Japan International Cooperation Agency

No.

Ministry of Industry

The Socialist Republic of Viet Nam

Final Report – Case Study on the Master Plan Study for Industrial Pollution Prevention in Viet Nam (Wastewater)

September 2000

International Center for Environmental Technology Transfer
Mitsubishi Chemical Engineering Corporation

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Contents

Chapter 1 Textile & Garment Sub-sector

1.1 Detailed Enterprise Study

1.2 Simplified Enterprise Study

CASE STUDY T-01

Phong Phu Textile Company

Survey Date: 1 December 1999
24 & 25 February 2000

1. General

1.1 Profile

Phong Phu Textile Company is a state-owned company that was established in 1965 as a textile manufacturing company. The company profile and organization of Phong Phu Textile Company are summarized in Table 1 and Figure 1.

Table 1 Enterprise Profile

Name of Company:	Phong Phu Textile Company
Ownership:	State-owned
Address:	District 9 Hochiminh City
Tel:	08-8963533/34/35
Director:	
Established:	1965
Corporate Capital:	
Number of Employees:	3,500
Main Products:	Yarns, Fabrics, Towels, Garments

1.2 Business Status

1.2.1 Production

Table 2 shows production and sales of the Company in 1998.
40 % of products are exported to the EU(Garment) and Japan(Towel.)

Table 2 Production and Sales in 1998

No.	Products	Production	Turnover
1	Fabric	9,361,000 m	227 billion VND
2	Towel	37,328,000 pcs	145.7 billion VND
3	Yarn	6,992,000 kg	84.2 billion VND
4	Garment	1,248,000 pcs	26.3 billion VND
5	Others		11.8 billion VND
	Total		495 billion VND

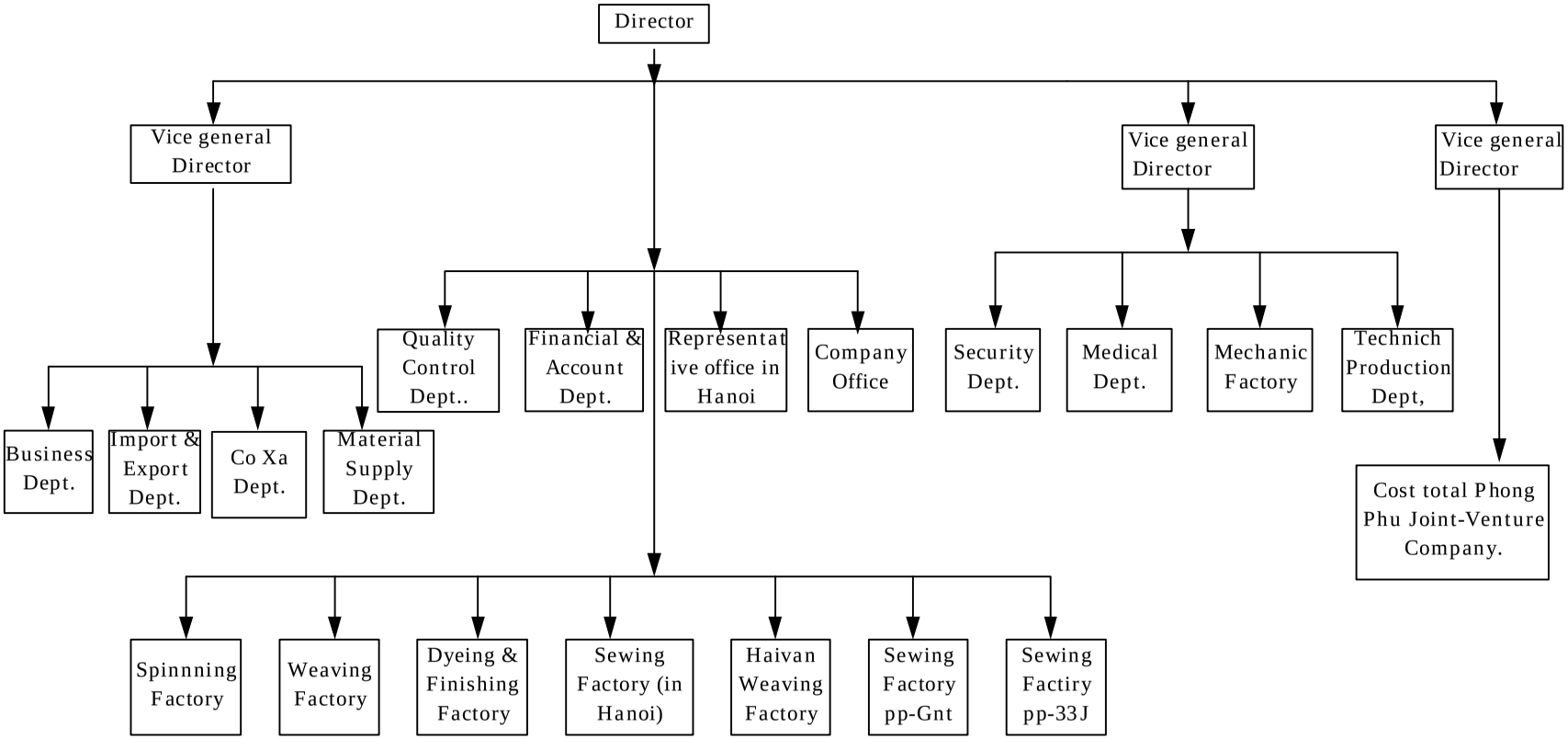

Figure 1 Organization of the Phong Phu Textile Company

1.2.2 Debt

Unknown

2. Production Technology

2.1 Process

Figures 2 and 3 show a simplified block flow diagram of the factory and a block flow diagram of the dyeing process, respectively.

Table 3 shows the operating condition of the dyeing process.

2.2 Future Plan

(1) Installation of a wastewater treatment plant; and
(2) Acquisition of ISO9002 certification.

3. Management Technology

3.1 Unit Consumption of Raw Material and Utilities

Table-4 shows the unit consumption of raw materials and utilities of the factory.

Table-4 Unit Consumption

No	Materials	Unit Consumption	Cost	Consumption/year
1	Fabric	1000 m		9,361million meter
2	Towel	1000 kg		2,400 t
3	Dye stuff			
	Fabrics (Indigo, Sulfur)	7 kg (2 %)		30 t
	Towel (Hoat Tinh)	1.5 kg (0.15 %)		3.6 t
4	Chemicals			
	a. Soda, H_2O_2			
	b.			120 t
5	Water			1,260,000 m^3
6	F.O.		1,495 VND/kg	4,500 t
7	Electricity		775 VND/kWh	24,000,000 kWh

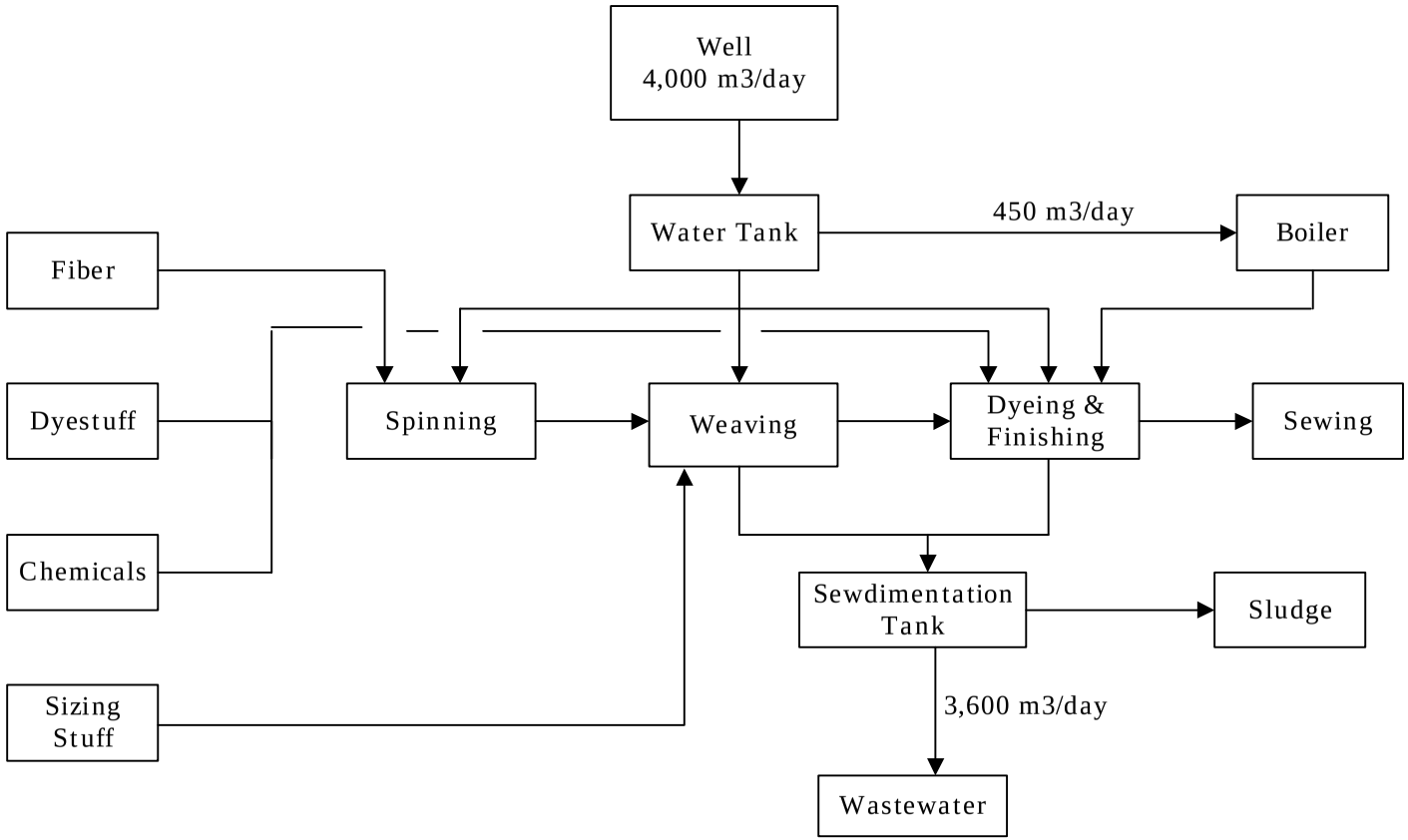

Figure 2 Simplified Block Flow Diagram

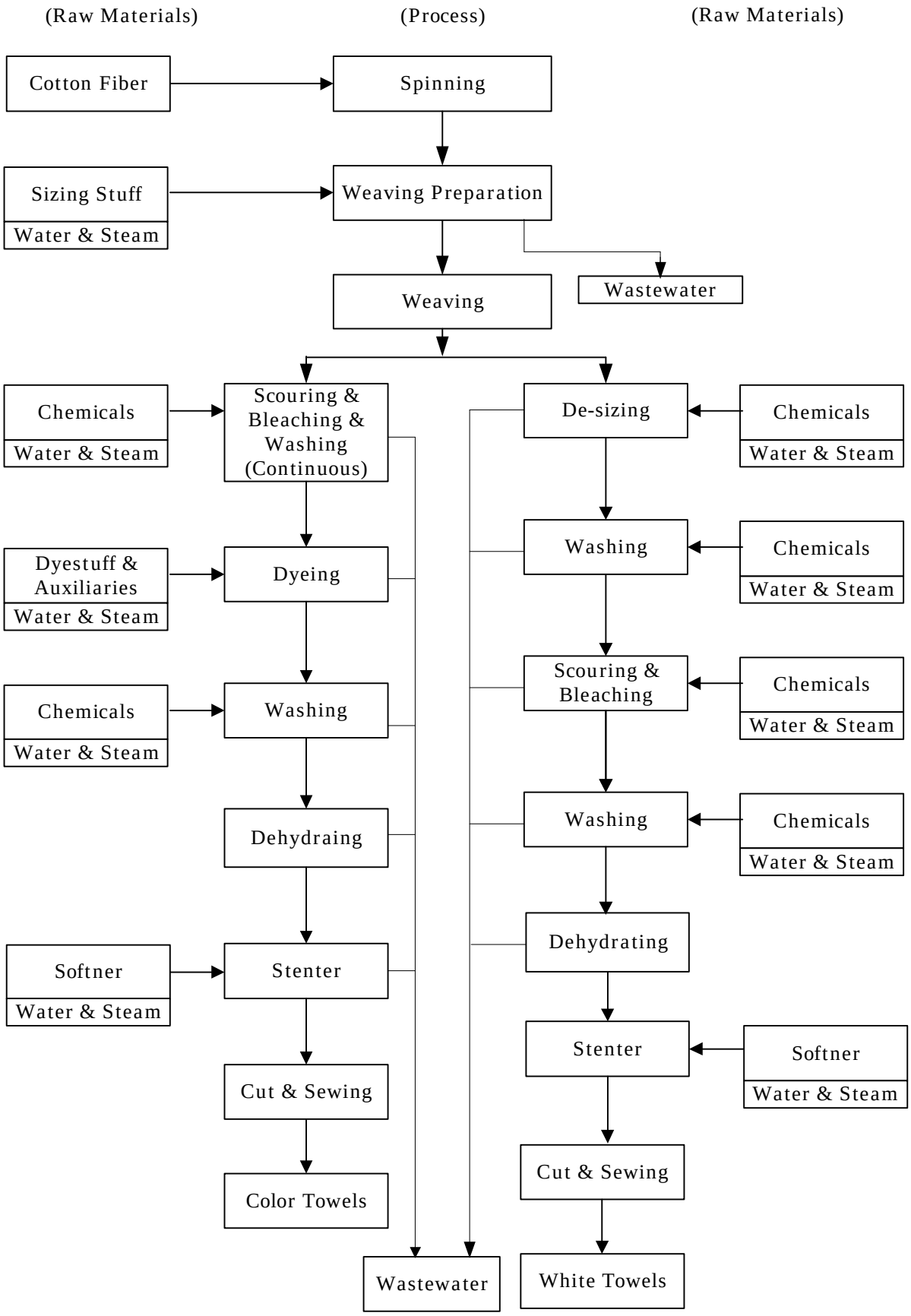

Figure 3 Process Flow Diagram

Table 3 Operating Condition of the Dyeing Process

(1) White Towel (Batch Process)			
M/C: Wince Type			
Fabric :270 kg			
Liquid Ratio:1:12			
Step	Chemicals	Temperature	Retention Time
De-sizing		90 ℃	45 min.
Scouring + Bleaching		100 ℃	100 min.
Hot Rinse		100 ℃	40 min.x3
Hot Rinse		80 ℃	30 min.
Cold Rinse		40 ℃	40 min.
Optical Bleaching		50 ℃	50 min.
Cold Rinse		30 ℃	20 min.
(2) Color Towel (Continuous + Batch Process)			
(2)-1 Continuous Scouring & Bleaching Process			
Speed:15 m/min			
Step	Chemicals	Temperature	Retention Time
Scouring Dipping		80 ℃	
Steaming		100 ℃	45 – 60 min.
Bleaching Steaming		100 ℃	60 min.
Washing		100 ℃	
(2)-2 Batch Dyeing Process			
M/C: Overflow Type			
Fabric:270 kg			
Liquid Ratio:1:12			
Step	Chemicals	Temperature	Retention Time
Hot Rinse		50 ℃	40 min.
Cold Rinse		30 ℃	20 min.
Dye		60 ℃	180 min.
Cold Rinse		30 ℃	30 min.
Washing		40 ℃	35 min.
Hot Rinse		60 ℃	70 min.
Cold Rinse		30 ℃	30 min.
(3) Cotton Fabric (after Sigeing)			
M/C: Jigger			
Fabric:250kg			
Liquid Ratio:1/3			
Step	Chemicals	Temperature	Retention Time
Scaming		98 ℃	200 min.
Hot Rinsing		50 ℃	60 min.
Cold Rinsing		30 ℃	20 min.
Mercerizing		30 ℃	140 min.
Hot Rinsing		30 ℃	60 min.
Cold Rinsing		30 ℃	20 min.
Bleaching		98 ℃	180 min.
Hot Rinsing		98 ℃	80 min.
Cold Rinsing		30 ℃	20 min.
Dyeing		60 ℃	230 min.
Cold Rinsing		30 ℃	30 min.
Fixing		40 ℃	30 min.
Cold Rinsing		30 ℃	15 min.
Washing		60 ℃	30 min.

4. Industrial Wastewater Treatment and Discharge

(1) Outline

1. The plant discharges a lot of wastewater at a volume of 3,600m^3/day, and its contamination is striking. PH, BOD and COD are in excess of the environmental standards of Vietnam.
2. Wastewater treatment is only done by sedimentation of SS in the sedimentation tank.
3. However, this treatment has no effect on the wastewater because the tank volume is too small to discharge volume.

(2) Sampling Points of the Field Study on December 1999

Wastewater samples were taken at the following spots for analysis in this study. Date: 1 December 1999

S1： At Scouring m/c(wash water of the #1tank)
S2： At Scouring m/c(wash water of the #4 tank)
S3： At Bleaching m/c(wash water after bleaching)
S4： At Wince dying m/c (wash water after dying)
S5： At Jet dying m/c (wash water after dying)
S6： Wastewater from the dying factory
S7： Discharged wastewater from whole factory (to city sewage)

(3) Results of Wastewater Analysis in December 1999

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table 5.

(4) Sampling Points in February 2000

Wastewater samples were taken at the following spots for analysis during this study. Date: 28 February 2000

S1：Composite sampling at the outlet of the dyeing factory (21samples mixing)
Sampling time: Taken every 15 minutes from 9:00 to 15:00
S2：At Wince dyeing m/c(after 1st cold rinse) Sampling time:9:45
S3 : At Wince dyeing m/c(after dyeing1st cold rinse) Sampling time:11:48
S4 : At Wince dyeing m/c(after 2nd cold rinse) Sampling time:11:55
S5 : At Wince dyeing m/c(after 3rd cold rinse) Sampling time:12:20

S6: At Wince dyeing m/c(after washing) Sampling time:12:30

S7: At Wince dyeing m/c(after fixing) Sampling time:13:15

S8: At Wince dyeing m/c(after 4th cold rinse) Sampling time:13:45

S9: At Wince dyeing m/c(after 5th cold rinse) Sampling time:13:50

Table 5 Wastewater Quality in December 1999

	Unit	S1	S2	S3	S4	S5	S6	S7
Temperature	℃		61.5		31.9	33	47	44.4
pH		12.98	9.5	8.16	6.6	11.48	11.46	11.4
Elec. Conductivity	μS/cm	9900	120	80	10	1190	350	11420
Turbidity	NTU	398	98	111	265		338	220
Oil Content	mg/l	191	12	42	Not det	7	24	33
BOD	mg/l	44	13	38	1	8	90	91
COD	mg/l	6568	198	321	10	75	487	608
DO	mg/l	5.5	1.7	1.5	10.5	13.8	11.6	
SS	mg/l	360	32	14	0	7	20	30
Total Nitrogen	mg/l	31.4	2.1	3.1	0.3	1.5	9.2	9.3
Residual Chlorine	mg/l	Not det	Not det	Not det	Not det	Not det	Not det	Not det
SO_4	mg/l	60	6	7	7	11200	132	97
Cyanogen	mg/l							0.05

(5) Results of Wastewater Analysis in February 2000

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table 6.

Table 6 Wastewater Quality in February 2000

	Unit	S1	S2	S3	S4	S5	S6	S7	S8	S9
Temperature	℃	32.8	29.3	75.2	42.5	32.9	30.2	29.1	28.9	29.5
pH		11.36	9.3	10.1	10.46	9.26		6.34	5.5	6.21
Elec. Conductivity	μs/cm	5360	220	1000	8420	3060	660	300	160	230
Turbidity	NTU	116	2	15	9	6	3	5	0	1
Oil Content	mg/l	10.66	7.8	6.4	7.93	5.33	0.8	3.57	0.92	1.55
BOD	mg/l	384	22	24	14	7	3	7	0	3
COD	mg/l	844	38	152	38	10	9	32	2	8
DO	mg/l	7.7	7.7	7.6	7.7	7.5	7.6	7.6	7.6	7.6
SS	mg/l	60	1	13	9	5	1	3	1	2
All Nitrogen	mg/l	22.5	0.8	3.3	1.2	0.3	0.8	9.1	0	0
Residual Chlorine	mg/l	Not det	Not det	Not det	Not det	Not det	Not det	Not det	Not det	Not det
SO4	mg/l	295	5	349	328	409	170	16	6	13
Cyanogen	mg/l									

5. Countermeasures for Improvement

5.1 Countermeasures for Production Technology Improvement

(1) Current Problems

a. Czech-made rotor type spinning machines have problems with quality.

b. Steam and water leakage from the pipe line is conspicuous.

c. Some dyeing machines(Wince type) are superannuated and corroded.

d. No countermeasures for energy saving have been adopted, except for recovery of steam condensation.

e. The liquid ratio of liquid flow type machines is high at 1:10～1:12.

(2) Countermeasures

a. Czech-made spinning machines should be improved.

b. Steam and water pipe lines should be repaired.

c. Some superannuated dyeing machines (Wince Type) should be renewed and converted into the low liquid ratio type machines.

d. Countermeasures for energy saving such as recovery of cooling water and heat recovery from the wastewater should be adopted.

5.2 Countermeasures for Management Technology Improvement

(1) Current Problems

a. The inside and outside of the dyeing plant are in disorder.
b. Standardization of operations and operation manual construction and utilization are inefficient.
c. Cost management measures, such as calculating unit consumption of the raw materials and energy, are hardly carried out.
d. The maintenance of facilities is inefficient.

(2) Countermeasures

a. The "5S Movement" should be executed.
b. Standardization of operation is very important. Operation manuals should be prepared and placed in a position where operators can see them easily.
c. ISO9000 series should be introduced.
d. Unit consumption analysis and promotion of cost reduction program should be executed.
e. As a first step, the total consumption of water and steam should be grasped.
f. The maintenance function should be reinforced.

5.3 Countermeasures for Wastewater Treatment

They should install the following wastewater treatment system to improve the quality of the wastewater of the factory to within Vietnam standards.

(1) Outline of the Wastewater Treatment System

a) Volume of wastewater: 3,600m^3/day;
b) Production capacity: 100,000**m**/day (Dyeing fabric);
c) Treatment Methods: Activated sludge process & Coagulating Sedimentation;
d) Investment Cost: 8,170,000,000 VND

(2) Flow Diagram of the Wastewater Treatment System

Figure 4 shows the flow diagram of the wastewater treatment system.

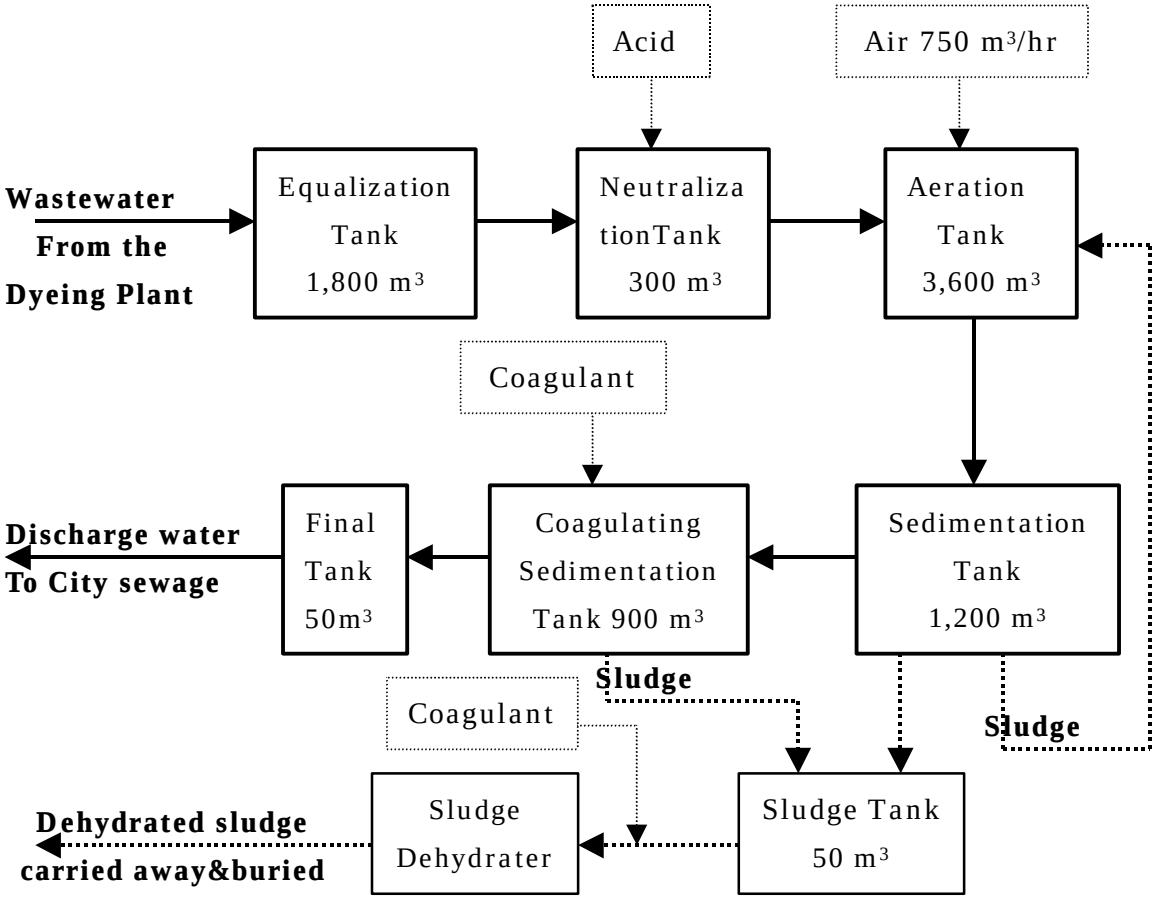

Figure 4 Flow diagram of wastewater treatment system

(3) Investment Cost

Table 7 shows the investment cost.

Table 7 Required Investment Cost of the Wastewater Treatment System

Items	Unit	Quanti ty	Unit price VND	Expenses VND
Equalization tank	m³	1,800	700,000	1,260,000,000
pH neutralization tank	m³	300	700,000	210,000,000
Aeration tank	m³	3,600	700,000	2,520,000,000
Sedimentation tank	m³	1,200	850,000	840,000,000
Coagulation tank	m³	900	850,000	765,000,000
Final tank	m³	50	700,000	35,000,000
Sludge tank	m³	50	700,000	35,000,000
Sewerage: 500 x 600	m³	150	300,000	45,000,000

Sub Total 1(Construction)				**5,710,000,000**
Wastewater Pump	piece	4	10,000,000	40,000,000
Aerator; capacity 150 m^3/h	piece	5	30,000,000	150,000,000
pH meter and metering pump	set	1	40,000,000	40,000,000
Agitator; capacity: 2 HP	piece	4	7,500,000	30,000,000
Acid mixture apparatus	set	1	200,000,000	200,000,000
Coagulant mixture apparatus	set	2	200,000,000	400,000,000
Sludge dehydrating machine	set	1	800,000,000	800,000,000
Electricity	set	1	200,000,000	200,000,000
Pipeline and accessories	set	1	300,000,000	300,000,000
Other equipment				300,000,000
Sub Total 2(Equipment)				**2,460,000,000**
Grand Total				**8,170,000,000**

6. Recommended Countermeasure for Improvement

6.1 Short Term Countermeasures

No	Countermeasure	Expected Results
1	Repair of the steam & water pipes	Energy savings and, improvement of the working environment
2	Installation of flow meters for water and steam	Grasp of unit consumption (Cost reduction)
3	Installation of a cooling water recovery system	Energy savings
4	Installation of a heat recovery system from the waste water	Energy savings
5	Standardization of operations	Improvement of product quality and cost reduction
6	Reinforcement of the maintenance function	Increase in equipment capacity, productivity and product quality
7	Execution of the "5S Movement"	Elimination of waste-fullness, increased worker morale, improvement in product quality and a gain in customer's trust.

6.2 Mid and Long Term Countermeasures

No	Countermeasure	Expected Results
1	Installation of a wastewater treatment system	Improvement of wastewater quality
2	Modernization of the Color Kitchen	Improvement of the accuracy of scaling, prevention of contamination and improvement of the working environment
3	Replacement of old wince type dyeing machines with liquid flow type ones that have a low liquid ratio	Reduction in the wastewater volume, reduction of chemical consumption, improvement of productivity and increased possibility of producing high value-added products
4	Acquisition of ISO9000 series certification	Improvement of product quality and cost reduction
5	Introduction of cost reduction programs	Cost reduction
6	Introduction of new dyeing technologies such as the Rapid Dyeing Method	Energy savings, reduction of chemical consumption and improvement of wastewater quality

7. Proposed Implementation Schedule

The proposed implementation schedule is shown in Figure 5.

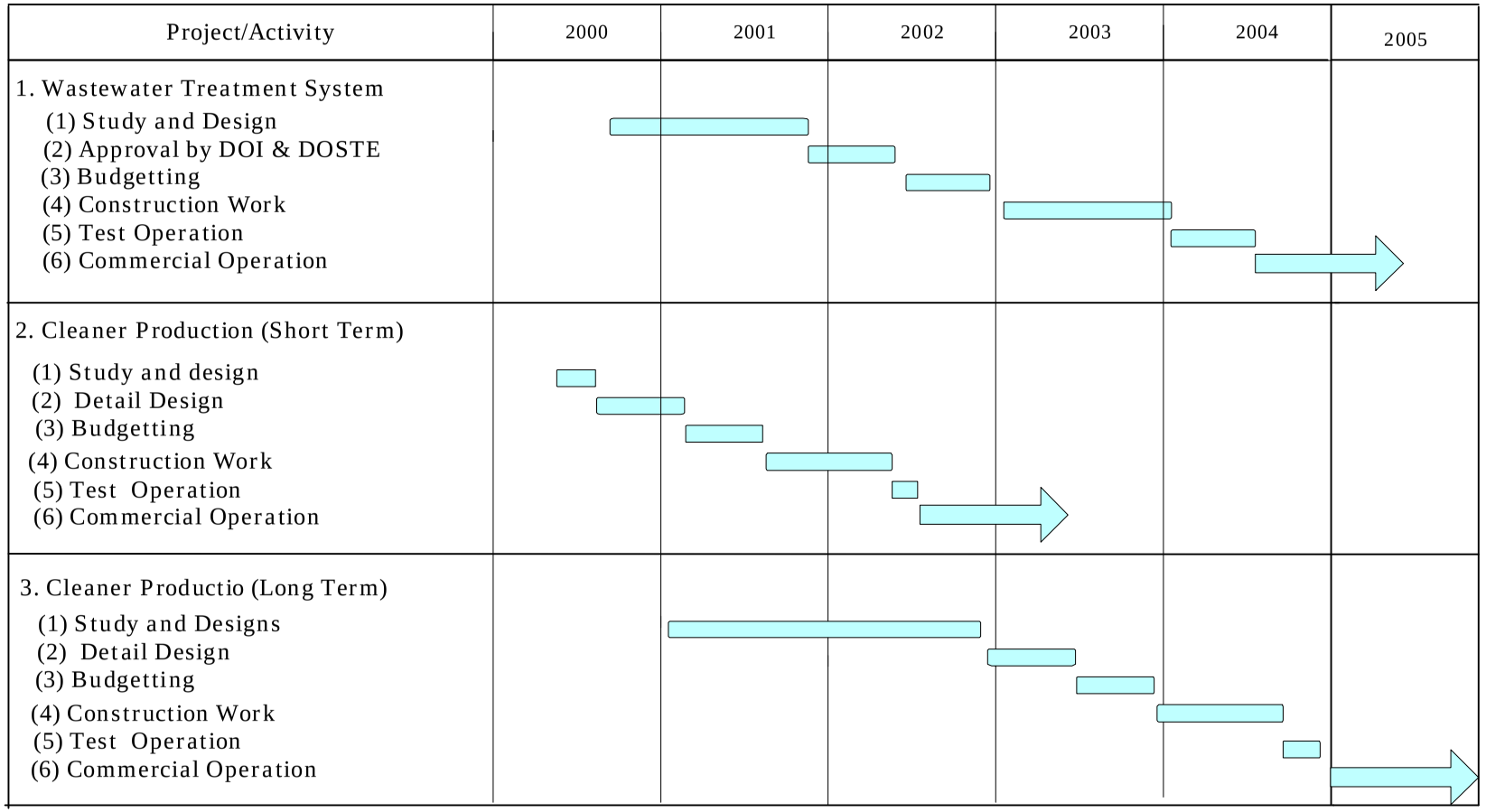

Figure 5 Proposed Implementation Schedule for Pollution Prevention Countermeasure

CASE STUDY T-02

Dong Phuong Knitting Company

Survey Date: 8 December 1999
28 & 29 February 2000

1. General

1.1 Profile

Dong Phuong Knitting Company is a state-owned company that was established in 1972 as a textile manufacturing company. The company profile and organization of Dong Phuong Knitting Company are summarized in Table 1 and Figure 1.

Table 1 Enterprise Profile

Name of Company:	Dong Phuong Knitting Company
Ownership:	State-owned
Address:	10 AU CO ST., Ward 17, Tan Binh District, Hochiminh City
Tel:	08-8101802
Director:	
Established:	1972
Corporate Capital:	
Number of Employees:	480
Main Products:	Knitting Fabrics & Knitting Garments

1.2 Business Status

1.2.1 Production

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

50～60% of their products are exported to Germany, Czech, France, Portugal, Korea, USA and Japan.

Table 2 Production and Sales in 1998

No.	Products	Production	Turnover
1	Warp Knitting Fabric (for Internal Production)	1,573,000 m^2	7,512 million VND
	(for Customer Supply)	578,000 m^2	
2	Circular Knitting Fabric (for Internal Production)	281,000 m^2	13,337 million VND
	(for Customer Supply)	117,000 m^2	
3	Garments	726,000 pcs	17,951 million VND
4	Others		131 million VND
	Total		38,931 million VND

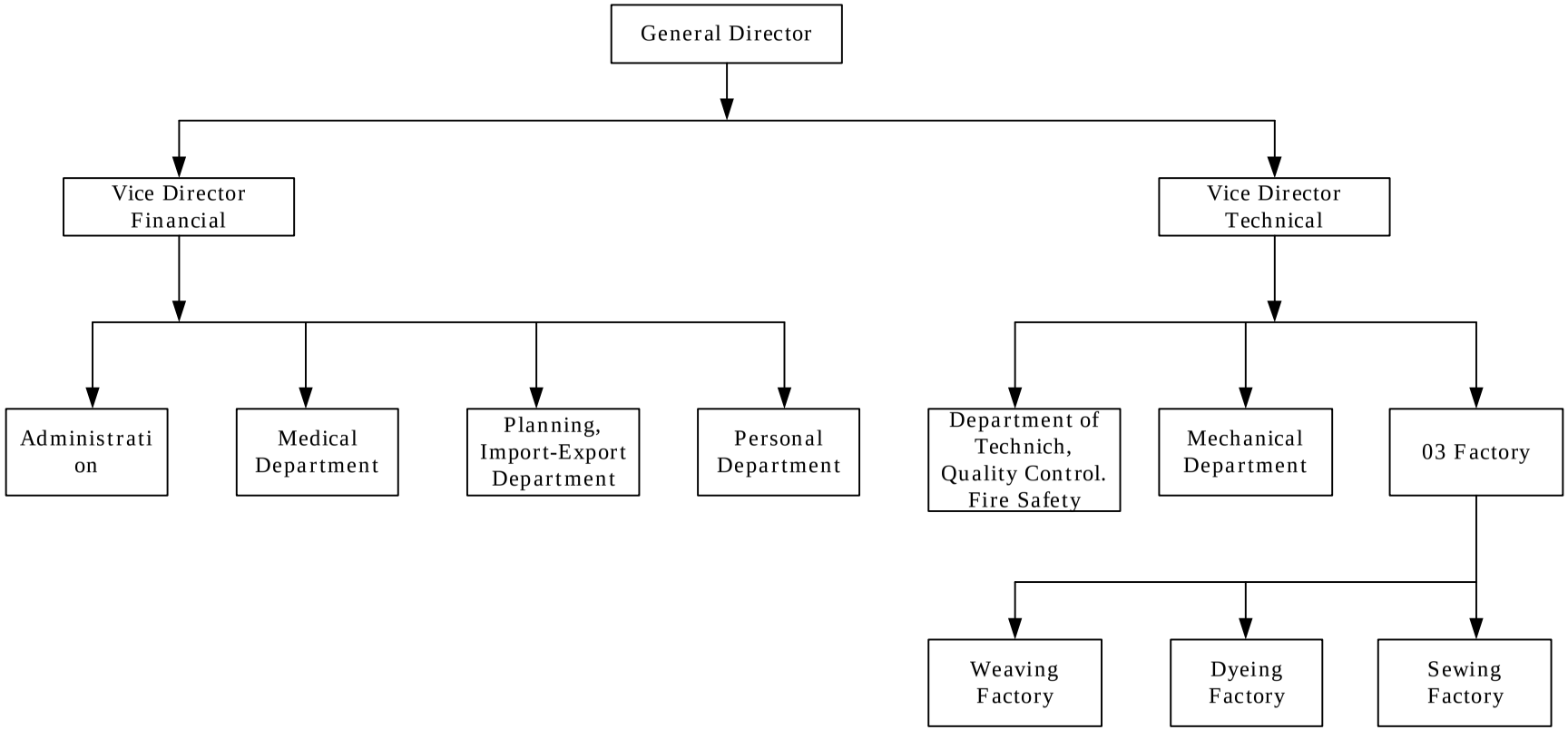

Figure 1 Organization of Dong Phuong Knitting Company

1.2.2 Debt

(1) Vay TTCN GDI; 7,937 million VND

(2) Vay 1,700 million VND

2. Production Technology

2.1 Process

Figures-2 and 3 show a simplified block flow diagram of the factory and a block flow diagram of the dyeing process.

Table 3 shows the operating condition of the dyeing process.

Table 3 Operating Condition of the Dyeing Process

(1) Polyester/Cotton			
M/C:Jet Type			
Fabric:270 kg			
Liquid Ratio:1/10			
Step	Chemicals	Temperature	Retention Time
Scouring		98 ℃	60 min.
Rinsing			30 min.
Bleaching(H_2O_2)		98 ℃	60 min.
Rinsing			30 min.
Dyeing of PES		130 ℃	30-60 min.
Rinsing			30 min.
Reduction		80 ℃	20 min.
Rinsing			30 min.
Dyeing of Cotton		60-80 ℃	60 min.
Rinsing			30 min.
(2) Cotton			
M/C: Over Flow Type			
Fabric:270 kg			
Liquid Ratio:1/10			
Step	Chemicals	Temperature	Retenrion Time
Scouring		98 ℃	60 min.
Rinsing		80 ℃	20 min.
Bleaching		98 ℃	60 min.
Rinsing		80 ℃	20 min.
Neutralizing		80 ℃	20 min.
Rinsing		98 ℃	30 min.
Dyeing		60-80 ℃	30-60 min.
Rinsing/Soaping		60 ℃	10 min.
Neutralizing		60 ℃	20 min.
Washing		98 ℃	30 min.
Fixing		50 ℃	30 min.

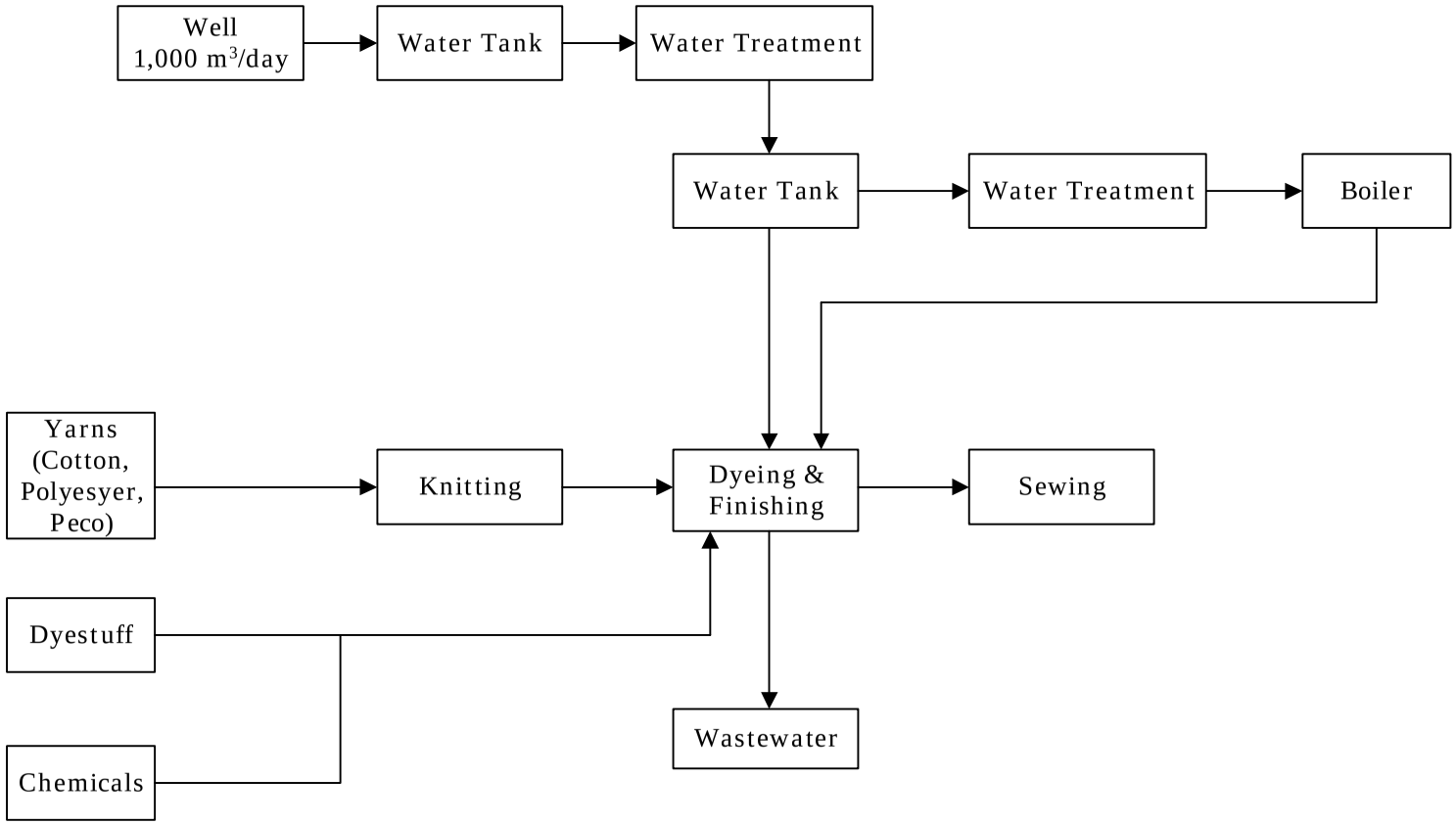

Figure 2 Simplified Block Flow Diagram

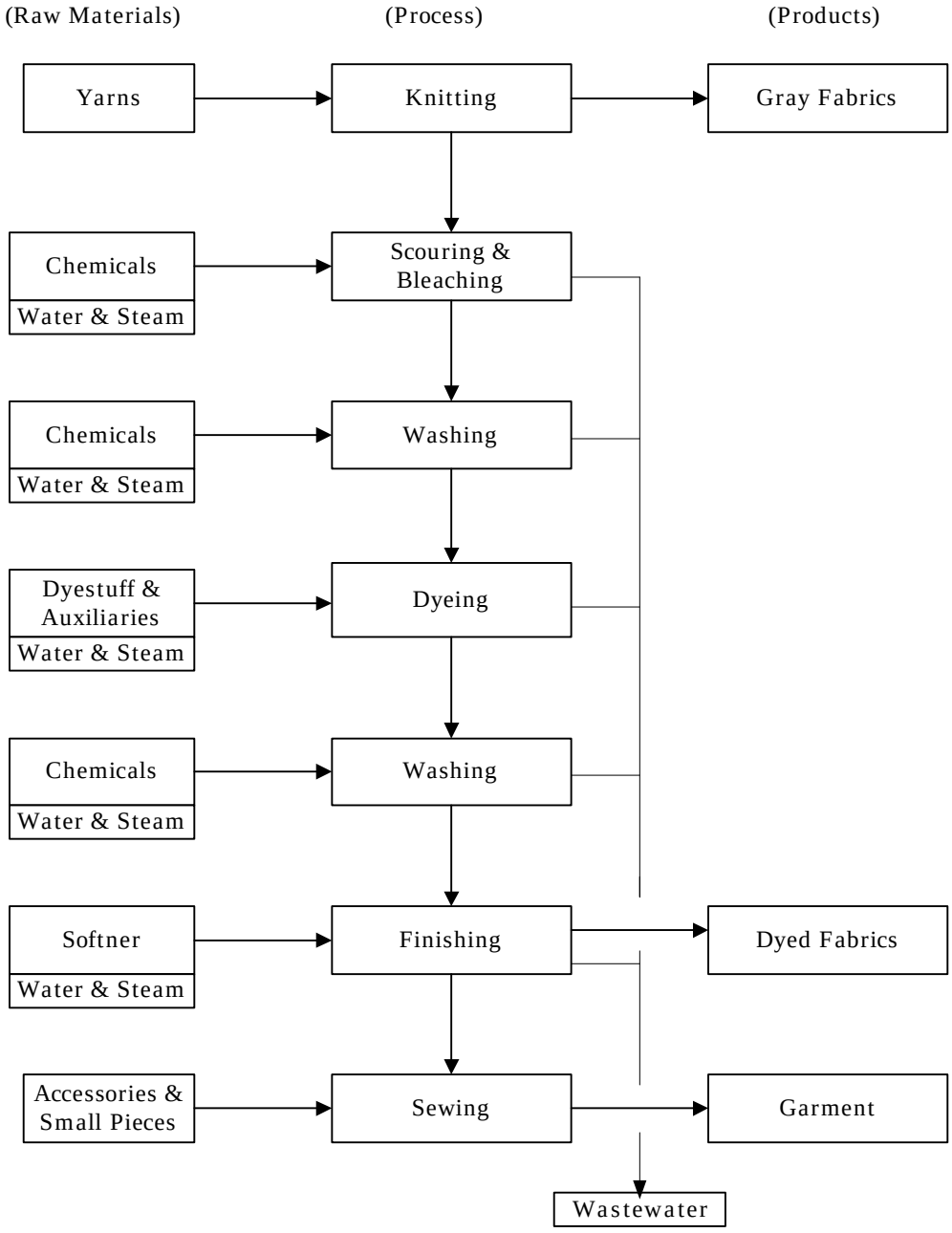

Figure 3 Process Flow Diagram

2.2 Future Plans

(1) Installation of a wastewater treatment system;

(2) Acquisition of ISO9002 certification;

3. Industrial Wastewater Treatment and Discharge

(1) Outline

1. No wastewater treatment system has been installed. Wastewater from the factory is discharged to the sewage directly.
2. PH, BOD, COD and SS are in excess of the environmental standards of Vietnam, and the introduction of a treatment system is indispensable to improving the wastewater water quality of the factory.
3. Wastewater volume is 500m^3/day.

(2) Sampling Points in December 1999:

Wastewater samples were taken at the following spots for analysis in this study.

Date: 8 December 1999

S1: At Jet dying m/c (wash water after dying)
S2: Discharged wastewater from the whole factory (to city sewage)
S3: Supply water from the well（under ground）
S4: Dying factory supply water after treatment
S5: At Wince dying m/c (wash water after bleaching)

(3) Results of Wastewater Analysis in December 1999

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table 4.

(4) Sampling Points in March 2000

Wastewater samples were taken at the following spots for analysis in this study.

Date: 1 March 2000

S1: At Overflow dyeing m/c #3(after scouring) Sampling time:13:33
S2: At Overflow dyeing m/c#3(after 1st cold rinse) Sampling time:13:45
S3: At Overflow dyeing m/c#3(after bleaching) Sampling time:15:07
S4: At Overflow dyeing m/c#3(after 2nd cold rinse) Sampling time:10:15
S5: At Overflow dyeing m/c#2(after dyeing) Sampling time:11:36
S6: At Overflow dyeing m/c#1(after neutralizing) Sampling time:10:20
S7: At Overflow dyeing m/c#1(after washing) Sampling time:11:26
S8: At Overflow dyeing m/c#1(after fixing) Sampling time:12:50
S9: At Overflow dyeing m/c#4(after 2nd bleaching) Sampling time:11:15

Table 4 Wastewater Quality in December 1999

	Unit	S1	S2	S3	S4	S5
Temperature	℃	60	34.4	29.2	28.9	94
pH		8.52	6.23	4.53	4.73	10.8
Electric Conductivity	μS/cm	800	514	460	410	230
Turbidity	NTU	9	1	3	0	106
Oil content	mg/l	Not det	4.7	Not det	Not det	16
BOD	mg/l	29	4	1	0	105
COD	mg/l	153	16	4	3	600
DO	mg/l	0.87	3.43	5.71	6.88	0.56
SS	mg/l	12	5	0	0	125
Total Nitrogen	mg/l	12	2.08	2.18	1.18	19.8
Residual Chlorine	mg/l	Not det	2.73	Not det	Not det	12.6
SO_4	mg/l	22	48	12	10	46
Cyanogen	mg/l					

(5) Results of Wastewater Analysis in March 2000

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table 5.

Table 5 Wastewater Quality in March 2000

	Unit	S1	S2	S3	S4	S5	S6	S7	S8	S9
Temperature	℃	60	36.6	60	31.4	53.3	30.2	66	41	41
PH		10.15	10.74	10.36	3.78	10.3	3.76	8.16	5.53	6.64
Elec. Conductivity	μS/cm	18300	1700	3800	510	22460	450	750	900	510
Turbidity	NTU									
Oil content	mg/l	62.2	26.6	37.8	0.9	4.6	0.6	15	2.2	1.6
BOD	mg/l	3525	438	600	8	300	4	290	20	23
COD	mg/l	6411	553	1206	23	1131	15	754	60	45
DO	mg/l	1.16	5.09			5.27	4.99	1.53		4.72
SS	mg/l	142	23	100	1	9	3	21	1	4
Total Nitrogen	mg/l	0.8	12	25	1.8	6.7	2.2	27.8	13.9	1.3
Residual Chlorine	mg/l	Ndtcd	Ndtcd		Ndtcd	Ndtcd	Ndtcd	Ndtcd	Ndtcd	Ndtcd
SO_4	mg/l	40	9	28	5	11730	17	10	48	7
Cyanogen	mg/l									

(6) Wastewater Treatment Facility Study

The results examined by Dong Phuong Knitting Co. in 1998 are as follows.

1) Design condition

①Production	Mosquito net :	6,560,000 m/year
	Knitting fabric	300 t/year
	T shirts	300,000 pcs/year
	Polo shirts	100,000 pcs/year
②Wastewater Volume		1,000 m^3/day
③Wastewater quality		
Temperature	45 ℃	
PH	5.2～5.6	
BOD	289 mg/l	
COD	515 mg/l	
SS	45 mg/l	
Color	160	
④Setting Area	638 m^2（23.3 m x 25 m）	

2) Investment cost （Currency Unit: French Franc）

Table 6 shows the investment cost of a wastewater treatment facility.

Table 6 Investment Cost of a Wastewater Treatment Facility

Item	Cost (FF)	%
Equipment	2,060,800	67%
Construction	676,800	22%
Transfer Technology	185,600	6%
Assembling & Operation	137,600	4.5%
Others	16,000	0.5%
Total	**3,076,800**	**100%**

4. Countermeasures for Improvement

4.1 Countermeasures for Production Technology Improvement

(1) Current Problems

a. Warp knitting machines are old and the tension adjustment does not work well. Accordingly, there is unevenness.

b. Liquid ratio is high, at 1:10～1:12, for the liquid flow type machines.
c. Facilities of the laboratory and the system of the color kitchen are not properly prepared.
d. No countermeasures for energy saving have been adopted including recovery of steam condensate.
e. The quality of supply water is at very low level.

(2) Countermeasures

a. Low liquid ratio dyeing machines (as 1:6) should be introduced if there is a chance to increase or renew machines.
b. Countermeasures for energy saving, such as recovery of steam condensate, recovery of cooling water and heat recovery from the wastewater should be adopted.
c. A supply water treatment system should be installed.
d. More proper facilities in the laboratory should be prepared.
e. The color kitchen system should be modernized.

4.2 Countermeasures for Management Technology Improvement

(1) Current Problems

a. The color kitchen and outside of the dyeing plant are in disorder.
b. Standardization of operations and operation manual construction and utilization are inefficient.
c. Cost management, such as calculating unit consumption of the raw materials and energy, is hardly carried out.
d. The maintenance of facilities is inefficient.

(2) Countermeasures

a. The “5S Movement” should be executed.
b. Analysis of unit consumption and promotion of cost reduction program should be executed.
c. As a first step, the company should grasp the amount of water and steam consumed.
d. ISO9000 series should be introduced.
e. Maintenance function should be reinforced.

4.3 Countermeasures for Wastewater Treatment

They should install the following wastewater treatment system in order to improve the quality of the wastewater of the factory to satisfy the Vietnamese standards.

(1) Outline of the Wastewater Treatment System

a) Volume of wastewater.： 1,000 m^3/day

b) Production capacity： 30,000 m/day (Dyeing fabric)

c) Treatment Methods：Activated sludge process & Coagulating Sedimentation

d) Investment Cost： 3,344,000,000 VND

(2) Flow Diagram of the Wastewater Treatment System

Figure 4 shows the flow diagram of the wastewater treatment system.

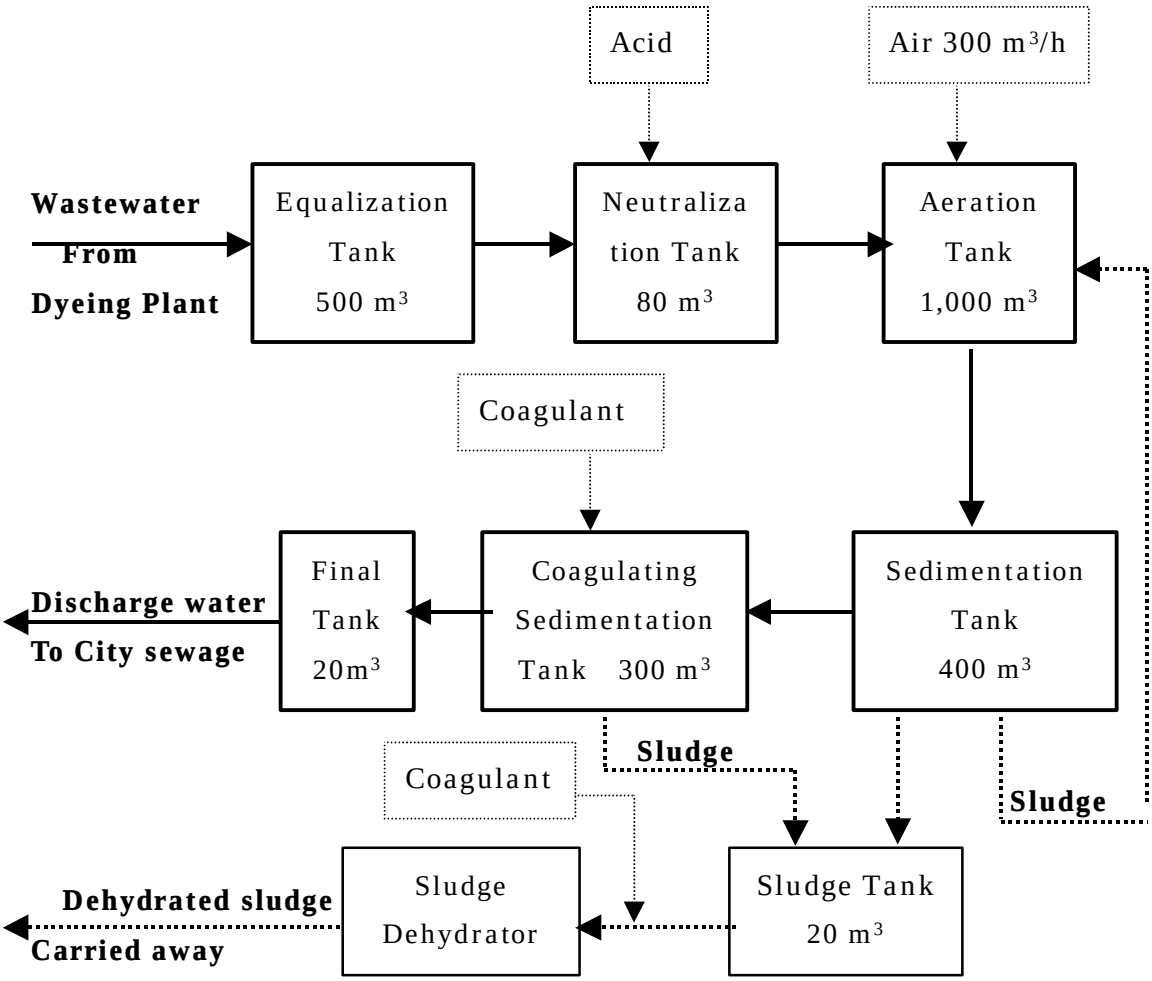

Figure 4 Flow Diagram of the Wastewater Treatment System

(3) Required Investment Cost

Table 7 shows the required investment cost.

Table 7 Required Investment Cost for a Wastewater Treatment System

Items	Unit	Quantity	Unit price VND	Expenses VND
Equalization tank	m^3	500	700,000	350,000,000
PH neutralization tank	m^3	80	700,000	56,000,000
Aeration tank	m^3	1,000	700,000	700,000,000
Sedimentation tank	m^3	400	850,000	340,000,000
Coagulation tank	m^3	300	850,000	255,000,000
Final tank	m^3	20	700,000	14,000,000
Sludge tank	m^3	20	700,000	14,000,000
Sewerage: 500 x 600	m^3	150	300,000	45,000,000
Sub Total 1(Construction)				**1,774,000,000**
Wastewater Pump	piece	4	10,000,000	40,000,000
Aerator; capacity 150 m^3/h	piece	2	30,000,000	60,000,000
pH meter and metering pump	set	1	40,000,000	40,000,000
Agitator; capacity: 2 HP	piece	4	7,500,000	30,000,000
Acid mixture apparatus	set	1	100,000,000	100,000,000
Coagulant mixture apparatus	set	2	100,000,000	200,000,000
Sludge dehydrating machine	set	1	500,000,000	500,000,000
Electricity	set	1	200,000,000	200,000,000
Pipeline and accessories	set	1	200,000,000	200,000,000
Other equipment				200,000,000
Sub Total 2(Equipment)				**1,570,000,000**
Grand Total				**3,344,000,000**

5. Recommended Countermeasure for Improvement

5.1 Short Term Countermeasures

No	Countermeasure	Expected Results
1	Installation of flow meters for water and steam	Grasp of unit consumption (Cost reduction)
2	Installation of a steam condensate recovery system	Energy savings
3	Installation of a cooling water recovery system	Energy savings
4	Installation of heat recovery system from the waste water	Energy savings
5	Standardization of operations	Improvement of product quality and cost reduction
6	Execution of the "5S Movement"	Elimination of waste-fullness, increase in worker's morale, improvement of product quality, and a gain in customer's trust

5.2 Mid and Long Term Countermeasures

No	Countermeasure	Expected Results
1	Installation of a wastewater treatment system	Improvement of wastewater quality
2	Modernization of the Color Kitchen	Improvement of the accuracy of scaling, prevention of contamination, improvement of the working environment
3	Acquisition of ISO9000 series certification	Improvement of product quality and cost reduction
4	Introduction of a cost reduction program	Cost reduction
5	Introduction of low liquid ratio type dyeing machines	Energy saving, reduction of chemical consumption and improvement of wastewater quality
6	Introduction of new dyeing technology such as the Rapid Dyeing Method	Energy saving, reduction of chemical consumption and improvement of wastewater quality

6. Proposed Implementation Schedule

A proposed implementation schedule is shown in Figure 5.

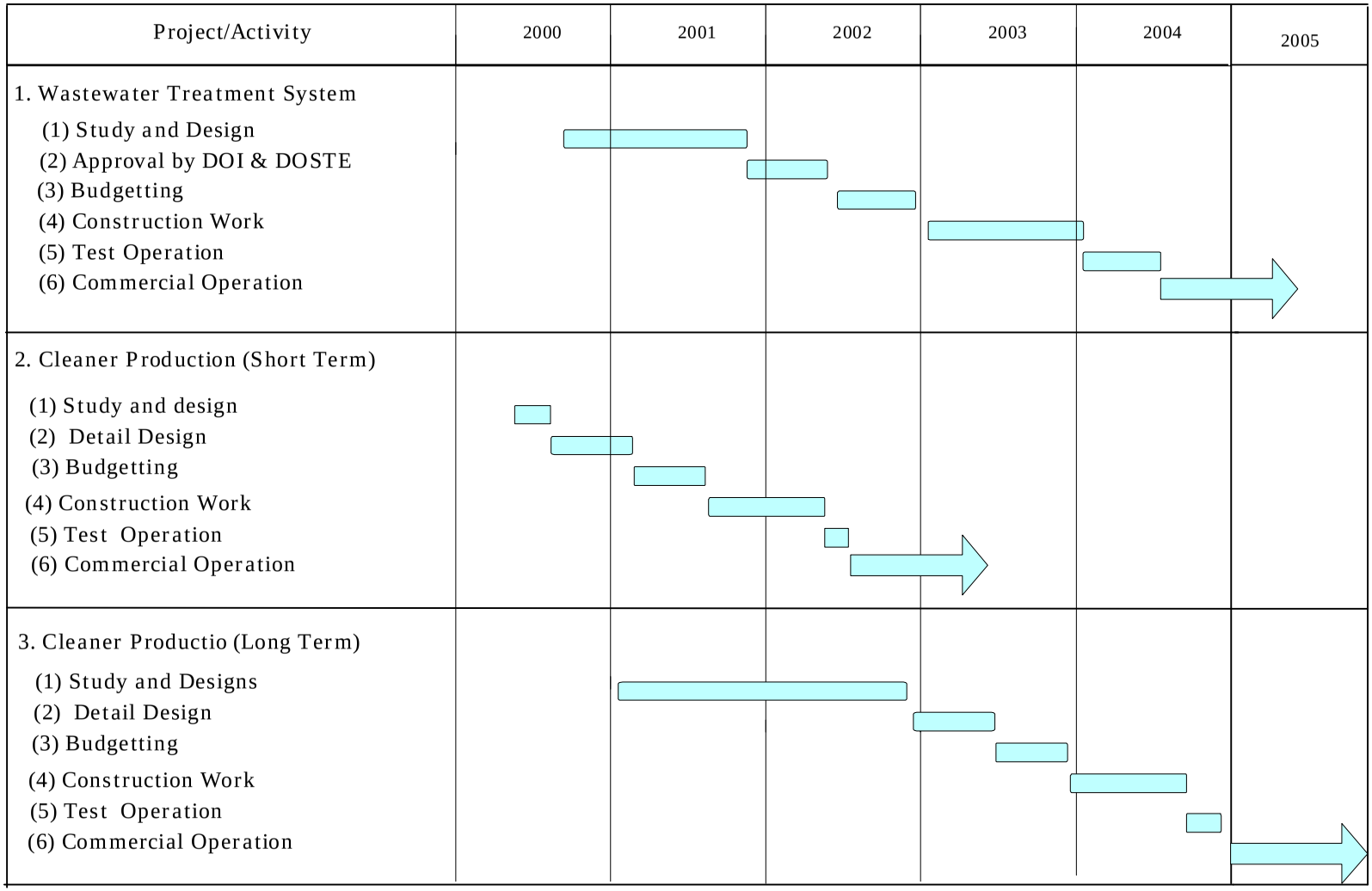

Figure 5 Proposed Implementation Schedule for Pollution Prevention Countermeasure

CASE STUDY T-03

Danang Textile Company

Survey date: 15 December 1999
6 & 7 March 2000

1. General

1.1 Profile

Danang Textile Company is a local state-owned company that was established in 1976 as a textile manufacturing company. It started out as a joint company invested partly by private capital and partly by state capital and became a local state-owned factory in 1982. In 1994 it rose to become a local state-owned company in 1994. The company profile and organization of Danang Textile Company is summarized in Table 1 and Figure 1.

Table 1 Enterprise Profile

Name of Company:	Danang Textile Company
Ownership:	Local state-owned
Address:	Hoa Khanh, Lien Chieu Danang City
Tel:	84 511 842127
Director:	Mr. HOANG SY PHONG
Established:	1976
Corporate Capital:	
Number of Employees:	400
Main Products:	Fabrics & Towels

1.2 Business Status

1.2.1 Production

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

The main market of this company is domestic.

Table 2 Production and Sales in 1998

Product	Production	Turnover
Woven fabrics	2,307,760 m^2/year	20,204,217,000 VND

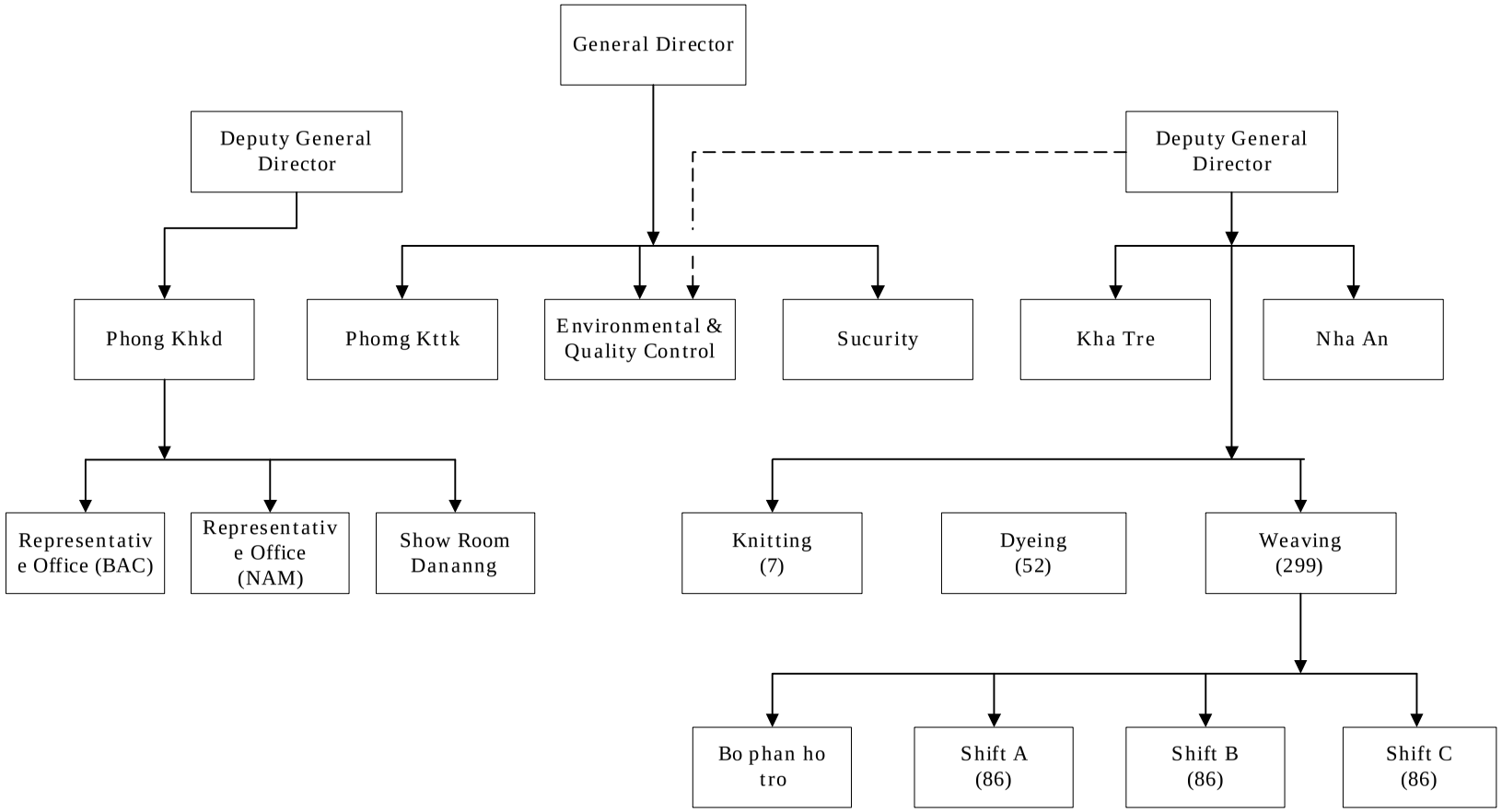

Figure 1 Organization of Danang textile Company

1.2.2 Debt

a. Short-term debt: 5,756.7 million VND.

b. ICO long-term debt: 38,396.42 U$.

c. Long-term debt: 5,915,000,000 VND.

d. Long-term investment fund: 506,533,000 VND.

2. Production technology

2.1 Process

Figures-2 and 3 show a simplified block flow diagram of the factory and a block flow diagram of the dyeing process, respectively.

Table 3 shows the operating condition of the dyeing process.

Table 3 Operating Condition for Cotton Towels

(1) Scouring & Bleaching			
M/C:Jigger			
Fabric:100 kg			
Liquid Ratio:1/5			
Step	Chemicals	Temperature	Retention Time
Scouring & Bleaching		60℃	60 min
Washing		60℃	30 minx3
(2) Dyeing			
M/C: Jet Type			
Fabric: 200 kg			
Liquid Ratio: 1/10			
Step	Chemicals	Temperature	Retention Tome
Dyeing		60℃	60 min
Washing		60℃	40 min
Neutralization		60℃	20 min
Washing		60℃	30 min

2.2 Future Plan

(1) Installation of a wastewater treatment system

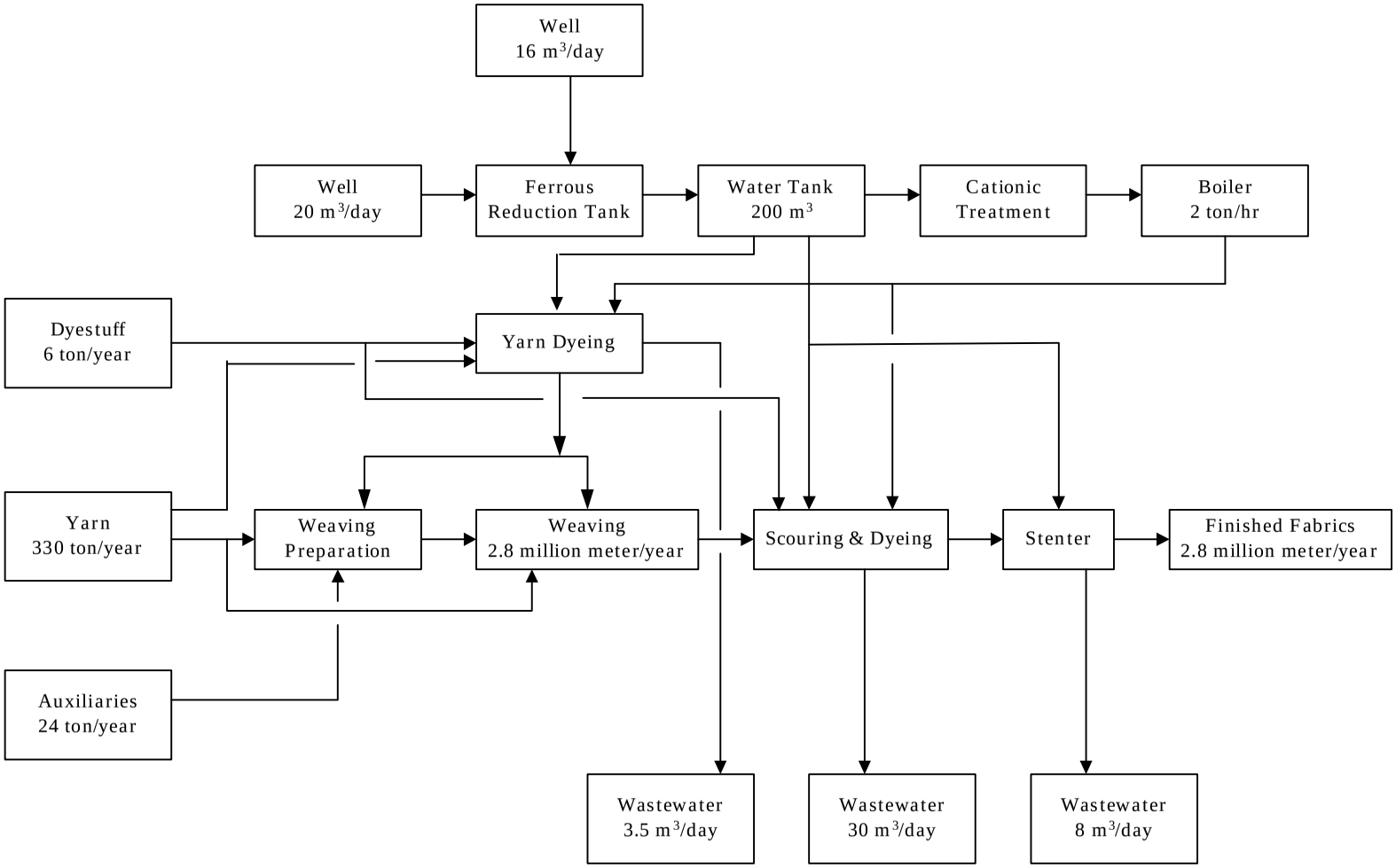

Figure 2 Simplified Block Flow Dioagram

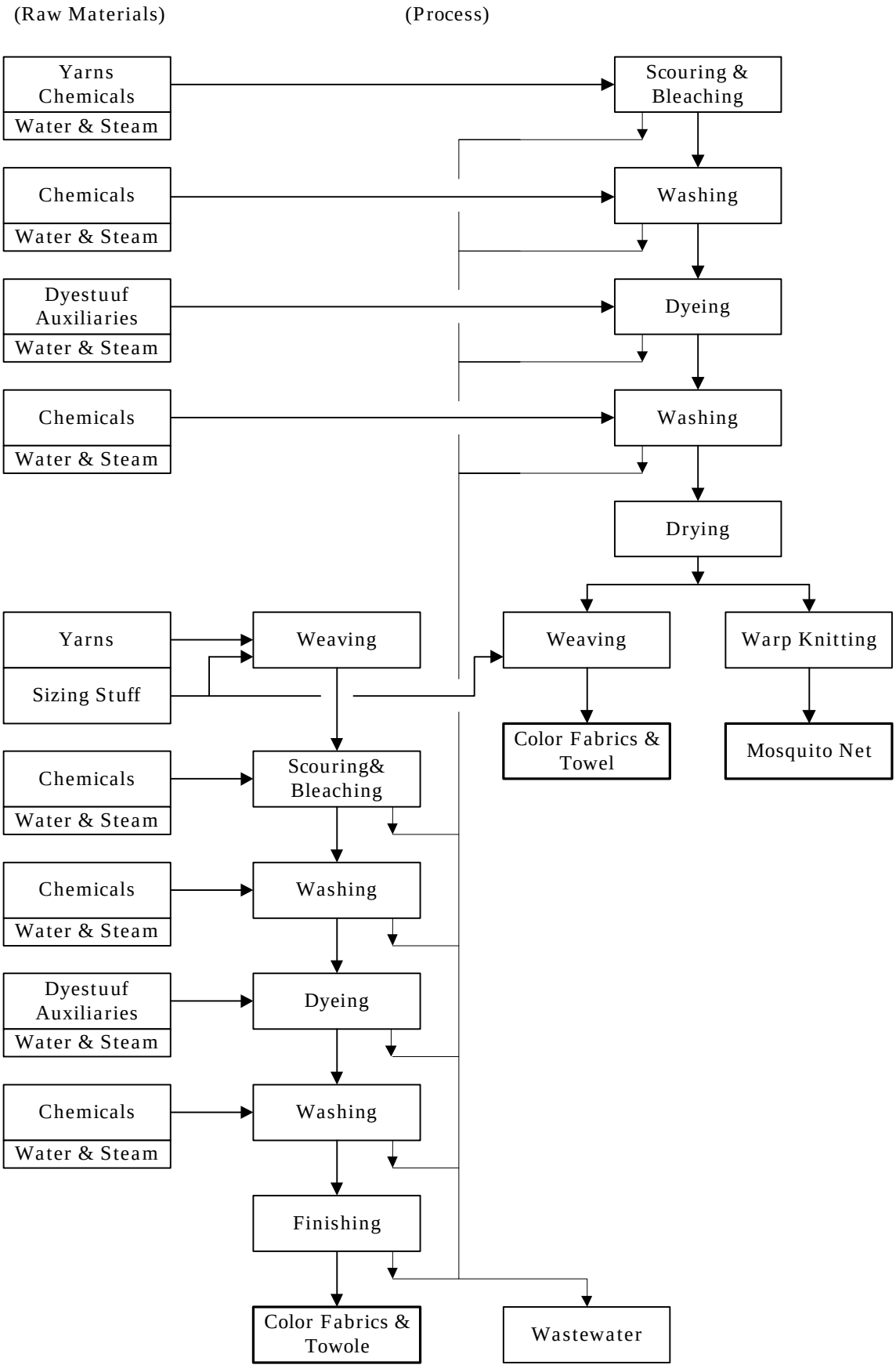

Figure 3 Process Flow Diagram

3. Management Technology

Table 4 shows the unit consumption of raw materials and utilities.

Table 4 Unit Consumption of Raw Materials and Utilities

No.	Items	Quantity/year	Cost (VND)
1	Yarns	330 tons	30,000,000/ton
2	Dyes	6 tons	180,000,000/ton
3	Organic auxiliaries	24 tons	2,700,000/ton
4	Detergents	0.3 tons	30,000,000 VND/ton
5	Water	30,000 m^3	1,000 VND/m^3
6	FO	350 tons	1,800,000 VND/ton
7	Electricity	1,085,545 kWh	770 VND/kWh

4. Industrial Wastewater Treatment and Discharge

(1) Outline

1. Wastewater is discharged outside without any treatment.
2. The company has a plan to install a wastewater treatment system which is estimated to cost 230 million VND. However the local government will not permit this project because of unprofitable investment.
3. Wastewater volume is 40 m^3/day.

(2) Sampling Points in December 1999

Wastewater samples were taken at the following spots for analysis in this study.

Date: 15 December 1999

S1：At Jigger dyeing m/c (washing water after bleaching)
S2：Wastewater discharged from dyeing factory (to city sewage)

(3) Result of Wastewater Analysis of Samples Taken in December 1999

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment (CEETIA) are shown in Table 5.

Table 5 Wastewater Quality in December 1999

	Unit	S1	S2
Temperature	℃	70	48.2
PH		12.2	11.4
Electric Conductivity	μS/cm	50900	4400
Turbidity	NTU	102	212
Oil content	mg/l	Trace	Trace
BOD	mg/l	208	236
COD	mg/l	8430	8610
DO	mg/l	2.08	8.4
SS	mg/l	117	253
Total Nitrogen	mg/l	36.1	17.2
Residual Chlorine	mg/l	Trace	Trace
SO_4	mg/l	2842	644
Cyanogen	mg/l		

(4) Sampling Points of the Field Study in March 2000

Wastewater samples were taken at the following spots for analysis in this study.

Date: 4 March 2000

S1：At the outlet of the dyeing factory：Composite Sampling

Sampling time: ① 10:45 ② 11:00 ③ 11:15 ④ 11:30 ⑤ 11:45
⑥ 13:57 ⑦ 14:20 ⑧ 14:40 ⑨ 15:00

(5) Wastewater Analysis in March 2000

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment (CEETIA) are shown in Table 6.

Table 6 Wastewater Qualities in March 2000

	Unit	S1
Temperature	℃	35.6
PH		10.12
Electric Conductivity	μS/cm	1330
Turbidity	NTU	51.8
Oil content	mg/l	0.92
BOD	mg/l	222
COD	mg/l	325
DO	mg/l	5.3
SS	mg/l	62
Total Nitrogen	mg/l	0.7
Residual Chlorine	mg/l	Trace
SO_4	mg/l	214.6
Cyanogen	mg/l	

(6) Study on Wastewater Treatment Facility

The results of the examination by Danang Textile Co. in 1999 are as follows.

1) Design condition

①Production： Dyeing fabric 23,000,000 m^2/year

②Wastewater Volume： 25 m^3/day

③Wastewater Quality： PH 9.3～10.0

BOD 140～200mg/l

COD 180～320mg/l

SS 150～160 mg/l

④Treatment methods： Coagulating sedimentation, Biological treatment

2) Investment Cost

Table 7 shows the investment cost of the wastewater treatment facility.

5. Countermeasures for Improvement

5.1 Countermeasures for Production Technology Improvement

(1) Current Problems

a. Shuttle type weaving machines are very old and not very efficient.
b. The exchange of shuttles is done manually, so that the machines must be stopped when shuttles are exchanged. This cause the quality of the fabric to be bad as an unevenness of tension occurs.
c. The maintenance of the soft cheese winders is very poor and the winders are operating without some parts.
d. There is a lot of steam leakage from the pipe lines.
e. No countermeasure for energy saving have been adopted, including the recovery of steam condensate.
f. The liquid ratio is high at 1:10～1:12 for the liquid flow type machines.

(2) Countermeasures

a. Automatic shuttle change type weaving machines should be introduced as early as possible.
b. Sufficient maintenance of the weaving machines must be performed.
c. The steam leakage problem at the dyeing plant should be solved immediately.
d. Countermeasures for energy saving such as recovery of cooling water and heat recovery from the wastewater should be adopted.

e. Low liquid ratio dyeing machines should be introduced when the number of machines are increased or renewed.

Table 7 Investment Cost of a Wastewater Treatment Facility

Items	Unit	Quantity	Unit price VND	Expenses VND
a. Expenses for construction and equipment installation				
Wastewater collection: - Sewerage: 300 x 400 BT - Collection pits with screen	 Mts piece	 108 6	 125,000 1,250,000	 13,500,000 7,500,000
Regulation tank: 3.5 3.5 x 1.8	m^3	22	650,000	14,300,000
Coagulation tank: 1.55 x 1.5 x 1.8	m^3	7	750,000	5,250,000
Sedimentation tank1: 2.7 x 3.3 x 3.0	m^3	27	750,000	20,250,000
pH neutralization tank: 1.55 x 1.5 x 3.0	m^3	7	750,000	5,250,000
Aeration + sedimentation 2: 3.3 x 4.8 x 3.0	m^3	47.5	650,000	30,888,000
Sludge tank: 2.0 x 2.0 x 2.0	m^3	8	650,000	5,200,000
Pump P1 and P2 (Italian-made)	piece	2	5,100,000	10,200,000
Pump after neutralization	piece	1	4,500,000	4,500,000
Platform	mts	12	450,000	5,400,000
Agitator; capacity: 2 HP	piece	2	7,500,000	15,000,000
Aerator; capacity 150 m^3/h	piece	1	23,800,000	23,800,000
pH meter and metering pump	set	1	33,000,000	33,000,000
Pipeline and auxiliaries	-			15,000,000
Coagulant and neutralization agent tank	piece	3	150,000	450,000
Sub Total (A)				**209,488,000**
b. Other expenses				
Expenses for project management (including construction, examination and approval):			5 % x 209,488,000 = 10,500,000 VND.	
Expenses for designing and technology transfer:			3.5% x 209,488,000 = 7,330,000 VND	
Expenses for examination of design and budget estimation:			1.5% x 209,488,000 = 3,142,000 VND.	
Sub Total (B)				**20,972,000 VND**
Grand total: (A)+ (B)				**230,460,000 VND**

5.2 Countermeasures for Management Technology Improvement

(1) Current Problems

a. The inside and outside of the dyeing plant are in disorder.
b. Operation standardization and creation of operation manuals are not sufficient.
c. Cost management, such as calculating unit consumption of raw materials and energy, is hardly being executed.

(2) Countermeasure

a. The "5S Movement" should be executed.
b. Operation standardization is very important. Operation manuals should be prepared and placed in a position where operators can see them.
c. Introduction of ISO9000 series should be promoted.
d. Analysis of unit consumption and promotion of cost reduction program should be executed.
e. As a first step, water and steam consumption levels need to be grasped.
f. Maintenance function need to be reinforced.

5.3 Countermeasures for Wastewater Treatment

They should install the following wastewater treatment system to improve the quality of the factory wastewater to within Vietnam standard values.

(1) Outline of the Wastewater Treatment System

a) Volume of wastewater.： 400m3/day
b) Production capacity： 14,000 m/day (Dyeing fabric)
c) Treatment Methods：Activated sludge process & Coagulating Sedimentation
d) Investment Cost： 1,485,000,000VND

(2) Flow Diagram of Wastewater Treatment System

Figure 4 shows the flow diagram of the wastewater treatment system.

(3) Investment Cost

Table 8 shows the investment cost of the wastewater treatment system.

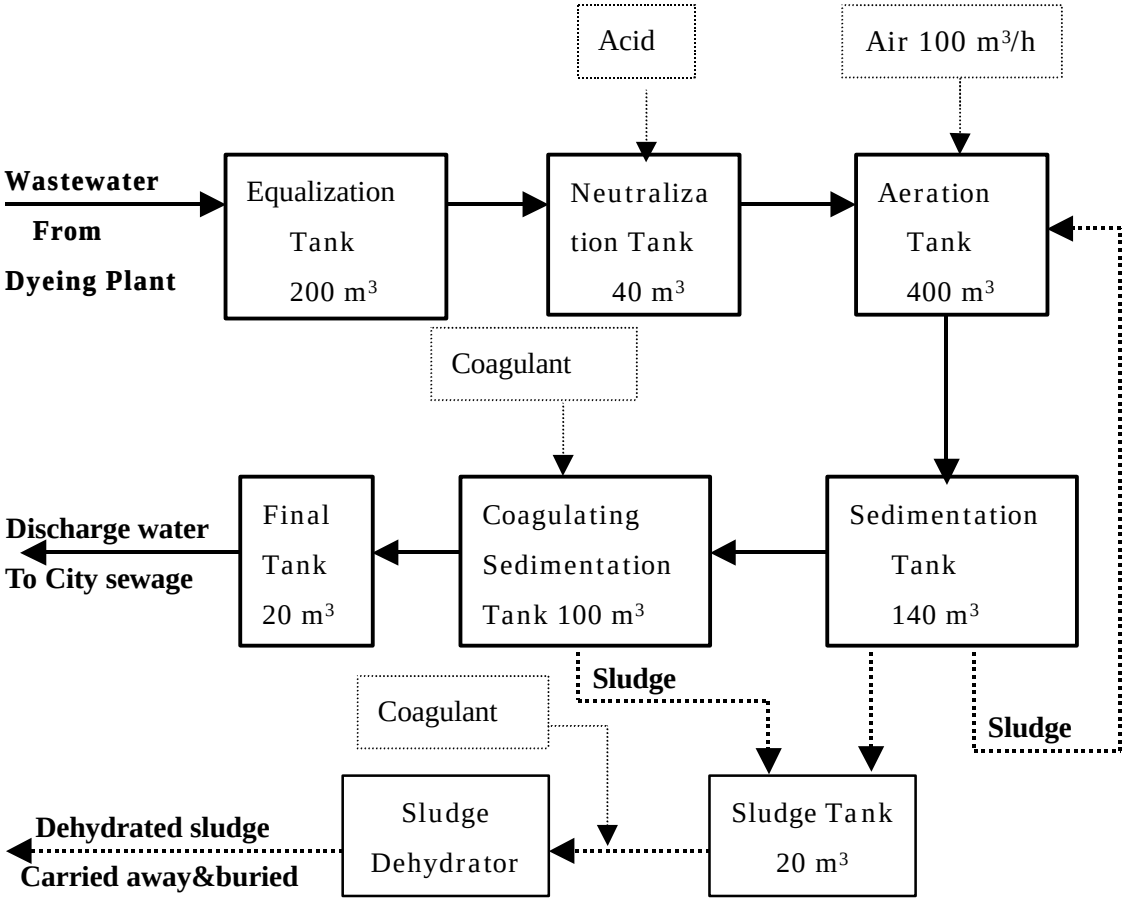

Figure 4 Flow Diagram of Wastewater Treatment System

Table 8 Investment Cost of a Wastewater Treatment System

Items	Unit	Quantity	Unit Price VND	Expenses VND
Equalization tank	m^3	200	700,000	140,000,000
pH neutralization tank	m^3	40	700,000	28,000,000
Aeration tank	m^3	400	700,000	280,000,000
Sedimentation tank	m^3	140	850,000	119,000,000
Coagulation tank	m^3	100	850,000	85,000,000
Final tank	m^3	20	700,000	14,000,000
Sludge tank	m^3	20	700,000	14,000,000
Sewerage: 500 x 600	m^3	50	300,000	15,000,000
Sub Total 1(Construction)				**695,000,000**
Wastewater Pump	piece	4	10,000,000	40,000,000
Aerator: capacity 150 m^3/h	piece	1	30,000,000	30,000,000
pH meter and metering pump	set	1	40,000,000	40,000,000
Agitator: capacity: 2 HP	piece	4	7,500,000	30,000,000
Acid mixture apparatus	set	1	50,000,000	50,000,000
Coagulant mixture apparatus	set	2	50,000,000	100,000,000
Sludge dehydrating machine	set	1	200,000,000	200,000,000
Electricity	set	1	100,000,000	100,000,000
Pipeline and accessories	set	1	100,000,000	100,000,000
Other equipment				100,000,000
Sub Total 2(Equipment)				**790,000,000**
Grand Total				**1,485,000,000**

6. Recommended Countermeasure for Improvement

6.1 Short Term Countermeasures

No	Countermeasure	Expected Results
1	Installation of flow meters for water and steam	Grasp of unit consumption (Cost reduction)
2	Installation of a steam condensate recovery system	Energy savings
3	Installation of a cooling water recovery system	Energy savings
4	Installation of heat recovery system from the waste water	Energy savings
5	Operation standardization	Improvement of product quality and cost reduction
6	Reinforcement of the maintenance function	Increase in equipment capacity, productivity and products quality
7	Execution of the “5S Movement”	Elimination of waste-fullness, increase in worker's morale, improvement of product quality and a gaining in customer's trust

6.2 Mid and Long Term Countermeasures

No	Countermeasure	Expected Results
1	Installation of a wastewater treatment system	Improvement of wastewater quality
2	Modernization of the Color Kitchen	Improvement of the accuracy of scaling, prevention of contamination and improvement of the working environment
3	Acquisition of ISO9000 series certification	Improvement of product quality and cost reduction
4	Introduction of a cost reduction program	Cost reduction
5	Introduction of new dyeing technology such as the Rapid Dyeing Method	Energy saving, reduction of chemical consumption and improvement of wastewater quality

7. Proposed Implementation Schedule

The proposed implementation schedule is shown in Figure 5.

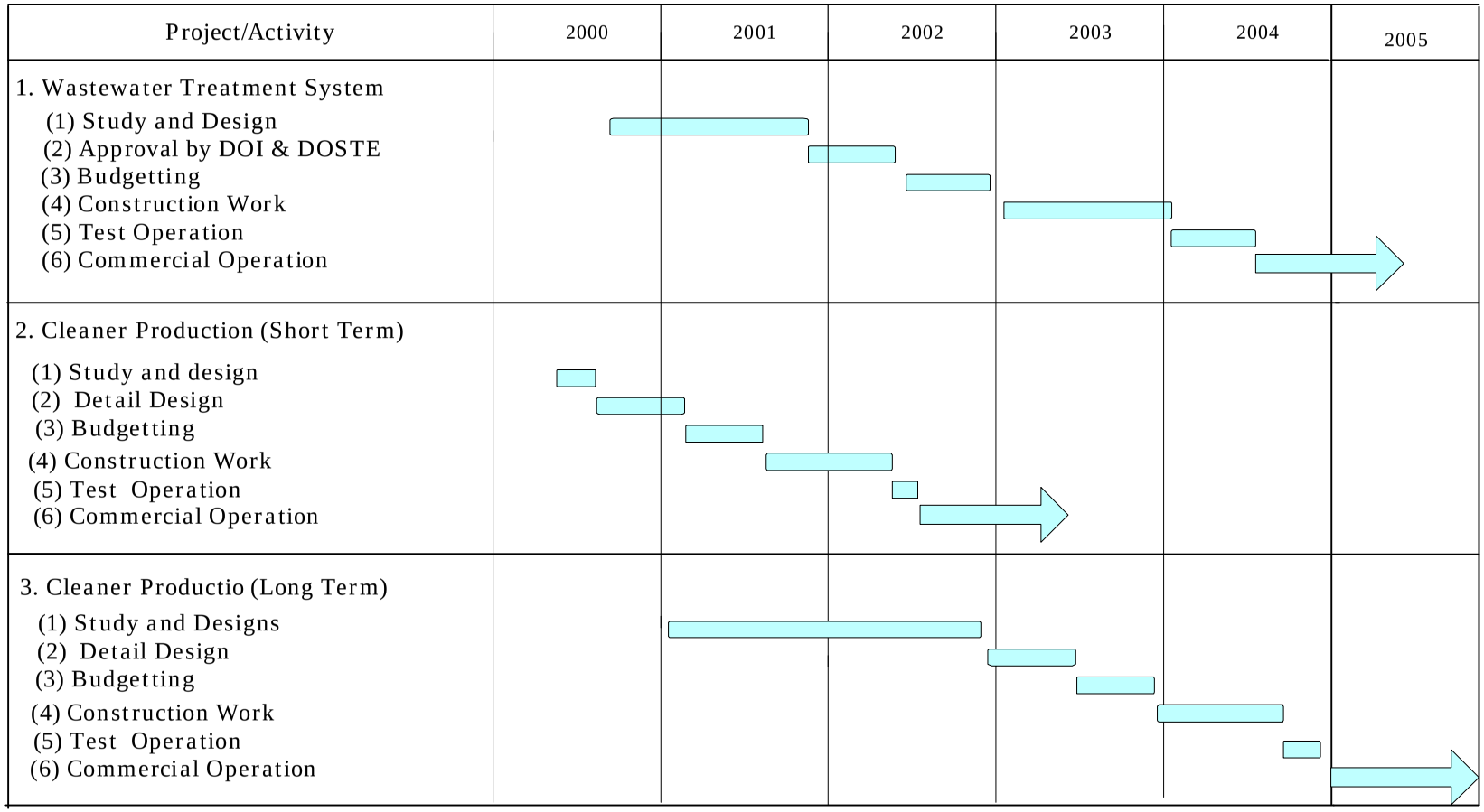

Figure 5 Proposed Implementation Schedule for Pollution Prevention Countermeasure

CASE STUDY T-04

Nam Dinh Textile Company

Survey Date: 25 November 1999
9 & 15 March 2000

1. General

1.1 Profile

Nam Dinh Textile Company is a state-owned company that was established in 1889 as a textile manufacturing company. The company profile and organization of Nam Dinh Textile Company is summarized in Table 1 and Figure 1.

Table 1 Enterprise Profile

Name of Company:	Nam Dinh Textile Company
Ownership:	State-owned
Address:	43 To Hieu Nam Dinh
Tel:	0350-849422-849749
Director:	NGO HUAN
Established:	1889
Corporate Capital:	
Number of Employees:	7,500
Main Products:	Yarns, Fabrics, Garments, Towels

1.2 Business Status

1.2.1 Production

Table 2 shows production and sales of the Company in 1999. 40% of products are exported to Japan, Sweden, Hong Kong, Norway, Korea, Germany, Netherlands, Russia and Poland.

1.2.2 Debt

Debts up to 31 December 1998:

1. Short-term debt: 203.38 billions VND;
2. Long-term debt: 196.21 billions VND;
3. Interest: 3,409.00 billions VND; and
4. Other debt: 46.54 billions VND

Total: 480.22 billions VND

Table 2 Production and Sales in 1999

No.	Items	Unit	1999	
			Plan	Implementation (V.A.T Included)
I	Industrial production value	1,000VND	392,500	400,000
II	Turnover	1,000 VND	378,000	410,680
III	Export turnover	1,000 US$	8,120	8,160
IV	Main product			
	- Various yarns	t	9,430	9,998
	- Sold yarns	t	4,069	6,323
	- Finished fabrics	1,000 m	15,619	14,626
	- Various kitchen towels	1,000 pcs	80,187	52,029
	- Garments	1,000 pcs	825	716
	(including subcontracted ones)		601	518
	(Company contracted garments)			
V	Payment to Government budget	Million VND	4,900	3,500
VI	Total employees	person	7,560	7,745
VII	Average income	VND/month	457,000	432,000
VIII	Profit (+), Loss (-)	Billion VND		

2. Production Technology

2.1. Process

Figures-2 and 3 show a simplified block flow diagram of the factory and a block flow diagram of the dyeing process, respectively.

Table 3 shows the operating condition of the dyeing process.

2.2 Future Plan

(1) Installation of a Wastewater Treatment system

3. Management Technology

Table 4 shows Unit Consumption of Raw Materials and Utilities.

Table 3 Operaing Condition of Dyeing Process

(1) Continuous Process

Step	Chemicals	Temperature	Retention Time
Singeing	2-4 burners, by Petro	95-100 ℃	
Washing			
De-sizing	By Enzyme	70-80 ℃	6-7 hours
Washing			
Scouring	NaOH, Na_2CO_3 and Others	100 ℃	90 min
Washing			
Bleaching	H_2O_2, Na_2SiO_3 and Others	100 ℃	60 min
Washing			
Mercerizing	NaOH and Others		
Washing	H_2SO_4,		
Pdding(Cotton)	Reactive Dye, Urea, Na_2CO_3,		
(Cotton/Polyester)	Ractive/Disaperse Dye, Urea, Acetic Acid, Na_2CO_3,Others		
Infra-red Drying			
Hot Flue		170 ℃	50-60 min
Washing			
Drying			

(2) Jigger

Step	Chemicals	Temperature	Retention Time
Scouring (M=1/5)	NaOH, Na_2CO_3, Others	100 ℃	
Washing (M=1/5)			
Bleaching (M=1/5)	NaClO, H_2O_2, NaOH, Na_2SiO_3,	95 ℃	
Washing (M=1/5)			
Dyeing (M=1/3) Vat Reactive Sulfur Directive	NaOH, Na_2CO_3, $Na_2S_2O_4$, H_2SO_4, Others		
Washing (M=1/5)			

(Remark) M:Liquid Ratio

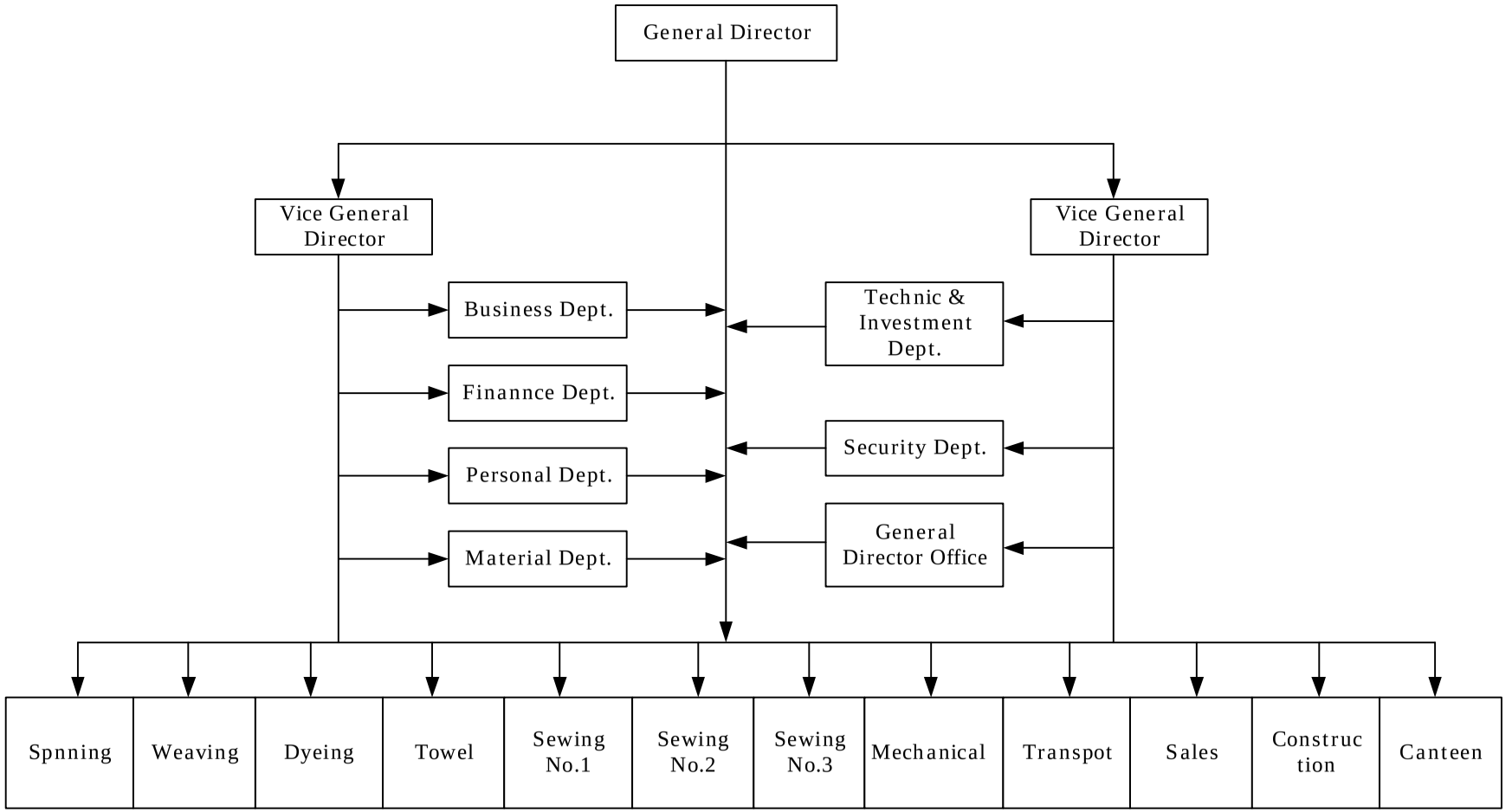

Figure 1 Organization system

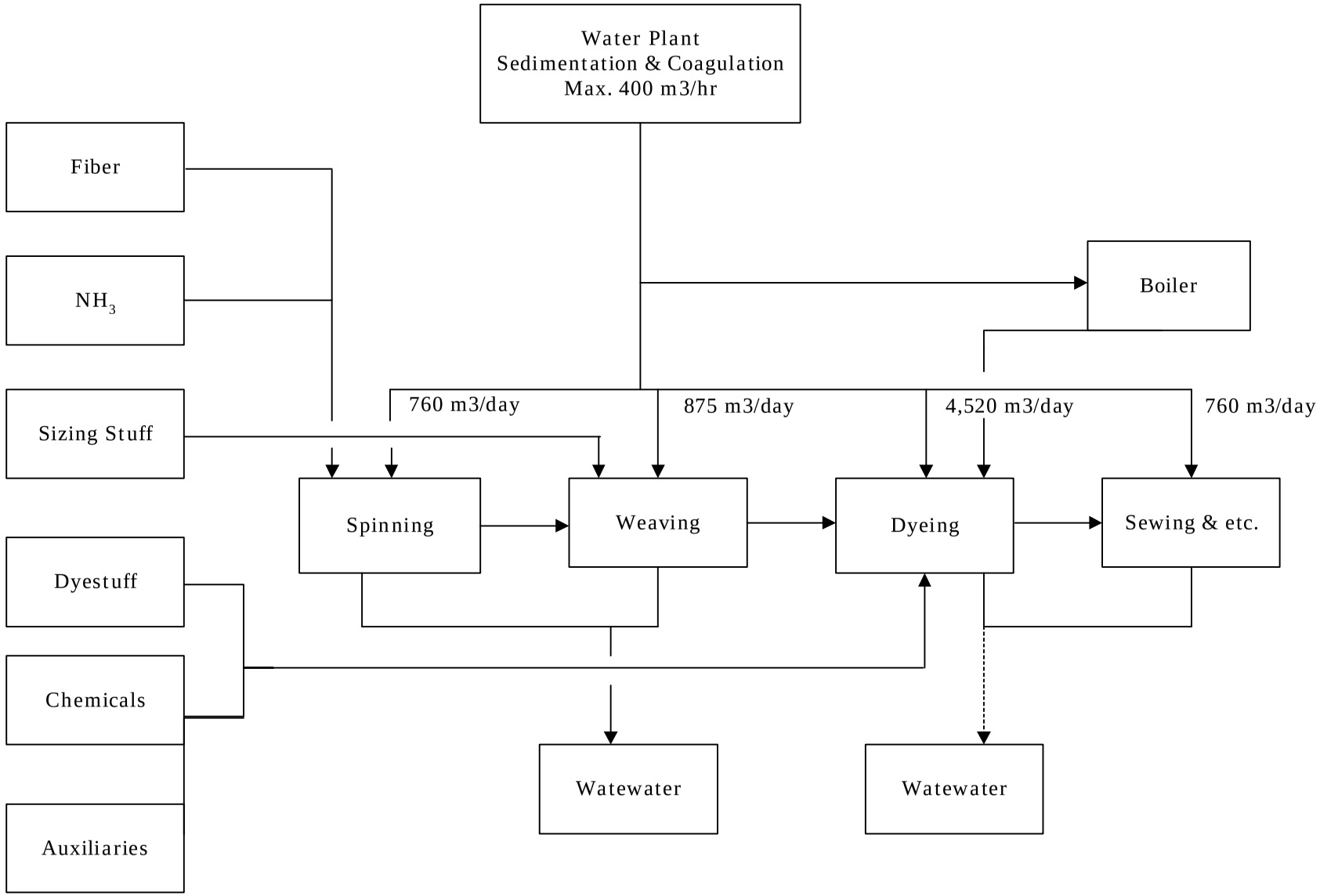

Figure 2 Simplified Block Flow Diagram

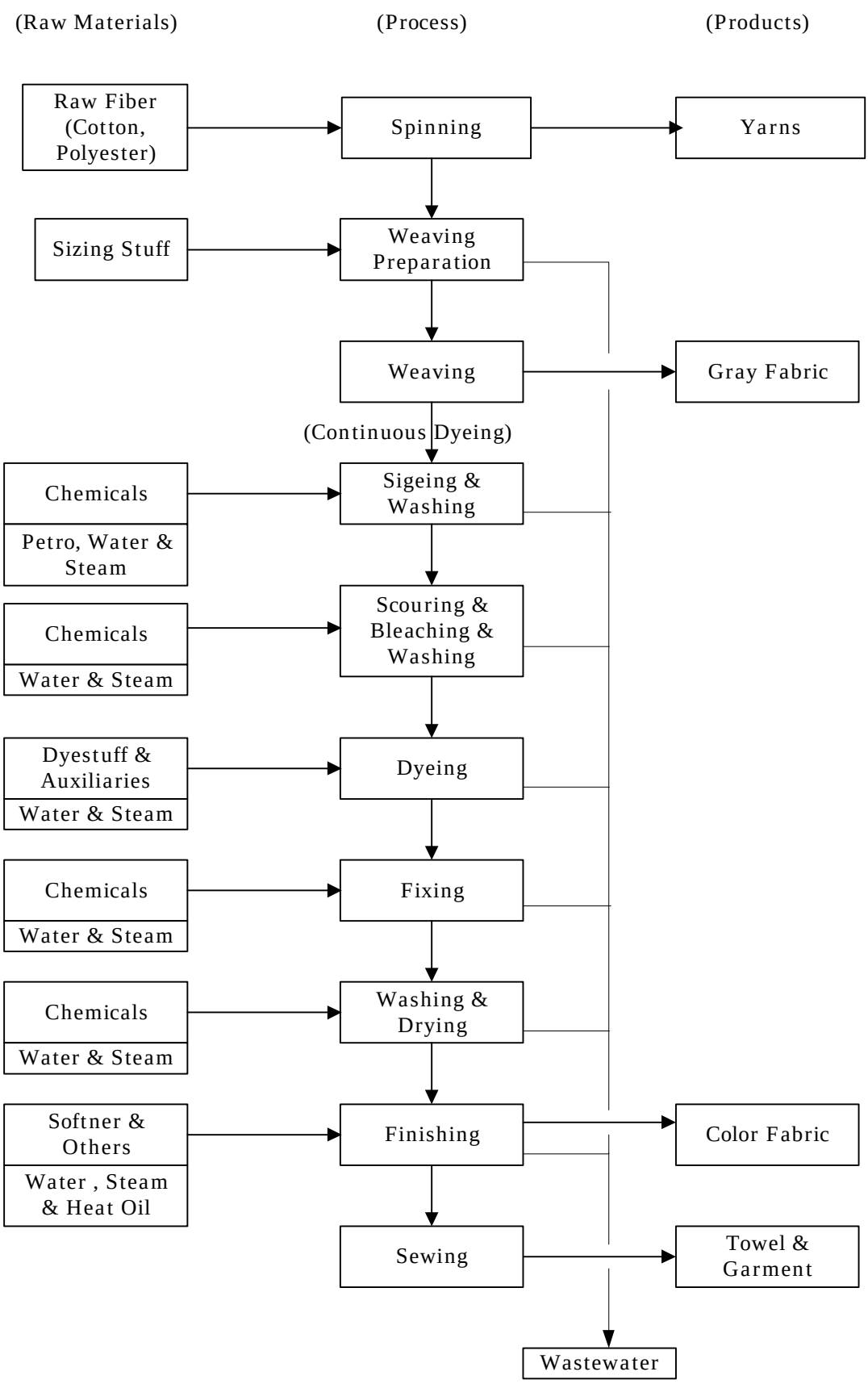

Figure 3 Process Flow Diagram

Table 4 Unit Consumption of Raw Materials and Utilities

No.	Materials	Production/year	Expenses
1	**Yarn**		
1-1	Cotton fibers	6,268 tons	131,284 millions VND
1-2	Manmade fibers	3,163 tons	33,717 millions VND
1-3	Water	434,632 m^3	131 millions VND
1-4	NH3	960 kg	9 millions VND
1-5	Electricity	35,025,776 kWh	25,503 millions VND
1-6	Grease and oil		458 millions VND
2	**Fabrics and towel**		
2-1	Yarns	3,954 tons	
2-2	Sizing agents	46 tons	
2-3	Electricity	5,576,088 kWh	4,059 millions VND
2-4	Water	310,000 m^3	93.6 millions VND
3	**Dyeing**		
3-1	Grey fabrics	9,600,000 meters	
3-2	Grey towels	62,300,000 pieces	
3-3	Dyes	36 tons	
3-4	Detergents	508 tons	
3-5	Auxiliaries	870 tons	
3-6	Water	1,600,000 m^3	483. 2 millions VND
3-7	Electricity	2,688,912 kWh	1,957 millions VND
3-8	FO	378,000 litters	
4	**Steaming**		
4-1	Coals	17,157 tons	
4-2	FO	427,000 litters	
4-3	Water	333,600 m^3	102.6 millions VND

4. Industrial Wastewater Treatment and Discharge

(1) Outline

1.The volume of wastewater is very high at 7,000 m^3/day. Furthermore, pollutant materials, such as PH, SS, BOD, and COD, exceed the environmental standards in Vietnam.

2. There is no wastewater treatment facility, and the company needs to improve the present condition because pollution problems are already occurring.

3. For their future plans, the company is complementary, having a wastewater treatment facility. However, they do not know when will be realize this plan due to a lack of financing.

(2) Sampling Points in November 1999

Wastewater samples were taken at following spots for analysis in this study.

Date: 25 November 1999

S1： At Scouring m/c(washing water of the 3 rd tank)
S2： At Scouring m/c(washing water after scouring)
S3： At Bleaching m/c(washing water after bleaching)
S4： At Scouring m/c(washing water of the 1st tank)

(3) Results of Wastewater Analysis in November 1999

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment (CEETIA) are shown in Table 5.

Table 5 Wastewater Quality in November 1999

	Unit	S1	S2	S3	S4
Temperature	℃	65.8	49.9	56	63.5
PH		10.6	10.66	8.64	10.6
Electric Conductivity	μS/cm	4650	4970	530	9970
Turbidity	NTU	123	302	39	376
Oil content	mg/l	0.05	0.04	0.07	0.09
BOD	mg/l	797.3	1050	559.7	910.8
COD	mg/l	1555	3240	589	3325
DO	mg/l	5.4	2.52	4.1	4.7
SS	mg/l	138	320	46	384
Total Nitrogen	mg/l	8.12	9.6	10.8	5.5
Residual Chlorine	mg/l	Trace	Trace	Trace	Trace
SO_4	mg/l	806.7	932.4	193.8	1232.2
Cyanogen	mg/l	0	0	Trace	Trace

(4) Sampling Points of in March 2000

Wastewater samples were taken at the following spots for analysis in this study.

Date: 15 March 2000

S1： At the outlet of continuous dyeing m/c：Composite Sampling
Sampling time:①11:10, ②14;00, ③14;30, ④15;00
S2： Supply water for dyeing process： Sampling time: 15:40

(5) Results of Wastewater Analysis in March 1999

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment (CEETIA) are shown in Table 6.

Table 6 Wastewater Quality in March 1999

	Unit	S1	S2
Temperature	℃	31.6	22.8
PH		9.51	7.85
Elec. Conductivity	μS/cm	501	189
Turbidity	NTU	4	0
Oil content	mg/l	Trace	0
BOD	mg/l	97	9.64
COD	mg/l	154	14
DO	mg/l	4.04	6.28
SS	mg/l	7	1
Total Nitrogen	mg/l	0.5	1.2
Residual Chlorine	mg/l	Trace	Trace
SO_4	mg/l	18	21
Ca	mg/l		33.2
Fe	mg/l		0.2
Mg	mg/l		6.7
$CaCO_3$	mg/l		83

(6) Study on Wastewater Treatment Facility

The results of the examination by NamDinh Textile Co. in 1998 is as follows:

1) Design condition

①Production： Yarns: 10,000 tons/year
Fabrics: 40,000,000 m/year
Garments: 1,500,000 items/year

②Wastewater Volume： 9,600 m^3/day

③Wastewater Quality：

PH 4～9
BOD 120～440 mg/l
COD 110～360 mg/l
SS 100 mg/l

④Treatment Methods： Filtration,Biochemical Treatment, Disaffection

2) Investment Cost

Table 7 shows the investment cost of the wastewater treatment system.

Table 7 Investment Cost of Wastewater Treatment Facility

Items	Cost US$
To purchase a wastewater treatment plant made overseas	2,500,000
Transportation and Insurance cost to Hai phong Port	52,000
Cost for manufacturer experts to install equipment	54,000
Other expenditures for project management, designing, construction materials and construction, transportation from Hai phong port, workers' training	1,400,000
Total	**4,060,000**

5. Countermeasures for Improvement

5.1 Countermeasures for Production Technology Improvement

(1) Current Problems

a. There is a lot of steam leakage from the pipe line.

b. No countermeasures for energy saving have been adopted, but steam condensate is being recovered.

c. Laboratory facilities and the color kitchen system are not properly prepared.

d. The data on the quality of supply water is too at low a level. If this data is actual, it is a very important problem for the dyeing process.

(2) Countermeasures

a. The steam piping should be repaired.

b. Countermeasure for energy saving, such as recovery of cooling water and heat recovery from the wastewater, should be adopted.

c. More suitable laboratory facilities should be prepared. (Now in planning)

d. The color kitchen system should be modernized.

e. The data on the quality of supply water should be checked. If the data is correct, the water treatment system should be completed.

5.2 Countermeasures for Management Technology Improvement

(1) Current Problems

a. The company started its operation a long time ago and it is now quite a large-scale plant. Accordingly, the facilities have a mixture of old and new machines, and these are divided into good and bad ones in terms of productivity and quality.

b. Regarding the spinning and weaving facilities, the management of old machines

is not good.

c. New continuous dyeing facilities, which were installed about 4 years ago, are in operation, and they are producing good results in their own way. However, their process control is at a very low level and it seems that these good facilities have not produced good efficient results in terms of quality.
d. Operation standardization of and preparation of operation manuals are inefficient.
e. Cost management, such as calculating unit consumption of the raw materials and energy, is hardly carried out.
f. Maintenance is inefficient, not only for old dyeing facilities, but also for new ones.
g. Most of the old dyeing facilities have suspended operations and their surroundings are dirty.
h. The color kitchen is very dirty and in disorder.

(2) Countermeasures

a. The ISO9000 certification program, which has just started for the dyeing process, should be strongly promoted. The experience gained from this program should be made the most of, and transfer to other processes.
b. Unnecessary facilities should be removed and the inside of the factory should be kept clean and in good order.
c. The maintenance function for facilities should be reinforced.
d. Operation standardization is very important. Operation manuals should be prepared and place in a position where operators can see them.
e. An analysis of unit consumption and promotion of a cost reduction program should be executed.
f. As a first step, water and steam consumption need to be grasped.
g. The “5S Movement” should be executed.

5.3 Countermeasures for Wastewater Treatment

The company should install the following wastewater treatment system in order to improve the quality of the factory wastewater to within Vietnam standard value.

(1) Outline of the Wastewater Treatment System

a) Volume of wastewater.： 4,800 m^3/day
b) Production capacity： 140,000 **m**/day (Dyeing fabric)

c) Treatment Methods：Activated sludge process & Coagulating Sedimentation

d) Investment Cost： 10,668,000,000 VND

(2) Flow Diagram of the Wastewater Treatment System

Figure 4 shows the flow diagram of the wastewater treatment system.

(3) Investment Cost

Table 8 shows the investment cost of the wastewater treatment system.

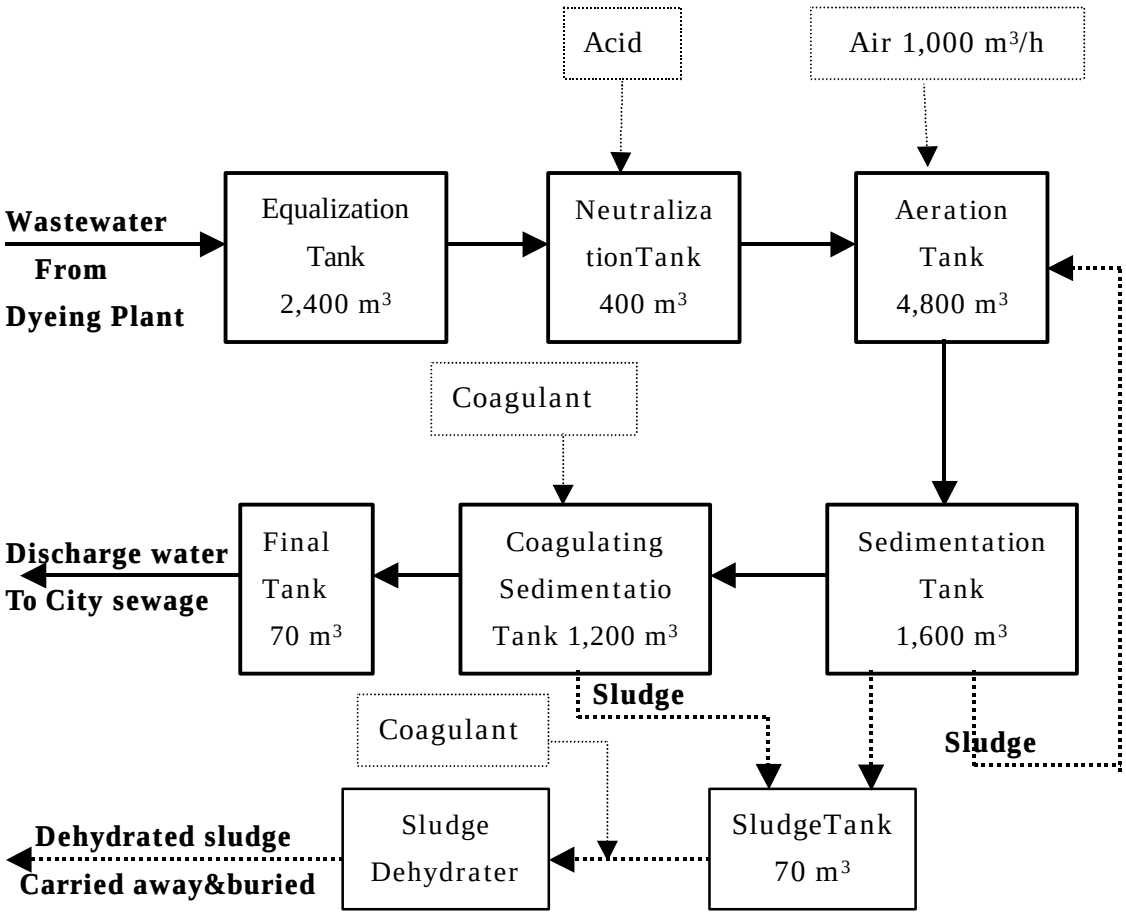

Figure 4 Flow Diagram of Wastewater Treatment System

Table 8 Investment Cost of Wastewater Treatment System

Items	Unit	Quantity	Unit price VND	Expenses VND
Equalization tank	m^3	2,400	700,000	1,680,000,000
pH neutralization tank	m^3	400	700,000	280,000,000
Aeration tank	m^3	4,800	700,000	3,360,000,000
Sedimentation tank	m^3	1,600	850,000	1,360,000,000
Coagulation tank	m^3	1,200	850,000	1,020,000,000
Final tank	m^3	70	700,000	49,000,000
Sludge tank	m^3	70	700,000	49,000,000
Sewerage: 500 x 600	m^3	300	300,000	90,000,000
Sub Total 1(Costruction)				**7,888,000,000**
Wastewater Pump	piece	4	10,000,000	40,000,000
Aerator; capacity 150 m^3/h	piece	7	30,000,000	210,000,000
pH meter and metering pump	set	1	40,000,000	40,000,000
Agitator; capacity: 2 HP	piece	4	7,500,000	30,000,000
Acid mixture apparatus	set	1	200,000,000	200,000,000
Coagulant mixture apparatus	set	2	200,000,000	400,000,000
Sludge dehydrating machine	set	1	900,000,000	900,000,000
Electricity	set	1	260,000,000	260,000,000
Pipeline and accessories	set	1	400,000,000	400,000,000
Other equipment				300,000,000
Sub Total 2(Equipment)				**2,780,000,000**
Grand Total				**10,668,000,000**

6. Recommended Countermeasure for Improvement

6.1 Short Term Countermeasures

No	Countermeasure	Expected Results
1	Installation of flow meters for water and steam	Grasp of unit consumption (Cost reduction)
2	Installation of a cooling water recovery system	Energy savings
3	Installation of heat recovery system from the waste water	Energy savings
4	Increased substantiality of the laboratory (in planning)	Improvement of product quality and cost reduction
5	Acquisition of ISO9000 series certification	Improvement of product quality and cost reduction
6	Reinforcement of the maintenance function	Increase of equipment capacity, productivity and product quality
7	Execution of the “5S Movement”	Elimination of waste-fullness, increase in of worker’s morale, improvement of product quality and a gain of customer's trust

6.2 Mid and Long Term Countermeasures

No	Countermeasure	Expected Results
1	Installation of a wastewater treatment system	Improvement of wastewater quality
2	Modernization of the Color Kitchen	Improvement of the accuracy of scaling, prevention of contamination and improvement of the working environment
3	Introduction of a cost reduction program	Cost reduction

7. Proposed Implementation Schedule

The proposed implementation schedule is shown in Figure 5.

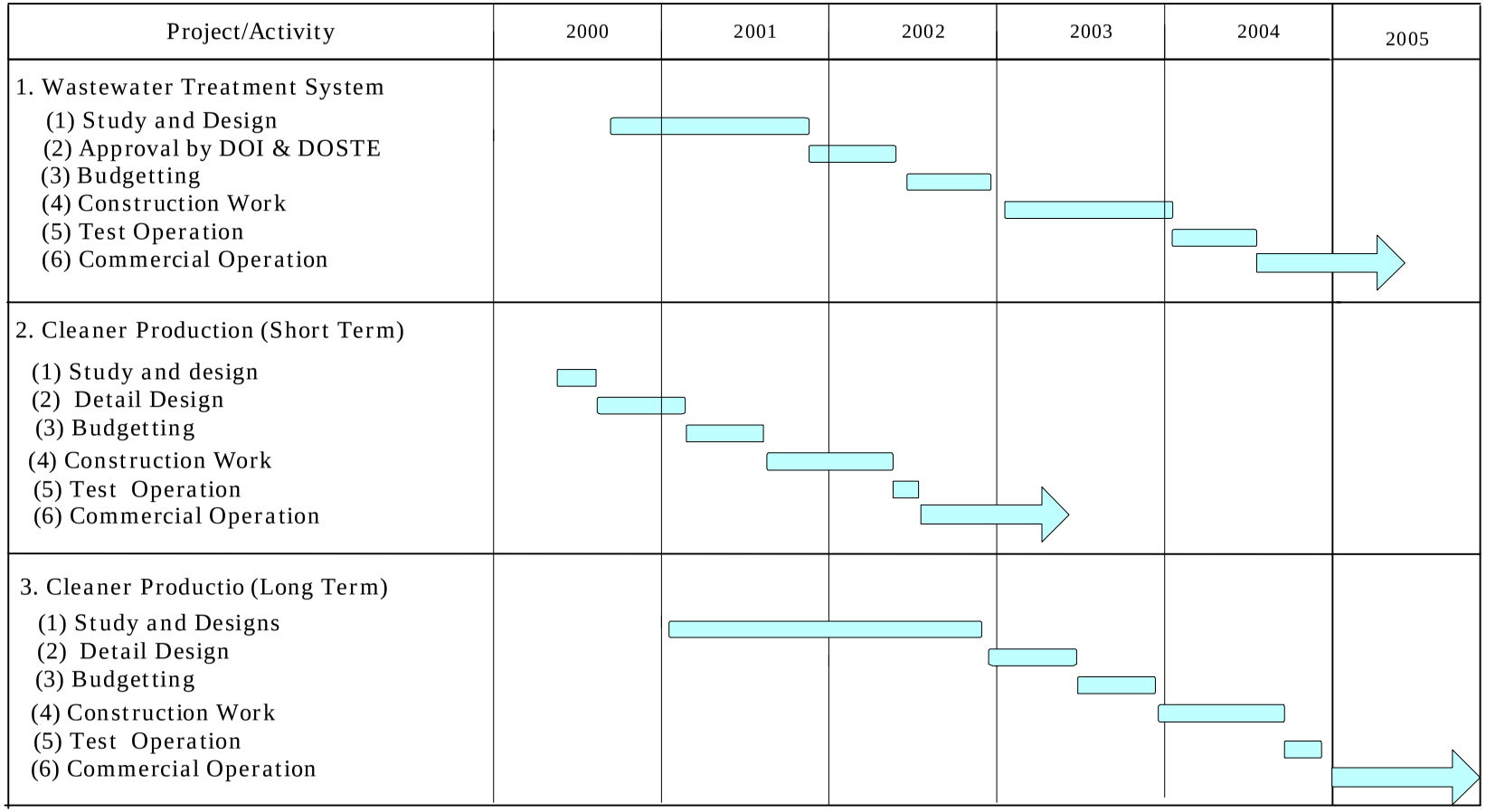

Figure 5 Proposed Implementation Schedule for Pollution Prevention Countermeasure

CASE STUDY T-05

Nam Dinh Silk Company

Survey Date: 26 November 1999
13 & 14 March 2000

1. General

1.1 Profile

Nam Dinh Silk Company is a state-owned company that was established in 1959 as a textile manufacturing company. The company profile and organization of Nam Dinh Silk Company is summarized in Table 1 and Figure 1.

Table 1 Enterprise Profile

Name of Company:	Nam Dinh Silk Company
Ownership:	State-owned
Address:	N 4 Ha Huy Tap Nam Dinh City
Tel:	0350-849622-849497
Director:	
Established:	1959
Corporate Capital:	
Number of Employees:	1,700
Main Products:	Yarns, Fabrics

1.2 Business Status

1.2.1 Production

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

Some products are exported to France, Italy, Japan, Germany, etc.

Table 2 Production and Sales in 1998

No.	Products	Production	Turnover
1	Fabric	3,367,000 m	104,465 million VND
2	Yarn	441,000 kg	8,759 million VND
	Total		113,204 million VND

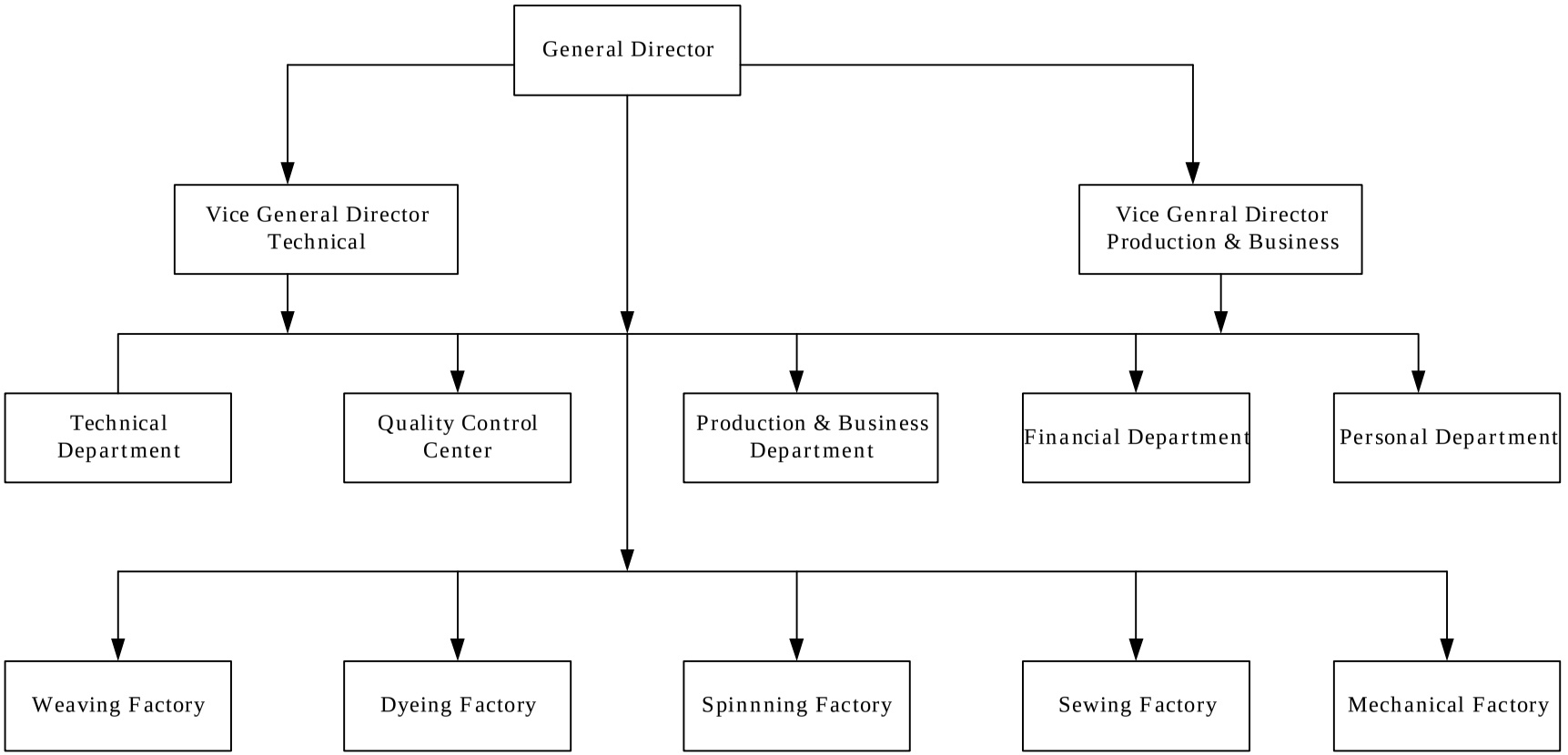

Figure-1 Organization of NAM DINH SILK Company

1.2.2 Debt

Total debt with Banks: 40,037,373,729 VND

Short-term debt (including VND and US$): 14,277,640,039 VND

Long-term debt: (including VND and US$): 17,820,112,967 VND

Long-term (including VND and US$): 6,435,223,640VND

Short term debt: (US$) 1,504,397,033 VND

2. Production Technology

Figure 2 and 3 show the simplified block flow diagram of the factory and the block flow diagram of the dyeing process, respectively.

3. Management Technology

Table 3 shows unit consumption of the raw materials and utilities.

Table 3 Unit Consumption of Raw Materials and Utilities

No.	Materials	Production	Expenses (VND)
1	Fabrics	5,585,000 m^2	
2	Yarns	500 t	
3	Disperse dyes	25,000 kg	
4	Vat dyes	9,750 kg	
5	NaOH	27,500 kg	
6	H_2O_2	40,000 kg	
7	Salt	3,800 kg	
8	Water	600,000 m^3	1,170,000,000 VND
9	FO	83,685 kg	1,631,837,500 VND
10	Coal	4,083 tons	1,224,900,000 VND
11	Electricity	5,358,500 kWh	4,340,385,000 VND

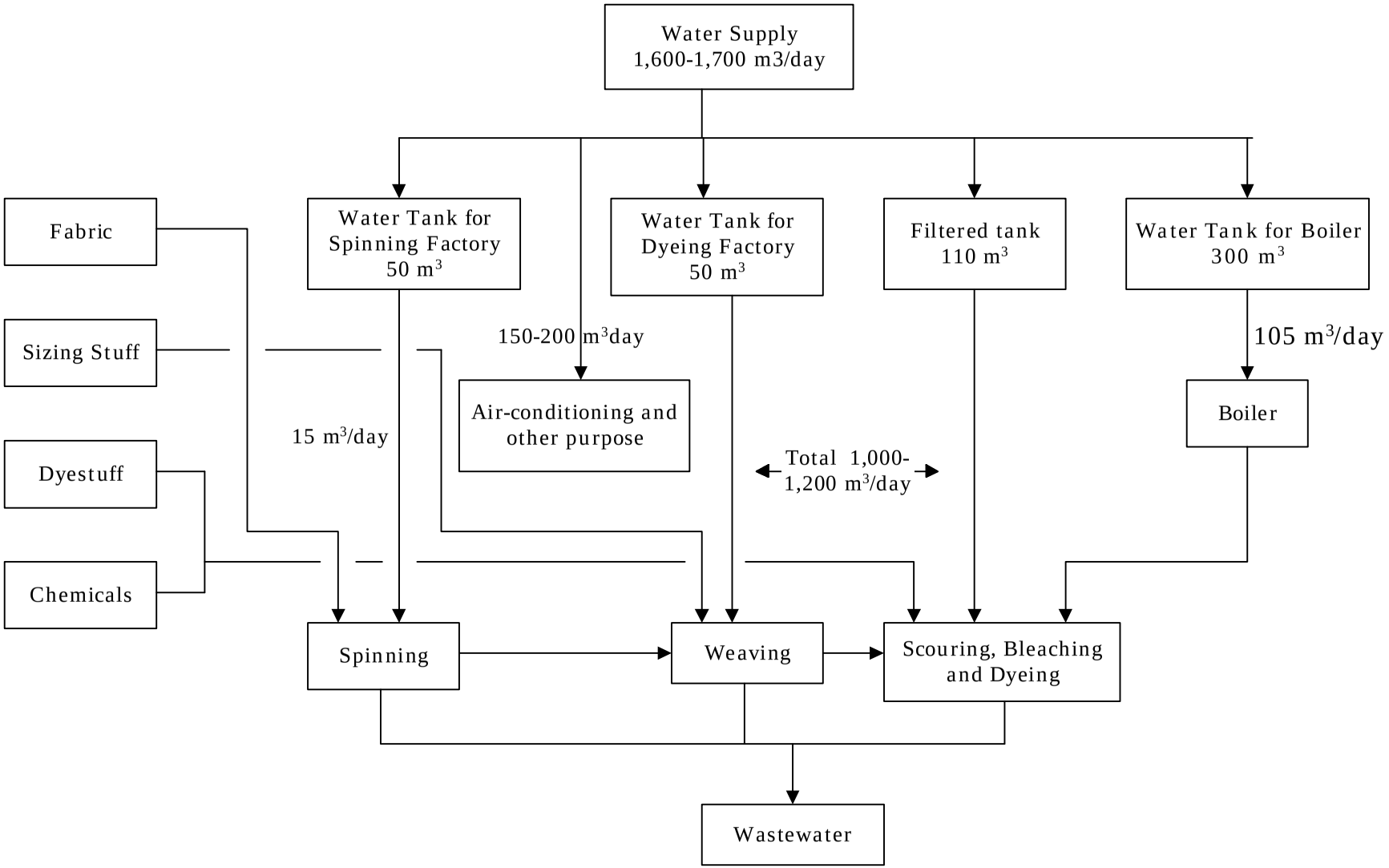

Figure 2 Simplified Block Flow Diagram

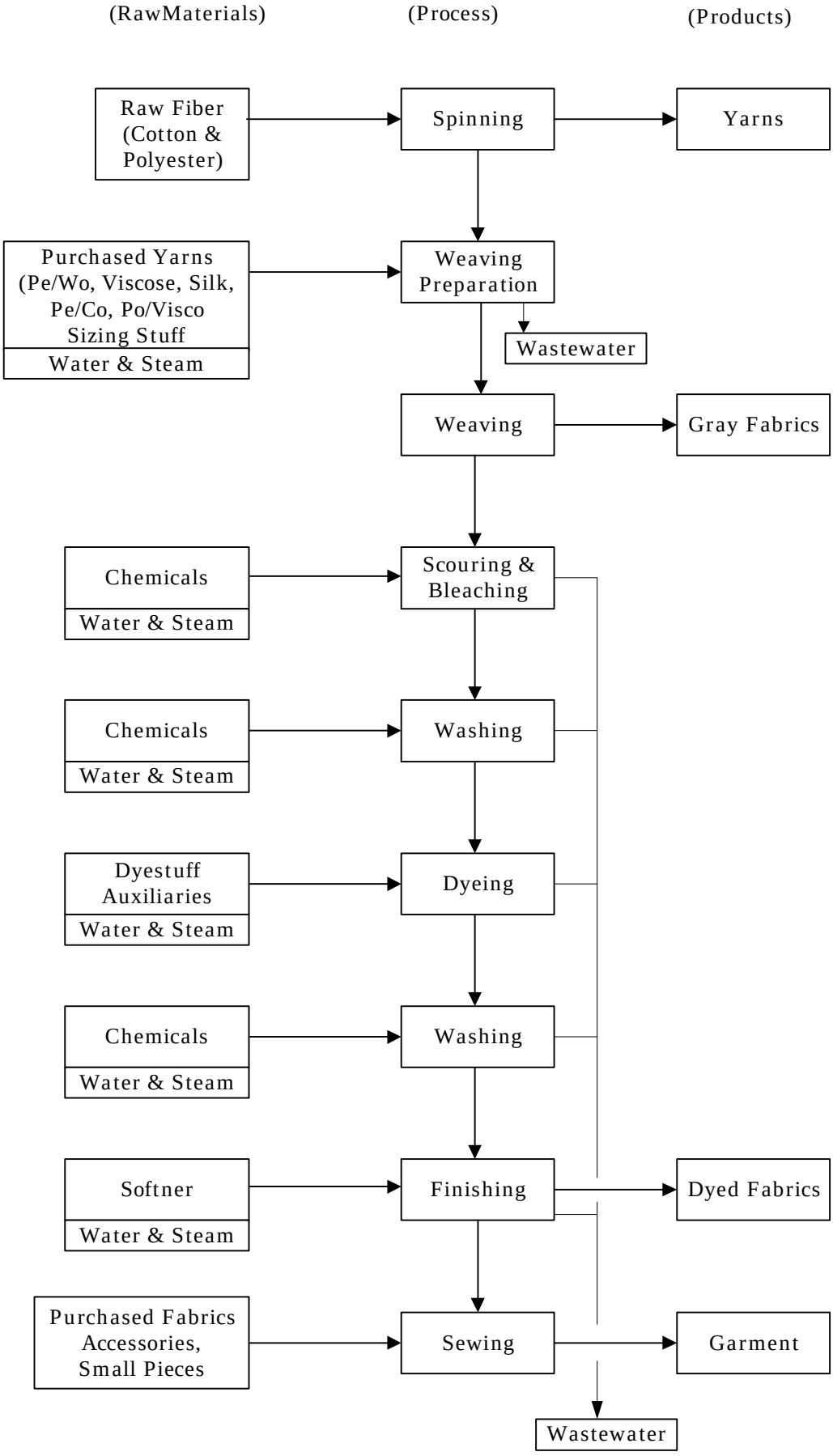

Figure 3 Process Flow Diagram

4. Industrial Wastewater Treatment and Discharge

(1) Outline

1. The volume of wastewater is large at 1,600 m^3/day, and BOD, COD and SS levels are high;
2. No wastewater treatment system has been installed;
3. Wastewater is discharged to the city sewage directly.

(2) Sampling Points in November 1999

Wastewater samples were taken at the following spots for analysis.

Date: 26 November 1999

S1： At Bobbin dyeing m/c (wash water after dyeing)
S2： At Bobbin dyeing m/c (wash water after scouring)
S3： At Jet dyeing m/c (wash water after scouring)
S4： Waste water from the dying factory (to city sewage)

(3) Results of Wastewater Analysis in November 1999

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment (CEETIA) are shown in Table 4.

Table 4 Wastewater Quality in November 1999

	Unit	S1	S2	S3	S4
Temperature	℃	47	70.3	63	35.3
PH		8.14	3.7	4.25	8.93
Electric Conductivity	μS/cm	230	270	1190	370
Turbidity	NTU	1.8	8.2	757	13.5
Oil content	mg/l	0.01	0.01	0.02	0.02
BOD	mg/l	60.2	132	644.2	522.7
COD	mg/l	83.8	880	2550	665
DO	mg/l	3.9	3.5	3.1	4.2
SS	mg/l	2.8	9.5	780	17.3
Total Nitrogen	mg/l	4.2	4.9	5.9	9.2
Residual Chlorine	mg/l	0.35	Trace	Trace	Trace
SO_4	mg/l	62.4	28.2	100.4	91.2
Cyanogen	mg/l	0.01	Trace	Trace	Trace

(4) Sampling Points in March 2000

Wastewater samples were taken at following spots for analysis in this study.

Date: 13 & 14 March 2000

S1：At the outlet of the dyeing factory：Composite Sampling 13 Mar.
Sampling time:①13:50,②14;05,③14;20,④14;35, ⑤14;50,⑥15;05,⑦15;20,⑧15;35
S2：Supply water after Ion treatment for calendar m/c：Sampling 14 Mar .
Sampling time:. 13:38
S3 : Supply water for the dyeing process： Sampling time: 13:50
S4: Supply water after sand filtration for bobbin dyeing：Sampling time: 13:56
S5: At the outlet of the dyeing factory：Composite Sampling 14 Mar.
Sampling time:①10:00②10:15③10:30④10:45⑤11:00⑥11:15⑦11:30⑧14;00
⑨14;15 ⑩14;30 ⑪14;45 ⑫15;00

(5) Results of Wastewater Analysis in March 2000

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment (CEETIA) are shown in Table 5.

Table 5 Wastewater Quality in March 2000

	Unit	S1	S2	S3	S4	S5
Temperature	℃	25.3	28.8	23.5	21.1	24.9
pH		6.67	8.28	8.3	8.09	9.53
Elec. Conductivity	μS/cm	510	960	890	181	313
Turbidity	NTU	48	2	2	1	10
Oil content	mg/l	Trace	0	0	0	Trace
BOD	mg/l	49.2				135
COD	mg/l	74				360
DO	mg/l	10.7	3.56	6.85		4.28
SS	mg/l	62	6	4	3	19
All Nitrogen	mg/l	2.82	0.15	0.12	0.09	3.4
Residual Chlorine	mg/l	0.29	Trace	Trace	Trace	0.31
SO_4	mg/l	38	1.88	1.32	0.59	46
Ca^{2+}	mg/l		4.4	30.8	40.8	26.4
Fe^{2+}	mg/l		0.77	0.13	0.21	0.41

(6) Study on Wastewater Treatment Facility

The results of examination by Namdinh Silk Co. in 1998 are as follows:

1) Design conditions

①Production: Yarns: 500 tons/year {average count (Ne):, 45/1}

Woven fabrics: 6,000,000 m^2/year {average fabric weight: 260 g/m^2 }

Dyeing fabrics 8,000,000 m^2/year

Garments: 120,000 shirts/year

②Wastewater Volume： 1,500 m^3/day

③Treatment Methods： Coagulating Sedimentation

④Setting Area： 4,500 m^3

2) Investment cost

The investment cost of the wastewater treatment system is estimated as follows;

1- Collecting tank of 100 m^3

2 - Sedimentation tank of 300 m^3

3- Reaction tank of 200 m^3

4- Overflow tank of 300 m^3 with filter

5- Separation tank of 300 m^3

Total ： 100,000,000 VND

5. Countermeasures for Improvement

5.1 Countermeasures for Production Technology Improvement

(1) Current Problems

a. The roller part of the spinning machines is an outdated type that does not adopt use of a large packaging system that causes the evenness of yarns to be bad.

b. A hand-binding type RT Winder is used for yarn winding, because it does not have a splicer system, and it does not satisfy export standards.

c. The maintenance of machines is poor. Especially, card wire damage is conspicuous at the spinning plant.

d. There is a lot of steam leakage in pipe lines.

e. No countermeasures for energy saving have been adopted, but of steam condensate is recovered.

f. The liquid ratio for jet type dyeing machines is high at 1:10～1:12.

g. The laboratory facilities and the color kitchen system are not properly prepared.

(2) Countermeasures

a. The roller parts of the spinning machines should be changed to a new type.

b. The splicing system should be equipped with hand-binding type winders.

c. It is necessary to change card wires deliberately otherwise it influences the quality of products greatly.

d. The steam leakage problem should be solved.
e. Countermeasure for energy saving, such as recovery of cooling water and heat recovery from the wastewater, should be adopted.
f. Low liquid ratio dyeing machines (as 1:6) should be introduced when there is a chance to increase or renew machines.
g. More suitable laboratory facilities should be prepared.
h. The color kitchen system should be modernized.

5.2 Countermeasures for Management Technology Improvement

(1) Current Problems

a. Product diversification is the major problem for management, but it is needed to determine production items which can utilize existing facilities efficiently.
b. Generally, the cleaning, arrangement and tidying of the facilities are insufficient and the maintenance of production facilities is poor.
c. In the dyeing process, the reproduction ratio is very high at 20 %. This means that quality control is inefficient.
d. In the dyeing process, water consumption is too high.
e. The color kitchen is very dirty and in disorder.
f. Operation standardization of and make-up of operation manuals are inefficient.
g. Cost management, such as calculating unit consumption of the raw materials and energy, is hardly carried out.
h. The maintenance of facilities is inefficient.

(2) Countermeasures

a. Production technology which meets the markets needs should be introduced.
b. Analysis of unit consumption and promotion of a cost reduction program should be executed.
c. As a first step, water and steam consumption level should be grasped.
d. Operation manuals should be prepared and place in a position where operators can see them.
e. The “5S Movement” should be executed.
f. ISO9000 series should be introduced.
g. The maintenance function should be reinforced.

5.3 Countermeasures for Wastewater Treatment

The company should install the following wastewater treatment system in order to improve the quality of the factory wastewater to within Vietnam standard value.

(1) Outline of the Wastewater Treatment System

a) Volume of wastewater.： 1,500 m^3/day

b) Production capacity： 40,000 **m**/day (Dyeing fabric)

c) Treatment Methods：Activated sludge process & Coagulating Sedimentation

d) Investment Cost： 4,111,000,000 VND

(2) Flow Diagram of the Wastewater Treatment System

Fiure-4 shows the flow diagram of the wastewater treatment system.

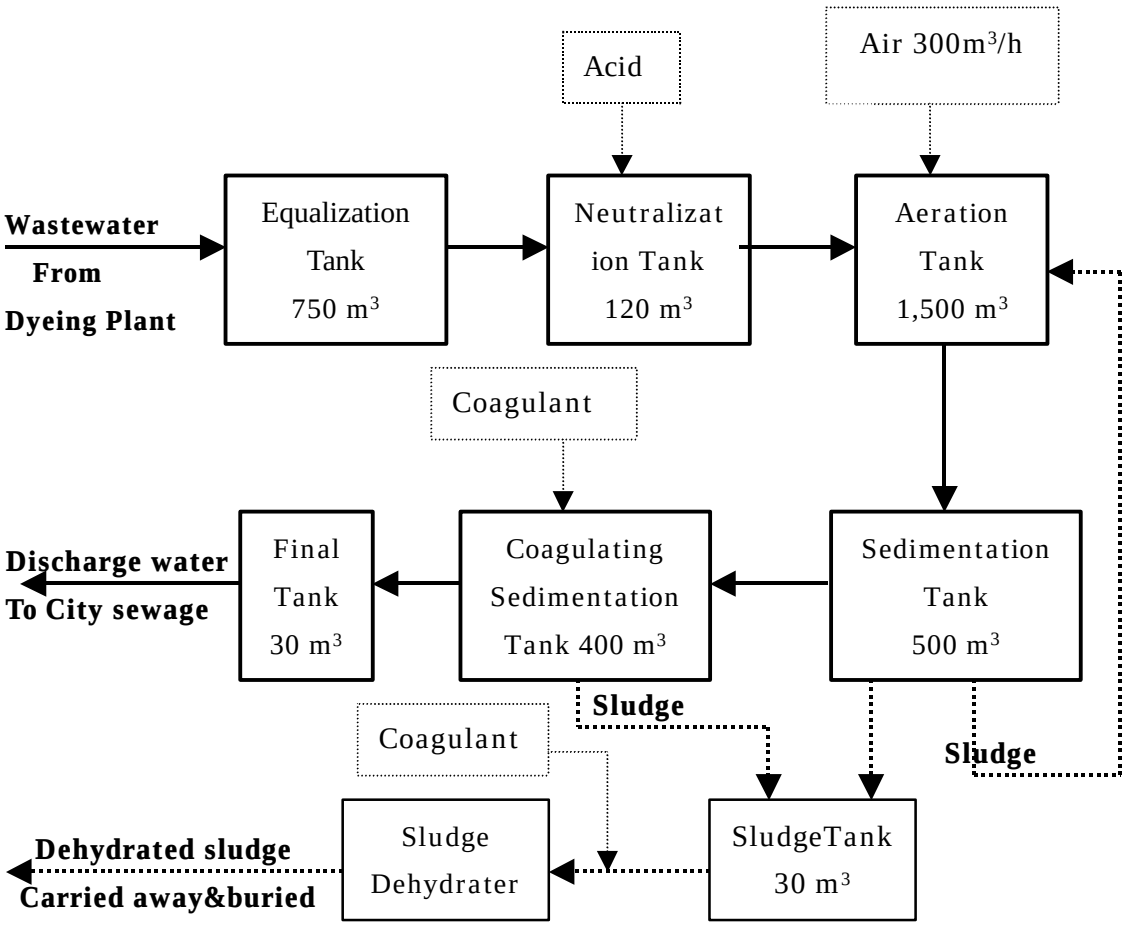

Figure 4 Flow Diagram of Wastewater Treatment System

(3) Investment Cost

Table 6 shows the investment cost of the wastewater treatment system.

Table 6 Investment Cost of wastewater treatment system

Items	Unit	Quantity	Unit price VND	Expenses VND
Equalization tank	m^3	750	700,000	525,000,000
pH neutralization tank	m^3	120	700,000	84,000,000
Aeration tank	m^3	1,500	700,000	1,050,000,000
Sedimentation tank	m^3	500	850,000	425,000,000
Coagulation tank	m^3	400	850,000	340,000,000
Final tank	m^3	30	700,000	21,000,000
Sludge tank	m^3	30	700,000	21,000,000
Sewerage: 500 x 600	m^3	150	300,000	45,000,000
Sub Total 1 (Costruction)				**2,511,000,000**
Wastewater Pump	piece	4	10,000,000	40,000,000
Aerator; capacity 150 m^3/h	piece	3	30,000,000	90,000,000
pH meter and metering pump	set	1	40,000,000	40,000,000
Agitator; capacity: 2 HP	piece	4	7,500,000	30,000,000
Acid mixture apparatus	set	1	100,000,000	100,000,000
Coagulant mixture apparatus	set	2	100,000,000	200,000,000
Sludge dehydrating machine	set	1	500,000,000	500,000,000
Electricity	set	1	200,000,000	200,000,000
Pipeline and accessories	set	1	200,000,000	200,000,000
Other equipment				200,000,000
Sub Total 2(Equipment)				**1,600,000,000**
Grand Total				**4,111,000,000**

6. Recommended Countermeasure for Improvement

6.1 Short Term Countermeasures

No	Countermeasure	Expected Results
1	Installation of flow meters for water and steam	Grasp of unit consumption (Cost reduction)
2	Installation of a cooling water recovery system	Save energy
3	Installation of heat recovery system from the waste water	Save energy
4	Operation standardization	Improvement of products quality, Cost reduction
5	Reinforcement of maintenance function	Upkeep of equipment capacity, productivity and products quality
6	Execution of the “5S Movement”	Elimination of waste-fullness, Lift up of worker’s morale, Improvement of products quality, Gaining of customer's trust

6.2 Mid and Long Term Countermeasures

No	Countermeasure	Expected Results
1	Installation of a wastewater treatment system	Improvement of wastewater quality
3	Modernization of the Color Kitchen	Improvement of the accuracy of scaling, Prevention of contamination, Improvement of the working environment
4	Acquisition of ISO9000 series certification	Improvement of product quality, Cost reduction
5	Introduction of a cost reduction program	Cost reduction
6	Introduction of low liquid ratio type dyeing machines	Reduction of wastewater volume, Reduction of chemicals consumption, Improvement of productivity, Possibility to produce high value-added products
7	Introduction of new dyeing technology, such as the Rapid Dyeing Method	Save energy, Reduction of chemicals consumption, Improvement of wastewater quality

7. Proposed Implementation Schedule

The proposed implementation schedule is shown in Figure 5.

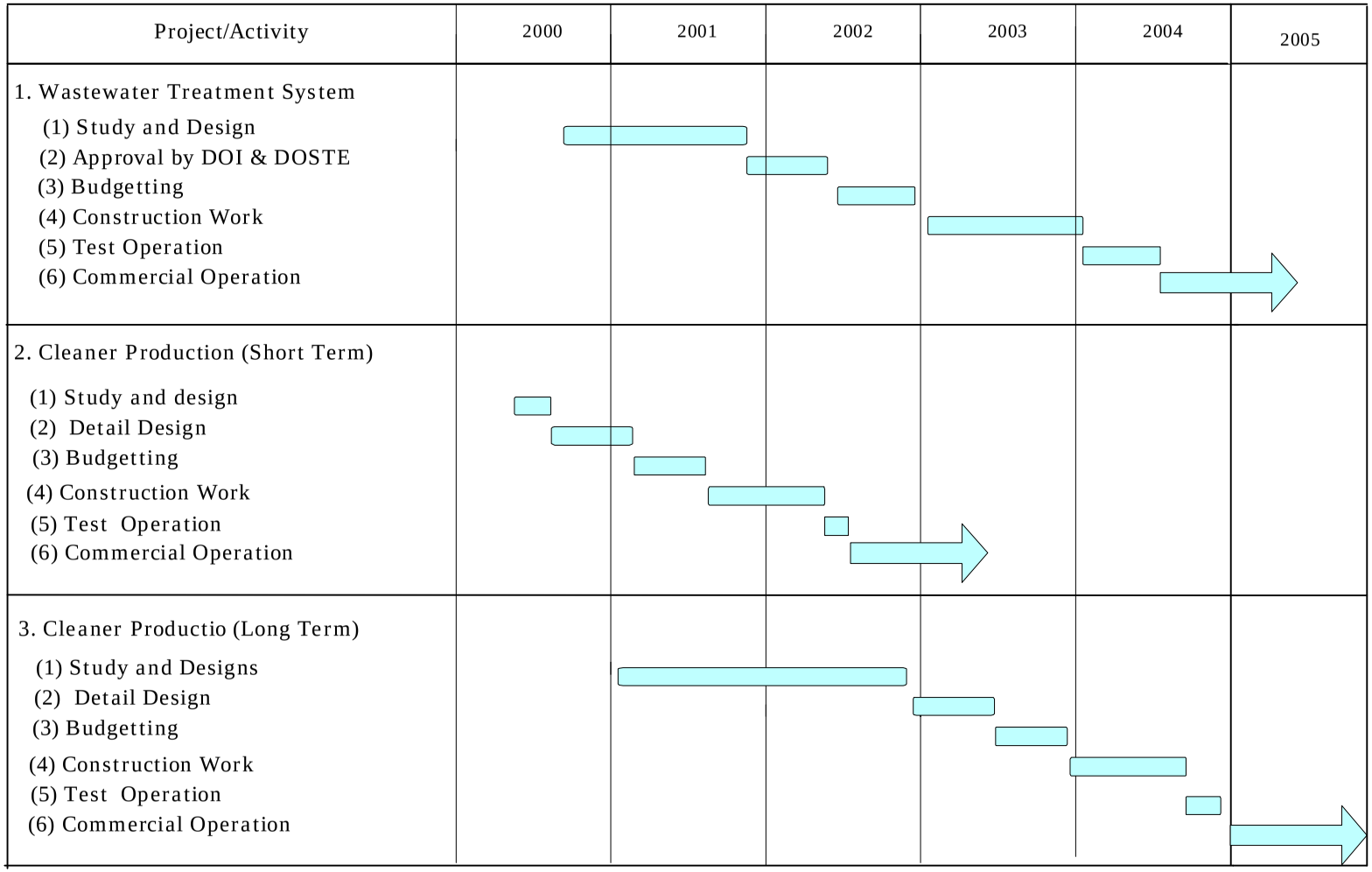

Figure 5 Proposed Implementation Schedule for Pollution Prevention Countermeasure

CASE STDY T-06

Duc Giang Garment Export and Import Company

Survey Date: 19 November 1999

1. General

1.1 Profile

Duc Giang Garment Export and Import Company is a state-owned company that was established in 1989 as a garment manufacturing company. The company profile of Duc Giang Garment Export and Import Company is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Duc Giang Garment Export and Import Company
Ownership:	State-owned
Address:	Thi Tran Duc Giang, Hanoi
Tel:	04-8271621
Director:	
Established:	1989
Corporate Capital:	
Number of Employees:	2,800
Main Products:	Jackets, Shirts

1.2 Business Status

1.2.1 Production

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

More than 95% of products are exported to the EU, Poland, Czech, Hong-Kong, Japan, etc.

Table 2 Production and Sales in 1998

No.	Items	Production	Turnover (1000VND)
1	Jackets	10,536	797,785
2	Shirts	71,812	1,618,565
3	Other items	20,124	457,136
	Total	**102,472**	**2,863,506**

1.2.2 Debt

Unknown

2. Production Technology

2.1 Process

The process flow of the factory is shown in Figure 1.

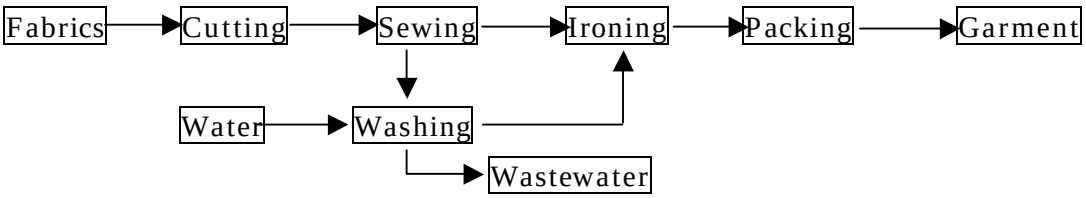

Figure 1 Process Flow of the Factory

2.2 Unit Consumption

The unit consumption of raw materials and utilities is shown in Table 3.

Table 3 Unit Consumption of Raw Materials and Utilities

No.	Materials	Production (tons)	Expenses
1	**Jackets**		
1-1	Fabrics	55.844	
1-2	Nonwoven interlining	23.933	
1-3	Auxiliaries	15.955	
2	**. Shirts**		
2-1	Fabrics	32.171	
2-2	Auxiliaries	16.500	
2-3	Softener	0.236	
3	**Water and Power**		
3-1	Water	97,200 m^3/year	
3-2	FO	21 tons/year	
3-3	Electricity	2,500,000 kWh/year	

2.3 Future Plans

Unknown

3. Management Technology

(1) The factory is very clean and in good order.

(2) The washing plant is especially well organized, neat, tidy, and clean and there is no problem with 5S.

(3) The facilities are well maintained.

(4) The operation is very simple, so there is no problem with operation management.

4. Industrial Wastewater Treatment and Discharge

(1) Flow Rate: 70 m^3/day

(2) Quantity: SS is the main pollutant, besides softener and enzymes.

(3) Treatment Facility: Only two sedimentation tanks are installed.

(4) Sampling:

Wastewater samples were taken at following spots for analysis in this study.

Date: 19 November 1999

S1： Supply water to the washing factory
S2： Wastewater from the washing factory (to the sedimentation tank)
S3： At the sedimentation tank
S4： Discharged wastewater from the sedimentation tank (to city sewage)

(5) Wastewater Quality

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table 4.

5. Recommended Countermeasure for Improvement

(1) It will be beneficial for the company to maintain its facility arrangement and tidiness from now on.

(2) The company needs to prepare operation manuals.

(3) In case that the quality of wastewater gets worse due to increased softener use or something similar, it will more efficient if bad quality wastewater is separated and small treatment facility is set up.

Table 4 Wastewater Quality in November 1999

	Unit	S1	S2	S3	S4
Temperature	℃	28.1	30.3	30.2	36.4
pH		7.1	7.45	7.28	7.8
Electric Conductivity	μS/cm	310	390	270	400
Turbidity	NTU	4.2	10.8	7.6	8.2
Oil content	mg/l	0	0.02	0.01	0.03
BOD	mg/l	5.7	40.7	38.2	33.4
COD	mg/l	15	55	47	52
DO	mg/l	5.7	1.7	1.6	9.8
SS	mg/l	4.9	12.1	10.2	11
Total Nitrogen	mg/l	4.9	7.9	8.1	8.5
Residual Chlorine	mg/l	20.6	13.4	22.0	4.96
SO_4	mg/l	18.4	63.4	39.6	4.8
Cyanogen	mg/l	Trace	0.02	0.02	0.03

CASE STUDY T-07

Vinh Phu Textile Company

Survey Date: 22 November 1999

1. General

1.1 Profile

Vinh Phu Textile Company is a state-owned company that was established in 1972 as a textile manufacturing company. The company profile of Vinh Phu Textile Company is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Vinh Phu Textile Co
Ownership:	State-owned
Address:	108 Hung Vuong Str. Viet Tri City Phu Tho Pro.
Tel:	021-845886
Director:	
Established:	1972
Corporate Capital:	
Number of Employees:	2,000
Main Products:	Yarns, Fabrics and Garments of Polyester and cotton

1.2 Business Status

1.2.1 Production

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

90% of products are made for the domestic market because the quality of their products is not so high.

Table 2 Production and Sales in 1998

No.	Items	Production	Turnover (VND)
1	Yarns	657 tons	19.118 billions
2	Fabrics	5,665,000 meters	49.547 billions
3	Garments	202,000 pieces	4.816 billions
4	Others		2.714 billions
	Total		**76.195 billions**

1.2.2Debt

Debts to Commerce bank:	40,694,278,894 VND
Debt to Government credit:	50,702,134,668 VND
Total	91,396,413,562 VND

2. Production Technology

2.1 Process

The Process flow of the factory is shown in Figure 1.

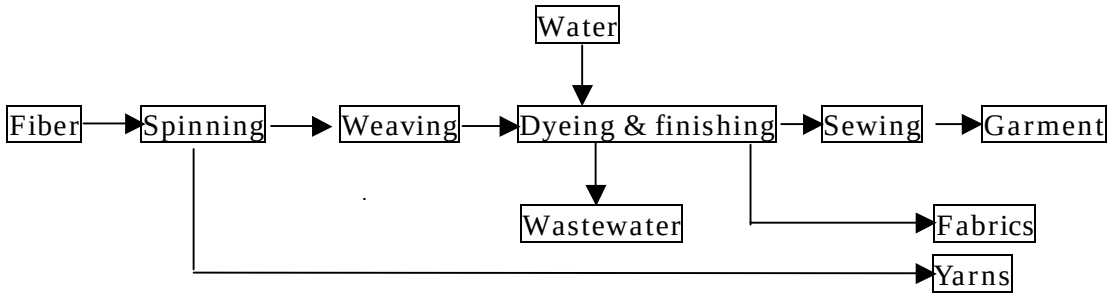

Figure 1 Process Flow of the Factory

2.2 Unit Consumption

The unit consumption of raw materials and utilities is shown in Table -3.

2.3 Future Plans

Unknown

3. Management Technology

(1) The roller part of China-made machines, which account for 70% of spinning machines, is outdated. The introduction of a large packaging system has been delayed, so the evenness of yarns is not good.

(2) The width of the fabric made by 500 China-made weaving machines is narrow and its production rate is low because its applications are limited.

(3) The China-made facilities can process only narrow-width fabric and the printing facilities have the same specifications. This is the most important problem in this factory.

(4) The inside of the plant is not well organized, is untidy, and is not cleaned well. The maintenance of the production lines is very poor.

(5) The spinning process especially, lacks process management and there are many problems with operation control.

(6) There are no improvement activities, such as a 5S campaign or QC activities, at the plant.

(7) As the production rate of old machines and new machines is not balanced, there

are many suspended machines, and the new ones have not been given full scope to their ability yet.

(8) Plant management and administration staff lack experience and knowledge for improving productivity and quality. It is inevitable to educate or train leaders and technicians, and also to have technical instruction from outside the company.

4. Industrial Wastewater Treatment and Discharge

(1) A biological water treatment system has been installed.

(2) The pH of wastewater is not controlled, so the efficiency of treatment is very low.

(3) Sampling:

Wastewater samples were taken at the following spots for analysis in this study on 22 November 1999.

S1： Wastewater from the spinning & weaving factory(to)

S2： At the wastewater treatment system (before biological treatment)

S3： Discharged wastewater (to city sewage after biological treatment)

(4) Wastewater Quality

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table 4.

5. Recommended Countermeasures for Improvement

(1) The highest priorities should be introduce a splicing method, which is the global standard in the spinning yarn business, to expand sales routes and raise the operation rate.

(2) Full-automatic German winding machines are too expensive to invest in, so it is better to introduce cheaper Italian manual splicing machines.

(3) pH of wastewater from the plant is high and it is not efficient for a biological system. Neutralization with acids at the mixing tank should be carried out.

Table 3 Unit Consumption of Raw Materials and Utilities

No.	Material	Production	Expenses (VND)
1	**Yarn production**		
1-1	Main materials (fibbers)	674.044 t	13,324,635,669
1-2	Auxiliaries		311,346,587
1-3	Water	11,247 m^3	20,201,577
1-4	Electricity	2,091,082 kWh	1,512,458,879
1-5	Depreciation		664,732,836
1-6	Other expenses		1,437,460,735
1-7	Salary and Social insurance		1,221,732,213
2	**Fabric production**		
2-1	Main material (yarns)	1,124.568 t	32,571,383,738
2-2	Auxiliaries	66.778 t	591,443,692
2-3	Water	7,895 m^3	14,500,324
2-4	Electricity	1,555,123 kWh	1,121,231,764
2-5	Depreciation		1,830,549,532
2-6	Other expenses		3,382,508,937
2-7	Salary and Social insurance		2,147,291,677
3	**Dyeing and printing production**		
3-1	Main materials(gray and dyed fabrics)	5,964,099 m	43,071,258,745
3-2	Dyes, chemicals, package materials	182.197 t	1,488,600,545
3-3	Water	212,160 m^3	394,885,331
3-4	Electricity	362,445 kWh	261,758,140
3-5	Depreciation		439,845,033
3-6	Other expenses		2,472,792,137
3-7	Salary and Social insurance		402,635,551
4	**Steam production:**	**12,878 t**	
4-1	Main material(coal dust)	3,603.806 t	1,256,358,848
4-2	2. Water	245,179 m^3	456,341,708
4-3	3. Coal	52.356 t	29,891,272
4-4	4. Electricity	365,964.7 kWh	264,299,771

Table 4 Wastewater Quality in November 1999

	Unit	S1	S2	S3
Temperature	℃	24.7	24.7	23.6
pH		7.3	10.7	10.47
Electric Conductivity	μS/cm	290	1880	1180
Turbidity	NTU	2.8	47.2	66.5
Oil content	mg/l	0.04	0.03	0.01
BOD	mg/l	16.5	116.4	132
COD	mg/l	21.5	151	158
DO	mg/l	2.4	3.8	2.75
SS	mg/l	5.8	51.7	73.5
Total Nitrogen	mg/l	19.1	18.5	18.7
Residual Chlorine	mg/l	Trace	Trace	Trace
SO_4	mg/l	97.6	192	259.2
Cyanogen	mg/l	0.02	0.03	0.02

CASE STUDY T-08

Thang Long Garment Company

Survey Date: 23 November 1999

1. General

1.1 Profile

Thang Long Garment Company is a state-owned company that was established in 1958 as a garment manufacturing company. The company profile of Thang Long Garment Company is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Thang Long Garment Company
Ownership:	State-owned
Address:	250 Minh Khai Str. Hanoi
Tel:	04-8623372
Director:	
Established:	1958
Corporate Capital:	
Number of Employees:	200
Main Products:	Jackets, Shirts, Trousers Jeans

1.2 Business Status

1.2.1 Production

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

80% of products are exported to Taiwan, Hong Kong, Korea, etc.

Table 2 Production and Sales in 1998

No.	Products	Production	Turnover
1	Jackets	743,000 pcs	50,140 million VND
2	Shirts	141,000 pcs	2,866 million VND
3	Trousers	86,000 pcs	2,356 million VND
4	Jeans	216,000 pcs	10,522 million VND
5	Jeans Shirts	102,ooo pcs	7,566 million VND
6	Others	254,000 pcs	5,476 million VND
	Total		78,881 million VND

1.2.2 Debt

20 billion VND with a foreign trading bank (Running Capital)

10 billion VND with an investment & development bank (Investment Capital)

2. Production Technology

2.1 Process

The Process flow of the factory is shown in Figure 1.

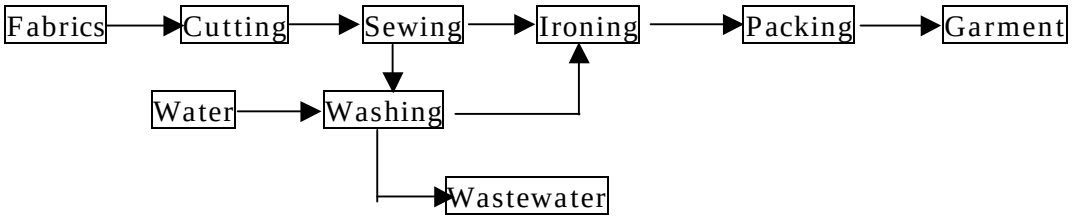

Figure 1 Process Flow of the Factory

2.2 Unit Consumption

The unit consumption of the raw materials and utilities is shown in Table 3.

2.3 Future Plans

Unknown

3. Management Technology

(1) Due to the old age of the facilities, the thermometer doesn't function so workers control the temperature according to their senses. Other than that, water volume and chemical volume control are done irresponsibly and are wasted. Accordingly, such things influence the quality of products.

(2) The company doesn't recover steam condensate from dryers, but discharges it as wastewater.

(3) The inside of the plant is in confusion and untidy.

(4) There are many empty beverage packs discharged in a sedimentation tank.

(5) As gauges are not maintained well all operations are controlled by the sense of workers.

Table 3 Unit Consumption of Raw Materials and Utilities

No.	Materials	Unit consumption	Expenses (VND/pieces)
1	**Jackets:**		
1-1	Fabric	3 meters	60,000
1-2	Water	0.07 m^3	105
1-3	Detergent	0.026 kg	187
1-4	Electricity	0.8 kWh	640
1-5	FO	0.8 kg	1,440
2	**Shirts:**		
2-1	Fabric	2 meters	32,000
2-2	Detergent	0.015 kg	108
2-3	Softener	0.01 kg	440
2-4	Whitening agent	0.001 kg	80
2-5	Acetic acid	0.001 kg	13
2-6	Electricity	0.5 kWh	400
2-7	FO	0.3 kg	540
2-8	Water	0.05 m^3	75
3	**Jeans:**		
3-1	Fabric	2 meters	48.000
3-2	NaClO	1 litter	900
3-3	Oxalic acid	0.04 kg	308
3-4	H_2O_2	0.01 kg	165
3-5	Acetic acid	0.001 kg	13
3-6	Whitening agent	0.002 kg	160
3-7	Softener	0.02 kg	880
3-8	Stone	0.3 kg	1,000
3-9	Enzyme	0.01 kg	1,000
3-10	Water	0.08 m^3	120
3-11	Electricity	0.7 kWh	560
3-12	FO	0.8 kg	1,440

4. Industrial Wastewater Treatment and Discharge

(1) Wastewater is discharged to a river after going through only two stage sedimentation pits.

(2)Sampling

Wastewater samples were taken at following spots for analysis in this study.

Date: 23 November, 1999

S1： At washing m/c (Enzyme washing Stage-1)
S2： At washing m/c (Enzyme washing Stage-2)
S3： At washing m/c (Enzyme washing Stage-3)
S4： At washing m/c (Enzyme washing Stage-4)
S5： Discharged waste water from the factory(to city sewage)
S6： At washing m/c (Stone washing Stage-1)
S7： At washing m/c (Stone washing Stage-2)
S8： At washing m/c (Stone washing Stage-3)
S9： At washing m/c (Stone washing Stage-4)

(3)Wastewater Quality

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table 4.

Table 4 Wastewater Quality in November 1999

	Unit	S1	S2	S3	S4	S5
Temperature	℃	45.5	45.4	30.8	39	30.3
PH		7.4	7.94	7.28	4.32	6.09
Elec. Conductivity	μS/cm	320	440	270	500	300
Turbidity	NTU	76.2	66.7	38.5	181	31.5
Oil content	mg/l	0.01	0.01	Trace	Trace	Trace
BOD	mg/l	31.6	61.8	51.8	51.8	79
COD	mg/l	62.8	71.2	52.8	56.3	88
DO	mg/l	7.33	6.73	7.6	6.55	6.9
SS	mg/l	89	78	41	196	40
Total Nitrogen	mg/l	9.11	9.42	8.2	10.1	8.96
Residual Chlorine	mg/l	22.7	9.93	Trace	9.22	7.09
SO_4	mg/l	89.2	153.6	98.4	192.8	100.8
Cyanogen	mg/l	0.04	0.03	0/05	0.04	0.08

	Unit	S6	S7	S8	S9
Temperature	℃	48.2	30.3	46.9	37.2
PH		10.1	2.29	6.5	7.18
Elec. Conductivity	μS/cm	5900	2730	640	240
Turbidity	NTU	270	321	315	247
Oil content	mg/l	Trace	Trace	0.01	Trace
BOD	mg/l	57.3	42.1	42.6	41.4
COD	mg/l	72.6	54.2	55.8	60.6
DO	mg/l	6.3	7.67	9.15	8.7
SS	mg/l	288	330	327	261
Total Nitrogen	mg/l	181.1	8.12	35.1	25.7
Residual Chlorine	mg/l	56.0	Trace	Trace	Trace
SO_4	mg/l	297.6	212.8	133.6	48.0
Cyanogen	mg/l	0.11	0.09	0.06	0.03

5. Recommended Countermeasures for Improvement

(1) The company should keep gauges in good repair and reduce the volume of water and amount of steam and chemicals used, as well as control the quality.

(2) The company should recover steam condensate from a dryer for saving energy.

(3) It is necessary for the company to reinforce the administration system such as arranging things and keeping the work place tidy, and to improve the morals of workers.

CASE STUDY T-09

Dong Xuan Knitting Company

Survey Date: 24 November 1999

1. General

1.1 Profile

Dong Xuan Knitting Company is a state-owned company that was established in 1959 as a knitting fabric manufacturing company. The company profile of Dong Xuan Knitting Company is summarized in Table1.

Table 1 Enterprise Profile

Name of Company:	Dong Xuan Knitting Company
Ownership:	State-owned
Address:	67 Ngo Thi Nham Str. Hanoi
Tel:	04-9716565
Director:	
Established:	1959
Corporate Capital:	
Number of Employees:	1,200
Main Products:	Knitwear

1.2 Business Status

1.2.1 Production

Table2 shows production and sales of the Company in 1998.

A major part of their products are exported to the EU and Asia and 60% of products are exported to Japan.

Table 2 Production and Sales in 1998

No.	Product items	Production (pieces)	Turnover (1998 figures)
1	Knitwear	6,036,000	75,722 billion VND
	Total	**6,036,000**	**75,722 billion VND**

1.2.2 Debt

75,000,000,000 VND (1998)

STATE BANK 15,000,000,000VND(Long Term Loan)

COMMERCIAL BANK 15,000,000,000VND (Interest Ratio 9.6%/year)

2. Production Technology

2.1 Process

The Process flow of the factory is shown in Figure 1.

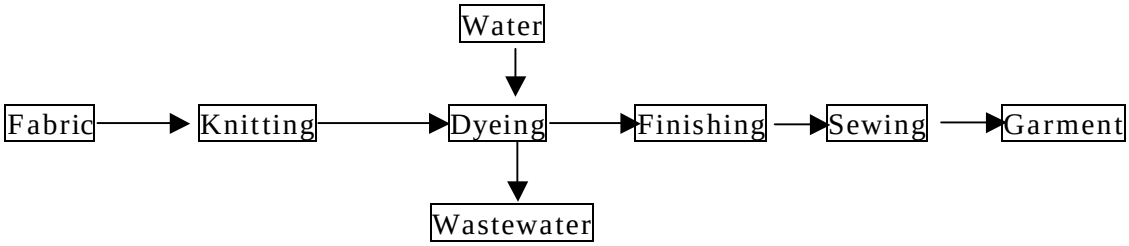

Figure 1 Process Flow of the Factory

2.2 Unit Consumption

The unit consumption of raw materials and utilities is shown in Table3.

Table 3 Unit Consumption of Raw Materials and Utilities

No.	Materials	Amount	Unit price	Expense
1	Yarn 40s/1	507,340 kg	45,980 VND/kg	23,328 millions VND
2	Yarn 30s/1	40,000 kg	44,390 VND/kg	1,756 millions VND
3	H_2O_2	134.50 kg	3,994 VND/kg	536.555 millions VND
4	CH_3COOH	5,913 kg	9,610 VND/kg	56.820 millions VND
5	Dyes			
6	Water	220,000 m^3	1,000 VND/m^3	220 millions VND
7	FO	416,000kg	1,800 VMD/kg	748.8 millions VND
8	Coal	2,158,000 kg	340 VND	733.7 millions VND
9	Electricity	1,867,510 kWh	800 VND/kWh	1,493.3 millions VND

2.3 Future Plans

The company has future plans to remove the dyeing factory, which discharges pollutants to the surrounding suburbs, because this factory is located in a thickly populated residential area and there is no space to install a wastewater treatment system.

The planned re-location area is in the southern part of Hanoi city where two textile factories are in operation and one food factory is scheduled to move out. A plan for constructing a water treatment center is being investigated in this area.

The company estimates the factory moving cost at US$ 4,000,000, but

investment funding is a problem.

3. Management Technology

(1) Many of the facilities are old, but they are used efficiently in their own way. The quality is not so bad.

(2) The management lacks the ability to cope with market diversification. The company manufactures mainly underwear and the like that is low in added value. Also, products, which are not technically difficult to produce are mostly manufactured.

(3) The company needs to improve production facilities and technology to meet the demand of customers in the future.

(4) Generally the plant is organized, neat, tidy and cleaned well and the working environment is good.

(5) A director has introduced a 5S campaign from Japan and the company is now implementing it.

This activity has had good results in its own way, including increase in productivity improvement.

(6) The company started working to obtain ISO9002 in August 1999, and is making effort to be certified by October 2000.

(7) The reprocessing rate is low as 3 %. The company has a system for increasing or decreasing the salary of workers according to the degree in which its targets accomplished. This system works well.

(8) The company has a good grasp of unit consumption of energy, raw material and chemicals.

4. Industrial Wastewater Treatment and Discharge

(1) Only SS is removed from wastewater at the sedimentation tank.

(2) Sampling

Wastewater samples were taken at following spots for analysis in this study.

Date: 24 November 1999

S1：Discharged wastewater from the whole factory(to city sewage)

(3) Wastewater Quality

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table4.

Table 4 Wastewater Quality in November 1999

	Unit	S1
Temperature	℃	47.6
pH		7.94
Elec. Conductivity	μS/cm	540
Turbidity	NTU	11
Oil content	mg/l	0.09
BOD	mg/l	39.5
COD	mg/l	41.5
DO	mg/l	6.2
SS	mg/l	15.3
Total Nitrogen	mg/l	5.8
Residual Chlorine	mg/l	4.8
SO_4	mg/l	184
Cyanogen	mg/l	Trace

5. Recommended Countermeasures for Improvement

(1) The company should recover steam condensate from the processes to a boiler as a measure to reduce steam consumption at the dyeing plant.

(2) The company should conduct a study on recovering and recycling discharged hot water from heat exchangers of dyeing machines.

(3) The company should drive forward the establishment of a joint wastewater treatment facility in the industrial zone where it is going to move in.

CASE STUDY T-10

Ha Dong Woolen Enterprise

Survey Date: 29 November 1999

1. General

1.1 Profile

Ha Dong Woolen Enterprise is a state-owned company that was established in 1989 as a textile manufacturing company. The company profile of Ha Dong Woolen Enterprise is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Ha Dong Woolen Enterprise
Ownership:	State-owned
Address:	Durong 70 Thi Xa Ha Dong Ha Tay
Tel:	04-8542745
Director:	
Established:	1959
Corporate Capital:	
Number of Employees:	595
Main Products:	Yarns for Carpet and Blanket, Fabrics dyed and printed

1.2 Business Status

1.2.1 Production

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

The major parts of products are for the domestic market. A pretty large amount of products had been exported to Russia until last year, but the number of products exported in 1999 was zero.

Table 2 Production and Sales in 1998

	Items	Production	Turnover
1	Carpet Yarn	121 t	7,441 million VND
2	Acrylic Yarn (for Blanket)	161 t	4,839 million VND
3	Knitting Fabric	40 t	1,600 million VND
4	Dyed Fabric	202,000 m	495 million VND
5	Printed Fabric	98,500 m	179 million VND
	Total		14,555 million VND

1.2.2 Debt

860 million VND with a commercial bank

2. Production Technology

2.1 Process

The Process flow of the factory is shown in Figure1.

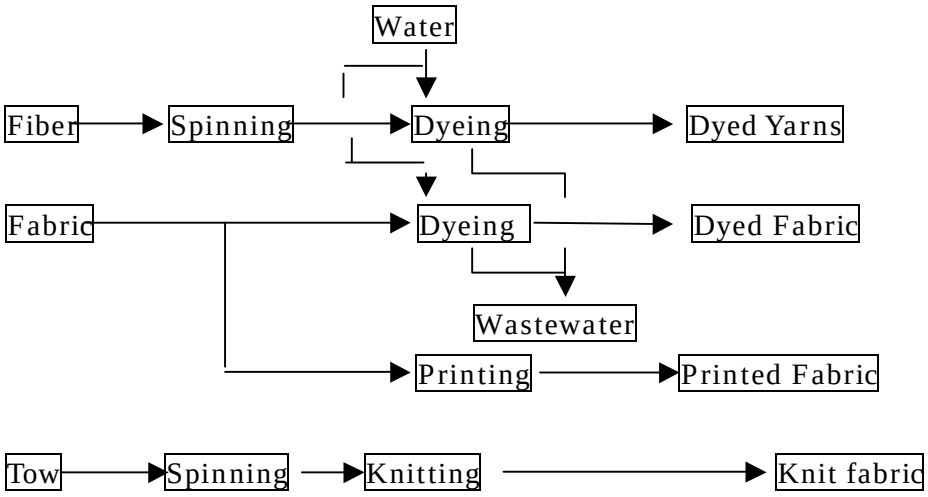

Figure 1 Process Flow of the Factory

2.2 Unit Consumption

The unit consumption of raw materials and utilities is shown in Table 3.

2.3 Future Plans

Unknown

3. Management Technology

(1) The facility was not in operation during our visit therefore, the study team did not have much of an opportunity to check it.

(2) The facilities are old, and both productivity and quality are not good.

(3) The spinning facilities are old and they are in poor repair as well.

(4) We were unable to make any judgments on the dyeing facilities as they were not in operation. However, it seems that the facilities are very old and maintenance on them is poor. Accordingly, it is impossible to expect profitable operations.

(5) We could not evaluate the administrative aspects of the dyeing facilities because they were not in operation. However, it seems that quality control is

not well performed from the appearance of the facilities.

(6) Generally, cleaning, arrangement and tidying of facilities are insufficient.

Table 3 Unit Consumption of Raw Materials and Utilities

No.	Material	Consumption	Remark	Expense (1000VND)
1	**Carpet Yarn**			
1-1	Yarns	138.5 ton	30,760 VND/kg	4,260,260.00
1-2	Acid Dye Stuff	1.338	80,000	107,040.00
1-3	CH_3COOH	2.077	9,500	19,731.50
1-4	Na_2SO_4	11.080	1,800	19,944.00
1-5	Others	1.662	25,000	41,550.00
2	**Acrylic Yarn(Blanket)**			
2-1	Yarns	170 ton	12,200 d/kg	2,074,000.00
2-2	Cationic Dye Stuff	2.890	135,000	390,150.00
2-3	CH_3COOH	2.550	9,500	24,225.00
2-4	Na_2SO_4	6.800	1,800	12,240.00
3	**Acrylic Knit**			
3-1	Tow	42.6 ton	20,800 VND/kg	886,080.00
3-2	Cationic Dye Stuff	0.724	135,000	97,740.00
3-3	CH_3COOH	0.852	9,500	8,094.00
3-4	Na_2SO_4	3.408	1,800	6,134.40
3-5	Others	1.704	30,000	51,120.00
4	**Dyed Fabric**			
4-1	Gray Fabric	201,400 m	6,000 VND/m	1,208,400.00
4-2	Directive Dye Stuff	1.407 ton	95,000 VND/kg	133,665.00
4-3	Chemicals	1.407	4,000	5,628.00
4-4	Wetting Agent	2.613	15,000	391,950.00
4-5	H_2O_2	0.201	7,000	1,407.00
4-6	Others	0.100	15,000	1,500.00
5	**Utility**			
5-1	Electricity	1,216,200 kWh	840 VND/kWh	1,021,608.00
5-2		741 ton	450 VND/kg	333,450.00
	Total			**10,725,161**

4. Industrial Wastewater Treatment and Discharge

(1) The company's wastewater treatment facility, which has quite a big sedimentation tank, is located outside of the plant. However, they receive complaints from residents because they are discharging wastewater without any treatment.

(2) Sampling

Wastewater samples were taken at following spots for analysis in this study.

Date: 29 November 1999

S1：Discharged wastewater from the whole factory (to city sewage)

(3) Wastewater Quality

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table 4.

Table 4 Wastewater Quality in November 1999

	Unit	S1
Temperature	℃	20.2
PH		7.5
Elec. Conductivity	μS/cm	380
Turbidity	NTU	11
Oil content	mg/l	Trace
BOD	mg/l	63.9
COD	mg/l	85.6
DO	mg/l	1.6
SS	mg/l	15.5
Total Nitrogen	mg/l	6.05
Residual Chlorine	mg/l	Trace
SO_4	mg/l	105.6
Cyanogen	mg/l	0

5. Recommended Countermeasures for Improvement

(1) The inside of the plant is dirty and in confusion. Workers should try to clean, tidy up and put things in order. In addition, the company should work to increase the spirits and morale of workers.

(2) The maintenance of facilities is poor. For this reason, it is hard to produce high-quality products and productivity declines. This is the main point for the company to focus on.

CASE STUDY T-11

Viet Tien Garment Export and Import Company

Survey Date: 2 December 1999

1. General

1.1 Profile

Viet Tien Garment Export and Import Company is a state-owned company that was established in 1976 as a garment manufacturing company. The company profile of Viet Tien Garment Export and Import Company is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Viet Tien Garment Export and Import Company
Ownership:	State-owned
Address:	7 Le Minh Xuaqn Str. Tan Binh District Hochiminh City
Tel:	08-8640800-8645082
Director:	
Established:	1976
Corporate Capital:	
Number of Employees:	5,000
Main Products:	Shirts, Jackets, Trousers, Sports suites

1.2 Business Status

1.2.1 Production

The major parts of products are exported to Japan(32-33%), the EU(35%), Taiwan(29%) and East Europe and Canada. Only 3-5% of products are for domestic market.

1.2.2 Debt

13,839,134,820 VND

2. Production Technology

2.1 Process

The Process flow of the factory is shown in Figure 1.

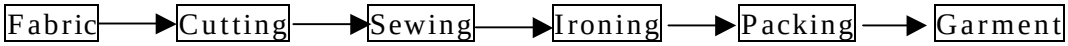

Figure 1 Process Flow of the Factory

2.2 Unit Consumption

Omission

2.3 Future Plan

Unknown

3. Management Technology

(1) The company has a sewing plant only. The study team cannot comment on this plant because it does not discharge wastewater.

(2) Regarding the plant administration, the company has introduced TQM, KAIZEN and 5S and it also has obtained ISO9002 certification.

4. Industrial Wastewater Treatment and Discharge

Not Applicable

5. Recommended Countermeasure for Improvement

(1) The company should try and work hard to maintain its current level. However, administrators should always check the operation, conditions and it is desirable for them to make efforts to improve further.

CASE STUDY T-12

Phuoc Long Textile Garment Company

Survey Date: 3 December 1999

1. General

1.1 Profile

Phuoc Long Textile Garment Company is a state-owned company that was established in 1975 as a textile manufacturing company by combining two companies which are established in 1959. The company profile of Phuoc Long Textile Garment Company is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Phuoc Long Textile Garment Company
Ownership:	State-owned
Address:	Phuoc Long B Ward District 9 Hochiminnh City
Tel:	08-8961100
Director:	Mr. LE VANG PHUC
Established:	1975
Corporate Capital:	
Number of Employees:	1,500
Main Products:	Fabrics

1.2 Business Status

1.2.1 Production

Table2 shows production and sales of the Company in 1998.

15% of products were exported to Japan and Europe in 1998 and 20% of products are expected to be exported in 1999.

Table 2 Production and Sales in 1998

Product	Production	Turnover
Fabric	13,395,000 m^2	99,500 million VND

1.2.2 Debt

Unknown

2. Production Technology

2.1 Process

The Process flow of the factory is shown in Figure 1.

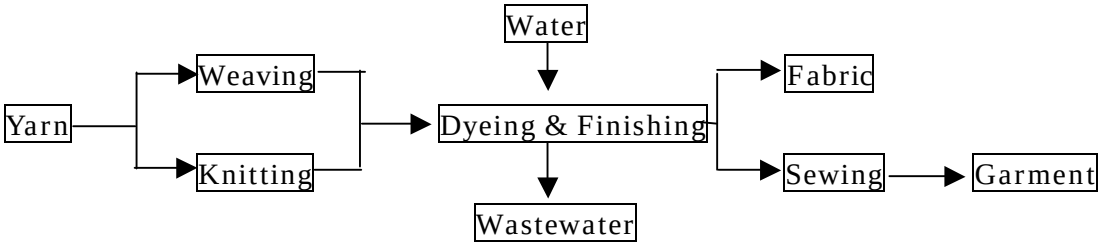

Figure 1 Process Flow of the Factory

2.2 Consumption of Raw Materials & Utility

The unit consumption of raw materials and utilities is shown in Table 3.

Table 3 Unit Consumption of Raw Materials and Utilities

No.	Material	Consumption	Remark
1	Gray Fabric	15 million m^2/year	
2	Dye Stuff	680 kg/month	
3	Softener	450 kg/month	
4	Auxiliary Chemicals	29,705 kg/month	
5	Sizing agent	1,470 kg/month	
6	Water	1,500 m^3/day	
7	Fuel	12,000 l/day	
8	Electricity	800,000 kWh/month	

2.3 Future Plans

Unknown

3. Management Technology

(1) The quality of wastewater is very bad and there are no treatment facilities.

(2) The plant discharges a lot of wastewater without any treatment,

(3) During the time we investigated the dyeing plant, no tidying up was done, nor were things put in order, or cleaned. Furthermore, there appears to be problems with production management.

(4) UNIDO performed a program for cleaner production from January 1998 to June 1999, but the study team was unable to get concrete information on the project from the person in charge.

4. Industrial Wastewater Treatment and Discharge

(1) No wastewater treatment system has been installed.

(2) This company is investigating the possibility of introducing the wastewater treatment system.
(Coagulation + Biological System). They requested EPC, which belongs to army, to design the system.

(3) The volume of wastewater is 1500 m^3/day.

(4) Sampling

Wastewater samples were taken at following spots for analysis in this study.

Date: 3 December 1999

S1： Discharged wastewater from the whole factory A (to city sewage)
S2： At Jet dying m/c (washing water after dying)
S3： Discharged wastewater from the whole factory B (to city sewage)
S4： At Jet dying m/c (washing water after bleaching)
S5： At sizing m/c of the weaving factory (waste sizing stuff)
S6： At sizing m/c (cooling water of the sizing tank)

(5) Wastewater Quality

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table4.

5. Recommended Countermeasure for Improvement

(1) Product quality must be improved and production costs must be reduced.

(2) The inside and outside of the plant is not tidy and this influences quality and moral. The company needs to keep the site clean.

(3) To solve the problems mentioned above, the company should undertake a 5S campaign and TQC activities.

Table 4 Wastewater Quality in December 1999

	Unit	S1	S2	S3	S4	S5	S6
Temperature	℃	43	58.6	58	60	32.2	33.8
pH		11.3	5.14	3.8	10.24	7.15	4.43
Elec. Conductivity	μS/cm	490	380	782	3140	1020	580
Turbidity	NTU	1	545	25	114	999	14
Oil content	mg/l	4.5	0.9	0.8	5.2	113	2.4
BOD	mg/l	784	16	5	40	9450	44
COD	mg/l	957	25	14	172	23998	172
DO	mg/l	4.2	2.33	4.3	2.5	0.39	5.33
SS	mg/l	19	10	30	12	8800	100
Total Nitrogen	mg/l	1.4	0.9	4.42	1.3	350	29.7
Residual Chlorine	mg/l	1.8	18.2	3.6	Trace	7.2	6.4
SO_4	mg/l	40	83	21	880	1200	31
Cyanogen	mg/l	0.05	0.01	0.02	0.37	Not det	Trace

CASE STUDY T-13

Thanh Cong Textile Company

Survey Date: 6 December 1999

1. General

1.1 Profile

Thanh Cong Textile Company is a state-owned company that was converted in 1976 from a private company that has been established originally in 1972 as a textile manufacturing company. The company profile of Thanh Cong Textile Company is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Thanh Cong Textile Company
Ownership:	State-owned
Address:	N0.8 Qoac Lo 1, Tan Binh District, Hochiminh City
Tel:	08-8495968
Director:	
Established:	1976
Corporate Capital:	
Number of Employees:	3,700
Main Products:	Yarns, Fabrics, Garments

1.2 Business Status

1.2.1 Production

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

More than 50% of their products (90% of garments) are exported to Japan, USA, Korea, Taiwan etc.

Table 2 Production and Sales in 1998

No.	Products	Production	Turnover
1	Yarn	3,753 t	
2	Fabrics	13,680,487 m	
3	Garments	5,484,709 pcs	
	Total		440,000 million VND

1.2.2 Debt

Unknown

2. Production Technology

2.1 Process

The Process flow of the factory is shown in Figure 1.

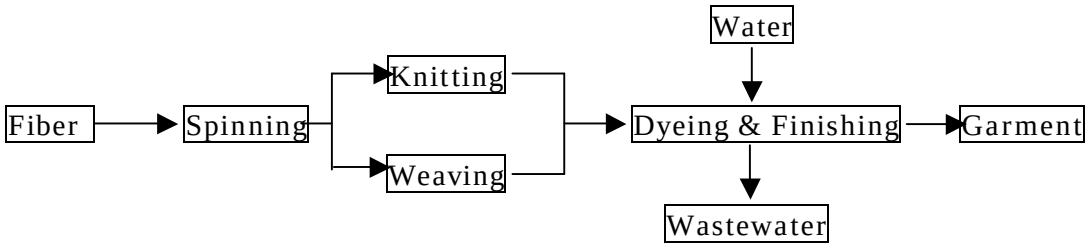

Figure 1 Process Flow of the Factory

2.2 Unit Consumption

The unit consumption of raw materials and utilities is shown in Table 3.

Table 3 Unit Consumption of Raw Materials and Utilities

No.	Items	Source/ Type	Utilization	Consumption (ton/year)	Notes
1	Fibres	Imported from various source	producing yarns	3,020	
2	Chemicals and auxiliaries	Imported	Sizing and dyeing yarn	4,827.3	
3	Dyes	Disperse, Direct, Active, Cationic dyes	Dyeing	85.5	

2.3 Future Plans

The company is planning to install new WJ type weaving machines to replace old shuttle type looms.

3. Management Technology

(1) A Japanese technician, who was dispatched by JODC, is instructing the plant so the management level of the plant is high.

(2) A TQM program is now in progress. There are many notices that help raise the morale of employees.

(3) There are no quality control activities, but there are graphs describing the production situation at many places throughout the factory.

(4) A 5S campaign has been performed thoroughly.

(5) A program to obtain ISO 9002 is now in progress.

4. Industrial Wastewater Treatment and Discharge

(1) No water treatment system has been installed.

(2) Wastewater from the factory is discharged to sewage through the wastewater tank.

(3) The wastewater volume is very large of 4800 m^3/day.

(4) Sampling

Wastewater samples were taken at following spots for analysis in this study.

Date: 6 December 1999

S1： At Jet dying m/c (washing water after reproducing)

S2：Discharged wastewater from the whole factory (to city sewage)

S3：At Jet dying m/c (washing water after dying)

(5) Waste water Quality

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table 4.

Table 4 Wastewater Quality in December 1999

	Unit	S1	S2	S3
Temperature	℃	60	33.1	60
pH		6.75	10.0	10.24
Elec. Conductivity	μS/cm	14600	2480	3900
Turbidity	NTU	4	42	31
Oil content	mg/l	11.8	31.9	5
BOD	mg/l	4	77	13
COD	mg/l	21	269	115
DO	mg/l	0.15	7.64	0.46
SS	mg/l	3	45	14
Total Nitrogen	mg/l	3.0	4.62	13.16
Residual Chlorine	mg/l	Not det	0.2	2.6
SO4	mg/l	5025	240	126
Cyanogen	mg/l	0.43	0.07	0.08

5. Recommended Countermeasures for Improvement

(1) The company should set up wastewater treatment facilities.

(2) Plant management at the company is progressing well. It is hoped that this situation will be maintained after the Japanese technician leaves the plant.

CASE STUDY T-14

Dong Nam Textile Company
(DOMATEX J.VCO., LTD)

Survey Date: 7 December 1999

1. General

1.1 Profile

DOMATEX J.VCO. LTD is a joint venture company between Dong Nam Textile Company, a state-owned company and Taiwan Capital and was established in 1992 as a dyeing sub-contracting. The company profile of DOMATEX J.VCO., LTD is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	DOMATEX J.VCO., LTD
Ownership:	Joint Venture between Dong Nam Textile Company and Taiwan
Address:	18/3 Au Co. St. W. 17. TB. District Hochiminh City
Tel:	08-8425519
Director:	
Established:	1992
Corporate Capital:	
Number of Employees:	70
Main Products:	Dyed knit fabrics

1.2 Business Status

1.2.1 Production

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

Table 2 Production and Sales in 1998

No.	Item	Production	Turnover
1	Dyed fabrics	882,793 kg	11,416,118,000 VND
2	Bleached fabrics	558,528 kg	7,610,746,000 VND
	Total	1,471,321 kg	19,026,864,000 VND

1.2.2 Debt

Debt with commercial banks: 1,100,000,000 VND

2. Production Technology

2.1 Process

The Process flow of the factory is shown in Figure 1.

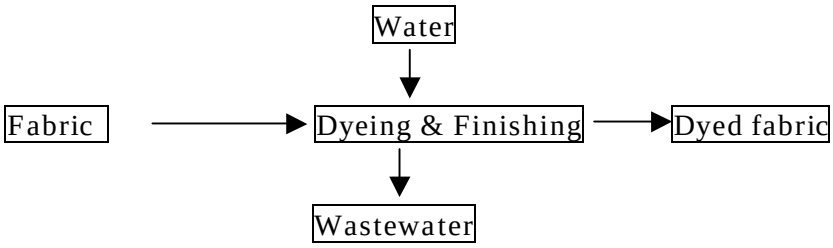

Figure 1 Process Flow of the Factory

2.2 Unit Consumption

The unit consumption of raw materials and utilities is shown in Table 3.

Table 3 Unit Consumption of Raw Materials and Utilities

No.	Materials	Production (tons)	Remarks
1	Gray Fabric	1,559,600 kg	
2	Dye Stuff	12,000 kg	4,661,802,000 VND
3	Water		
4	F.O.	1,548,000 lit	2,435,140,000 VND
5	Electricity	1,329,600 kWh	996,852,000 VND
6	Chemicals		
6-1	NAOH	1,500 kg/	
6-2	Soda	6,300 kg/	
6-3	NA_2SO_4	18,000 kg/	
6-4	H_2O_2	3,500 kg/	
6-5		130 kg/	

2.3 Future Plans

Unknown

3. Management Technology

(1) The surroundings of machines in the dyeing plant are kept tidy, but the chemical kitchen is not in good order.

(2) No improvement activities, such as a 5S campaign or TQC activities, are been undertaken.

(3) Operation manuals and information on production conditions are not provided

at the plant site. Therefore, a visual system for operation control has not been adopted.

4. Industrial Wastewater Treatment and Discharge

(1) Regarding wastewater treatment, the company applies both a chemical treatment by using coagulating agents and a physical treatment with filtration equipment.

(2) However, as the wastewater treatment performance is insufficient, the discharged wastewater doesn't clear standards in Vietnam.

(3) Wastewater volume is 300 m^3/day.

(4) Sampling:

Wastewater samples were taken at following spots for analysis in this study.

Date: 7 December, 1999

S1： Waste water from the dying factory

S2： Discharged wastewater from the whole factory (to city sewage)

S3： At Jet dying m/c (washing water after scouring)

S4： At Jet dying m/c (washing water after dying)

(5) Wastewater Quality

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table 4.

Table 4 Wastewater Quality in December 1999

	Unit	S1	S2	S3	S4
Temperature	℃	39	35	60	60
pH		10.8	10	10.64	4.2
Elec. Conductivity	μS/cm	3040	1730	834	759
Turbidity	NTU		10	28	73
Oil content	mg/l	7.1	0.57	7.5	11.5
BOD	mg/l	17	308	12	263
COD	mg/l	126	2353	66	1820
DO	mg/l	0.8	0.47	0.55	0.66
SS	mg/l	4.8	40	88	97
Total Nitrogen	mg/l	2.4	3.1	37.7	10.6
Residual Chlorine	mg/l	1.24	1.87	0.75	0.12
SO_4	mg/l	352.2	37.4	518	60
Cyanogen	mg/l	0.1	0.05	0.19	0.34

5. Recommended Countermeasures for Improvement

(1) Improve product quality and reduce production cost at the dyeing plant:

A) The color matching laboratory and chemical kitchen are untidy. As this influences product quality and productivity, it is necessary to clean them up regularly.

B) The company should positively conduct a study to save water and recover heat both are effective method for cutting manufacturing cost and environmental loads.

(2) It is recommendable that the company build a joint wastewater treatment facility with the knit dyeing plant next door.

CASE STUDY T-15

Binh Loi Blanket-Wool Company

Survey Date: 9 December 1999

1. General

1.1 Profile

Binh Loi Blanket-Wool Company is a state-owned company that was established in 1963 as a textile manufacturing company. This company was joined with the Vietnam Blanket-Wool Company group. The company profile of Binh Loi Blanket-Wool Company is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Binh Loi Blanket-Wool Company
Ownership:	State-owned
Address:	438 No Tranglong St., Binh Thanh District Hochiminh City
Tel:	08-8432359
Director:	
Established:	1963
Corporate Capital:	
Number of Employees:	850
Main Products:	Blanket, Moa Fabric, Acrylic Yarn, Acrylic Top

1.2 Business Status

1.2.1 Production

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

Main market of this company is domestic and only 10～15% of products are exported.

Table 2 Production and Sales in 1998

No.	Products	Production	Turnover
1	Blankets	1,074,760 m^2	43,697 million VND
2	Acrylic Yarn	399,995 kg	23,297 million VND
3	Boa Fabric	87,439 m	3,652 million VND
4	Acrylic Top	444,695 kg	4,332 million VND
	Total		75,246 million VND

1.2.2 Debt

Unknown

2. Production Technology

2.1 Process

The process flow of the factory is shown in Figure 1.

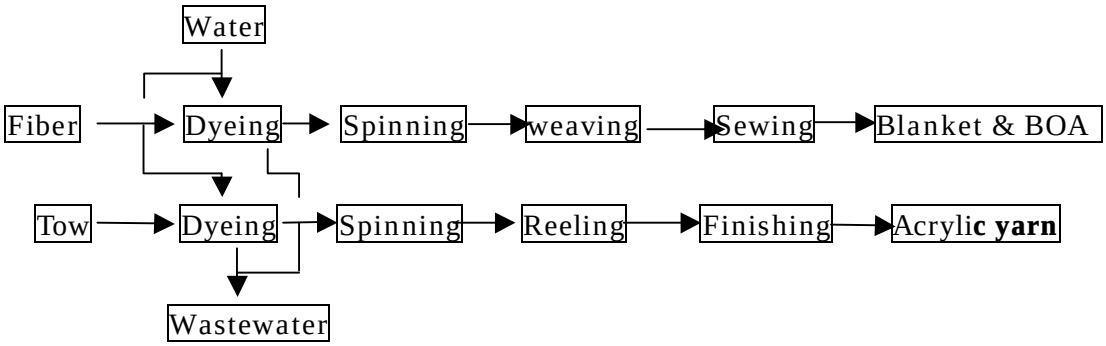

Figure 1 Process Flow of the Factory

2.2 Unit Consumption

The unit consumption of the raw materials and utilities is shown in Table 3.

Table 3 Unit Consumption of Raw Materials and Utilities

No.	Material	Consumption	Remarks
1	Acrylic Fiber	896,858 kg	
2	Polyester Fiber	182,532 kg	
3	Wool Fiber	55,080 kg	
4	Warp Yarn(PET/PECO=30)	11,453 kg	
5	Acrylic Tow	676,612 kg	
6	Dye Stuff	164,207 kg	
7	Organic Auxiliary	6,701 kg	
8	Water	68,084 m^3	
9	Fuel Oil	433,514 lit	
10	Electricity	156,054 kWh	

2.3 Future Plans

The company has the following plans;

(1) To install new tow dyeing machines that are fitted for tow dyeing

(2) To improve the printing machine to be capable of printing 8 colors (the present machine can print only 6 colors.) and can connect to a continues heat setter

3. Management Technology

(1) It is obvious that machines have become too old for use, and there are quality

problems. The maintenance of the tow converters is especially not good and they do not seem to be operating normally.

(2) The handling of fiber and tow at the dyeing process is in disorder.
Needless to say, but there are stains and mixtures of foreign materials and this causes damage to the form of the tow.

(3) Generally, the inside and outside of the plant is untidy, not in order, and not clean, and production facilities are not maintained well. It is hard to say that they have a normal level of factory management.

(4) There are no improvement activities such as a 5S campaign or QC activities.

4. Industrial Wastewater Treatment and Discharge

(1) A biological wastewater treatment system has been installed.

(2) However, the wastewater treatment system does not function fully.

(3) Wastewater volume is 200 m^3/day.

(4) Sampling

Wastewater samples were taken at following spots for analysis in this study.

Date: 9 December 1999

S1： At a tow dying m/c (washing water after dying)

S2：At a Acrylic fiber dying m/c (washing water after dying)

S3：Wastewater from the dying factory

S4：At the biological treatment Tank (wastewater treatment system)

S5：At the sedimentation tank (after biological treatment)

S6：Discharged wastewater from the whole factory (to city sewage)

S7：At tow dying m/c (washing water after bleaching)

(5) Wastewater Quality

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table 4.

5. Recommended Countermeasures for Improvement

(1) To improve product quality and reduce product cost:

A) It is necessary to tidy up and clean inside and outside of the plant thoroughly. A 5S campaign is an effective way to solve such kinds of problems.

B) The handling of products is too rough. Acrylic fibers are very delicate and required to be handled with care.

C) The company should reinforce the maintenance of machines, especially tow converters at the spinning plant.

D) Managers and plant leaders should not attribute the reason that their products don't meet the standards of the export market, only to their old production facilities. Instead they should be aware of the lack of their own plant management technology and try to devote themselves to their responsibilities.

Table 4 Wastewater Quality in December 1999

	Unit	S1	S2	S3	S4	S5
Temperature	℃	37.5	34.9	35.7	31.1	30.8
PH		4.77	4.97	4.75	7.3	7.35
Elec. Conductivity	μS/cm	1220	1050	300	1510	1540
Turbidity	NTU	3	7			24
Oil content	mg/l	22	18.4	45	23	12.8
BOD	mg/l	42	51	186	90	15
COD	mg/l	229	188	445	449	113
DO	mg/l	8.34	8.9	2.12	7.05	3.88
SS	mg/l	31	20	30	358	85
Total Nitrogen	mg/l	9.96	4.25	16.2	43.4	26.5
Residual Chlorine	mg/l	Not det	Not det	Not det	0.12	0.15
SO4	mg/l	785	45	134	148	154
Cyanogen	mg/l	0.22	0.25	0.13	0.07	0.03

	Unit	S6	S7
Temperature	℃	29.6	33.5
pH		3.19	3.8
Elec. Conductivity	μS/cm	3160	240
Turbidity	NTU		9
Oil content	mg/l	7.6	9.3
BOD	mg/l	2	107
COD	mg/l	52	240
DO	mg/l	3.07	7.05
SS	mg/l	6	2
Total Nitrogen	mg/l	6.83	10.9
Residual Chlorine	mg/l	0.7	Not det
SO_4	mg/l	160	17
Cyanogen	mg/l	0.03	0.11

CASE STUDY T-16

Thang Loi Textile Company

Survey Date: 10 December 1999

1. General

1.1 Profile

Thang Loi Textile Company is a state-owned company that was established in 1959 as a textile manufacturing company. This company was unified from Vinatexco and Vinatenifico. The company profile of Thang Loi Textile Company is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	ThangLoi Textile Company
Ownership:	State-owned
Address:	No.2 Highway No.1, 15th ward-Tanbinh Dist. Hochiminh City
Tel:	08-8495977
Director:	
Established:	1959
Corporate Capital:	
Number of Employees:	3000
Main Products:	Yarns, Finishing fabrics, Apparel products

1.2 Business Status

1.2.1 Production

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

The main market of this company is the domestic market and only 10～15% of products are exported.

Table 2 Production and Sales in 1998

No.	Items	Design	1998	1999 plan
1	Yarns	8, 000 t/year	5,725	5,400
2	Finished fabrics	15,000,000 m./year	12,834,000	11,200,000
3	Apparel products	1,500,000 converted items /year	1,041,000	1,200,000

1.2.2 Debt

Unknown

2. Production Technology

2.1 Process

The Process flow of the factory is shown in Figure 1.

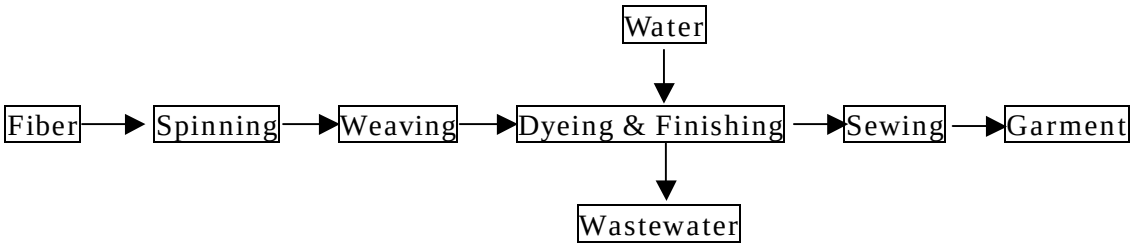

Figure 1 Process Flow of the Factory

2.2 Unit Consumption

The unit consumption of raw materials and utilities is shown in Table 3.

Table 3 Unit Consumption of Raw Materials and Utilities

No.	Items	Utilization in	Quantity (ton/year)	Note
1	Cotton fiber	Spinning	4,000	
2	Manmade fibers	Spinning	2,500	
3	F.O	Boilers, oil-circulation heater	3,200.000	
4	D.O	Generators and cars	288,000 litters/year	
5	Electricity	Production and illumination	32,000,000 kWh	

2.3 Future Plans

Unknown

3. Management Technology

(1) The machines in the new spinning factory are in pretty operating good condition. However, the study team was not able to see the old spinning factory and the weaving factory.

(2) The condition of the dyeing factory is a little better than the average condition in other factories, which was observed in this study. However, the condition and operating levels of the machines are insufficient.

(3) There are a lot of steam leakage from machines and steam pipings.

(4) The reprocessing ratio is very high, between 10～15%. This means that the quality control system is not effective.

(5) A program to obtain the certification of ISO 9002 certification was under progress.

(6) The technical manager of the company has been to Japan to receive training on factory management systems such as TQM and Kaizen.

4. Industrial Wastewater Treatment and Discharge

(1) No water treatment system has been installed.

(2) Wastewater from the factory is discharged to the sewage directly.

(3) Wastewater volume is 4800 m^3/day.

(4) Sampling :

Wastewater samples were taken at following spots for analysis in this study.

Date: 10 December 1999

S1： At Jet dying m/c (washing water after dying)

S2： At Wince dying m/c (washing water after bleaching)

S3： At Rotary printing m/c(washing water of the rotary screen)

S4： Discharged wastewater from the whole factory (to city sewage)

(5) Wastewater Quality

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table 4.

5. Recommended Countermeasures for Improvement

(1) The rate of reprocessing is too high (10 to 15%). There are quality control problem and the company should introduce TQM and 5S.

(2) There is a lot of steam leakage and this causes an energy loss. The company should try save energy as much as possible.

(3) The company's plan for wastewater treatment facilities is flawed, because it will only be able to treat wastewater from the dyeing process organically and will treat wastewater from the scouring process chemically. The company needs to review this problem.

Table 4 Wastewater Quality in December 1999

	Unit	S1	S2	S3	S4
Temperature	℃	36	60	27.8	31.2
PH		10.0	11.2	5.96	10.5
Elec. Conductivity	μS/cm	9900	12300	40	460
Turbidity	NTU		53	445	
Oil content	mg/l	156	22	123	1
BOD	mg/l	294	162	228	14
COD	mg/l	5125	2753	1372	341
DO	mg/l	0.4	0.98	0.4	1.2
SS	mg/l	450	86	260	12
Total Nitrogen	mg/l	51.3	25.9	27.8	10.5
Residual Chlorine	mg/l	3.1	14.2	0.22	0.45
SO_4	mg/l	1523	2210	11.2	164
Cyanogen	mg/l				

CASE STUDY T-17

Hoa Tho Textile & Garment Company

Survey date: 14 December 1999

1. General

1.1 Profile

Hoa Tho Textile Company is a state-owned company that was established in 1961 as a textile manufacturing company. The company profile of Hoa Tho Textile Company is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Hoa Tho Textile Company
Ownership:	State-owned
Address:	Hoa Tho Vang. Danang City
Tel:	84511846217
Director:	Mr. TRAN VAN PHO
Established:	1961
Corporate Capital:	
Number of Employees:	1300
Main Products:	Yarns, Fabric, Towels and Subcontracted of Sewing Products

1.2 Business Status

1.2.1 Production

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

The main markets of this company are Taiwan, Japan & the EU for garment and towels and the domestic market for fabrics.

Table 2 Production and Sales in 1998

No.	Products	Output	Revenue
1	Type of Fiber:(kg)	1,430,415	33,809,913,068 VND
1-1	-PE Fiber	317,947	
1-2	-Cotton	42,790	
1-3	-PECO	1,069,678	
2	Type of Fabrics(m)	20288,254	9,656,762,388 VND
2-1	-Towel	1,410,957	
2-2	-Calico	877,297	

1.2.2 Debt

Liabilities at the end of 1998: VND 2,810,500,000
USD 3,372,000

Of which:	payable to employees	151,500,000 VND
	payable to financial company	2,659,000,000 VND
	bank borrowing	3,372,000 VND

2. Production technology

2.1 Process

The Process flow of the factory is shown in Figure 1.

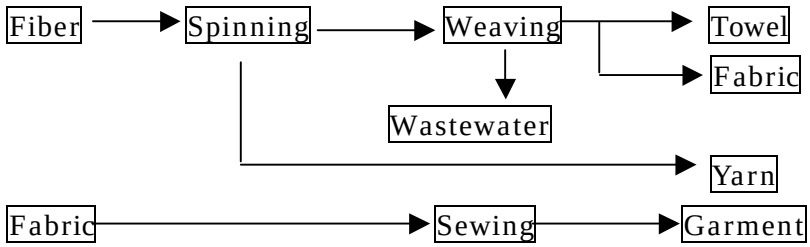

Figure 1 Process Flow of the Factory

2.2 Unit Consumption

The unit consumption of raw materials and utilities is shown in Table 3.

2.3 Future Plans

Unknown

3. Management Technology

(1) New spinning machines are maintained at a standard level, but it is obvious that old machines have become too old for use. There are also many problems with product quality.
(2) A splicing system is not installed at the winding process.
(3) A ring-type machine is used at the yarn twisting process, but double twisters have not been introduced yet. There are problems with splicing control.
(4) Although new and powerful comer machines have been introduced, all of them are currently suspended, and only card yarns which are low in added value are

manufactured.

(5) Sizing machines at the weaving preparation process are made in the U.S. and they are in good operating condition.

(6) All weaving machines are shuttle type and their weaving width is narrow. It is necessary to renovate these machines.

(7) Towel weaving machines are getting too old for use and can manufacture only low value added products, such as towels for advertising.

(8) Tidiness and arrangement of the spinning plant are comparatively good, but the maintenance of the old type machines is poor.

(9) Management of bobbins at the robbing, spinning and yarn winding processes is not good.

(10) The weaving plant is generally untidy and in disorder. Weaving machines are too old for use and also in poor maintenance because the company cannot get spare parts sufficiently.

(11) There are no improvement activities such as a 5S campaign and QC activities at the plant.

Table 3 Unit Consumption of Raw Materials and Utilities

No.	Material	Quantity	Expenses (VND)
1	Fiber products		
1-1	Main material:(kg)	1,596,679	18,236,621,423
(1)	-PE	1,295,435	
(2)	-Original cotton	190,080	
(3)	-Tan dung cotton	111,164	
1-2	Auxiliary material		360,507,889
1-3	Electricity (kWh)	6,871,087	5,906,399,229
2	Fabrics products		
2-1	Fiber material:(kg)	270,578	7,231,789,083
(1)	-Cotton	127,838	
(2)	-PECO	142,740	
2-2	Auxiliary material		191,915,188
2-3	FO(kg)	122,000	103,965,375
2-4	Electricity (kWh)	539,415	450,143,939
3	Garment products		
3-1	Fabric material		
3-2	Auxiliary material		95,910,723
3-3	Electricity (kWh)	119,794	101,687,968
4	Regional water	19,530	39,060,000
4-1	-Air conditioning	8,694	
4-2	-Industrial hygiene	9,545	
4-3	-Boiler	220	
4-4	-Water put on fire tree	1,070	

4. Industrial Wastewater Treatment and Discharge

(1) Industrial wastewater is discharged only from the sizing system of the weaving process in small quantities.

(2) The wastewater from the sizing system is treated by a small biological system.

(3) Sampling

Wastewater samples were taken at following spots for analysis in this study.

Date : 14 December 1999

S1：At Sizing m/c of the weaving factory (discharged sizing stuff)

S2：Wastewater from the weaving factory(after biological treatment tank)

(4) Wastewater Quality

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table 4.

Table 4 Wastewater Quality in December 1999

	Unit	S1	S2
Temperature	℃	58.4	34.1
pH		6.69	4.39
Elec. Conductivity	μS/cm	540	27200
Turbidity	NTU	1295	261
Oil content	mg/l	0	Trace
BOD	mg/l	18450	1768
COD	mg/l	77800	17220
DO	mg/l	1.8	2.3
SS	mg/l	19600	362
Total Nitrogen	mg/l	235	28.7
Residual Chlorine	mg/l	0.71	Trace
SO_4	mg/l	184	536
Cyanogen	mg/l		

5. Recommendation

(1) Sizing agents from the weaving plant are treated, but the company should reduce the discharge volume by the reuse method.

(2) As for plant management, in order to improve the quality of products and manufacturing costs:

A) It is necessary for the company to tidy up inside and outside of the plant and to clean the plant thoroughly. A 5S campaign is an effective way to solve such kind of problems.

B) Some of the old machines are operating without some parts. This is a

problem for product quality and they need to reinforce the maintenance of the machines.

C) The company must to pay attention to mistakes in variety mixture (bobbin color control and so on) which is the basic of process management.

D) It is desirable that managers and plant leaders take leadership for solving the above-mentioned problems and make efforts to improve results.

CASE STUDY T-18

29-3 Textile-Garment Company

Survey date: 16 December 1999

1. General

1.1 Profile

29-3 Textile-garment Company is a local state-owned company that was established in 1976 as a textile manufacturing company. The company profile of 29-3 Textile-Garment Company is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	29-3 Textile-Garment Company
Ownership:	Local state-owned
Address:	Dien Bien Phu St. Danang City
Tel:	84 511 821275
Director:	Mr. HUYNH VAN CHINH
Established:	1976
Corporate Capital:	
Number of Employees:	1,700
Main Products:	Towels, Cotton Garment, Polyester and Rayon

1.2 Business Status

1.2.1 Production

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

Most of their products are exported to Japan.

Table 2 Production and Sales in 1998

No.	Items	Design	1998	1999
1	Towels	500 tons	253 tons	400 tons
2	Garment	2,500,000 pieces	2,026,079 pieces	2,100,000 pieces
3	Stone-washing	1,000,000 pieces		100,000 pieces

1.2.2 Debt

Unknown

2 Production technology

2.1 Process

The Process flow of the factory is shown in Figure 1.

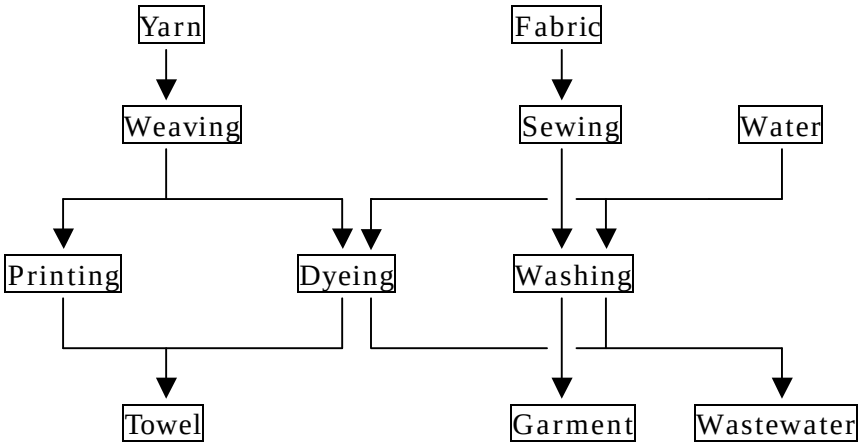

Figure 1 Process Flow of Factory

2.2 Unit Consumption

The unit consumption of raw materials and utilities is shown in Table 3.

Table 3 Unit Consumption of Raw Materials and Utilities

No.	Items	Quantity	Cost	Total
1	Towels	400 tons		
	Bleached towels	200 tons		
	Dyed towels	200 tons		
2	Dyes	0.5 ton		
3	Organic solvents	25 tons		
4	H_2O_2 50%	45 tons		
5	Water	250 m^3/day	2,000 VND/m^3	100,000 m^3/year
6	FO	400 tons		
7	Electricity	200 kWh	800 VND/kWh	16 hours/day

2.3 Future Plans

Uncertain

3 Management Technology

(1) The weaving machines in use are very old. They are working well, but are terribly inefficient.
(2) The garment washing plant is new and has not been established very long, so it is very clean, tidy and things are in order. 60% of products are exported to Japan and the plant is requested to be kept tidy by Japanese buyer.
(3) The situation at the inspection process is the same as at the garment washing plant.
(4) The dyeing plant is not as good as the other 2 plants. Hank dyeing is done by traditional hand-dyeing.
(5) The printing process is also done manually.

4 Industrial Wastewater Treatment and Discharge

(1) Chemical treatment (Coagulation and sedimentation) facilities have been completed and will serve as the companies wastewater treatment facilities. These facilities will be in operation shortly. However, there are some problems with the design conditions.
(2) The wastewater treatment system has just been completed and will begin operation by the end of 1999.
(3) This system consists of coagulation and sedimentation.
(4) In the future, a biological system will be added.
(5) Wastewater quantity is 250 m^3/day.
(6) Sampling

Wastewater samples were taken at the following spots for analysis in this study.

Date: 16 December 1999

S1：At Wince dying m/c (washing water after bleaching)
S2：Wastewater discharged from the dying factory
S3：Discharged wastewater from the whole factory (to city sewage)
S4：At Wince dying m/c (washing water after dying)

(7) Wastewater Quality

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table 4.

Table 4 Wastewater Quality in December 1999

	Unit	S1	S2	S3	S4
Temperature	℃	95	22.2	31.8	96
PH		10.4	7.4	9.9	10.8
Elec. Conductivity	μS/cm	960	1440	271	27520
Turbidity	NTU	1136	123	19	23
Oil content	mg/l	0	Trace	Trace	0
BOD	mg/l	2504	1674	84.7	104
COD	mg/l	19640	4870	433	467
DO	mg/l	4.35	1.31	6.64	1.85
SS	mg/l	1200	141	25	30
Total Nitrogen	mg/l	115	18.5	4.1	4.25
Residual Chlorine	mg/l	Trace	Trace	Trace	1.06
SO_4	mg/l	292	384	82.4	60.4
Cyanogen	mg/l				

5. Recommendations

(1) Some of the weaving machines are being renovated. It is expected to be managed in the same way at its washing plant not to be dragged into old machines.

(2) Sufficient maintenance of old machines should be carried out.

(3) A 5S should be introduced at the dyeing plant.

(4) Printing facilities should be improved (renewed) and converted to a mechanical system.

(5) It is recommended that not only should ISO9000 certification be obtained, but also that quality control methods, such as TQM, should be introduced.

(6) It may be difficult to clear regulation standards at the wastewater treatment plant which is using only chemical treatment. It is necessary to conduct a study on the possibility of introducing a biological treatment system as soon as possible.

CASE STUDY T-19

Hue Textile company

Survey Date: 3 & 4 March 2000

1. General

1.1 Profile

Hue Textile Company is a state-owned company that was established in 1988 as a textile company. The company profile of Hue Textile Company is summarized in Table 1.

Table 1 Enterprise Profile

Name of Company:	Hue Textile Company
Ownership:	State-owned
Address:	Xa Thuy duong, Huong Thuy, unh Thua thien Hue
Tel:	054 822011, 054 822012
Director:	HUYNH VAN THAO
Established:	1988
Corporate Capital:	
Number of Employees:	1800
Main Products:	Yarns, Towel, Garment

1.2 Business Status

1.2.1 Production

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

More than 90% of towels and knitting garment products are exported to Japan, Taiwan, Germany, Poland, etc.

Table 2 Production and Sales in 1998

Products	Capacity	Turnover
Yarns	4,200 ton	
Towel	200 ton	
Knitting Products	400 ton	
Total	4,800 ton	160 billion VND

1.2.2 Debt

Unknown

2. Production Technology

2.1 Process

The Process flow of the factory is shown in Figure 1.

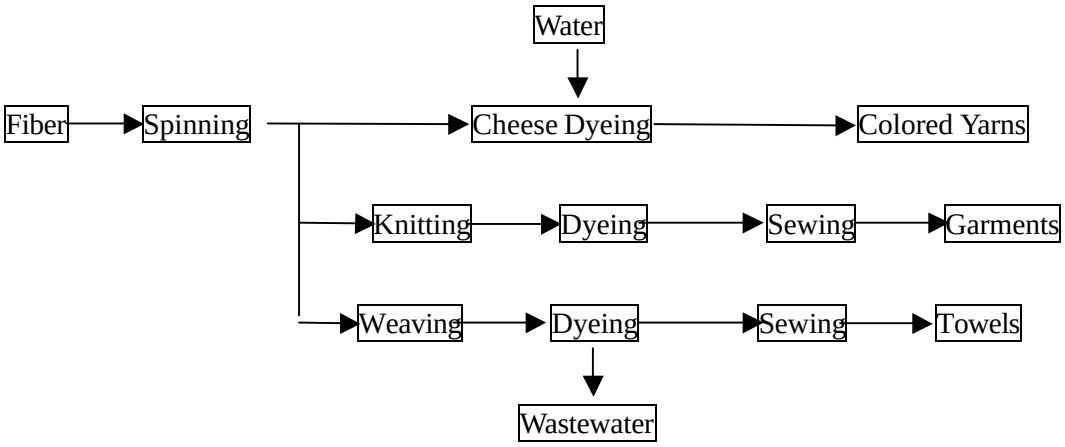

Figure 1 Process Flow of the Factory

2.2 Unit Consumption

The unit consumption of the raw materials and utilities is shown in Table 3.

Table 3 Unit Consumption of Raw Materials and Utilities

Material	Quantity	Expenses(VND)
Ⅰ. Spinning	4,200 ton	
(1) Cotton	2,500 ton	
(2) PE Fiber	2,000 ton	
(3) Water	240,000 m^3	
(4) Electricity	22,500,000 kWh	
Ⅱ. Knitting Process	400 ton	
(1) Water	88,000 m^3	
(2) FO.	600 ton	
(3) Electricity	1,500,000 kWh	
(4) Dyestuff	7,014.2 kg	
(5) Caustic Soda	5,400 kg	
(6) Bleaching Chemicals	18,000 kg	
Ⅲ. Towel	260 ton	
(1) Yarns	230 ton	
(2) Water	50,000 m^3	
(3) Electricity	700,000 kWh	
(4) Dyestuff	3,600 kg	
(5) Caustic Soda	9,000 kg	

2.3 Future Plans

(1) To invest in a combed spinning line of 8,000 spindles.
(2) To upgrade to a total of 50,000 spindles in the existing spinning mill.
(3) To increase the capacity of the knitting mill up to 1,500 ton/year.
(4) To invest in a weaving and dyeing, finishing mill with capacity of 10,000,000 m^2 /year

3. Management Technology

(1) The spinning plant is in good order and tidy. Operation management is good too.
(2) The weaving and knitting machines which are at another site are very old and the maintenance on them is inefficient. They have many problems with quality.
(3) The dyeing plant of the main factory is kept in good order, is tidy and is clean. They do not have so many problems with operation management.
(4) A water treatment system has been installed in the dyeing plant, but it is in disorder, untidy and dirty. The operation management is at a very low level. For example, coal in the filter tank has not been changed for 3 years since the plant was start up.
(5) The flow rate of the wastewater from the factory is 300 m^3/day. The quality of the wastewater is out of the standards in Vietnam.

4. The Treatment and Discharge of Industrial Wastewater

(1) Volume of the wastewater: 300 m^3/day
(2) Method of wastewater treatment:
   a. Neutralization
   b. Trickling Filter
   c. Filtration

(3) The wastewater treatment system:

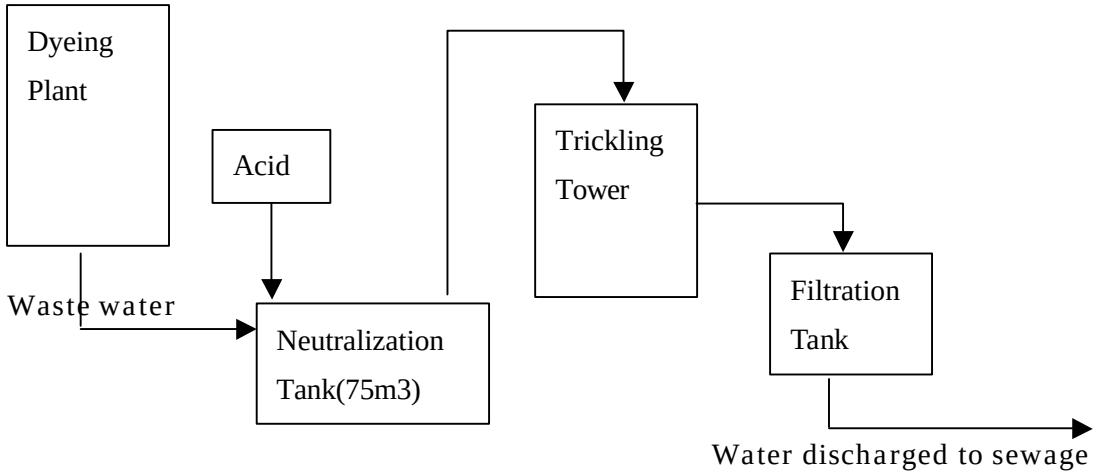

Figure-2 Wastewater Treatment System

(4) Sampling:

Wastewater samples were taken at following spots for analysis in this study.

Date: 4 March 2000

S1：At the outlet of the dyeing factory：Sampling time:10:17

S2：At the Regulation Tank ： Sampling time:11:00

S3 : At the outlet of the dyeing factory： Sampling time:12:00

S4: At the Regulation Tank ：Sampling time:11:45

S5: At the outlet of the Carbon Filtration Tank：Sampling time:11:50

(5) The quality of the wastewater

Wastewater qualities analyzed by Hanoi University Civil Engineering Center of Environment Engineering of Towns and Industrial Areas (CEETIA) are shown in Table 4.

Table 4 Wastewater Quality in March 2000

	Unit	S1	S2	S3	S4	S5
Temperature	℃	33.7		31.5	32.4	27.5
pH		10.67		10.3	10.7	9.76
Elec. Conductivity	μS/cm			6,060	10,800	1,400
Turbidity	NTU	83	21	32.6	16.2	16.8
Oil content	mg/l	Trace	1	Trace	Trace	2
BOD	mg/l	231	186	194	114	273
COD	mg/l	720	1020	520	1120	920
DO	mg/l	2.59		4.49	4.54	8.06
SS	mg/l	91	74	35	28	18
Total Nitrogen	mg/l	24.5	31.5	17.5	21	28.2
Residual Chlorine	mg/l	0	53.2	0	92.4	0
SO_4	mg/l	893	908	791	881	326
Cyanogen	mg/l					

5. Recommended Countermeasures for Improvement

(1) Management of the wastewater treatment system should be thoroughly improved.

a. Operating conditions should be cleared.

b. Operators should be trained.

c. The equipment should be maintained.

d. The system, including its surroundings should be kept in good order and clean.

(2) The quality of the treated water is not clearing Vietnam standards because the design of the existent treatment system is not adequate for this factory. When planning for the next treatment system is carried out, a careful survey is necessary for introducing a suitable system.

(3) It is desired that the company will makes efforts to realize their very aggressive future plans.

(4) They are investigating the possibility ISO9002 acquisition. Furthermore, the company should introduce activities such as TQC, 5S,etc. in succession.