the study team.

As a result, the block flow diagram and basic dimensions of major equipment for wastewater treatment system are respectively shown in Figure 2 and Table 6.

(3) Required Cost

The required construction cost of the wastewater treatment system, based on the above conceptual design, is estimated at 2.1 billion VND by the factory project team.

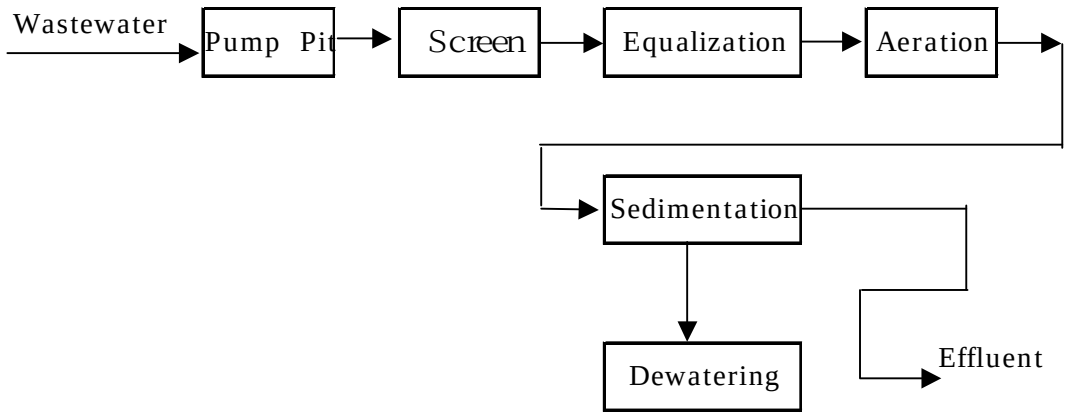


Figure 2 Block Flow sheet of the Wastewater Treatment System
(Ha Tay Foodstuff Processing Company)

Table 6 Basic Dimensions of Major Equipment

Name of Equipment	No. of Units Required	Remarks
Pump Pit	1	$10m^3$ RC
Wastewater Pump	2	Submerged, $0.8m^3$/min 3.6kW
Screen	1	1mm mesh
Equalization Tank	1	$160m^3$ RC, 7m dia. 4.5m d
Blower for the Equalization Tank	2	Rotary $1.6m^3$/.min 1.9kW
Aeration Equip. for the Equal.Tank	1	Diffuser Type
Transfer Pump	2	Volute, $0.2m^3$/min 0.4kW
Aeration Tank	1	$360m^3$ RC, 5mw*4.5mD*16mL
Blower for the Aeration Tank	2	Rotary $13m^3$/.m 16kW
Equipment for the Aeration.Tank	1	Diffuser Type
Sedimentation Tank	1	64m3, 5m dia. 4m d RC
Return Sludge Pump	2	Volute, $0.2m^3$/m 0.2kW
Sludge Collector	1	Mechanical Rake
Dewaterring Facilities	1	Belt Filter, 1.3m Width
Chemical Dosing	1	Cation Polymer Tanks and Pumps
Control Building	1	4mW*8mL Steel Slated, 2 Stories

CASE STUDY F-10

Thang Long Tobacco Company

Survey Date: 26 November 1999

1. General

1.1 Profile

Thang Long Tobacco Company was established in 1957 and is a member of the Viet Nam Tobacco Corporation. The company profile of Thang Long Tobacco Company is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Thang Long Tobacco Company
Ownership:	State-owned
Address:	235 Nguyen Trai Street, Thanh Xuan, Ha Noi
Director:	Mr. Nguyen Tien Dung
Established:	6 January 1957
Corporate Capital:	
Number of Employees:	1,175
Main Products:	Various Kinds of Tobacco

The Company site has an area of 64,718 m^2, which includes 2,131 m^2 for the Mechanical Tobacco Company and 1,140 m^2 for the Tobacco Research Institute.

1.2 Business Status

1.2.1 Production

The company has a production capacity of 300 million box/year. Actual annual production averages around 200 or 230 million boxes (70 % of designed capacity). Production of individual products in 1998 is summarized in Table 2.

Table 2 Production in 1998

Product	Production (1,000 Boxes)		Turnover (million VND)
	Products	Consumption	
International Brand Name	9,273	9,301	74,408
Vietnamese Brand Name	49,050	49,049	288,408
Cigarette with filter	108,547	103,295	161,761
Cigarette without filter	24,085	23,411	16,367
Total	190,955	185,056	540,964

2. Production Technology

2.1 Block Flow Diagram

Figure 1 shows the block flow diagram of the factory.

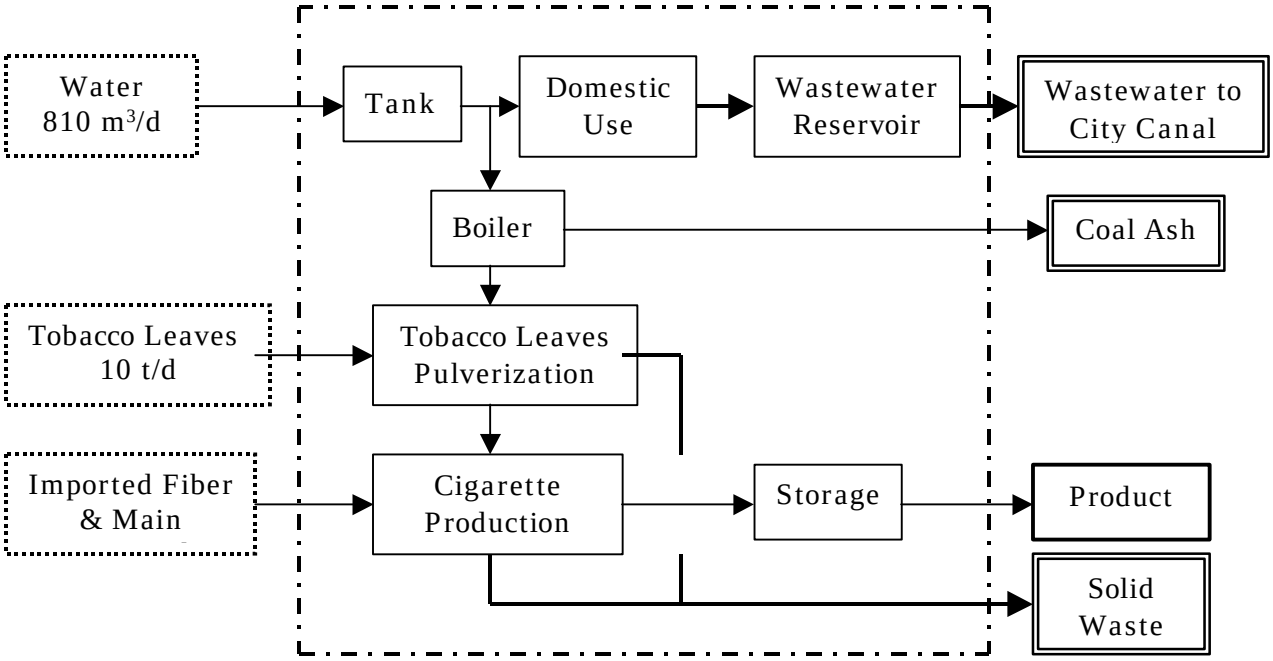


Figure 1 Block Flow Diagram of the Factory

2.2 Unit Consumption

2.2.1 Paper, Filter, Packaging Materials

The main materials used for production in 1998 were as follows:

Cigarette paper:	183.5 t
Yellow wax for filters	51.5 t
Sn coated Aluminum foil	171.6 t
Plastic film	67.7 t
Other packaging materials	920.0 t
Others	260.0 t

Unit consumptions of the main materials for each product are summarized in Table 3.

Table 3 Unit Consumption of Main Materials in 1998

Product	Main Materials (kg)	Unit Consumption (kg/1000 box)
International brand name	102,003	11.0
VINATABA	539,550	11.0
Cigarettes with filters	868,376	8.0
Cigarettes without filters	144,510	6.0
Total	1,654,439	8.66

2.2.2 Leaves

Tobacco leave consumption was as follows:

Imported pulverized leaves for international brand:	131,076 t
Imported pulverized leaves for VINATABA	705,575 t
Tobacco raw materials	2,744,292 t
Total	3,580,943 t

2.2.3 Utilities

Table 4 summarizes utilities consumption in 1998.

Table 4 Utilities Consumption in 1998

Item	Unit Consumption (per 1,000 boxes)		Unit Cost (VND)	Total Consumption	Payment (1,000 VND)
Water	1,322	M^3	3,000	252,481	757,443
Oil	0			0	0
Coal	7.33	Kg	450,000	1,400	630,000
Electricity	1,658	KWh	839	3,548,620	2,977,292

3. Environmental Management

3.1 Industrial Wastewater Treatment and Discharge

No industrial wastewater is created in the Company. Only domestic wastewater is collected and discharged to city canal through a pond without treatment. A sample was taken at the inlet of the wastewater pond in this study on 26 November 1999. Table 5 shows the analysis results of the sample.

Table 5 Wastewater Quality

Item	Unit	Sample (14:55)	TCVN 5945
Flow Rate	m^3/h		
Temperature	℃	30.5	40
pH	-	7.31	5.5-9
Electric Conductivity	µS/cm	504	
Turbidity	mg/l	31	
Oil & Grease	mg/l	0.67	10
DO	mg/l	6.5	
SS	mg/l	106	100
COD	mg/l	91	100
BOD	mg/l	62	50
Total Nitrogen	mg/l	3.2	60
Residual Chlorine	mg/l	0.03	2

3.2 Environmental Management

Industrial sanitation is at the center of the company's concerns because the company belongs to the "risky" industry category. The following actions have been taken so far:

1) Reconstruction of internal roads and water canalization;
2) Cultivation of 500 trees and an ornamental garden;
3) Establishment of a dust protection system for all equipment and provision of dust filtration bags for 100 % of the rolling/forming machines;
4) Equipping 100 % of the production departments with vacuum cleaners and installing air conditioners in 3/4 of the production departments and 2/5 of the storage areas;
5) Introduction of an air compressor for sanitary and hygiene works;
6) Construction of a sedimentation pond for wastewater;
7) Designation of a separate area for solid waste;
8) Organization of a sanitary control team and weekly inspection system.

4. Comments

Thang Long Tobacco Company does not create industrial pollution problems as far as wastewater is concerned. Therefore, it is recommended that the company continuously take action to maintain and improve the work environment as they have done in the past.

CASE STUDY F-11

Viet Tri Food Processing Company

Survey Date: 30 November 1999

A study on the Viet Tri Food Processing Company was performed at the company after giving them very short notice of our visit and briefly informing them on the details of the survey. This company was a substitute for another company that was selected for the study, but was not in operation during the second field survey.

1. General

1.1 Profile

Viet Tri Food Processing Company is a state-owned company that was established in 1962 as a manufacturer of Mono-sodium glutamate, Noodles and Soy sauce. 10 years ago, the company joined with Haiha Confectionary Company and began to produce glucose syrup, various kinds of candies and rice paper. Mono-sodium glutamate is now produced in a joint venture with South Korea. The company profile of Viet Tri Food Processing Company is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Viet Tri Food Processing Company
Ownership:	State-owned
Address:	Viet Tri
Director:	Truong Luoc Chinh
Established:	1962
Corporate Capital:	
Number of Employees:	
Main Products:	Glucose syrup, Candy, Rice paper

1.2 Business Status

1.2.1 Production

Production capacities and actual production are summarized in Table 2.

Table 2 Production Amount

Product	Production Capacity	Actual Production
Glucose syrup	3,000 t/y	2,000-2,500 t/y
Candy	5,000 t/y	3,000-4,000 t/y
Rice paper	200 t/y	100 t/y

2. Production Technology

2.1 Process

Figure 1 shows an overall block flow diagram of the factory.

The enterprise uses city water for domestic purposes and underground water from a 60 meter deep well for process use.

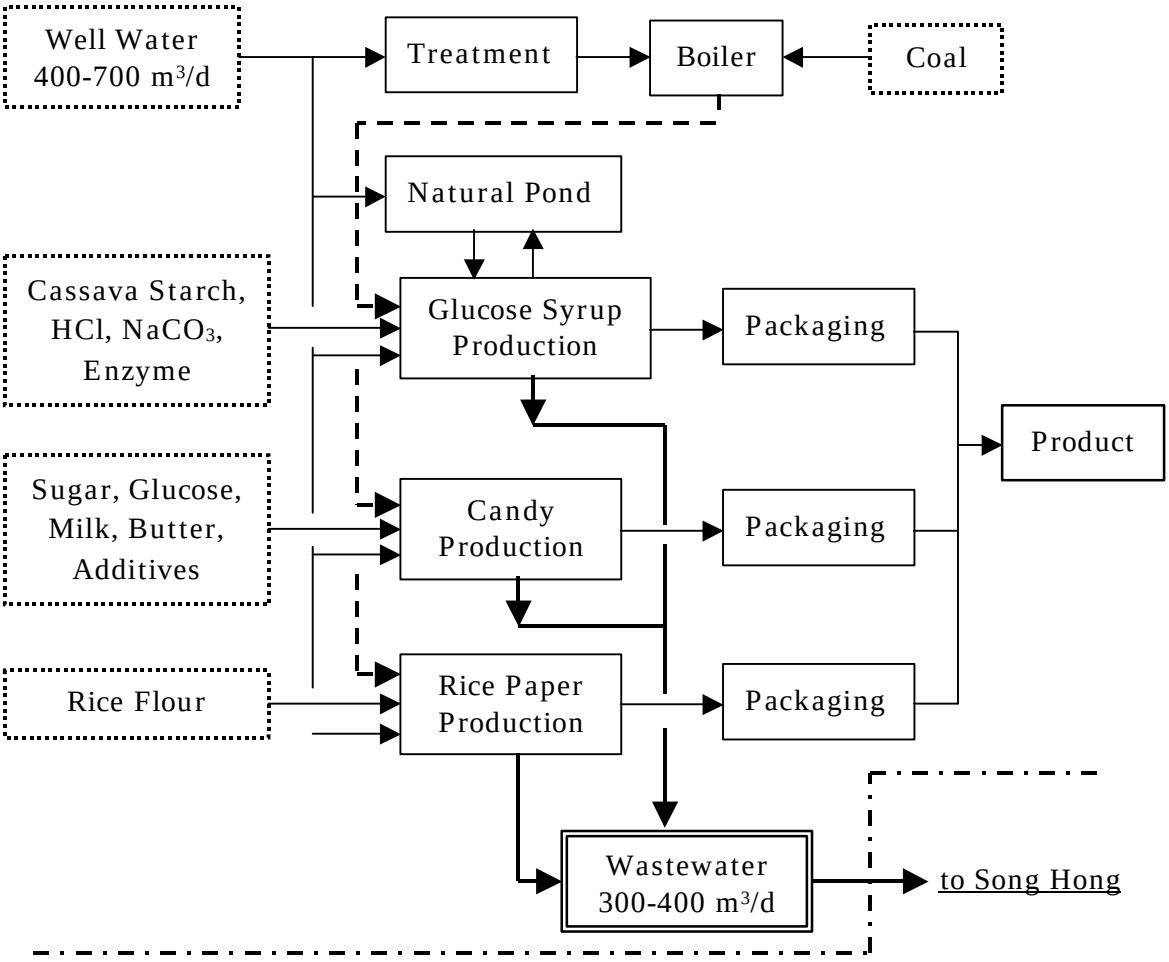


Figure 1 Overall Block Flow Diagram of the Factory

2.1.1 Glucose Syrup

The Food Industry Research Institute (FIRI) licensed the glucose syrup production process consisting of liquefaction of cassava starch, saccharification, filtration and decolorization with activated charcoal to the company. 600 m^3/day of cooling water is recycled between a natural pond and the vacuum evaporator.

2.1.2 Candy

The enterprise has a soft candy production line and a jelly candy production line.

2.1.3 Rice Paper

The rice paper production process consists of dissolution of rice flour, centrifugal dewatering and paper production. The process is operated based on a two shift system. The centrifugal separator is washed several times per shift.

3. Industrial Wastewater Treatment and Discharge

Washing equipment and/or floors in every production section create wastewater, which is discharged into the Red river without treatment. Wastewater quality here was evaluated by CECE in December 1998. In this study, wastewater samples were collected at the following spots:

#1 Wastewater caused by washing a filter in the glucose syrup section;

#2 Cooling water from the vacuum evaporator in the glucose syrup section;

#3 Wastewater from the glucose syrup section;

#4 Mixed wastewater from the glucose syrup section and the candy section;

#5 Wastewater from the centrifugal separator in the rice paper section.

Analysis results of wastewater mentioned above are shown in Table 3 compared with the report issued by CECE in December 1998.

Table 3 Wastewater Qualities

Parameter	Unit	Sample Number					CECE (12/98)	TCVN 5945
		#1	#2	#3	#4	#5		
Sample Collection Time		9:56	10:10	10:20	10:37	11:15	9:30	
Flow Rate	m^3/h							
Temperature	℃	35.3	63	40.4	29.4	27.7	40.6	40
pH	-	6.1	6.74	6.5	7.05	7.2	6.97	5.5-9
Electric Conductivity	μS/cm	610	480	407	590	500	500	
Turbidity	NTU	1980	62	1350	73	120	49	
Oil & Grease	mg/l	1.3	1.45	3.5	5.6	8.5		10
DO	mg/l	4.5	4.1	2.65	6.29	4.7	5.3	
SS	mg/l	3875	845	497	284	161	126	100
COD	mg/l	22400	9890	587	466	284	180	100
BOD	mg/l	16240	7480	459	348	190	225	50
Total Nitrogen	mg/l	26.12	16.75	12.48	10.2	2.52	0.024	60
Residual Chlorine	mg/l	2.6	0.4	0.16	0.13	0.22	0.3	2

4. Recommended Countermeasures for Improvement

4.1 Short Term Countermeasures

Meticulous improvement activities are recommended on a short-term basis as follows:

1) Windows should be sealed up so as to prevent possible invasion of insects or dust into the production area.

4.2 Mid and Long Term Countermeasures

On a long-term basis, it is recommended that a wastewater treatment system be installed. A conceptual design of a wastewater treatment system was carried out based on the results of wastewater quality analysis.

(1) Design Basis

The total amount and quality of industrial wastewater to be treated are summarized as shown in Table 4. This data was estimated using water consumption balance issued by the enterprise and the analysis results of wastewater samples taken by CECE at major discharge points.

Table 4 Base Data for W.W.T.S Conceptual Design

	IN	OUT	TCVN 5945 (B)
Flow Amount	400 m^3/day		
PH	6 ～8	5 ～ 9	5.5 ～ 9.0
BOD (mg/l)	2360	50	50
COD (mg/l)	3230	100	100
S S (mg/l)	797	100	100
Oil (mg/l)	4.6		10
Total – N(mg/l)	12	60	60

(2) Conceptual Design

Based on the above data, conceptual design work was done by the study team.

As a result, a block flow diagram and basic dimensions of major equipment for the wastewater treatment system are shown respectively in Figure 2 and Table 5.

(3) Required Cost

Required construction cost of the wastewater treatment system, based on the above conceptual design, is estimated at 9.8 billion VND by the factory project team.

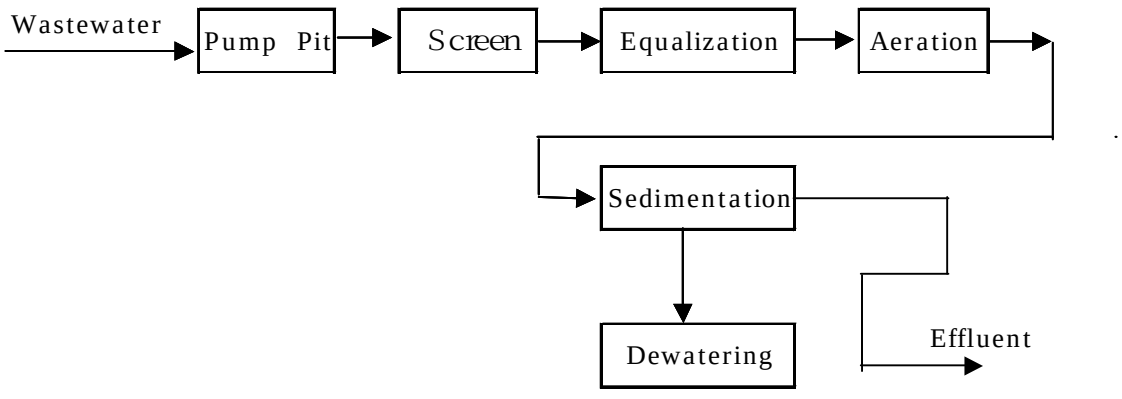


Figure 2 Block Flow Diagram of the Wastewater Treatment System (Viet Tri Food Processing Factory)

Table 5 Basic Dimensions of Major Equipment

Name of Equipment	No. of Units Required	Remarks
Pump Pit	1	$17m^3$ RC
Wastewater Pump	2	Submerged, $1.3m^3$/min 5.9kW
Screen	1	1mm mesh
Equalization Tank	1	$270m^3$ RC, 9m dia. 4.5m d
Blower for the Equalization Tank	2	Rotary $2.9m^3$/.min 3.5kW
Aeration Equip. for the Equal.Tank	1	Diffuser Type
Transfer Pump	2	Volute, $0.3m^3$/min 0.6kW
Aeration Tank	1	$600m^3$ RC, 5mw*4.5mD*14mL*2 sets
Blower for the Aeration Tank	2	Rotary $39m^3$/.m 47kW
Equipment for the Aeration.Tank	1	Diffuser Type
Sedimentation Tank	1	110m3, 6m dia. 4m d RC
Return Sludge Pump	2	Volute, $0.3m^3$/m 0.4kW
Sludge Collector	1	Mechanical Rake
Dewaterring Facilities	2	Belt Filter, 2m Width*2sets
Chemical Dosing	1	Cation Polymer Tanks and Pumps
Control Building	1	8mW*10mL Steel Slated, 2 Stories

CASE STUDY F-12

Viet Tri Sugar-Beer-Alcohol Company

Survey Date: 30 November 1999

1. General

A very short meeting was held with Mr. Nguyen Van Su, Director of Viet Tri Sugar-Beer-Alcohol Company, which was not operating the sugar producing plant during the second field survey period. The study team couldn't make case study comments, because answers to the questionnaires were not submitted, which the Company was supposed to send later to MOI.

1.1 Profile

The company profile of Viet Tri Sugar-Beer-Alcohol Company is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Viet Tri Sugar-Beer-Alcohol Company
Ownership:	State-owned
Address:	Viet Tri
Director:	Mr. Nguyen Van Su
Established:	
Corporate Capital:	
Number of Employees:	
Main Products:	Sugar, Beer, Ethanol

The Company has the following production capacities:

Beer	5 million l/year (Brand name: "Vigar")
Ethanol	1 million l/year
Sugar cane	500 t/year

1.2 Business Status

1.2.1 Production

1.2.2 Debt

2. Production Technology

The Company produces their three products with equipment from China.

3. Management Technology

4. Industrial Wastewater Treatment and Discharge

The Company has carried out an evaluation on environmental impact of the factory. A related report is to be sent to MOI in the future.

The Company invested 2 billion VND in a biological treatment wastewater treatment system, which has not yet proved effective. A Japanese expert once suggested to the Company that they use coagulation sedimentation.

Mr. Su thinks that wastewater treatment is a critical issue in Viet Nam because wastewater treatment systems recommended by many organizations have not yet functioned effectively.

5. Comments

Comments were supposed to be made after receipt of answers to the questionnaires, however, answers were not submitted.

CASE STUDY F-13

Sai Gon Beer Company

Survey Date: 02 December 1999

1. General

1.1 Profile

Sai Gon Beer Company is the biggest brewing company in Viet Nam. It was established by a French company, BGE, in the early 1950's and was converted to a state-owned company called the Alcohol and Beer Beverage Company No.2 in 1975. They acquired their present status under VINABECO (Vietnam Alcohol Beverage and Beer Corporation) in 1985.

The profile of Sai Gon Beer Company is summarized in Table 1.

Table 1 Company Profile

Name of Company:	Sai Gon Beer Company
Ownership:	State owned
Address:	187 Nguyen Chi Thanh-Pre, 5-HCM City
Tel / Fax:	
Director:	Mr. Nguyen Chi Thanh
Established:	Original company -1950's, Present company-1985
Corporate Capital:	
Number of Employees:	2,500 (1,900 permanent and 600 temporary)
Main Products:	Beer

The Company has three subsidiaries (a liquor company, a mineral water company, and a transportation company) and two joint ventures (with an English company for the production of cans and with Vietnam Malaysia Glass Company for producing bottles).

1.2 Business Status

1.2.1 Production

The originally designed production capacity of the factory was 134 million l/year. After improvement of the production process and upgrading equipment, the Company now produces 190 million l/year of three types of beer; (1) Saigon Domestic Beer, (2) 333, and (3) Saigon Export Beer.

Annual production and sales in 1998 are shown in Table 2.

Table 2 Production and Sales in 1998

Product	Production	Turnover
Beer	190 million liter (Maximum 200 million)	1,200 billion VND

1.2.2 Debt

2. Production Technology

2.1 Process

20% of the original equipment that was installed by the French company BGE is still utilized, while the other 80% has been replaced with new equipment imported from Germany. A 200 million liter production level is projected in 2000. A new fermentation process is equipped with a CIP (Cleaning in Place) system that operates without an automatic sequence control system. Two kinds of supply water are utilized. One kind is well water for the boiler and processes, and the other is city water for domestic use. Well water treatment is composed of clarification, sedimentation and purification that utilizes an ion exchange.

Figure 1 shows a simplified block flow diagram of the factory.

2.2 Unit Consumption

Unit consumption of main materials and utilities will be summarized after getting answers to the questionnaires. The volume of supply well water, 1,642,500 m^3/year, was calculated using the pump capacity.

2.3 Future Plans

Recently, the Institute of Hygiene and Sanitary Works under the Ministry of Health (MOH) investigated and requested that the Factory improve the working environment. The company has future improvement plans as follows:

1) Improvement of fermentation technology;
2) Reduction of CO_2 concentration in emissions because it is 30 times higher than the Viet Nam standard.
3) Improvement of the lighting system in the work area;
4) Improvement of ventilation in order to lower work area humidity.

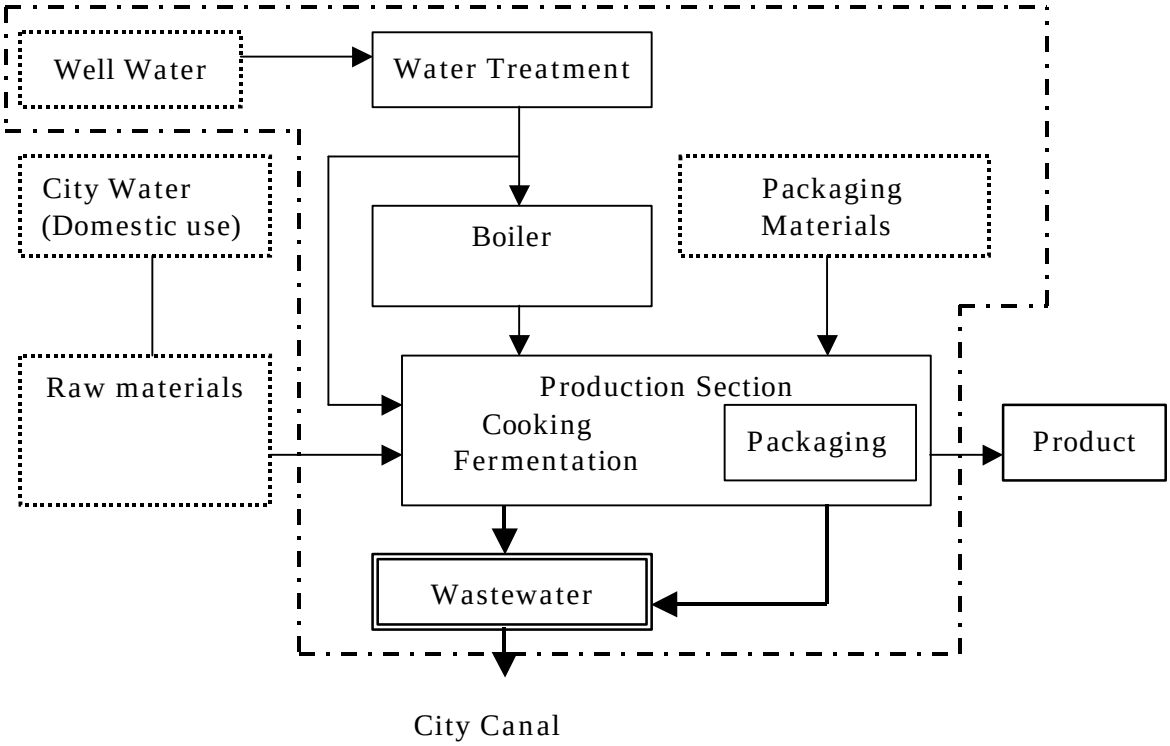


Figure 1 Block Flow Diagram of the Factory

3. Management Technology

The Factory started preparations in 1997 for application for the ISO9002 certificate, which they are scheduled to obtain by March 2000.

4. Industrial Wastewater Treatment and Discharge

Wastewater from each section is directly discharged to a city canal without any treatment. The volume of wastewater is estimated by subtracting supply water from process consumption.

Wastewater samples were collected at the following spots on 2 December 1999, for analysis in the study.

① Filter washing wastewater in the fermentation section;

② Washing wastewater in the packaging section;

③ Wastewater from the supply water treatment system.

Table 3 shows qualities of wastewater samples mentioned above.

Table 3 Wastewater Quality

Item	Unit	Sample number (sampling time)			TCVN 5945 Category B
		① (13:30)	② (13:40)	③ (13:55)	
Temperature	℃	35.0	42.7	32.6	40
pH	-	6.50	11.2	9.4	5.5-9
Electric Conductivity	μS/cm	1750	1300	220	
Turbidity	mg/l	47	115	1100	
Oil & Grease	mg/l	0.12	0.17	0	10
DO	mg/l	5.7	4.3	5.4	
SS	mg/l	279	553	3150	100
COD	mg/l	425	426	10.2	100
BOD	mg/l	268	256	6	50
Total Nitrogen	mg/l	8.58	6.24	6.24	60
Residual Chlorine	mg/l	0.07	0.00	0.00	2

The Factory has plans to install a wastewater treatment system with an activated sludge unit. Although a rough feasibility study has already been completed and the cost required is estimated at 2 million US$, in order to actually implement the project, there remain some unsolved difficulties such as; (1) limited site area with an insufficient amount of available space to enable the construction of an aeration system with the required surface area, and (2) financial limitations. The project has not yet been authorized by MOI.

5. Recommended Countermeasures for Improvement

5.1 Short Term Countermeasures

On a short-term basis, the company should put the acquisition of the ISO 9002 certificate by March 2000, as currently planned, as its highest priority.

5.2 Mid and Long Term Countermeasures

The company needs to solve the space limitation issue and install a wastewater treatment system. A conceptual design of a wastewater treatment system was carried out based on the results of wastewater quality analysis.

(1) Design Basis

Total amount and quality of industrial wastewater to be treated are summarized as shown in Table 4. This data was estimated using water consumption balance issued by the enterprise and the analysis results of wastewater samples taken by CECE at major discharge points.

Table 4 Base Data for W.W.T.S Conceptual Design

	IN	OUT	TCVN 5945 (B)
Flow Amount	4000 m^3/day		
PH	6.5 ～11	5 ～ 9	5.5 ～ 9.0
BOD (mg/l)	245	50	50
COD (mg/l)	405	100	100
S S (mg/l)	660	100	100
Oil (mg/l)	0.16		10
Total – N(mg/l)	6.4	60	60

(2) Conceptual Design

Based on the above data, conceptual design work was done by the study team. As a result, block flow diagram and basic dimension of major equipment for wastewater treatment system is shown respectively in Figure 2 and Table 5.

(3) Required Cost

The required construction cost of the wastewater treatment system, based on the above conceptual design, is estimated at 18.0 billion VND.

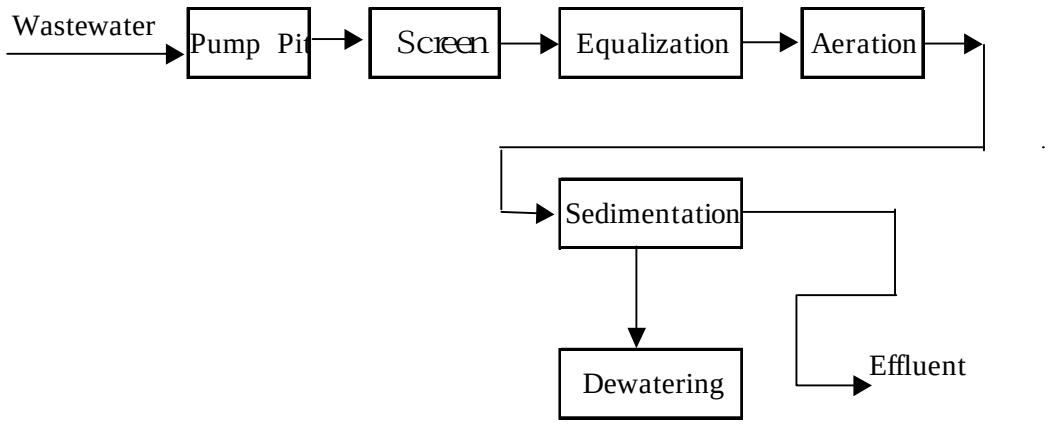


Figure 2 Block Flow sheet of the Wastewater Treatment System (Sai Gon Beer Co mpany)

Table 5 Basic Dimensions of Major Equipment

Name of Equipment	No. of Units Required	Remarks
Pump Pit	1	167m^3 RC
Wastewater Pump	2	Submerged, 13.3m^3/min 59.3kW
Screen	1	1mm mesh
Equalization Tank	1	2670m^3 RC, 27.5m dia. 4.5m d
Blower for the Equalization Tank	2	Rotary 30m^3/.min 36kW
Aeration Equip. for the Equal.Tank	1	Diffuser Type
Transfer Pump	2	Volute, 2.8m^3/min 6.2kW
Aeration Tank	1	4000m^3 RC, 5mw*4.5mD*30mL*6sets
Blower for the Aeration Tank	2	Rotary 41m^3/.m 49kW
Equipment for the Aeration.Tank	1	Diffuser Type
Sedimentation Tank	1	1070m3, 18m dia. 4m d RC
Return Sludge Pump	2	Volute, 2.8m^3/m 3.7kW
Sludge Collector	1	Mechanical Rake
Dewaterring Facilities	2	Belt Filter, 2m Width*2sets
Chemical Dosing	1	Cation Polymer Tanks and Pumps
Control Building	1	8mW*10mL Steel Slated, 2 Stories

CASE STUDY F-14

Ajinomoto Vietnam Co., Ltd.

Survey Date: 3 December 1999

1. General

1.1 Profile

Ajinomoto Vietnam Co., Ltd. is a joint venture established in 1992 between Viet Nam Food Company and Ajinomoto Co., Ltd. in Japan.

The company profile of Ajinomoto Vietnam Co., Ltd. is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Ajinomoto Vietnam Co., Ltd.
Ownership:	Joint venture
Address:	Bien Hoa Industrial Zone, Dong Nai Province
Director:	Mr. Maeda
Established:	1992
Corporate Capital:	52 million US$
Number of Employees:	600
Main Products:	Flavoring, Seasoning Powder

So far, the Company has expanded through the following three stages:

1) Production of 5,000 t/year of Monosodium Glutamate (MSG) by importing glutamic acid from Indonesia;
2) Production of 12,000 t/year of MSG based on fermentation technology;
3) Expansion of the production capacity to up to 20,000 t/year of MSG.

1.2 Business Status

1.2.1 Production

1.2.2 Debt

2. Production Technology

The production technologies of the Company are not disclosed in this report because they are required to be kept strictly confidential.

Figure 1 shows a conceptual flow diagram of the Factory.

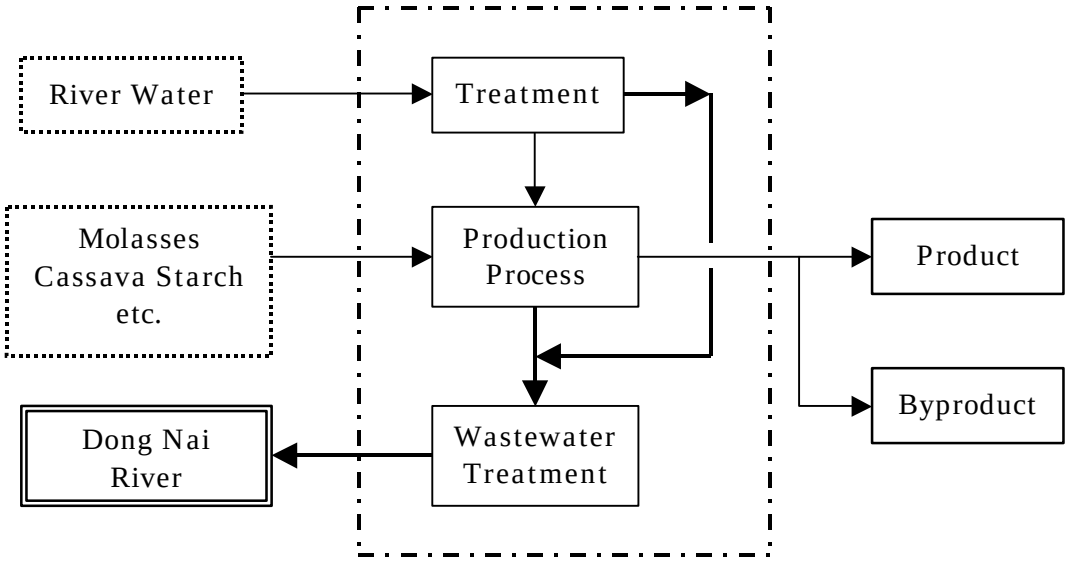


Figure 1 Block Flow Diagram of the Factory

3. Management Technology

The wastewater lines in the Factory are equipped with sensors to monitor leakages from processes. The company intends, by equipping the sensors mentioned above, to:

1) Fulfill its responsibility to preserve the environment;
2) Manage and minimize production losses caused by leakage appropriately.

4. Industrial Wastewater Treatment and Discharge

The Company maintains a positive policy on environmental preservation. Upon application for construction of the factory, the Company conducted EIA, which was approved by MOSTE. The Company's main activities for environmental preservation are as follows:

1) Wastewater treatment;
2) Recovery of process waste as a by-product fertilizer called “AMI AMI”;
3) Removal of SOx from a boiler;
4) Acquisition of ISO 14000.

Wastewater is properly treated and controlled with a wastewater treatment system designed and constructed by EPC, so that the quality of treated water meets the National regulation standards.

Figure 2 Wastewater Treatment system designed by EPC

In this study, two samples were collected at the final discharge to the Dong Nai River and at the outlet of the wastewater treatment system. The results of analysis by CECE are shown in Table 2.

Table 2 Wastewater Qualities

Item	Unit	Sample number (Sampling time)		TCVN 5945 (1995)
		1 (11:05)	2 (11:15)	
Flow Rate	m^3/h			
Temperature	℃	32.3	30.4	40
pH	-	8.0	7.20	5.5-9
Electric Conductivity	µS/cm	230	4200	
Turbidity		18	12	
Oil & Grease	mg/l	0.12	0.17	10
DO	mg/l	4.8	4.5	
SS	mg/l	22	24	100
COD	mg/l	11.3	60	100
BOD	mg/l	7	27	50
Total Nitrogen	mg/l	3.21	4.92	60
Residual Chlorine	mg/l	0.06	0.06	2

5. Comments

In summary:

1) Wastewater from Ajinomoto Vietnam Co., Ltd. is well treated by a suitable facility;
2) Process waste is appropriately recovered and made into a byproduct;
3) Production losses are appropriately controlled and minimized.

We concluded that Ajinomoto Vietnam Co., Ltd. is one of most successful companies for adding Cleaner Production and End of Pipe technologies.

CASE STUDY F-15

Dielac Factory

Survey Date: 7 December 1999

1. General

1.1 Profile

Dielac factory belongs to a state-owned company, Vietnam Dairy Products Company, which is the only powder milk producing company in Viet Nam. The factory took over technologies from the Switzerland Nestle group which it had belonged to until 1975. The profile of the Dielac Factory is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Vietnam Dairy Products Company - Dielac Factory
Ownership:	State-owned
Address:	Industrial Zone Bien Hoa
Director:	Mr. Nguyen Van Tam (Vice Director)
Established:	1975
Corporate Capital:	
Number of Employees:	270 (500 if seasonal temporary workers are included)
Main Products:	Powder Milk, Nutrition Powder, Biscuits of Various Kinds

1.2 Business Status

1.2.1 Production

Table 2 shows the production amount in 1998.

The Factory was operating at full capacity during the study period.

Table 2 Production in 1998

Product	Production (Cans/year)
Milk Powder	24,000,000
Nutrition Products	12,000,000
Total	36,000,000

1.2.2 Debt

The responsibility of the Factory is limited to production. Data and

information related to sales or debt are subject to the control of the company's headquarters.

2. Production Technology

2.1 Process

Figure 1 shows a simplified block flow diagram of the factory.

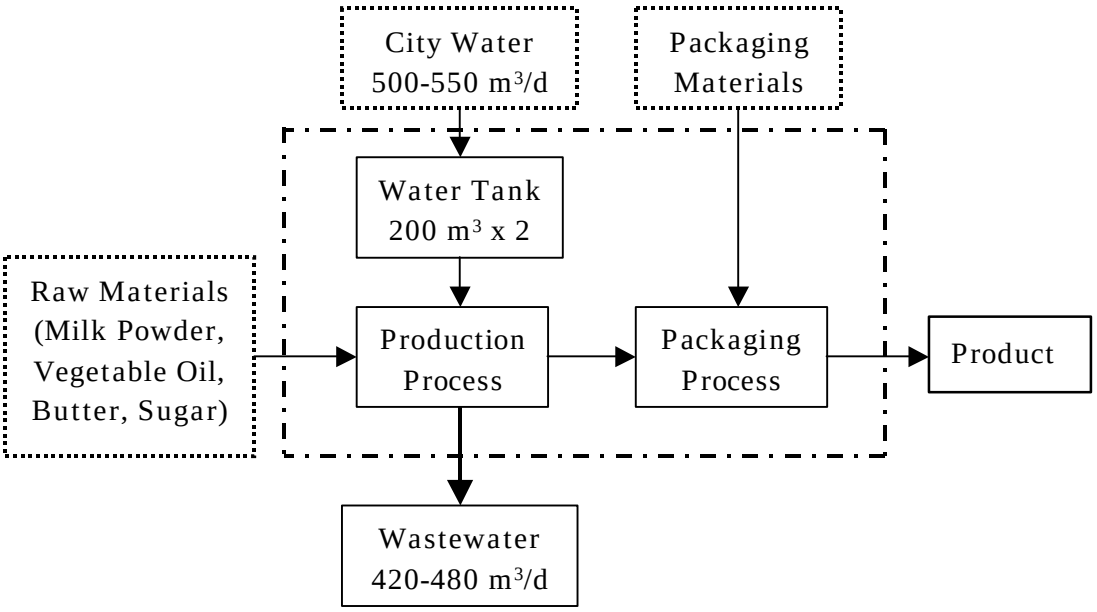


Figure 1 Block Flow Diagram of the Factory

Both production processes of milk powder and nutrition powder consist of the following three units:

① water mixing unit;

② drying unit;

③ dry mixing unit.

As for the drying process, the milk powder section and the nutrition powder section are equipped with a spray-dryer and a drum-dryer respectively.

Every production unit is equipped with a measuring meter for water intake.

2.2 Operation

The Factory has adopted a three-shift working system. All the production processes are operated continuously.

The City water supply is cut a few days a month because the Factory is located at a relatively high elevation and the city water pumping capacity is not sufficient

enough. The Factory is obliged to purchase water with tank lorries.

Under normal operation, floor washing creates wastewater. Successive, three day cleaning of all the equipment is carried out twice a month.

2.3 Unit Consumption

Table 3 shows unit consumption in 1998.

Table 3 Unit Consumption in 1998.

Product	Material	Unit	Unit Consumption
Milk Powder	Milk Powder	kg/1000 cans	234
	Butter	kg/1000 cans	82
	Oil	kg/1000 cans	29
	Sugar	kg/1000 cans	105
Nutrition Powder	Milk Powder	kg/1000 cans	73
	Oil	kg/1000 cans	39
		kg/1000 cans	120
	Sugar	kg/1000 cans	117
Utilities	Fuel Oil	l/1000 cans	135
	Diesel Oil	l/1000 cans	40
	Water	m^3/cans	5.5

3. Management Technology

Preparation work for application for the ISO 9002 certificate started in March 1999 and the Factory obtained the certificate in November 1999. Production losses are calculated monthly.

4. Industrial Wastewater Treatment and Discharge

4.1 Wastewater Quality

Industrial wastewater is created by floor and production equipment washing and discharged without treatment into the city canal after being mixed with domestic wastewater. The conceptual wastewater route and the spots where wastewater samples were taken in this Study are shown in Figure 2.

The domestic wastewater amount is calculated based on the intake of city water and process water consumption.

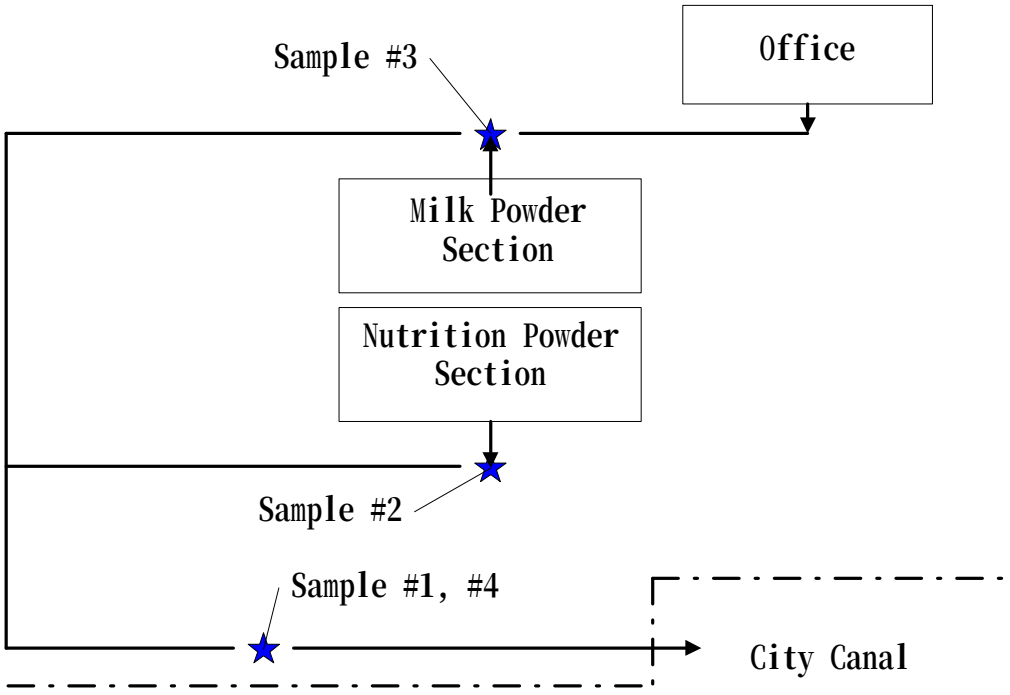


Figure 2　Wastewater Sample Collection Spots

Figure 3　Sampling state of Sampling point No.1

Table 4 shows the results of wastewater quality analysis carried out by CECE compared with the results done by an institute under DOSTE in 1996. All samples in Table 4 were taken during ordinary operation.

Table 4 Wastewater Quality

Item	Unit	Sample number				1996	TCVN 5945
		#1	#2	#3	#4		
Sample Collection Time		10:50	11:02	11:16	11:35		
Temperature	℃	34.2	47.2	38.5	33.9		40
PH	-	6.6	5.40	8.56	6.6	8.9	5.5-9
Electric conductivity	μS/cm	210	200	170	220		
Turbidity	NTU	38	614	25	43		
Oil & Grease	mg/l	0.25	0.18	0.2	0.2		10
DO	mg/l	3.1	1.8	3.7	2.96		
SS	mg/l	171	3254	74	251	50-120	100
COD	mg/l	280	360	240	320	540-988	100
BOD	mg/l	170	194	151	197	190	50
Total Nitrogen	mg/l	6.24	13.1	12.64	10.61		60
Residual Chlorine	mg/l	0.2	2.22	1.2	0.38		2

4.2 Wastewater Treatment System Project

A project was set up and authorized by MOI for the introduction of a wastewater treatment system. The required investment amount was preliminarily estimated at 1 million US$. The project implementation schedule, however, has not yet been finalized. Several vendors who intend to bid for the project are collecting basic data and information, including data on wastewater qualities.

5. Recommended Countermeasures for Improvement

5.1 Short Term Countermeasures

It is clear that the Factory is well organized and managed, as evidenced by the acquisition of ISO 9002. It is recommended that efforts be continuously made to maintain the environment in good condition as well as to improve productivity. For example, the wastewater discharge pipe should be periodically cleaned to avoid plugging.

5.2 Mid and Long Term Countermeasures

On a mid and long term basis, it is recommended that a wastewater treatment system be installed. A conceptual design of a wastewater treatment system was carried out based on the results of wastewater quality analysis.

(1) Design Basis

The total amount and quality of industrial wastewater to be treated are summarized and shown in Table 5. this data was estimated using water consumption balance issued by the enterprise and analysis of the results of wastewater samples taken by CECE at major discharge points.

Table 5 Base Data for W.W.T.S Conceptual Design

	IN	OUT	TCVN 5945 (B)
Flow Amount	450 m^3/day		
PH	6.5 ～	5 ～ 9	5.5 ～ 9.0
BOD (mg/l)	185	50	50
COD (mg/l)	300	100	100
S S (mg/l)	211	100	100
Oil (mg/l)	0.3		10
Total – N(mg/l)	8.4	60	60

(2) Conceptual Design

Based on the above data, conceptual design work was done by the study team. As a result, a block flow diagram and basic dimensions of major equipment for the wastewater treatment system are shown respectively in Figure 4 and Table 6.

(3) Required Cost

The required construction cost of the wastewater treatment system, based on the above conceptual design, is estimated at 2.8 billion VND.

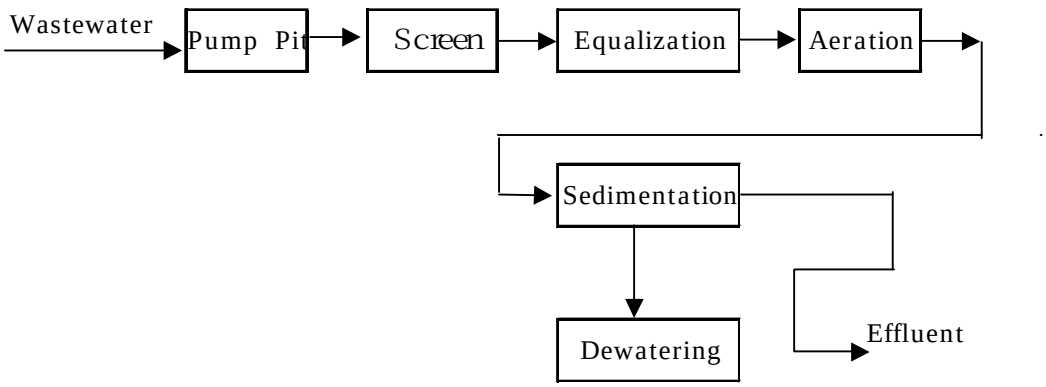


Figure 4 Block Flow sheet of the Wastewater Treatment System
(Ha Tay Foodstuff Processing Company)

Table 6 Basic Dimension of Major Equipment

Name of Equipment	No. of Units Required	Remarks
Pump Pit	1	19m^3 RC
Wastewater Pump	2	Submerged, 1.5m^3/min 6.7kW
Screen	1	1mm mesh
Equalization Tank	1	300m^3 RC, 9.5m dia. 4.5m d
Blower for the Equalization Tank	2	Rotary 3.3m^3/.min 4kW
Aeration Equip. for the Equal.Tank	1	Diffuser Type
Transfer Pump	2	Volute, 0.3m^3/min 0.7kW
Aeration Tank	1	450m^3 RC, 5mw*4.5mD*20mL
Blower for the Aeration Tank	2	Rotary 3m^3/.m 4kW
Equipment for the Aeration.Tank	1	Diffuser Type
Sedimentation Tank	1	120m3, 6m dia. 4m d RC
Return Sludge Pump	2	Volute, 0.3m^3/m 0.4kW
Sludge Collector	1	Mechanical Rake
Dewaterring Facilities	1	Belt Filter, 0.5m Width
Chemical Dosing	1	Cation Polymer Tanks and Pumps
Control Building	1	4mW*6mL Steel Slated, 2 Stories

CASE STUDY F-16

Thien Huong Food Processing Company

Survey Date: 08 December 1999

1. General

1.1 Profile

Thien Huong Food Company was originally established as a joint venture company with a French company called ORSAN for producing mono sodium glutamate.

In 1987, the company separated from the joint venture and started to produce instant noodles and other food materials (rice noodle, porridge, soup, chili sauce, and roasted peanuts.)

The Company profile is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Thien Huong Food Company
Ownership:	State owned
Address:	Tan Thoi Hiep Commune, District 12, HCM City
Director:	Mr. Nguyen Thanh Phuong (Vice Director)
Tel / Fax:	84－8－8912922 / 84－8－8911174
Established:	1987
Corporate Capital:	
Number of Employees:	1,180
Main Products:	Instant Noodle, Soup, Chili Sauce, Roast Peanut

1.2 Business Status

1.2.1 Production

Table 2 shows production and sales of the company in 1998. The company exported one third of it's total production.

Table 2 Production and Sales in 1998

No.	Product	Unit	Production	Turn over
1	Instant Noodles	t	21,015	Total sales in 1998; 296 billion VND (21 million US$) Export; 7 million US$
2	Rice Porridge	t	2,137	
3	Seasoning (Soup)	t	2,568	
4	Chili Sauce	1,000 bottles	1,005	
5	Roasted Peanuts	t	624	
6	Rice Noodle	t	4.85	

1.2.2 Debt

The company is in good financial situation and has debt of only 9 billion VND.

2. Production Technology

2.1 Process

Figure 1 shows a block flow diagram of the whole factory and water usage for each section.

Well water is used as process water, including washing use, boiler water and domestic use. Supply water is treated by filtration systems, and boiler feed water is treated with ion exchange columns.

Flow meters are provided at each supply line to production sections and at the boiler feed.

2.2 Unit Consumption

2.2.1 Utility Consumption;

Table 3 shows water and utility consumption in 1998.

Table 3 Water and Energy Consumption

Material	Unit	Quantity	Unit Price (VND)	Total (1000 VND)
Water	m^3	239,808	1,000	239,808
Fuel Oil	t	2,763,660	1350	4,228,400
Diesel Oil	t	45.2	2450	110,715
Electricity	kWh	2,371,691	750	1,778,768

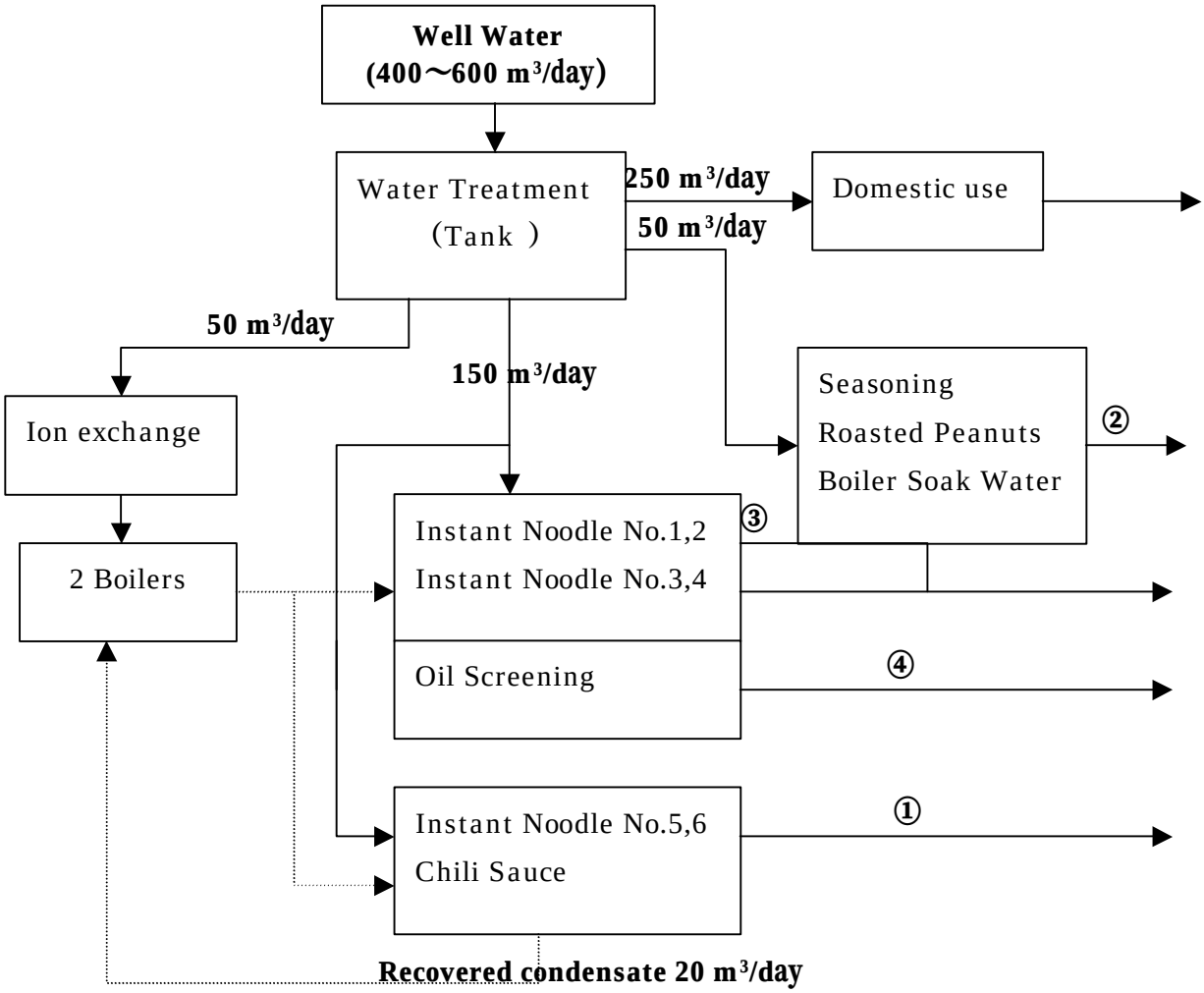


Figure 1 Block Flow Diagram of the Factory and Water Usage

2.2.2 Unit Consumption for Main Products in 1998

Table 4 shows raw material unit consumption for main products.

Table 4 Raw Material Consumption in 1998

No.	Material	Unit	Unit Consumption	Total Consumption	
1)	Instant Noodle				
	—Wheat Flour	kg	686.2		
	—Vegetable Oil	kg	175.4		
	—Sodium Glutamate	kg	2.4		
	—Salt	kg	20.2		
	—Fuel Oil	kg	252.9		
	—Diesel Oil	l	2.2		
	—Electricity	kWh	77.9		
2)	Seasoning Soup				
	—Sodium Glutamate	kg	62.2	159.6	
	—Pepper	kg	4.6	11.8	
	—Dried Garlic	kg	1.7	4.4	
	—Chili Powder	kg	4.5	11.6	
	—Sugar	kg	22.0	56.5	
	—Ribo (Sweeten Mat.)	kg	1.3	3.3	
	—Dried Onion	kg	2.4	5.8	
	—Salt	kg	1,092.2	2,804.3	
	—Electricity	kWh	57.0	146.3	
3)	Instant Rice Porridge				
	—Rice	kg		2,103,280	
	—Seasoning	kg		80.2	
	—Dried Meat	kg		30.0	
	—Vegetable Oil	kg		40.2	
	—Electricity	kWh		552,160	
4)	Instant Rice Noodles				
	—Rice Noodles	kg		12,574	
	—Seasoning	kg		1,265	
	—Vegetable Oil	kg		455	
5)	Baby Noodles				
	—Noodle Crumples	kg		44,100	
	—Sodium Glutamate	kg		1,201	
	—Sugar	kg		1,310	
	—Seasoning	kg		39	
	—Fuel Oil	kg		597	
	—Electricity	kWh		1,990	
6)	Coated Peanut				
	—Peanut	kg		304.1	
	—Rectified Oil	kg		87.1	
	—Coconut	piece		120,000	
	—Wheat Flour	kg		203.7	
	—Sugar	kg		131.0	
	—Diesel Oil	l		87.3	
	—Electricity	kWh		49.8	
7)	Instant Chinese Noodles	kg		861.0	
	—Chinese Rice Noodles	kg		65.0	
	—Seasoning	kg		29.0	
	—Vegetable Oil	kg		87.0	
	—Dried Meat Powder	kWh		40.0	
	—Electricity				

2.3 Environmental Pollution Reduction Program and Future Plans

2.3.1 Environmental Pollution Reduction Program

The company is carrying out an environmental pollution reduction program in cooperation with SIDA and UNIDO. In the first phase of the program completed in September 1999, 62 items on aspects pertaining to the environment were recommended by a study team. 52 of these items have already been carried out.

The implementation results are as follows:

1) The amount of wastewater was reduced from 800 m^3/day to 400 m^3/day.
2) 30 % of steam (20 t/day) is recovered as steam condensate. Steam supply pressure was reduced from 0.8 kg/cm^2 to 0.2 kg/ cm^2 through engineering optimization.
3) Improvements on the infrastructure, such as the work environment were implemented.

Human resources required for the project include 7 staff members of the company, as well as 7 staff members from UNIDO, SIDA and DOSTE. The first stage of the study was implemented from February 1998 to September 1999. The implementation cost of 1.5 billion VND has been supported by SIDA and UNIDO.

This Program is still ongoing.

2.3.2 Future Plans

The company has future plans as follows:

1) Installation of new instant noodle production equipment (three old lines will be renewed.);
2) Installation of a wastewater treatment system in the near future.

3. Management Technology

Production losses are calculated monthly. Flow meters are provided to each supply line of production sections.

4. Industrial Wastewater Treatment and Discharge

Wastewater is discharged continuously by washing and heating the cooking equipment. Wastewater samples were collected at the following spots on 8 December 1999. Sampling points are shown in Figure 1.

① Instant noodle No.5 & 6 production sections;

② Boiler and Porridge Production sections;

③ Instant noodle No.1 & 2 production sections;

④ Oil screening and product storage sections.

Analysis results conducted by CECE are shown in Table 5.

Table 5 Wastewater Quality

Item	Unit	Sample number and sampling time				TCVN 5945
		① 12:52	② 13:03	③ 13:15	④ 13:25	
Flow rate	m^3/h					
Temperature	℃	30.8	29.6	43.4	30	40
PH	-	5.95	8.96	7.51	6.62	5.5-9
Electric Conductivity	μS/cm	3540	960	380	1690	
Turbidity	mg/l	189	32	47	193	
Oil & Grease	mg/l	0.27	0.32	0.21	0.32	10
DO	mg/l	1.15	2.13	2.96	0.32	
SS	mg/l	1250	99	114	219	100
COD	mg/l	600	180	240	320	100
BOD	mg/l	360	96	153	198	50
Total Nitrogen	mg/l	28.1	6.24	12.48	53.04	60
Residual Chlorine	mg/l	0.83	0.19	0.33	0.9	2

5. Recommended Countermeasures for Improvement

5.1 Short Term Countermeasures

It is understood that the Company has achieved good progress in implementing cleaner production technologies, (CP) taking the advice of UNIDO and SIDA. Steady and continuous practice of improvement activities is recommended.

5.2 Mid and Long Term Countermeasures

On a long term basis, it is recommended that End of Pipe technology for treating wastewater be introduced. The study team made a conceptual design of a wastewater treatment system based on the results of wastewater analysis as follows:

(1) Design Basis

The total amount and quality of industrial wastewater to be treated are summarized and shown in Table 6. This data was estimated using water consumption balance issued by the enterprise and analysis of the results of wastewater samples taken by CECE at major discharge points.

Table 6 Base Data for W.W.T.S Conceptual Design

	IN	OUT	TCVN 5945 (B)
Flow Amount	250 m^3/day		
PH	6.0 ～9.0	5 ～ 9	5.5 ～ 9.0
BOD (mg/l)	225	50	50
COD (mg/l)	370	100	100
S S (mg/l)	560	100	100
Oil (mg/l)	03		10
Total – N(mg/l)	17.5	60	60

(2) Conceptual Design

Based on the above data, conceptual design work was done by study team. As the result, block flow diagram and basic dimensions of major equipment for the wastewater treatment system is shown respectively in Figure 2 and Table 7.

(3) Required Cost

The required construction cost of the wastewater treatment system, based on the above conceptual design, is estimated at 1.8 billion VND by the factory project team.

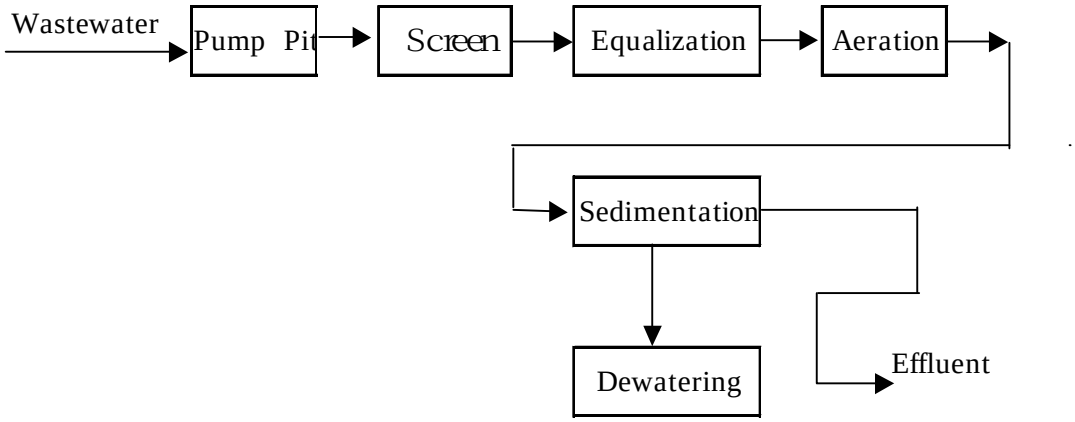


Figure 2 Block Flow sheet of the Wastewater Treatment System
(Thien Huong Food Processing Company)

Table 7 Basic Dimensions of Major Equipment

Name of Equipment	No. of Units Required	Remarks
Pump Pit	1	$10m^3$ RC
Wastewater Pump	2	Submerged, $0.8m^3$/min 3.7kW
Screen	1	1mm mesh
Equalization Tank	1	$167m^3$ RC, 7m dia. 4.5m d
Blower for the Equalization Tank	2	Rotary $1.9m^3$/.min 2.3kW
Aeration Equip. for the Equal.Tank	1	Diffuser Type
Transfer Pump	2	Volute, $0.2m^3$/min 0.4kW
Aeration Tank	1	$250m^3$ RC, 5mw*4.5mD*12mL
Blower for the Aeration Tank	2	Rotary $2m^3$/.m 2.5kW
Equipment for the Aeration.Tank	1	Diffuser Type
Sedimentation Tank	1	67m3, 5m dia. 4m d RC
Return Sludge Pump	2	Volute, $0.2m^3$/m 0.2kW
Sludge Collector	1	Mechanical Rake
Dewaterring Facilities	1	Belt Filter, 0.2m Width
Chemical Dosing	1	Cation Polymer Tanks and Pumps
Control Building	1	4mW*6mL Steel Slated, 2 Stories

CASE STUDY F-17

Sai Gon Foodstuff Company

Survey Date: 9 December 1999

1. General

1.1 Profile

Sai Gon Foodstuff Company (SAFOODSCO) is a state-owned company that was established in 1962. The Company profile is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Sai Gon Foodstuff Company
Ownership:	State-owned
Address:	70/1 Highway 1A, Linh Xuan, Thu Duc, HCM City
Director:	Mr. Tran Thang Hoa
Established:	1962
Corporate Capital:	
Number of Employees:	112
Main Products:	Glucose syrup, Maltose, Maltosedextrine and others

SAFOODSCO originally used to produce confectionary from cassava, and during its history they have diversified their products into soy sauce, beverages and purified water. Now, the main product line of the Company depends on the saccharification of starch. Currently, the Company is composed of the following two enterprises:

1. Linh Xuan Food Processing Enterprise: produces Glucose syrup, high-maltose and maltosedextrine;
2. Sai Gon Food Processing Enterprise: produces beverages, purified water, alcohol, soy sauce, cake and sausage.

A case study was carried out on the Linh Xuan Food Processing Enterprise. The Enterprise owns a 3 hectare factory lot.

1.2 Business Status

1.2.1 Production

Table 2 shows annual production and sales in 1998. SAFOODSCO says it maintains a 30 – 40 % market share in the HCMC area.

Table 2 Production and Sales in 1998.

Enterprise	Product	Production	Turnover (million VND)
Linh Xuan	Glucose syrup	980,371 kg	4,672.4
	High-Maltose	95,342 kg	585.9
	Maltosedextrine	0 kg	0
Sai Gon	Beverage	434,750 l	1,623.0
	Purified water	87,500 l	205.0
	Alcohol	95,000 l	133.0
	Soy sauce	21,000 l	128.5
	Cake	13,300 kg	788.0
	Sausage	0 kg	0
Total			8,135.8

1.2.2 Debt

2. Production Technology

2.1 Process

The production equipment was imported from Germany in 1962. Since then, a lot of improvements have been achieved.

Figure 1 shows a conceptual block flow diagram of the factory.

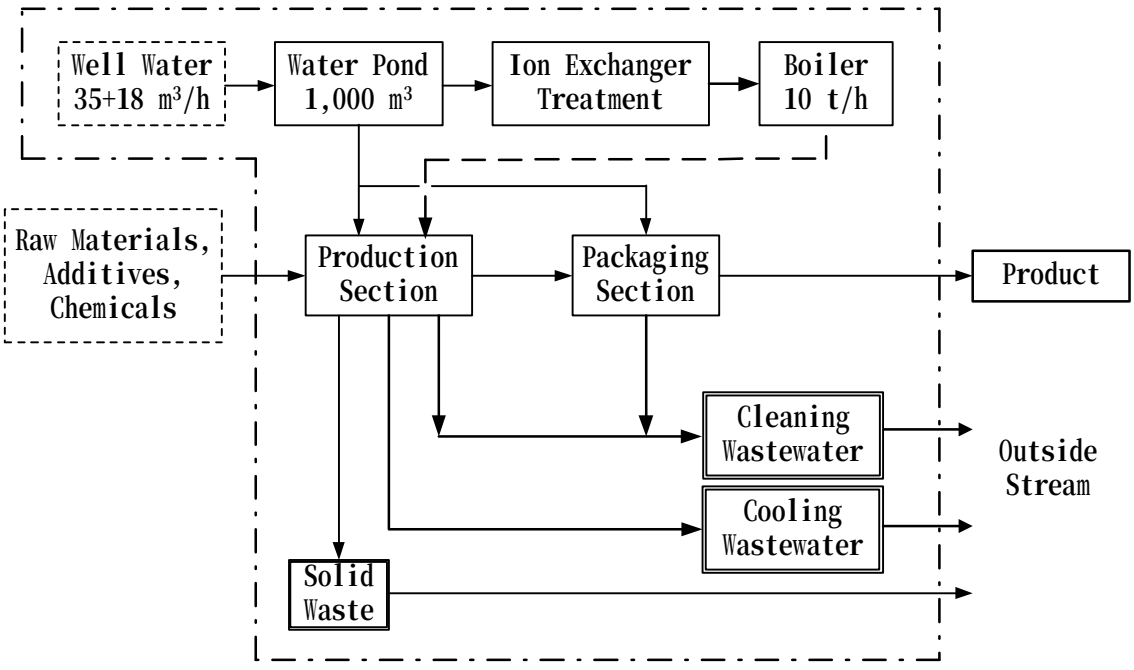


Figure 1 Conceptual Block Flow Diagram

The production process of SAFOODSCO is based on hydrolysis with acids and hydrolysis with enzymes using a common production line.

2.1.1 Hydrolysis Process with Acids

A hydrolysis process with hydrochloric acid is used to produce glucose syrup. This process is composed of the following unit operations:

1) Mixing starch and HCl;
2) Hydrolysis;
3) Soda Ash Neutralization;
4) Concentration;
5) Decolorizaton with activated carbon;
6) Filtration;
7) Concentration;
8) Cooling.

Equipment made of stainless steel resistant to pH 1.8-2 acid was imported.

This process has work environment problems that are caused by HCl emissions from the HCl tank and hydrolysis reactors because they are open vessels. Therefore, SAFOODSCO plans to change the hydrolysis process to an enzymatic process, gradually, step by step.

2.1.2 Hydrolysis Process with Enzymes

A hydrolysis process with enzymes is used to produce high-maltose syrup and maltosedexitrine. This process is composed of the following unit operations:

1) Mixing starch with $Na_2 CO_3$ and $CaCO_3$;
2) Hydrolysis;
3) Primary Filtration;
4) Decolorizaton with activated carbon;
5) Secondary Filtration;
6) Concentration;
7) Cooling.

Currently 50 % of their products are being produced using enzymatic hydrolysis.

2.2 Operation

The whole production process is manually operated, as well as the washing of drums and plastic containers for the products. Each production unit is operated batch wise. Concentration is carried out by vacuum evaporation under 0.09 MPa for one (1) hour. In the final unit operation, the product is cooled from 58 ℃ to 35 ℃ by spraying cooling water on the outside wall of a cooling vessel for 20 minutes, and this creates cooling wastewater.

After completion of production for a raw material lot, production equipment is washed, creating wastewater. Cooling wastewater accounts for more than 80 % of all wastewater from the Factory. Waste activated carbon from the decolorization unit is sold as fertilizer.

2.3 Unit Consumption

Consumption of raw materials and utilities and unit consumption, calculated with consumption and production, are summarized in Table 3.

Table 3 Consumption of Raw Materials and Utilities

Product	Material	Consumption		Unit Consumption		Cost (million Dong)
Glucose-syrup	Starch	1,356,756	kg	1.384	kg/kg	2,170.8
	Carbon Z1	2,940	kg	3.00	g/kg	102.9
	Carbon TQ	2,156	kg	2.20	g/kg	44.2
	HCl(30%)	5,881	kg	6.00	g/kg	7.6
	$NaHSO_4$	98	kg	0.10	g/kg	1.5
	Na_2CO_3	3,920	kg	4.00	g/kg	9.0
	Water	104,164	m^3	0.106	m^3/kg	
	Fuel Oil	280,365	l	0.286	l/kg	434.5
	Electricity	234,082	kWh	0.239	kWh/kg	175.6
High Maltose-syrup	Starch	147,385	kg	1.546	kg/kg	397.9
	Carbon Z1	107	kg	1.12	g/kg	3.6
	Carbon TQ	817	kg	8.57	g/kg	16.7
	HCl(30%)	192	kg	2.01	g/kg	0.3
	Na_2CO_3	483	kg	5.07	g/kg	1.1
	Enzyme	57	kg	0.598	g/kg	6.7
	$NaHSO_4$	9.5	kg	0.01	g/kg	0.1
	Water	16,208	m^3	0.17	m^3/kg	
	Fuel Oil	27,267	l	0.286	l/kg	42.3
	Electricity	22,767	kWh	0.239	kWh/kg	17.1
Maltosedextrine						

3. Management Technology

Production losses mainly result from filtration after the decolorization unit because the water content of activated carbon reaches 65 %. Total losses are calculated at 7 %. It is expected that production losses will be improved by the installation of new filtration equipment, which is designed to provide an operation of 35 % water content in activated carbon. Losses caused by washing equipment are considered insignificant compared with losses through filtration.

4. Industrial Wastewater Treatment and Discharge

Wastewater created by the cooling or washing operation is discharged into an outside stream without treatment. SAFOODSCO says that improvement of production technology will reduce the wastewater amount. Three water samples were taken and analyzed in the study as follows:

#1 Cooling wastewater mixed with evaporator condensate;

#2 Final outlet for discharge;

#3 Supply water in the pond.

#3 sample was taken to confirm the pH of supply water because the pH of wastewater was rather low.

Figure 2 Supply Water Pond and Container Washing state

Table 4 shows the results of water quality analysis. Supply water qualities are compared with the results provided by Pasteur Institute of HCMC in November 1999.

Table 4 Water Quality

Item	Unit	Wastewater			Supply water	
		Sample Number		TCVN 5945	Sample #3 (11:45)	Pasteur Institute
		#1 (11:25)	#2 (11:35)			
Temperature	℃	37.5	37.4	40	29.3	
pH	-	5.3	5.21	5.5-9	4.95	4.67
Electric conductivity	μS/cm	30	30		30	
Turbidity	NTU	5	7		1	
Oil & Grease	mg/l	0.14	0.2	10	0	
DO	mg/l	2.52	2.63		3.8	
SS	mg/l	54	88	100	14	
COD	mg/l	11.8	352	100	19	
BOD	mg/l	7	220	50	5	
Total Nitrogen	mg/l	14.3	17.7	60	11.7	
Residual Chlorine	mg/l	0.05	0.05	2	0.01	
SO_4^{2-}	mg/l				0.62	2.29
NO_3^-	mg/l				1.1	8.67
Cl^-	mg/l					7.1

5. Recommended Countermeasures for Improvement

5.1 Short Term Countermeasures

It is recommended to take, or work out measures, on a short term basis, as follows:

1) Separate and reuse cooling water waste from other wastewater; cooling waste could be recovered and reused because it is clean.
2) Seal vessels in order to protect the work environment from HCl emission until the process is changed over to enzyme hydrolysis.

5.2 Mid and Long Term Countermeasures

In the long term it is recommended that the company deliberately implements a process conversion to enzymatic hydrolysis as they currently are planning.

CASE STUDY F-18

Tuong An Oil Company

Survey Date: 10 December 1999

1. General

1.1 Profile

The company profile of Tuong An Oil Company is summarized in Table 1.

The company was established as a subsidiary company of VOCARIMEX (Vegetable Oil Cosmetics Aromas Company of Viet Nam), in 1973. The area of the company was originally 1.8 ha, but this will increase to 2.8 ha after an expansion project. Installation work for a new production line is underway, but the implementation schedule is being delayed.

Table 1 Company Profile

Name of Company:	Tuong An Oil Company
Ownership:	State owned
Address:	48/5 Road 11, Tan Binh Distr. HCM City
Director:	Mr. Doan Tan Nghiep
Tel / Fax:	8153972 / 8153649
Established:	1973
Corporate Capital:	
Number of Employees:	403
Main Products:	Vegetable Oil, Soap, Coconut Milk

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.	Product	Unit	Production	Turn over (million VND)
1	Shortening	t	1,476.1	18,307.7
2	Margarine	t	2,111.3	31,954.0
3	Cooking Oil	t	18,133.4	264,726.7
4	Coconuts Oil	t	246.0	2,887.2
5	Soy bean Oil	t	504.5	7,754.8
6	Peanuts Oil	t	81.5	1,375.4
7	Sesame Oil	t	149.5	3,866.9
8	Raw Peanuts Oil for Export	t	399.2	5,998.9
9	Raw Coconuts Oil for Export	t	197.9	1,313.7
10	Natadecoco	t	128.4	1,120.0
11	Soap	t	148.9	578.3
12	Raw Oil (after Press)	t	49.4	
13	Tank/Cans (for Cleaning)	Piece	52,431,000	
14	PET Bottle	Piece	3,341,714,000	
			23,626.3 t 52,431.000 P 3,341,714,000 P	339,883.7

1.2.2 Debt

The company has a debt of 11.6 million VND with the Investment Bank of HCMC.

2. Production Technology

2.1 Process

The company uses typical expellers and a refining process for the production of several kinds of edible oil. The company possesses two refining lines, which are composed of a batch process (capacity;30 t/d, 4 t/batch) and a continuous process (capacity; 27 t/d). Total production capacity of oil is 60 t/day. A small amount of soap is produced as a by-product from recovered oil materials. Oil cake from the expeller is sold as animal feed. The overall block flow diagram of the factory is shown in Figure 1.

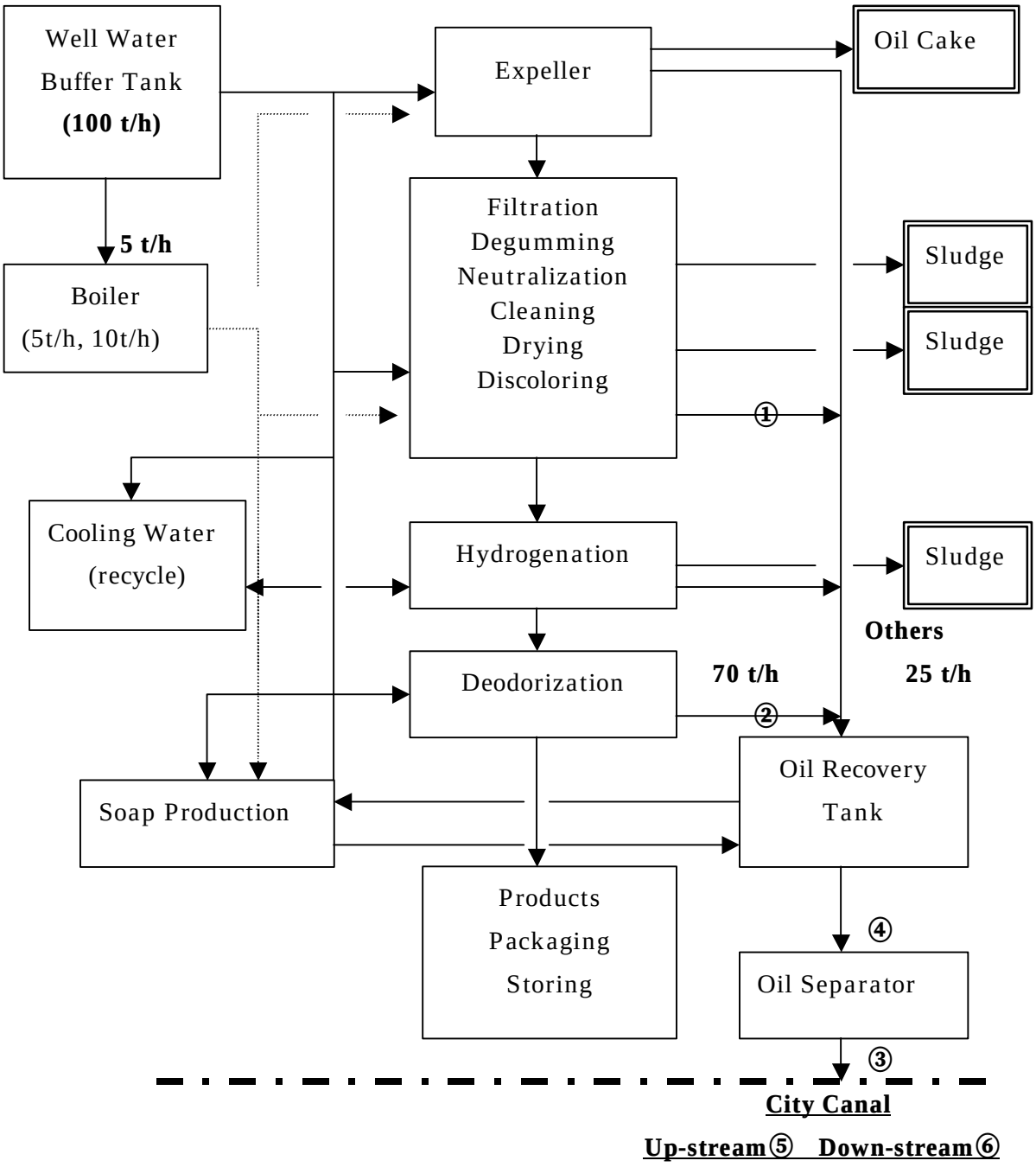


Figure 1 Block Flow Diagram of the Whole Factory

2.2 Unit Consumption

The annual unit consumption of raw materials for each product, and the total consumption of water, fuel oil and diesel oil in 1998, are summarized in Table 3. Water consumption is calculated based on pump specification capacity.

Table 3 Unit consumption of Raw material for each product

No	Raw Material	Quantity (t)	Cost (million VND)
1	Shortening	1,476.1	72.318
	—Sodium ash	1.727	7.295
	—Activated clay	1.653	10.081
	—Activated coal	0.798	18.452
	—Diatomite	0.730	0.874
	—Nickel	0.310	35.615
2	Margarine	2,111.3	252.167
	—Sodium ash	5.236	22.117
	—Activated clay	11.633	70.937
	—Activated coal	1.689	39.027
	—Diatomite	0.245	2.901
	—Nickel	1.020	117.185
3	Cooking oil	18,133.4	1,280.768
	—Sodium ash	51.904	219.240
	—Activated clay	98.884	602.970
	—Activated coal	15.550	428.603
	—Diatomite	2.582	29.955
4	Refined coconut oil	246.0	18.271
	—Sodium ash	0.937	3.959
	—Activated clay	0.787	4.801
	—Activated coal	0.383	9.096
	—Diatomite	0.035	0.413
5	Refined soy-bean oil	504.5	53.278
	—Sodium ash	1.210	5.115
	—Activated clay	6.306	38.457
	—Activated coal	0.383	8.858
	—Diatomite	0.071	0.848
6	Refined Peanut oil	81.5	875
	—Sodium ash	0.435	1.841
	—Activated clay	0.244	1.490
	—Activated coal	0.057	1.317
	—Diatomite	0.011	0.137
7	Refined sesame oil	149.5	44.545
	—Sodium ash	0.925	3.908
	—Activated clay	2.092	12.760
	—Activated coal	1.195	27.627
	—Diatomite	0.021	0.251
8	Roasted peanut oil for export	399.2	7.499
	—Sodium ash	0.622	2.630
	—Activated clay	0.798	4.868
9	Natade-coco	128.4	6.664
	—$Na_2S_2O_5$	0.387	6.241
	—Soda (NaHCO3)	0.168	0.423
10	Soap	148.9	7.499
	—Sodium ash	19.357	81.762
	—Soda (NaHCO3)	2.280	5.719
11	Raw oil (after press)	49.5	
12	Cleaning Tanks / Cans	52,431 pcs	44.293
	—Sodium ash	10.486	44.293
13	Pet Bottle	3,341,714 pcs	1,528.000
	—P.E.T.	152.800	1,528.000

14	Utilities —Water —Fuel oil —Diesel oil for generator	 800 – 850 2,434.410 32.238	 3,999.000 102.400

2.3 Future plans

The company is now conducting an expansion project. The project is supposed to be completed in June 2000. Thereafter the production capacity will be expanded from 60 t/day to 150 t/day. A German engineering Company (Krupp) is overseeing all facets of the project from basic design to test operations, including ensuring that wastewater quality satisfies the national standard.

After completion of construction work of the new production line, the existing production lines are supposed to be renovated to improve productivity.

3. Management Technology

The amount of wastewater is calculated based on pump design capacity.

4. Industrial Wastewater Treatment and Discharge

Wastewater is mostly discharged from the vacuum formation unit in the deodorization section. The quantity is estimated at 70 m^3/h. Total wastewater quantity is estimated at less than 100 m^3/h, and is collected to a small final oil separator and discharged to a city canal without treatment.

Wastewater samples were collected at the following spots on 10 December 1999. Sampling points are shown in Figure 1 and the analysis results are shown in Table 4

① Discharge from Neutralization section;
② Discharge from Deodorization section;
③ Outlet of final oil separator;
④ Inlet of final oil separator;
⑤ Upstream of the wastewater discharge point in the city canal;
⑥ Downstream of the wastewater discharge point in the city canal.

Table 4 Wastewater Quality

Item	Unit	Sampling number and sampling time							TCVN 5945
		① 13:42	② 13:49	③ 14:00	④ 14:08	⑤ 14:22	⑥ 14:32	Ref. 1996	
Flow Rate	m^3/h								
Temperature	℃	42.6	40.2	41.2	42.1	26.4	27.2		40
PH	-	8.21	5.10	8.65	8.75	7.02	7.21	7.2	5.5-9
Electric Conductivity	μS/cm	660	170	1480	1860	240	360	630	
Turbidity	mg/l	1152	13	1032	1212	65	131		
Oil & Grease	mg/l	0.5	0.06	0.32	0.48	0.03	0.16	136	10
DO	mg/l	2.58	0.75	1.42	1.82	0.31	0.82		
SS	mg/l	3208	44	1604	3320	96	271	230	100
COD	mg/l	4840	320	4424	516	280	760	504	100
BOD	mg/l	3400	187	3040	3412	198	436	221	50
Total Nitrogen	mg/l	4.8	6.5	7.5	10.5	9.8	12.6		60
Residual Chlorine	mg/l	3.12	0.21	0.08	3.09	0.24	0.52		2

The data analyzed by HCMC Environmental Management Center in 1996 is also shown in Table 4.

5. Recommended Countermeasures for Improvement

5.1 Short Term Countermeasures

It is understood that the Company is making progress in process improvement. The company should make meticulous efforts to improve and maintain the environment such as:

1) Investigating the dimensions of the oil separator that are required to achieve its intended function;
2) Removing oil spilled on the access road inside the premises.

5.2 Mid and Long Term Countermeasures

After completion of the new production line, it is recommended that the company rearrange the existing line as well and install a wastewater treatment system.

CASE STUDY F-19

Chuong Duong Beverage Company

Survey Date: 14 December 1999

1. General

1.1 Profile

Chuong Duong Beverage Company is a state owned company that was established in 1952 as an alcohol beverage producing company. It was incorporated into an affiliate company of VINABECO in 1975. The company produces several kinds of soft drinks. The current total capacity of beverages is 30 million liter/year. Light liquor (low alcohol content of less than 5% diluted with soda water) is the most produced product in this company. In addition, the Company produces crown caps for bottles. The profile of Chuong Duong Beverage Company is summarized in Table 1.

Table 1 Company Profile

Name of Company:	Chuong Duong Beverage Company
Ownership:	State owned
Address:	379 Ben Chuong Duong Quan 1- TP, HCM City
Tel / Fax	8368747 / 8367176
Director:	Mr. Nguyen Van Dang
Established	1952
Corporate Capital	
Number of Employees:	530
Main Products:	Many Kinds of Beverages, Light Liquor, Bottle Caps

1.2 Business Status

1.2.1 Production

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

1.2.2 Debt

The company carries no debt. Company business is going quite well, and profits after taxes in 1998 were 7 % of turnover.

Table 2 Production and Sales Amounts in 1998

No.	Product	Unit	Production Amount	Turnover (million VND)
1	Soft Drinks	m^3	6,484	23,195.5
2	Soda	m^3	2,565	6,712.4
3	Syrup	m^3	25.3	372.9
4	Light Liquor	m^3	13,678	29,683.7
5	Caramel	m^3	75.5	288.2
6	Crown Cap	1000 pcs	88,663	1,478.6
	Total			61,713.3

2. Production Technology

2.1 Process

The company uses well water in the factory. The well is 200 m in depth due to its high iron content. A two-stage supply water treatment system is applied to get suitable quality for process use. $Ca(OH)_2$ and a sand filter are used in the primary treatment system. The secondary treatment system uses $Ca(OH)_2$, $FeSO_4$, $Ca(ClO)_2$, and filters.

The overall block flow diagram is shown in Figure 1.

The Company operates 16 hours per day with a two shift system. Normal daily water consumption is estimated at 800 to 1,000 m^3. Since 90 % of supply water is wasted, 10 % is used for production. 80 to 90 % of wastewater comes from the recycled bottle washing section.

2.2 Unit Consumption

Annual consumption of main materials and utilities for each product in 1998 are summarized in Table 3.

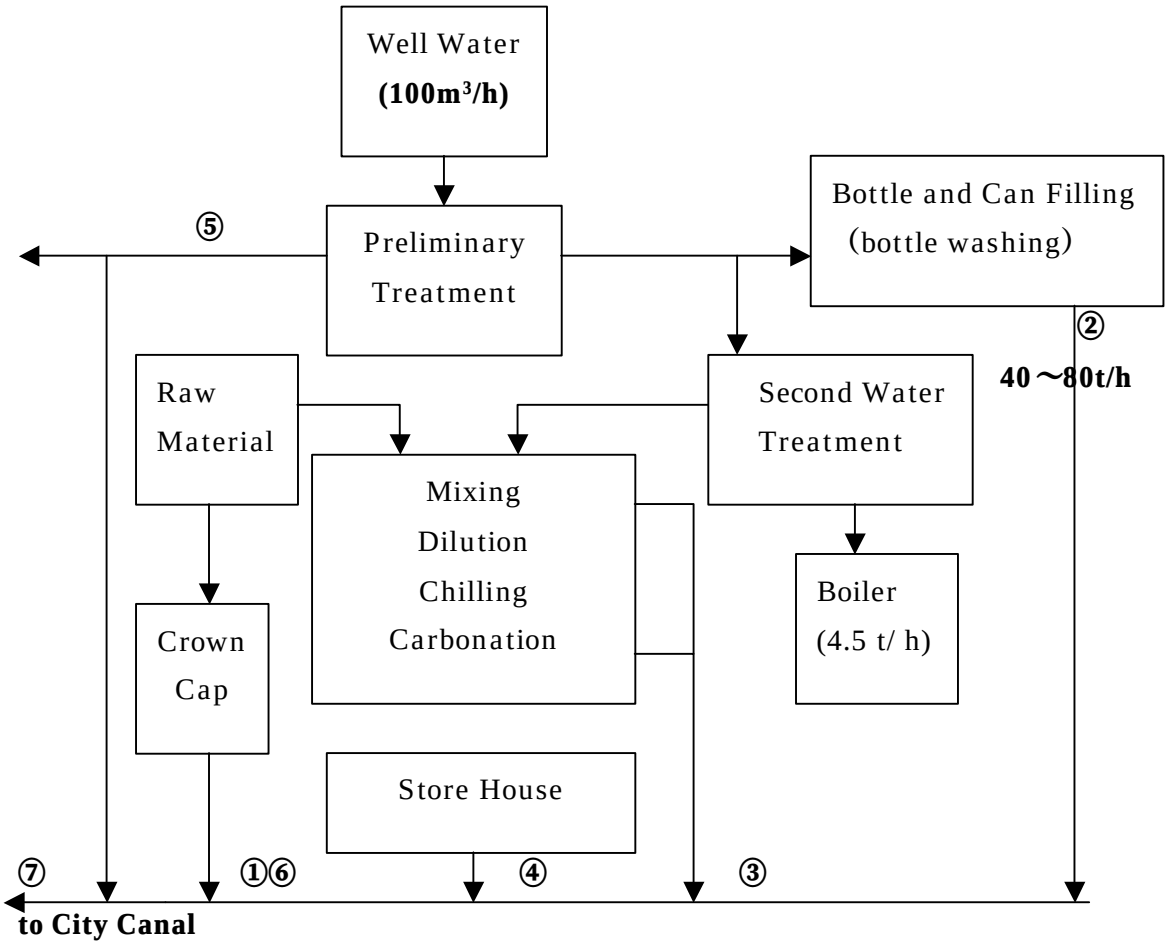


Figure 1 Block Flow Diagram of The Whole Factory

Table 3(1) Materials and Utilities consumption, and their Costs in 1998

No.	Material	Unit	Quantity	Cost (million VND)
1	Soft Drinks			
	—Sugar	kg	771,319	4,929.4
	—Citric Acid	kg	2,784	44.1
	—Sodium Benzoate	kg	2,015	26.9
	—Diatomite	kg	3,290	39.2
	—CO_2	kg	95,917	152.0
	—Flavor	l	8,303	50.5
	—Fuel oil	kg	74,566	115.4
	—Electricity	kWh	271,030	245.9
	—Stabilizer PB3	kg	2,269	150.0
	—Activated Carbon	kg	3,242	103.2

Table 3(2) Materials and Utilities consumption, and their Costs in 1998

No.	Material	Unit	Quantity	Cost (million VND)
2	Soda Drinks			
	—$Na(HCO_3)_2$	kg	1,436	17.1
	—Sodium Citrate	kg	2,554	13.5
	—CO_2	kg	60,794	96.4
	—Fuel oil	kg	29,494	45.7
	—Electricity	kWh	107,204	97.3
3	Syrup			
	—Sugar	kg	19,383	123.857
	—Citric Acid	kg	192	3.042
	—$Na(HCO_3)_2$	kg	35	0.417
	—Sodium Benzoate	kg	19	0.254
	—Flavor	kg	325	1.975
	—Fuel oil	l	295	0.450
	—Electricity	kWh	1,057	0.959
4	Light alcohol			
	—Sugar	kg	60,558	369.0
	—CO_2	kg	236,320	374.6
	—Citric Acid	kg	7,640	211.1
	—Alcohol (Purified)	l	758,088	2,964.1
	—Caramel	kg	8,800	90.2
	—$Na(HCO_3)_2$	kg	4,696	55.9
	—Sodium Benzoate	kg	8,442	44.6
	—Fuel oil	kg	157,293	243.5
	—Electricity	kWh	571,724	518.7
5	Crown cap			
	—Tin (Sn)	kg	239,126	2,236.8
	—Electricity	kg	138,430	125.6
	—Alcohol fuel	l	38,500	150.5
	—Lacquer (inside)	kg	1,540	117.1
	—Ink	kg	468	158.8
	—PVC	kg	24,700	541.5
	—Toluen	kg	1,850	11.2
	—Lacquer (outside)	kg	2,075	2.1
6	Caramel			
	—Sugar	kg	64,529	
	—Diesel oil	l	18,700	

2.3 Future Plans

The Company has the following future plans for process improvement:

1) Renovation of bottling equipment;

The company has 4 bottling lines which were manufactured in 1947,

1958, 1966, and 1977. The oldest line was renovated in 1999. The next investment will take place in 2001.

2) Wastewater treatment equipment;
   Equipment should be installed in the near future. The detailed schedule, however, has not yet been fixed because of a shortage in finances.

Government permission is mandatory for a project that requires investment over 1 billion VND. The Company needs a bank loan for the implementation of the project.

3. Management Technology

4. Industrial Wastewater Treatment and Discharge

Mainly wastewater(80～90 %) is continuously discharged from the recycled bottle washing section, while other wastewater is intermittently discharged in the equipment washing process, in the crown cap manufacturing section and in the beverage production section, as well as by back washing of the supply water treatment system.

Industrial wastewater is collected and sent to a city canal without treatment. Only supply water quality was checked in 1997 and 1998 by VINABECO. The analysis results showed high iron content in supply water.

Seven wastewater samples were collected at the following spots shown in Figure 1 on 14 December 1999, for analysis in this study.

① Collected wastewater at all the production sections;
② Bottle washing section;
③ Collected wastewater from the bottling section and the soft drink preparation section;
④ Wastewater of the entire soft drink production section, including the boiler unit;
⑤ Drain of the primary supply water treatment system;
⑥ Second sample of collected wastewater from all the production sections;
⑦ Final discharge from the Factory.

The analysis results are shown in Table 4.

Table 4 Wastewater Quality

Item	Unit	Sampling number and sampling time							TCVN 5945
		① 11:30	② 12:57	③ 13:12	④ 13:27	⑤ 13:35	⑥ 13:45	⑦ 13:55	
Flow Rate	m^3/h								
Temperature	℃	31.6	31.7	34.2	33.3	31.1	32.2	32.7	40
pH	-	8.82	8.62	8.97	8.72	8.41	8.47	8.35	5.5-9
Electric Conductivity	μS/㎝	1,160	1,150	1,160	1,160	1,090	1,170	1,170	
Turbidity	mg/l	35	35	23	20	44	27	32	
Oil & Grease	mg/l	0.15	0.04	0.11	0.20	0.0	0.12	0.20	10
DO	mg/l	3.52	4.21	3.89	3.41	4.32	2.79	2.82	
SS	mg/l	115	128	127	94	126	88	92	100
COD	mg/l	600	640	652	490	150	490	560	100
BOD	mg/l	375	387	479	340	89	311	344	50
Total Nitrogen	mg/l	7.2	7.4	5.2	7.2	4.2	7.5	10.5	60
Residual Chlorine	mg/l	0.1	0.18	0.24	0.07	0.18	0.34	0.11	2

①⑥ were taken at the same spot at different times to check the quality fluctuation.

5. Recommended Countermeasures for Improvement

5.1 Short Term Countermeasures

It is understood that the Company is well managed. The company should make continuous efforts to maintain a clean work environment. For example, the following should be improved:

1) The floor in the mixing section should be sloped to avoid making puddles;
2) A cigarette butt was found on a heat exchanger. The food producing area should be maintained clean at all times.

5.2 Mid and Long Term Countermeasures

Installation of a wastewater treatment system is recommended on a mid-term basis. The study team made a conceptual design based on the results of wastewater quality analysis as follows:

(1) Design Basis

The total amount and quality of industrial wastewater to be treated are summarized and shown in Table 5. This data was estimated using water consumption balance issued by the enterprise and the analysis results of wastewater samples taken by CECE at major discharge points.

Table 5 Base Data for W.W.T.S Conceptual Design

	IN	OUT	TCVN 5945 (B)
Flow Amount	1010 m^3/day		
PH	～	5 ～ 9	5.5 ～ 9.0
BOD (mg/l)	340	50	50
COD (mg/l)	550	100	100
S S (mg/l)	102	100	100
Oil (mg/l)	0.1		10
Total – N(mg/l)	7.4	60	60

(2) Conceptual Design

Based on the above data, conceptual design work was done by the study team. As a result, a block flow diagram and basic dimensions of major equipment of the wastewater treatment system is shown respectively in Figure 2 and Table 6.

(3) Required Cost

The required construction cost of the wastewater treatment system, based on the above conceptual design, is estimated at 5.4 billion VND.

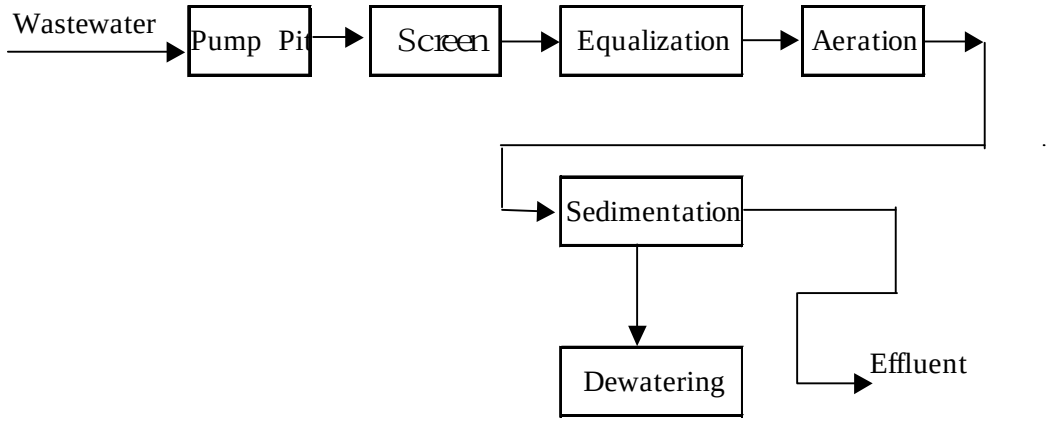


Figure 2 Block Flow sheet of the Wastewater Treatment System
(Chuong Duong Beverage Company)

Table 6 Basic Dimensions of Major Equipment

Name of Equipment	No. of Units Required	Remarks
Pump Pit	1	$10m^3$ RC
Wastewater Pump	2	Submerged, $0.8m^3$/min 3.4kW
Screen	1	1mm mesh
Equalization Tank	1	$153m^3$ RC, 7m dia. 4.5m d
Blower for the Equalization Tan	2	Rotary $1.5m^3$/.min 1.9kW
Equipment for the Equal.Tank	1	Diffuser Type
Transfer Pump	2	Volute, $0.2m^3$/min 0.4kW
Aeration Tank	1	$345m^3$ RC, 5mw*4.5mD*16mL
Blower for the Aeration Tank	3	Rotary $50m^3$/.m 56kW*3sets
Equipment for the Aeration.Tank	1	Diffuser Type
Sedimentation Tank	1	61m3, 4m dia. 4m d RC
Return Sludge Pump	2	Volute, $0.2m^3$/m 0.2kW
Sludge Collector	1	Mechanical Rake
Dewatering Facilities	5	Belt Filter, 3m Width*5 sets
Chemical Dosing	1	Cation Polymer Tanks and Pumps
Control Building	1	8mW*18mL Steel Slated, 2 Stories

CASE STUDY F-20

Sai Gon Cigarette Factory

Survey Date: 9 December 1999

1. General

1.1 Profile

Sai Gon Cigarette Factory, established in 1929, is a member of the Viet Nam Tobacco Corporation (VINATABA) and has the biggest production capacity. The Company profile is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Sai Gon Cigarette Factory
Ownership:	State-owned
Address:	152 Tran Phu Str., Distr. 5, HCM City
Director:	Mr. Vuong Quang Thai (Vice Director)
Established:	1929
Corporate Capital:	
Number of Employees:	1,868
Main Products:	Cigarette

1.2 Business Status

1.2.1 Production

The Factory produces 22 kinds of cigarettes based on 16 recipes. Production and sales in 1998 are shown in Table 2.

Table 2 Production and Sales in 1998

Product	Production	Turnover
Cigarettes	858,119,000 pack	1,618 billion VND

2. Production Technology

2.1 Block Flow Diagram

Figure 1 shows the overall block flow diagram of the Factory. In order to solve an environmental problem caused by dust emission, the Factory implemented countermeasures step by step as follows:

1) Installation of centrifugal separators and cyclone separators in 1994;
2) Installation of bag-filters in 1996;
3) Installation of water spray type duct collectors in 1998.

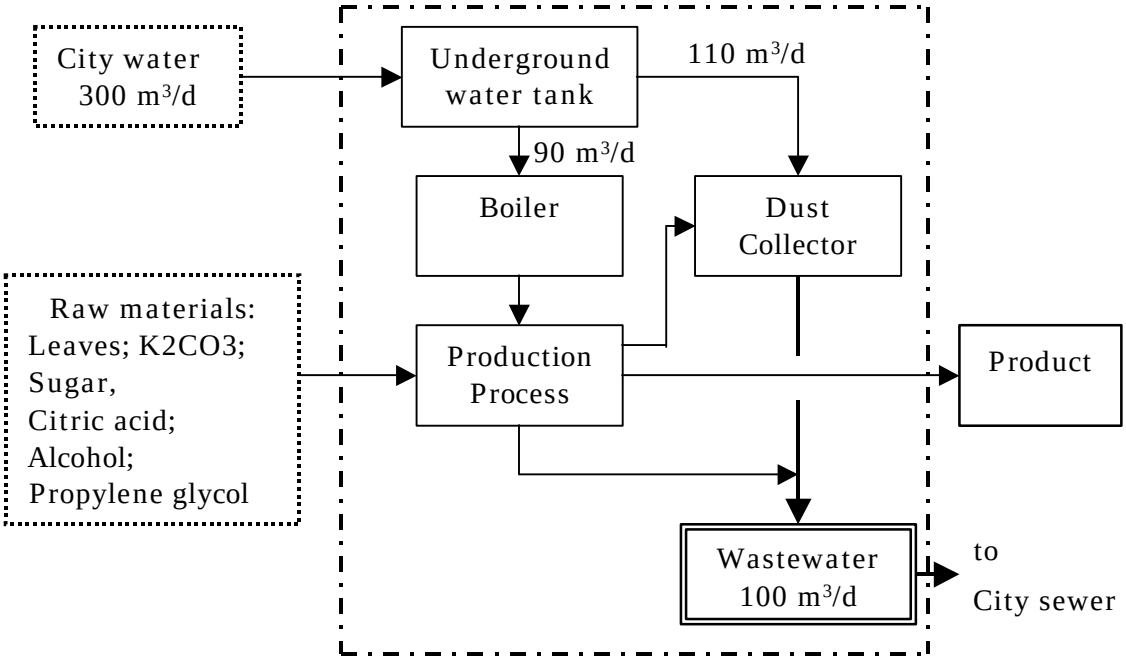


Figure 1 Overall Block Flow Diagram

2.2 Unit Consumption

Unit consumption and annual payment are calculated and shown in Table 3 based on the consumption of main raw materials and utilities.

3. Management Technology

Qualities of products and semi-finished products are checked every hour. The Factory provides every employee in the production department with a uniform with a section name. This could be an effective method to keep employee morale high.

Table 3 Unit Consumption and Payment in 1998

Material	Consumption per Day	Annual Consumption	Unit Consumption per 1,000 pack	Unit Price (VND)	Payment (million VND)
Leaves	42 t	15,861 t	18.483 kg	32	507,552
K_2CO_3	300 kg	91,200 kg	0.106 kg	7,800	2
Sugar	600 kg	193,000 kg	0.225 kg	6,000	1,158
Citric Acid	250 kg	73,000 kg	0.085 kg	13,000	949
Alcohol	300 kg	91,100 kg	0.106 kg	7,000	638
Propylene Glycol	80 kg	24,800 kg	0.029 kg	20,000	496
Water	300 m^3	95,000 m^3	0.111 m^3	2,700	257
Fuel Oil	4,600 kg	1,400,000 kg	1.631 kg	1,500	7,100
Electricity	32,000 kWh	9,540,000 kWh	11.12 kWh	880	8,395

4. Environmental Management

4.1 Industrial Wastewater Treatment and Discharge

The following four samples of wastewater were taken on 15 December 1999.

① A dust collector (water quality, however, does not represent normal conditions, due to a float-valve malfunction);

② A dust collector blow-down;

③ Final discharge (mixed with domestic wastewater);

④ Dust collector blow-down (gathered).

Table 4 shows the results of quality analysis of the samples mentioned above conducted by CECE.

4.2 Odor

One problem that the Factory believes needs to be solved is the odor that is emitted with air from the final dust collectors.

Table 4 Wastewater Quality

Item	Unit	Sample number and sampling time				TCVN 5945
		① 10:45	② 10:55	③ 11:04	④ 11:24	
Temperature	℃	45.4	36.7	30.6	29.6	40
pH	-	7.51	8.17	6.87	6.91	5.5-9
Electric Conductivity	μS/cm	620	230	300	170	
Turbidity	NTU	37	8	35	16	
Oil & Grease	mg/l	0.12	0.1	0.18	0.17	10
DO	mg/l	3.71	3.78	0.84	2.79	
SS	mg/l	159	38	148	64	100
COD	mg/l	640	208	272	290	100
BOD	mg/l	388	123	158	169	50
Total Nitrogen	mg/l	65	31.3	7.5	8.2	60
Residual Chlorine	mg/l	016	0.15	0.1	0.04	2

5. Comments

It is understood that Sai Gon Cigarette Factory has made its best effort to improve the working environment. In addition, it seems that the Factory has little problem with its industrial wastewater in terms of quality, as well as quantity.

It is recommended that the Factory continue to take action to maintain and improve the work environment as it has done in the past.

CASE STUDY F-21

Thuan Phuoc Seafoods and Trading Corporation

Survey Date: 16 December 1999

1. General

1.1 Profile

Thuan Phuoc Seafoods and Trading Corporation is a state-owned company established in 1987. The company profile is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Thuan Phuoc Seafoods and Trading Corporation
Ownership:	State-owned
Address:	20 Thanh Bo Street, Danang City
Tel / Fax:	511-822654/828118/821159/824783 FAX: 511-825872
Director:	Ms. Nguyen Thi Phi Anh (Managing Director)
Established:	1987
Corporate Capital:	1.4 million US$
Number of Employees:	600 (1,000 during a peak season)
Main Products:	Seafood

An expansion project is underway to increase the current production 2,000 t/year up to 3,000 t/year.

1.2 Business Status

1.2.1 Production

Table 2 shows production and sales of the Company in 1999 up to November. 60 % of the turnover comes from exporting products to Japan and the rest to EU.

Table 2 Production and Sales in 1999 up to November

Product	Production (kg)	Turnover (US$)
Shrimp	717,853	5,085,410
Fish	194,049	444,767
Cuttlefish	1,154,250	3,81,904
	108,918	300,677
Total	2,175,070	9,642,758

1.2.2 Debt

The corporation is in debt as follows:

Investment and Development Bank:	4,330 million VND
Agriculture Bank branch No. 3:	1,000 million VND
Department of Investment:	3,395 million VND

2. Production Technology

2.1 Process

The simplified block flow diagram is shown in Figure 1.

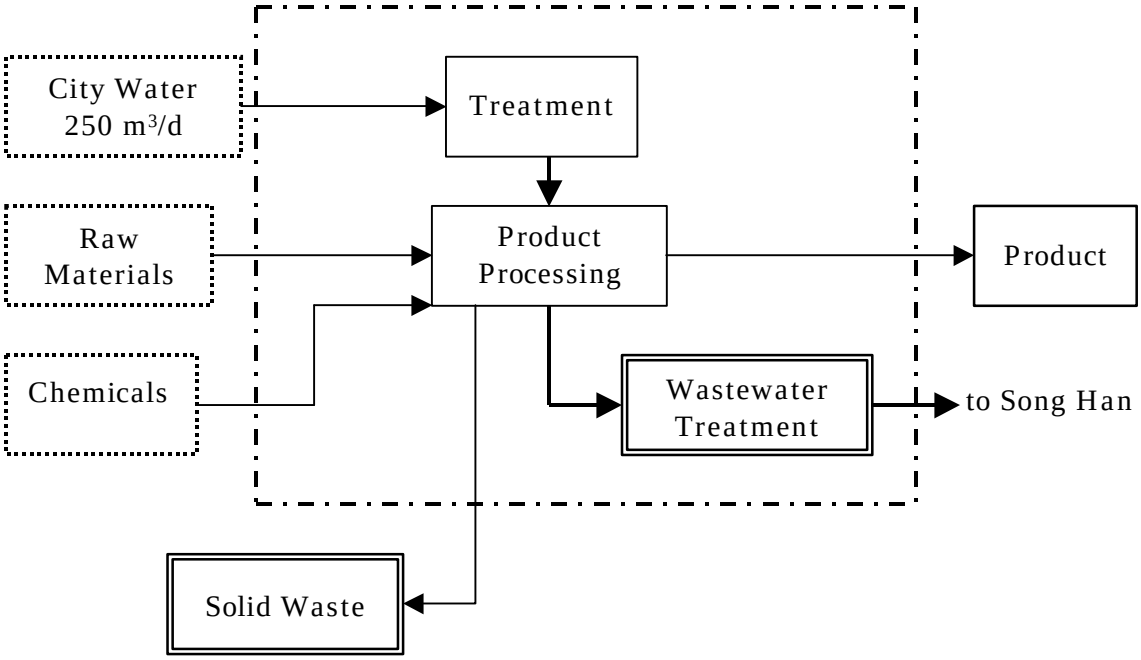


Figure 1 Block Flow Diagram of the Whole Factory

City water is treated before sent to the production line. Solid waste recovered in the processing section is sold everyday to a contractor as animal feed.

2.2 Raw Materials

Consumption of main materials in 1999 up to November is summarized in Table 3.

Table 3 Consumption of Raw Materials in 1999 up to November

Product	Material	Consumption (kg)	Payment (1,000 VND)
Frozen shrimp	Fresh shrimp $CaCl_2$ (5-7 ppm)	1,006,398.9	58,086,999
Frozen fish	Fresh fish $CaCl_2$ (5-7 ppm)	274,244.1	3,733,365
Frozen squid	Fresh squid $CaCl_2$ (5-7 ppm)	1,482,967.6	36,170,526
Others		41,863.4	1,090,003

2.3 Utilities

Utilities consumption in 1999 up to November is summarized in Table 4.

Table 4 Utility Consumption in 1999 up to November

Name	Consumption for Processing	Total Consumption	Unit Cost
City Water	89,000 m^3	97,756 m^3	3,000 VND/ m^3
Electricity	1,532,886 kWh	1,530,734 kWh	809 VND/kWh

3. Management Technology

The factory is carrying out quality control of its product based on GMP and HACCP.

4. Industrial Wastewater Treatment and Discharge

Wastewater from the production area is collected and sent to a treatment system composed of a settler and a two-stage multi layer filter. Treated wastewater is discharged into the river Han.

The wastewater treatment system was designed by the Consulting and Designing Construction Company under the Department of Construction, Danang City. In order to prevent odor generation, the wastewater treatment system is completely covered with concrete. Once every three months, the system is opened and sludge is to be removed.

Two wastewater samples were taken on 16 December 1999 at the discharge

point to the river Han at different time. Table 5 shows the results of quality analysis carried out by CECE.

Table 5 Wastewater Quality

Item	Unit	Sample number		TCVN 5945
		① 14:45	② 15:00	
Flow Rate	m^3/h			
Temperature	℃	19.8	19.7	40
PH	-	7.31	7.36	5.5-9
Electric Conductivity	μS/cm	1,540	1,430	
Turbidity		380	280	
Oil & Grease	mg/l	0.25	0.23	10
DO	mg/l	5.55	4.32	
SS	mg/l	824	730	100
COD	mg/l	570	600	100
BOD	mg/l	380	395	50
Total Nitrogen	mg/l	116.2	109.2	60
Residual Chlorine	mg/l	0.18	0.21	2

With regard to improving or adding wastewater treatment systems, the Factory has difficulties due to the following:

1) Shortage of finance because no bank provides loan for an investment that cannot make profit;
2) Lack of technology to prevent odor.

The Factory is seeking an appropriate and cheap technology to prevent odor generation.

5. Comments

The Factory is well organized and managed as proved by the introduction of GMP and HACCP. It is understood that the Factory is making every effort to maintain the international competitiveness.

Concerning wastewater treatment, the current system is functioning well in terms of odor prevention. The study team is to review the system and suggest simple and possible countermeasures for improvement without big invest requirement.