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REDUCTION OF INDUSTRIAL POLLUTION
IN HO CHI MINH CITY
Project TF/VIE/97/001

CLEANER PRODUCTION CASE STUDIES
FOOD PROCESING, PULP & PAPER AND TEXTILE PROCESSING SECTORS

Ho Chi Minh City
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Contents

Click on the blue text

Introduction

HCMC is the largest city in Vietnam and an important center for culture, technology, business, trade and investment. The city has experienced substantial growth over the past 10 years and has contributed significantly to the country's GNP, especially through the food, textile and garment industries. However this has resulted in increasing environmental impacts due to industrial and urban wastes.

The city's environment committee (now the Environmental Management Section of HCMC-DOSTE) has issued a "Black Book", listing the major polluting companies in HCMC. A significant number of these companies are from the food processing, pulp & paper and textile dyeing industries, due to the effects of untreated high organic strength waste-waters. While HCMC- DOSTE realized that something had to be done, the question was what ? The factories could not be closed nor forced to implement expensive "end-of-pipe" measures, as many local communities depends on the factories for their income. A solution had to be found to address these problems cost-effectively.

HCMC- DOSTE turned to the United Nations Industrial Development Organization (UNIDO) and the Swedish International Development Co-operation Agency (SIDA) for assistance and advice on how to solve these duel problems of environment protection and competitive production. Together UNIDO, SIDA and DOSTE decided to implement a program of Cleaner Production (CP) demonstrations in HCMC. The aim of this program being to show that preventative approaches to environmental problems through reducing the consumption of resources, minimizing waste at source, improving management practices and introducing efficient clean technologies can significantly improve environmental and economic performance. In short, ***"turning waste into profits".***

This booklet contains information about the results achieved in the 6 participating companies listed below. It is hoped that by disseminating these results, other industries in Vietnam and elsewhere, will learn that cleaner production makes business sense.

This report was prepared by UNIDO consultant, ***Dr P. K. Gupta***, who was ably assisted during the project by international and local experts in each industrial sector.

Food Processing

- Thien Huong Food company
- VISSAN Slaughterhouse

Pulp and Paper

- Xuan Duc Paper Company
- Linh Xuan Paper Company

Textile Dyeing

- Phuoc Long Textile Company
- Thuan Thien Bleaching & Dyeing Company

1. Executive Summaries

1.1 Thien Huong Food Company

Thien Huong Food Company is one of the largest food processing factories in HCMC, with a current workforce of 1,200 people. The main product is instant noodles, but the factory also produces instant rice soup, soup powder, salted peanuts and chilli sauce. These products are sold both in the domestic and export markets. The company is state-owned and has an effective management system. The company has been singled out to be privatized soon, which has put pressure on the management to improve the economic performance of the company. The factory was included in the "Black Book" by the environmental authorities due to its environmental impact and its location within a residential area. It is thus faced with the double challenge of improving both its competitiveness and its environmental performance.

In order to improve its environmental performance Thien Huong Food Processing Factory decided to join the CP project. A Cleaner Production 'task force' with six members, was established under the supervision of the Deputy Director responsible for production. Since the production process comprises many different production lines, it was decided to focus the CP assessment on the production of instant noodles. With the assistance of national and international experts, the team carried out a thorough analysis of the waste streams, with a view to identifying how they could be reduced or eliminated by optimizing the production process. A wide range of CP measures were selected for implementation and so far 24 measures, mostly low or no cost measures, have been implemented with total investments of approximately 880 MVND (62,000 US$). These measures have resulted in direct cost savings of 8880 MVND (633,700 US$) per annum. The main environmental improvements have been a 66% reduction in waste water volumes, 30-35% reduction in organic pollution load and a significant reduction in gaseous emissions.

However, the above results are not the final results of the project. The company now has a team of trained professionals, who are capable of identifying and implementing even more cleaner production measures. These measures will result in even higher economic savings and more environmental improvements. The company has also made changes within the management system to ensure that the tight control on the consumption of resources is maintained. On a monthly basis the company compiles reports on the consumption of all major resources, and a reward and punishment system has been put in place, to give the workers incentives to minimize the waste of resources.

These impressive results were not achieved easily. The CP project initially faced many problems. The main problems were ignorance about the CP concept and an attitude, which implied a resistance to change. None of the plant personnel were ever exposed to CP, and the systematic approach to problem solving was absent in the company. As a large and well managed food company, there was also a feeling prevailing in the company that no further improvements could be made in the production process. The regular interaction between the external experts and the company staff, coupled with increasing regulatory pressure to minimize the environmental impact, brought about a radical change in the attitude of management and employees. At the end of the project, the CP team of the factory stated that the main benefit of the project, despite all the savings listed above, had been a change in attitude of the company management.

An indication of this awareness has been that the Board of Directors, has earmarked a budget of VND 120 Mill (8500 US $) per month for the Cleaner Production Programme. This is a good indicator that continuous improvement of the environmental and economic performance of the company will now occur.

For more information about the project please see chapter 3. A short description of the CP methodology used, is given in chapter 2.

Summary of the CP Demonstration Project in Thien Huong Food Company

Investment	VND (USD 62,000)
Savings	VND (USD 663,700)
Pay back period	
Environmental savings	68% reduction in waste water volume 30-35% reduction in organic pollution Significant reduction in gaseous emissions
Management changes	Monitoring system to check the consumption of 27 key production inputs has been installed A system to reward workers for meeting improving the resource efficiency has been Established.
Product quality improvements	Improved shelf life of products Decreased percentage of broken noodles from 9 to 3 per cent 25 per cent improvement in production capacity

1.2 Vissan Slaughter House

Vissan Slaughter house is the only integrated meat complex in the city and was selected as one of the six companies to participate in the CP demonstration project. This case study presents briefly the results achieved during the project and the barriers encountered. Vissan Slaughter House is run as a service industry to provide a facility for slaughtering animals to customers on a payment basis. The company also slaughters animals for the production of frozen meat, processed meat, canned meat & sterilized sausages etc. The products are sold both in domestic and export markets. Due to large volume and high pollution load, generated from slaughtering activities, this factory has been included in the "Black Book" by the Environmental Authority. However due to the high investment and operating costs required for the treatment of wastes, low profit margin (less than 1% of annual turnover) and increasing public and regulatory pressure, the company is facing a challenge to improve its environmental performance.

After deciding to join the CP project, a Cleaner Production task force with 10 members was established under the supervision of the Deputy Director and directly coordinated by the Head- of the Technical Division. Since the major pollution load in the company is contributed by the slaughtering section, it was decided to select the slaughter house as the audit focus the for CP assessment. With the assistance & support of national & international experts, the CP team carried out a detailed assessment of the slaughtering section, including measurement & analysis of various waste streams to identify the sources of wastes and opportunities to reduce waste generation. In addition to wastewater generation, areas related to energy saving potential from frozen & cold storage section were also included in the study. A wide range of CP measures were selected for implementation and so far 9 measures, mostly low cost measures, have been implemented with a total investment of approximately 135 MVND (10,000 US $). These measures have resulted in direct savings of 392 MVND (28,000 US $) excluding anticipated savings in wastewater treatment costs. The major environmental improvements achieved are, 20% reduction in wastewater volume (trade effluent), 33% reduction in organic pollution load, 27% reduction in solid waste generation and substantial reduction in gaseous emissions.

However, the above mentioned results are not the final outcome of the project, and savings calculated are only direct savings accrued from resource conservation of expensive potable water, fuel and electrical energy. Additional savings anticipated from reduced waste treatment & handling costs are not included here, as they are not yet been incurred. The company has a well qualified team of professionals and are in the process of identifying and evaluating more involved CP measures, like the rendering of solid wastes, blood plasma protein recovery, offal cutting & cleaning device for by-product recovery. These measures will not only result in higher economic savings but also significant improvements in environmental performance. The company has also improved management systems for proper recording and reporting, and regular meetings are now held to monitor resource consumption and waste generation. Management is also planning to conduct regular meetings with customers to educate them on the environmental & economic implications of lost resources.

Being a service sector industry and having limited control on operating practices, the project faced several problems in the beginning, like the lack of awareness of customers regarding resource consumption and environmental degradation. As such, it was difficult at the start of the project to obtain full site information.

Motivation of staff (customer & employee), attitudinal problems like resistance to change and the myth that environmental protection will always cost money, were some of the barriers experienced. In addition, being a food processing sector, hygiene and a fear of quality deterioration also hampered the progress in the beginning.

The regular interaction and intensive involvement of the team members during the in-company brain-storming sessions and ownership of the CP options by CP team members brought the radical change in attitude of management and employees. One of the CP team members, trained in CP in India, became the champion of CP and was instrumental in bringing attitudinal and system change within company. Vissan is now on its way to implement more involved CP options, as well as planning to install a wastewater treatment plant for the remaining pollution load.

For more information about the case study, please refer Chapter 4 and the CP assessment methodology given in Chapter 2.

Summary of the CP Demonstration Project in Vissan Slaughter House

Investment	135 MVND (US $ 10,000)
Direct Savings	392 MVND (US $ 28,000)
Pay back Period	<5 months
Environmental savings	20% reduction in wastewater volume 33% reduction in organic pollution load 27% reduction in solid waste Significant reduction in gaseous emission
Management Systems	- Monitoring to control consumption of key inputs - Proper recording & reporting of data - Training to encourage customers/employees to collect the maximum possible blood & offal and reduce water consumption - Proper inventory & storage of frozen meat
By-product recovery	- Increased recovery of blood as fish meal - Dry handling of offal & intestine content to use as fertilizer - Close loop recycle of cooling waters

1.3 Xuan Duc Paper Company

The Xuan Duc Paper Company is a secondary fibre based paper mill, producing unbleached carton and duplex paper with an installed production capacity of 10 Tonne per day. The company has a workforce of 180 people and annual turnover of US$ 10million. The company's production is consumed in the domestic market principally for industrial usage. The company is state owned and is effectively managed. The company was included in the "Black Book" by the environmental authorities due to the large volume of untreated wastewater discharged into city water systems. Globally the Pulp & Paper sector is passing through recession, and like other units, Xuan Duc paper company is also under pressure to improve its economic performance.

Xuan Duc Paper Company participated in the CP project with the twin objectives of production cost reduction and the reduction of environmental pollution load. This later objective assisting them to achieve compliance with environmental requirements. A CP team with 7 members was established under the leadership of the deputy director and chief executive of the company. During the pre-assessment phase of the project and based on input resource consumption, the following areas were selected as CP audit focus.

1. Water conservation
2. Furnace oil (fuel) and electrical energy conservation
3. Raw material and chemical conservation
4. Reduction in the percentage break (finished rejected/ off-cut paper)

A total of 45 CP options were generated and evaluated by the team. Thirty –seven of them were found to be feasible and these were considered for implementation. So far, 21 CP measures have been implemented through the company's own internal resources at a modest investment of 200 MVND (15,000 US $). These measures have resulted in direct cost savings of 1288 MVND (96,000 US $) per annum. Thus, the overall pay back period is less than 2 months. The major environmental savings have been a 33% reduction in wastewater volume, 20% estimated reduction in organic pollution load, 30% reduction in gaseous emissions and a 30% reduction in solid waste.

Xuan Duc is geared up to continue the CP efforts and the above-mentioned results are not the complete story. M/s. Xuan Duc has already incorporated most of the cost intensive CP measures in their third paper machine (expansion programme) which is not yet operational, hence, has not been accounted in this case study. The company is also participating in the energy conservation project of MOSTE and has acquired in-house capability to expand and develop the CP programme further. They have also developed a proper management system to ensure control on resource consumption and particularly of production scheduling to reduce the amount of off-cut (break) paper. Specific resource consumption including electrical energy, fuel and paper waste (break) , are monitored on a daily basis and corrective measures are taken if necessary. The company has also started construction of wastewater treatment plant (pre-treatment unit).

Since the company was already participating in the energy conservation project and one of key CP team members was trained in CP before the project started, no major barriers were faced in terms of attitude, however, poor coordination of the CP team and operating pressure on employees, restricted both the time and the effort required for effective implementation.

During the project, the company was expanding and many CP measures developed during the project were incorporated during this expansion phase. There is a strong commitment from the company to continue to develop the project further. Xuan Duc is also committed to the on-going investigation of other CP opportunities as well as going ahead with the treatment of residual wastes.

For more information about the project, refer to Chapter 5 "Xuan Duc Paper Company" and to Chapter 2, " CP methodology".

Summary of the CP Demonstration Project in Xuan Duc Paper Company

Investment	200 MVND (US $ 15,000)
Savings	1288 MVND (US $ 96,000)
Pay back Period	<2 months
Environmental savings	- 33% reduction in wastewater volume - 20% reduction in organic pollution load - 30% reduction in gaseous emission - 30% reduction in solid waste generation
Management changes	- Management system to monitor day-to-day input material consumption & % paper break (off-cuts and other paper waste)
Product Quality improvement	- Decreased % break from finished paper - 5% increase in production

1.4 Linh Xuan Paper Company

Linh Xuan Paper Company is a medium sized pulp & paper mill, having an installed capacity of 2000 T/annum of tissue paper and 5000 T/annum of ceremonial joss paper using waste paper and bamboo waste as raw materials. Of late, the company has transferred the joss paper production section to another company, therefore, this case study deals only with tissue paper production.

Tissue is currently mainly sold in the domestic market but this business is facing severe competition, both in terms of demand and profit margin, therefore the company is exploring export markets and quality improvements are seen as necessary. In view of high organic pollution load & volume from black liquor generated during bamboo pulping this factory was included by the environmental authorities in the "Black book" category. The need for quality improvement and environmental performance, were the major driving forces for this company to participate in the CP project.

A CP team with 7 members was established under the supervision of the deputy director in-charge of production. Major attention was paid to reduce the consumption of water, bleaching chemicals, waste paper, fuel and electrical energy, as well as proper control on consistent paper weight. After the detailed CP assessment & data compilation, 34 viable CP measures were selected for implementation and so far 19 measures at a moderate investment of 700 MVND (50,000 US $) have been implemented. These measures have resulted in direct cost savings of 1400 MVND (100,000 US $) per annum. Thus, the overall pay back period is six months. The financial and environmental implications from a new paper machine installed for low weight twin ply tissue are not included in this case study. The major environmental improvements have been a 45% reduction in wastewater volumes, significant reduction in organic pollution load and chloro-organic compounds, due to 39% reduction in bleaching chemical usage, and an estimated 35% reduction in gaseous emission due to a 33% reduction in fuel consumption.

After implementation of the remaining CP measures, a further reduction in wastewater volume & load is expected and the company is seriously considering rationalization of the steam generation and supply system to reduce fuel consumption further. The company has also improved the management system to ensure proper control on input resource consumption, quality of paper and percentage break from finished paper, to minimize reprocessing. Now on a daily basis, reports on production and consumption are compiled and corrective measure taken where necessary.

Poor availability of records and audit reports, low understanding of the CP concept, lack of proper CP approaches and an indifferent attitude towards any change were some of the barriers faced in the pre-assessment phase. However, with more experience & some early results of CP, like control of paper weight variation, a radical change in management and employees' attitude was evident.
More than 50% of the CP measures have already been implemented by company's own resources in a fairly short period. The Board of Directors have also decided to review the CP assessment due to the changed scenario resulting from the transfer of joss paper production.

For more information about the case study, please refer to Chapter 6 “Linh Xuan Paper Company”.

Summary of the CP Demonstration Project in Linh Xuan Paper Company

Investment - CP	700 MVND (US $ 55,000)
Savings from CP measures	1400 MVND (US $ 100,000)
Pay back Period	<6 months
Environmental savings	- 45% reduction in wastewater volume - 35% * reduction in organic pollution load - 20%* reduction in gaseous emission - 30% reduction in solid waste generation
Management changes	- Monitoring system to control input consumption - Control on quality & % paper break
Product Quality	- Uniform paper weight - Ability to produce low weight twin ply tissue - Increased production due to reduced % break

- Figures are estimated based on reduction in input material consumption.

1.5 Phuoc Long Textile Company

Phuoc Long is a large scale composite textile mill in HCMC having a permanent workforce of 1283 people. The company is engaged in the production and processing of more than 20 different types of products ranging from synthetic fibres to natural fabric like cotton and silk. Their products are mostly sold in the domestic market and depending upon market demand, the product mix changes regularly. The company is a State owned enterprise and has been included in the 'Black Book'' by the environmental authority due to its volume of trade effluent having high organic, inorganic pollution load and colour from unexhausted dyestuffs.

In order to improve its environmental and economic performance, while remaining competitive against increasing competition from the textile sector in neighbouring countries, Phuoc Long Textile Company decided to join the CP project. A Cleaner Production task force initially with 6 members was established and at a later stage, 2 more members were added. Dyeing unit (B) was selected as an audit focus and the director of the dyeing plant coordinated the CP project. A detailed CP assessment was done and information was collected and compiled in order to identify sources of waste generation and the possibilities for minimization. In view of the non-availability of data on waste generation, resource consumption figures were used as a benchmark for identification and evaluation of CP measures. A total of 45 CP measures were identified by the team and after detailed feasibility analysis, 33 measures were found to be feasible and agreed upon by the management to be taken up for implementation. Due to resource availability, the unit has so far implemented 19 CP measures, with a total investment of 61 MVND (4,400 US $). These measures have resulted in direct cost savings of 565 MVND (40,000 US $) per annum. The investment costs & accrued benefits from new machines have not been accounted in this case study. The major environmental benefits reported by the unit are a 26% reduction in wastewater volume and significant reduction in pollution load and gaseous emissions. Due to the complexity of the operation & common facilities for the entire factory, the impact on pollution load could not be assessed.

The above-mentioned results are a compilation and estimation from dyeing unit B only. The company has also started implementing the CP measures in unit A as well. Several more CP measures are at various stages of implementation and their performance evaluation will be carried out by the team at later stage. The economic calculation is bound to change drastically when the cost of waste treatment and disposal, which has not been considered so far, are also added into the financial analysis. The company now seems to be convinced about the frequently argued concepts of part-recycling of spent baths, cooling water and waste heat. These measures will result in even higher economic savings and additional environmental improvements.

However, to date the company has not been able to make the requisite changes in their management system and there is an absence of proper records and a lack of monitoring mechanisms, resulting in poor control on the consumption of resources.

The project, like any other CP project had problems initially due to the poor understanding of the CP concept, poor availability of records & reports on consumption & production, and poor organization within the CP team. A key CP team member responsible for 'driving' the project left the company in the middle of the project, which subsequently lost momentum.

One of the major barriers beyond management control was the frequent change in the product and the wide variation in shade and colour depth, therefore inhibiting the CP team to compare data on a daily, monthly or yearly basis.

Some of the facilities are common for the entire company and their separate accounting for the present audit was also realized as a major problem. In addition, the unit is presently planning for a major technology upgrade and any investment and efforts on CP, at this moment, was not considered to be economic. However, regular interaction between the staff and CP experts, and encouraging results from low cost CP measures motivated the CP team to some extent and the company has prepared an implementation plan to implement quite a few CP measures in the near future.

For more information about the case study, please refer to Chapter 7 "Phuoc Long Textile Company".

A Summary of the CP Demonstration Project in Phouc Long Textile Company

Investment - CP	61 MVND (US $ 4,400)
Savings	565 MVND (US $ 40,000)
Pay back Period	<2 months
Environmental savings	- 26% reduction in wastewater volume - Significant reduction in gaseous emission - Moderate reduction expected in pollution load.
Production Quality improvement	- Reduced rejection rate due to black soot - New product range added*

* Financial implication not included in the case study

1. 6 Thuan Thien Bleaching & Dyeing Company

Thuan Thien Bleaching & Dyeing is a small family owned enterprise, undertaking bleaching & dyeing of polyester & blended knitwear. It employs a workforce of 20 semi-skilled labourers. The company is a job-order unit having an average product mix of 70% bleaching & 30% dyeing activities. It is located in a densely populated residential area. Due to black stack gas emissions and smoke from a kerosene oil fired stentor, the company has always been under constant pressure from neighbours & the regulatory agency to relocate and was also included in the "Black Book" by the environmental authority. These issues were probably the driving force for the unit to participate in the CP project.

A small CP team with 3 members headed by the owner himself was established. Being a small unit, the entire unit including utilities were taken for CP assessment. With the assistance of national & international experts, a CP assessment and compilation of existing data was done to identify the CP potential. Due to the lack of proper monitoring & analytical facilities, the required analysis of waste streams could not be carried out & hence input resource consumption figures were used for identifying CP measures. A total of 43 CP measures were identified, of which 26 of them were found to be feasible for immediate implementation. Due to resource availability and priorities of the company, 14 CP measures have been implemented so far with total investment of approx. 1400 MVND (100,000 US $). Implementation of these measures has resulted in direct savings of 1000 MVND (75,000 US $) per annum. The major environmental benefits estimated from implementation of CP are, 70% reduction in gaseous emissions, 30% reduction in organic pollution load and a 34% reduction in wastewater volume.

According to Thuan Thien, participation in the CP project was particularly useful in controlling air pollution problems, reducing wastewater volume & pollution load, and reducing the rejection/re-dyeing of fabric. The company is now geared up to take more involved CP measures related to the reuse/recycle of spent bath and waste heat. These measures will result in additional economic, as well as environmental savings. In a small way, the company has also started recording and reporting consumption and production data on monthly basis to compare the consumption pattern. Air quality monitoring on the shop floor and the external environment is also being carried out by an agency to evaluate the performance of the implemented CP measures

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In absence of a well defined management system, it was difficult to obtain site information, previous reports and audits necessary for the commencement of the CP programme. On compilation of information, collected from one of year data, significant variations in actual production & product mix were observed, and this was the major problem in establishing baseline information. Poor understanding of CP concept and an indifferent attitude towards CP were other major barriers at the start of the programme. However, the increasing regulatory pressure and developing a relationship between the experts & company management were the two catalysts to enable the unit to go for the CP measures undertaken. After implementation of a couple of CP measures, the company realized the economical & environmental benefits and an implementation plan for other viable CP measures was developed.

For more information about the case study, please refer to Chapter 8 "Thuan Thien Bleaching & Dyeing Company".

Summary of the CP Demonstration Project in Thuan Thien Bleaching & Dyeing Company

Investment	1400 MVND (US $ 100,000)
Direct Savings	1000 MVND (US $ 75,000)
Pay back Period	1.5 year
Environmental savings	34% reduction in wastewater volume 30% reduction in organic pollution load 70% reduction in gaseous emission
Management Changes	- Systems for proper recording & reporting of inputs & outputs
Production Quality improvement	- Improved finish of product - Reduced rejection/reprocessing of fabric - 30% increase in production capacity

2. CLEANER PRODUCTION ASSESSMENT METHODOLOGY

For Cleaner Production to be effective & sustainable, it is essential to employ a planned and deliberate approach, while still being flexible enough to adapt to unexpected circumstances. In this project the CP assessment methodology developed in India during project "DESIRE" (*Demonstrations in Small Industries for Reducing Waste- UNIDO 1996*[1]*)*, has been used with minor modifications. The methodology divides the CP audit into six steps and 18 tasks. The objective of each step is briefly discussed below:

Step-1: Getting Started:

Planning and organization of the cleaner production audit, including the designation of the CP team, listing major process steps to select the audit focus.

Step-2: Analysing Process Steps:

Preparation of detailed process flow diagrams for the selected audit focus & preparation of material /energy balances to quantify waste, its costs & causes thereof.

Step-3: Generating Cleaner Production Opportunities:

Identification of potential cleaner production opportunities and preliminary selection of workable CP opportunities.

Step-4: Feasibility Analysis:

Evaluation of the technical & financial feasibility and environmental desirability of CP options in order to select technological and economically feasible cleaner production solutions

Step-5: Implementing & monitoring Cleaner Production Solutions:

Preparation for actual implementation of feasible CP solutions, and monitoring of the results achieved by their implementation.

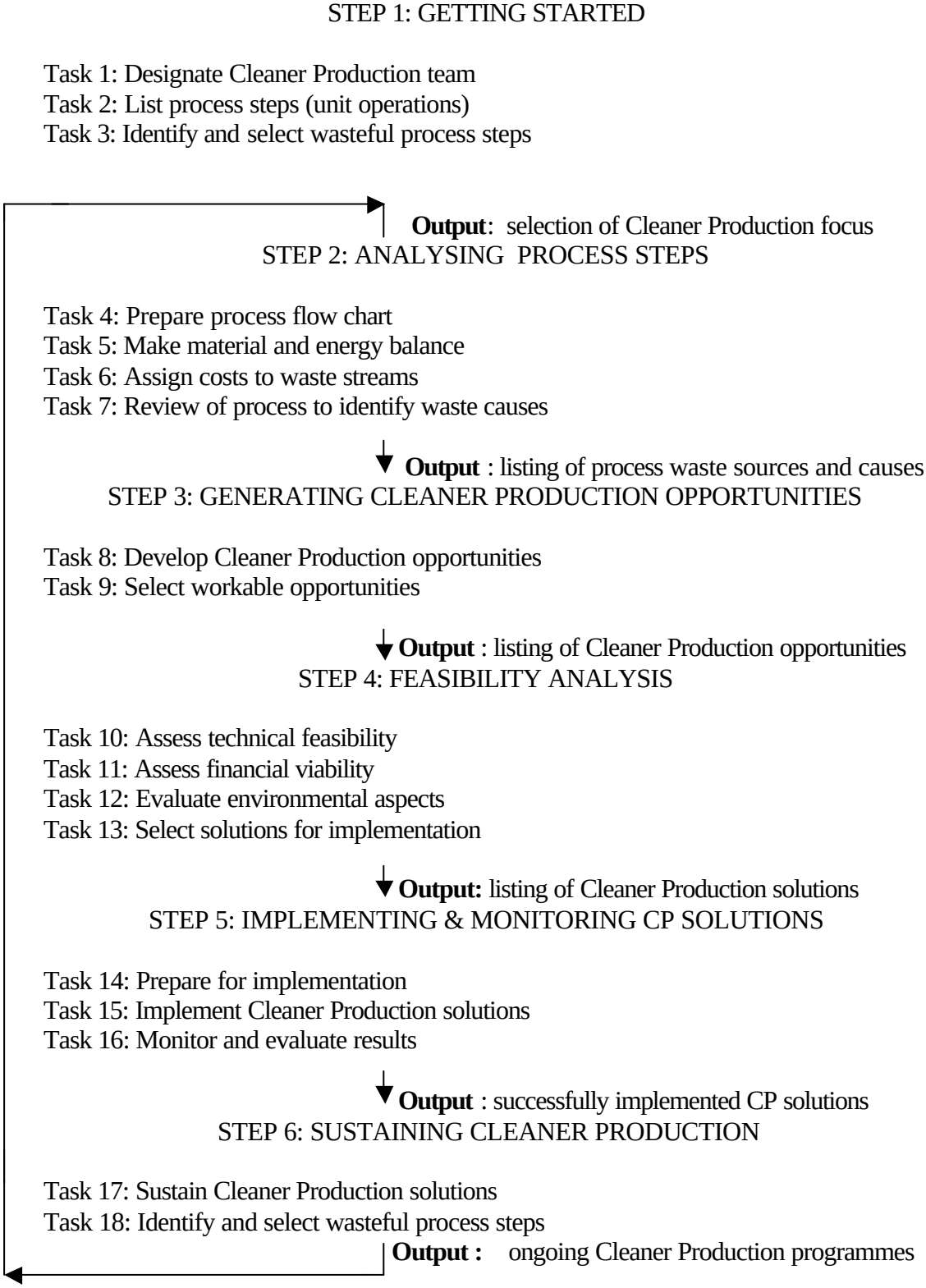
Step-6: Sustaining Cleaner Production:

Human resource development & strategies for sustenance of CP and selection of another CP audit focus.

A flow chart indicating systematic approach for an effective Cleaner Production programme is included in Fig.2.1 below:

[1] Refer to the National Cleaner Production Center – Vietnam (details annex 1)

Figure 2.1
A systematic approach for an effective Cleaner Production programme



3. CASE STUDY-1 : THIEN HUONG FOOD COMPANY

3.1 INTRODUCTION

Thien Huong Food Company joined the project in February 1998. A detailed CP assessment was conducted and a wide range of cleaner production measures have been identified and are currently being implemented by the company. To date a total of 62,000 US $ has been invested resulting in annual savings of 633,700 US $ and significant improvements in environmental performance. In the meantime, the unit has installed a new, fully automatic noodle line having higher productivity and this is expected to reduce resource consumption and waste generation even further.

3.2 FACILITY BACKGROUND

Thien Huong Food Company is a state owned enterprise, and is one of the largest producers of instant noodles in Ho Chi Minh City. The unit was built in 1962 and has a workforce of around 1,200 including administrative staff.

The unit has an installed capacity for the manufacture of an average 25,000 tonne of instant noodles, 2,500 tonne of instant rice soup, 2,500 tonne of soup powder, salted peanuts and chilli sauce per annum. In this case study the instant noodle section was selected as the audit focus and will be discussed from this point.

The instant noodles manufacturing process can be divided into following 8 steps:

Flour Mixing: The wheat flour is mixed with a seasoning solution containing monosodium glutamate, salt and other additives and dumped into a distribution disc for continuous feeding to rollers.

Rolling and Cutting**:** Wheat dough is rolled and pressed by a series of pressing rolls with decreasing thickness to increase the toughness of the noodles. The dough sheet is cut and bent into a mesh of noodles by cutting rollers.

Steaming**:** The noodle mesh is steamed in a longitudinal steam chamber, using live steam for modification of flour and proteins. Steamed noodles are cooled and dried (partly), using fans and cut into blocks for further processing.

Swelling**:** Cooled noodles are immersed into the seasoning solution in order to remove any flour dust, and for flavouring the noodles.

Cutting and Fixing**:** Swelled noodles after partly drying, using fans, are cut manually as per the size requirement, and arranged manually in the frying moulds (Bowls).

Frying**:** Moulds filled with noodles are conveyed to the frying pan by a continuous running conveyer belt. Noodles are retained in the frying oil at a temperature around 170^0C for 4-5 minutes to get crispy and flavoured. Frying bath heating is done by direct firing of furnace oil.

Cooling**:** Fried noodles are cooled in a chamber with fan-forced ventilation before packaging**.**

Packaging**:** After quality checking and weight control, noodles are packed into plastic pouches along with seasoning oil and a spice pack. These small packs are further packed into different sizes of cartons before despatch.

3. 3 RESOURCE CONSUMPTION

Input raw materials, water and major sources of energy which are important from an economical and environmental view are computed and given in Table 3.1. Waste generation quantity (wherever sufficient data were available) is also listed in Table 3.2.

TABLE 3. 1 : INPUT MATERIALS CONSUMPTION

	Input Material	*Total Annual Consumption*	*Specific consumption per tonne of product*	*Remark*
	Wheat Flour (MT)	21350	854 kg	OK
	Water Consumption (m^3)	316,000	12.7	Very high
	Furnace oil for frying (liter)	4,125,000	165 liter.	Very high
	Fuel oil for steam generation	NQ.	NQ.	
	Shortening oil for frying Tonne	4,625	185 kg	Very high
	Electrical Energy KWhr.	Not recorded*	-	-

- **Electrical energy consumption exclusively for the instant noodle section was not available.**

The input material consumption presented in the above table, indicates that water, fuel and frying oil consumption is high compared to its stoichiometric requirements, as well as compared with other similar units in neighbouring countries, having almost similar technology. Product analysis data also supports higher consumption leading to higher losses of frying oil.

High fuel consumption was mainly due to poor combustion practices, low efficiency of energy utilization and higher losses due to radiation heat losses and open pan frying practices. Excess consumption of shortening oil could be attributed to several reasons, and most notable were the quality of oil used, poor control on frying practices and polymerization of oil due to there being no control on temperature.

TABLE 3. 2 : WASTE GENERATION

	Wastes	*Annual Generation*	*Generation Per Tonne of Product*	*Remark*
	Waste Water (m^3)	269,000	10.78 ltrs.	Very high
	Pollution Organic load			
	COD	208 T	8.3 kg	High
	BOD	88 T	3.5 kg	High
	Gaseous Emissions	Concentration analysed but gas volume was not accurately measured	-	Total load is very high
	SO_2			
	Solid Waste	NQ	NQ	Insignificant
	% Damaged (MT)	2,200	88 Kg	Very high

- **Based on 25,000 MT of production per year.**
- **Wastewater presently is discharged into city drain without proper treatment.**

The high organic pollution load was mainly due to loss of flour, frying oil and burnt or waste noodles entering the wastewater drain. Occasional cleaning of the frying pan and noodle wire mesh cleaning contributes a shock load to wastewater. Due to a lack of proper monitoring and measuring equipment, quantification of gaseous emissions was not done, however, based on fuel consumption, generation of major stack gases like So_x and Green house gases (CO_2) were calculated.

3.4 APPROACH TO CLEANER PRODUCTION

The unit participated in the cleaner production project and formed a CP team. The CP team collected and compiled the data as per the six step CP methodology discussed in Chapter 2. Data on various major input materials and energy consumption, were good indicators of higher consumption as compared to similar producers elsewhere. The CP team conducted a detailed cause analyses for the high consumption of resources and the causes so identified were used as a base to explore the CP possibilities. Detailed analysis of finished products was also done to confirm exact losses and their sources. This exercise enabled the unit to identify a large number of CP options with attractive financial returns and reductions in waste water, air emissions, the generation of sludges (slurry) and solid wastes. For preparing an implementation plan, CP options were subjected to detailed technical, economical and environmental feasibility analysis. Only feasible and environmentally desirable options were selected as CP solutions for implementation.

3.5 CLEANER PRODUCTION SOLUTIONS

A total of 62 CP measures were identified and selected for implementation. During the initial stage of implementation, particular attention was paid to those improvements which could be carried out at low or no cost to the unit. These were given a higher priority as they are easy to implement and often result in significant savings.

A good number of the feasible options have already been implemented or are under implementation. A selection of the CP measures implemented and their impact is presented in Table 3.3.

3.6 CONSTRAINTS IN CLEANER PRODUCTION

The commencement of the CP programme was hampered by several constraints. The major constraints were ignorance about the CP concept, lack of knowledge of CP assessment and attitudinal constraints. None of the plant personnel were ever exposed to CP. The systematic approach to problem solving was absent and the usual tendency of jumping on to solutions dominated. Being a large and well managed food industry, there was also a feeling that whatever was being done was the best that could be done. However, with regular interaction between the company and experts, coupled with increasing regulatory pressure to control pollution, a radical change was brought about in the attitude of management and employees. As already mentioned, the CP team has already done a commendable job by finding several CP solutions and more importantly, getting a very large percentage implemented. It is, therefore, quite logical to conclude that there are now no more barriers within the CP programme.

3.7 CONCLUSION

The implementation of the cleaner production measures has contributed significantly to improvement, in areas such as the discharge of waste water, emissions to the air, working conditions, improvement in production quantity and quality, as well as in the conservation of material, energy and man power. These results are shown in tables 3.4, 3.5 & 3.6

The Board of Directors of the company on realizing the benefits of CP, has earmarked a budget of VND 120 Mill (8500 US $) per month for the Cleaner Production Programme. In addition, the company has now gone for several high investment options for Cleaner Technology in the production and utility sections. A total of 13 Bill VND approx. 0.9 million US $ has been invested so far to further optimize resource consumption, and to upgrade product quality for export.

TABLE 3.3 MAJOR CLEANER PRODUCTION OPTIONS IMPLEMENTED

	CP Solution	***Environmental Benefit***	***Investment (M. VND)***	***Annual Savings (M. VND)***	***Remarks***
1.	Installation of water flow meter in water supply wells	Reduction of Waste water generation	4 M VND	60 M VND	Strict Management control on water usage
2.	Optimization of combustion practice in frying oil furnace	Reduced Gaseous emission	Nil	900 M VND	Training of furnace operator (practices)
3.	Temperature controller to reduce oil polymerisation due to high temp.	-Reduced oil emission -Oil sludge	120 M VND	4,000 M VND	Reduced sludge handling
4.	Fixing of platform and conveyor belt to reduce breakage of noodles	Nil	10 M VND	1,000 M VND	Significant red. in breakage (coupled with proper training incentive for workers)
5.	Fan flat nozzles to clean noodle mesh	Reduced Wastewater generation	2.0 M VND	NQ	Better cleaning of mesh
6.	Insulation of steaming chamber of all the 7 lines	Reduced Gaseous emission	200 M VND	600 MVND	Reduced fuel consumption for steam generation
7.	Optimization of moisture content in noodles before frying	Nil	NQ	(Reduced oil cons.)	Not quantified separately
8.	Reduction of steam pressure for noodle steaming	Reduced Gaseous emission	Nil	220 M VND	Increased production due to availability of steam
9.	Recovery of oil from broken noodles & oil sludge	Reduced oily sludge quantity.	Using the existing equipment (Peanut Section)	400 M VND	
10.	Partition of flour mixing and noodle section and spring doors to reduce dust	Nil	70 MVND	NIL	Quality will improve
11.	Collection of condensate for reuse as boiler feed water	Reduced Gaseous emission	30 MVND	52 M VND	
12.	Installation of new high efficiency boiler	Reduced Gaseous emission	2.1 B VND	NQ	Undergoing installation
13.	Installation of fully automatic noodle line	- Reduced Cons. Of shortening oil - Reduced Gaseous emission	11 B VND	NQ	Not yet fully operational

- *Option No.12 & 13 has not been included for economic and environmental impact evaluation.*

TABLE 3.4 ECONOMIC BENEFITS

S.No.	*CP Solution*	*Before*	*After*	*% age*	*Economic Benefits*	
					MVND	USD
1.	Production Capacity (MT)	20,000	25,000	+ 25%	NQ	NQ
2.	Water Consumption m^3/T	12.7	5.3	- 58%	80	5700
3.	Furnace oil for frying lit/T	165	138	- 16%	700	50000
4.	Furnace oil for steaming lit/T	125	NQ	-	-	-
5.	Shortening oil for frying lit/T	185	160	- 13%	6000	428000
6.	Broken Noodles %	9%	3%	- 66%	2100	150000
	TOTAL				8880	633,700

TABLE 3.5 ENVIRONMENTAL BENEFITS

S.No.	*Factor*	*Before*	*After*	*% age*	*Remarks*
1.	Waste water Vol. m^3/T	10.8	4.1	- 66%	
2.	Pollution load • COD kg/T • BOD kg/T • O/G kg/T	 8.3 3.5 NA	 5.6 2.2 NA	 -32% -37% -	Significantly reduced.
3.	Gaseous Emission	NQ	NQ	-	Significantly reduced, due to reduced fuel consumption and better combustion

- **Economic benefits incurred due to increased production and reduced waste treatment cost not accounted.**
- **Gaseous concentration were analysed but total load was not computed due to non-availability of gaseous volume.**
- **All figures are based on 25,000 T/annum production**

TABLE 3.6 RESULT OF CP-DEMO PROJECT AT A GLANCE

S.No.	*Item*	*No.of Value*	*% age share*
1.	Total No. of CP solutions identified	62	
2.	No. of CP solutions implemented so far	24	39%
3.	No.of CP solutions under implementation	8	13%
4.	No.of CP solutions to be implemented	10	16%
5.	No.of CP solutions requiring detailed technical and financial details	14	22%
6.	Rejected	6	10%
7.	CP-Technique wise Distribution of CP Measures Good housekeeping Input Material Change Process Modification/control Equipment Modification Technology Change Recycle/Reuse/Recovery	 10 2 22 18 6 5	 16% 3% 35% 28% 10% 8%
8.	Savings in Resource Consumption/year a. Water consumption m^3 b. Furnace oil Cons. m^3 c. Shortening Oil T	 181,000 625 500	 -58% -16% -13%
9.	Reduction in Pollution Load/year a. Waste water Vol. m^3 b. Organic Pollution Load -COD (T) -BOD (T) c. Gaseous Emissions	 144,000 67 29 NQ	 -66% -32% -37% Expected >30%
10.	Improved Quality of the Product	Positive	Export share has increased
11.	Total Investment made Mill VND US $	 880 62,000	
12.	Direct Savings Mills VND US $	 8880 633,700	
13.	Pay Back Period	< 2 months	
14.	Impact on Production Capacity	Increased 5000 T	25%

- **Economics of new boiler and new auto production line not included.**

4. CASE STUDY-2: VISSAN SLAUGHTER HOUSE

4.1 INTRODUCTION

VISSAN is the only integrated modern slaughter house and meat processing unit in the country. Cleaner production opportunities identified during the study are currently being implemented by the company. To date, the company has invested a total of 10,000 US $ resulting into direct tangible monetary benefits of US $ 28,000 and more than 35% reduction in organic pollution load and 27% reduction in solid waste generation.

4.2 COMPANY PROFILE

Vissan Slaughter House is a state owned company and is the largest slaughtering, meat processing and frozen meat storage Co in Vietnam. VISSAN is located on an island in Binh Thanh district –Ho Chi Minh City. It is a large scale unit, established in 1970, with a workforce of more than 2,000 employees and an installed capacity of 2,400 pigs/shift, 300 cows/shift and a frozen processed meat capacity of 1000 MT. However, capacity utilization is less than $1/4^{th}$ of installed capacity and total turnover of the company is about 670 Billion VND (50 million US$). VISSAN consumes an average of 1,200 m^3/day of potable water from city water network and 2,500 m^3/day of cooling water from Saigon River. The resulting effluents are discharged directly into the river without any treatment. The main product lines are pig slaughtering, bovine slaughtering, chilled frozen meat, processed meat, and sterilized sausages.

4.3 PROCESS OVERVIEW

Based on its environmental impact, the slaughtering section was selected as the audit focus during the study. A brief description of the slaughtering process both for cattle and pigs is given below:

BOVINE SLAUGHTERING

- RECEIVING AREA : To reduce stress on the animals, to make up glycogen depletion and to flush out intestinal pathogen bacteria, animals are held for 24-36 hrs and often health inspections are undertaken before slaughtering.
- STUNNING: Animals are driven from the receiving area to the slaughtering area, where an electric shock is applied to stun the animal before slaughtering, to ensure no movement, the brain is punctured by a pointed knife and the animals are then suspended on an overhead rail by their hind legs.
- SLAUGHTERING: The jugular vein is cut to drain the blood, and horns and legs are removed before de-skinning.
- DRESSING: Skin is removed downwards by using a sharp knife and by pulling manually. Blood and tissue fall on the floor.
- EVISCERATION: The dressed carcass is cut open to remove the intestinal contents which are then further segregated into edible and non edible portions, in the offal cleaning section.
- CARCASS SPLITTING AND WASHING: The carcass is split using an electric circular saw. After washing, fat is trimmed before a quality control check, the carcass is weighed and handed over the to owner, or issued for processing.

PIG SLAUGHTERING

- LAIRAGE : Pigs like bovines are also held for 24 hrs to recover from fatigue and stress and enough water is provided to flush bacteria.
- STUNNING : Before slaughtering pigs are stunned using high frequency, low voltage electric current and hoisted onto an overhead rail for slaughtering.
- STICKING AND BLEEDING: The carotid artery and jugular vein are cut to drain out blood and to get the muscles relaxed for easy dehairing.
- SCALDING & DEHAIRING : After bleeding, pigs are dipped in into a scalding tank with hot water ($60^{o}C$) for 4-5 minutes to loosen the hair. Dehairing is done mechanically using revolving beaters. Final dehairing is done manually by hoisting the pig onto the overhead rail.
- EVISCERATION: The head is removed and belly is cut to open to remove the viscera, which is transported by a moving pan to segregate edible and non edible offal. Intestines are cleaned for sausage casings.
- SPLITTING : The carcass after washing and, trimming is cut into two halves and the split carcass is once again washed. After checking for quality, the carcass is ready for despatch.
- UTILITIES - Utilities includes water supply, boiler house and maintenance workshop.

4.4 RESOURCE CONSUMPTION AND WASTE DESCRIPTION

During the slaughtering process, several by-products and waste streams are generated which are partly collected and partly disposed of. The major wastes/by-products are:

- **Blood**
- **Hides**
- **Offal**
- **Stomach contents & manure**
- **Waste water**
- **Hair**

With the exception of hides and part of the blood, all the wastes end up in the waste water stream contributing fats, tissues, oil & grease, hair, blood & dust leading to the high organic pollution load.

4.5 APROACH TO CLEANER PRODUCTION.

Having assessed the potential impact of cleaner production in VISSAN, the CP- team identified that the waste water generation from the slaughtering section, and the potential for energy savings from the frozen and cold storage section, were the two main areas and that CP efforts should be focused mainly on these sections. After detailed investigations, a number of project areas were identified:

- **Blood collection & handling practices.**
- **Offal cleaning and washing**
- **Water usage**
- **Energy consumption in cold storage section.**

All the above mentioned areas have a high potential for pollution load reductions & economic benefits. Some of the waste streams do not have tangible profit enhancement potential, but are highly detrimental to the environment. Such streams need proper segregation for treatment or reuse. Some of the waste streams have a high potential for recycling or by product formulation these are listed in TABLES 4.1 and 4.2.

TABLE 4.1 WASTES HAVING RECYCLE/BY-PRODUCT FORMULATION OPPORTUNITIES.

No.	***Description of Stream***	***Probable Env. Impact***	***Recycle/Recovery Potential***
1.	BLOOD	Very high Organic Pollution Load	• Efficient blood handling and reuse for haemotonics • Coagulation and thermal drying for high protein meal.
2.	OFFAL	Very high pollution load and solid waste	• Rumen digesta can be dried and mixed with coagulated blood for animal feed. • Non edible offal can be rendered to make tallow.
3.	HAIR	Organic and solid pollution load (often choking sewers)	• Proper collection and conversion into fertilizer

4.6 CLEANER PRODUCTION OPPORTUNITIES

Cleaner production opportunities were identified using CP assessment reports and causes of waste generation. A total of 21 CP opportunities were selected for implementation, a description of the most important are given below:.

a) Discharge of blood, constituting a significant organic pollution load, which at present is collected partly by customer & partly discharged into the drain.

b) Solid wastes from offal handling & cleaning, which is at present discharged into drains leading to a higher pollution load,

c) Excessive consumption of potable water for processing and cooling water from the river leads to a higher waste volume.

d) Energy losses in the refrigeration section due to leakage, improper temperature control & under-utilization of storage capacity.

e) Excess consumption of furnace oil in the boiler house due to a poorly tuned boiler. This results into excessive air emission (mainly smoke, SOx & carbon monoxide).

TABLE 4.2 WASTE GENERATION & MAJOR CAUSES

Operation	***Sources of Waste Generation***	***Nature of Waste***	***Probable Causes of Waste Generation***
Lairage	- Bovine Lairage - Pig Lairage	- Solids - Wastewater	• Defecation during lairage • Left over animal feed • Cleaning of lairage Pans • Under utilization of pan size & capacity • Time for lairage
Slaughtering	- Stunning - Sticking - Bleeding	- Blood - Wastewater - Vomit - Blood	• Cleaning of animal before slaughtering • Improper blood collection device • Intestinal/stomach liquid during hanging • Operation for cleaning • To assist dehairing
	- Scalding	- Waste Water - Heat	• Continuous overflow of scalding tank • No temp - control • No scalding aid chemical used
	- Dehairing	- Waste Water - Hairs	• To remove hairs from pig • No collection of hairs • Improper design of nozzles in dehairing drum
Offal Cleaning	- Pig line - Bovine Line	- Solid waste - Wastewater - Ruman digesta	• To remove paunch material • Improper handling of offal • No collection of Rumen digesta • Inefficient cleaning process • No offal rendering facility.

Causes mentioned above for waste generation were used as base for identifying CP-opportunities.

4.7 CLEANER PRODUCTION APPLICATION

During the CP assessment phases, particular attention was paid to those options which could be implemented easily, with low investment. These were given higher priorities, as they were easy to implement and are largely oriented towards a reduction in pollution load, and have tangible and intangible savings by recovery of organic by-products

The major CP measures, which have already been implemented by the VISSAN under this project, are briefly described below:

A. COLLECTION OF BLOOD FOR SALE AS FISH MEAL

The organic pollution level from blood constituted the major portion (200,000 ppm of BOD/kg of blood). Blood collection tray/troughs have been installed. This simple measure has resulted in the following benefits.

- Collection of an average additional 500 kg of blood daily, which is currently given free to fishmeal manufacturers.
- Reducing the organic pollution concentration & load in wastewater.
- Improving the slaughtering floor housekeeping and hygiene conditions.
- Reduced water consumption & pollution volume required to flush out blood.

Implementation cost : negligible

Annual Savings : Nil (As WWTP does not exist)

B. COLLECTION OF SOLID WASTE (FOR RESALE AS MANURE/SOIL CONDITIONER)

The solid waste load and Total Suspended Solids (TSS) in waste water was contributed mainly by the wet offal cleaning operation. This also leads to choking of the wastewater drain, solids settling in wastewater collection sump and foul odours due to biodegradation. Solid wastes from the offal cleaning section including, rumen digesta are now collected before wet cleaning, with the following benefits.

- On an average, 4 tonne of solid waste is collected & sold for composting to farmers.
- Significant reduction in organic pollution load & suspended solid in waste water
- The prevention of frequent choking of sewers leading to overflows & maintenance/ cleaning costs.
- Reduced cleaning frequency of waste water pump sump & reduced pump wear & tear.
- Improved the cleanliness of the factory premises

Implementation cost : Nil

Annual Saving : Significant saving in waste handling & disposal.

C. PROCESS WASTE WATER :
Installation of nozzles and reduction of pipe diameter

The water consumption of the slaughtering section and offal cleaning section was reduced by installing:

(a) closing valves at all the open hoses;
(b) reducing the diameter of washing pipes and hoses;
(c) installation of perforated flow restrictors in wash/cleaning basins;
(d) installation of high pressure quick shut off valves for floor cleaning hoses.

The implementation of the above CP measures has resulted in:

a) Daily savings of 250 m^3 of potable water,
b) Reduced pollution load and volume,
c) More effective cleaning of carcasses and offal due to increased pressure.

Implementation costs : 20 Million VND (1400 US$)

Direct Annual Savings : 100 Million VND (7000 US$ -

Excluding potential saving in WWTP)

D. COOLING WATER

The water consumption for refrigeration systems alone, accounts for 2,500 m^3/day of untreated river water. For various cooling purposes the following actions were taken:

a) Close loop recycle of compressor cooling water, by installing cooling tower,
b) Close loop recycle for sterilization equipment by installing another cooling tower.

This has not only resulted into water savings, but significant reduction of wastewater volume.

Implementation cost : 110 M VND. 8,000 US $

Annual Savings : 300 M VND. 21,000 US $

E. OPTIMIZATION OF BOILER COMBUSTION AND OPERATION

The air/fuel ratio in the boiler was optimized to improve the combustion efficiency and reduce the fuel consumption. Benefits achieved from this measure include:

a) Furnace oil consumption reduced by 15 Tonne/annum in spite of increased steam requirement in newly installed sterilized sausage production line.

b) Reduced gaseous emission from boiler

Implementation cost : Nil

Annual Direct Savings : 20 M VND.

F. OPTIMISATION OF REFRIGERATION TEMPERATURE AND STORAGE CAPACITY

The highest electrical energy consumption in VISSAN, is in the refrigeration system (cold-storage warehouses for frozen meat). The temperature was increased from -45^{o}C to -35^{o}C and the storage capacity was optimized (partly so far) to reduce the energy consumption. This has resulted so far in reduced electricity consumption of 950,000 kWhr per annum, savings equivalent to 72 Mill. VND or 5,000 US$.

G. IMPROVING SCALDING PROCESS

In slaughtering the only source of thermal energy consumption is the scalding operation. To reduce the high energy consumption from the continuous overflow of the scalding tank, caustic addition to the tank was practiced. This measure has not only reduced the heat and water loss, but has also improved the dehairing process, consequently eliminating any possibility of bacterial contamination to the carcass.

Economic Impact not quantified.

4. 8 MAJOR CP MEASURES UNDER IMPLEMENTATION

The company is currently developing a close loop recycle system for the refrigeration system condenser cooling water (2,500 m^{3}/day), and replacing river water with rain harvested water from the live stock storage sheds. This option will result in the following benefits.

a) Reduced energy consumption for pumping (2 stage) river water for once through cooling.

b) Due to water quality, condensers are frequent cleaned and must be replaced after two years due to scaling. The life of the condensers and the cooling efficiency will increase significantly due to good quality water usage.

c) Wastewater from this operation will be eliminated.

Investment costs : 180 M VND (33,000 US$)

Expected savings : 120 M VND (22,000 US$)

4.9 CONSTRAINTS IN CLEANER PRODUCTION

Initially, the project suffered from several constraints and the actual CP assessment was delayed. The major constraints encountered within VISSAN were:

a) Being a service sector industry, VISSAN has limited control on customers regarding resource consumption, and the customers have no concern for environmental pollution and/or resource utilization.

b) The attitude of personnel was indifferent toward CP, believing that environmental programmes will always "cost money" and that CP is impossible in the short term and expensive.

c) Being a state owned enterprise and having a monopoly, few people were concerned about the environment or the financial health of the company.

d) Fear of a negative impact on the quality of the product and hygiene.

Catalyst for change : One of the CP team members was trained in CP and was instrumental in bringing about the attitudinal and system changes in VISSAN. Though late, the company has been responding well, and has already implemented some innovative low cost CP measures and several major options are now under implementation.

4. 10 LONG TERM SUSTAINABILITY OF CP WITHIN VISSAN.

Having realized the immediate dividends in financial and environment performance, VISSAN has embarked on the identification of more complex CP opportunities. The CP team has already started gathering information on the costs and benefits of solid waste rendering, blood plasma protein recovery, offal cutting and cleaning for by-product recovery. CP team meetings are held regularly, and a close watch on resource consumption and waste generation is kept. Occasionally customers are trained on better operating practices and the optimum usage of resources.

4.11 CONCLUSION

In addition to tangible financial savings, this project has resulted so far in the significant reduction in environmental pollution load. In due course, the costs of treating the company's waste water will be considerably reduced.

TABLE 4.3 : RESULT OF CP DEMONSTRATION PROJECT AT A GLANCE

NO.	*ITEM*	*NO. OR VALUE*	*% AGE SHARE*
1.	Total No. of CP solutions identified	21	
2.	No. of CP solutions implemented so far	9	43%
3.	No. of CP solutions under implementation	3	14%
4.	No. of CP solution to be implemented	1	5%
5.	No. of CP solutions requiring technical and financial details	6	29%
6.	Rejected	2	9%
7.	Savings in resource consumption/year		
	a. Potable water consumption m^3	90,000	20%
	b. Furnace oil consumption MT	15	6%
	c. Electrical consumption Kwhr.	950,000	17%
8.	Reduction in Pollution Load/Year		
	d) Waste water vol. m^3	90,000	20%
	e) Organic pollution load BOD & COD (Tonne)	310	33%
	f) Gaseous emissions	NQ	NQ
	g) Solid waste	1,255 T	27%
9.	Total Investment Made		
	Mill. VN D	135	
	US$	10,000	
10.	Direct Savings Mill. VN D	392	
	US$	28,000	
11.	Pay Back Period	< 5 Months	

5. CASE STUDY-3 : XUAN DUC PAPER COMPANY

5.1 INTRODUCTION

M/s. XUAN DUC is a state owned enterprise located in Phouc Long A Ward, District 9, HCMC with a work force of around 180 employees. A wide range of cleaner production opportunities have been identified, and are currently being implemented by the company. To date, a total of 15,000 US $ has been invested, resulting into annual savings of US $ 96,000 and a significant reduction in environmental pollution load and volume. The unit is also currently undergoing expansion, and the highlight of this expansion is that most of the more costly CP options identified during the CP assessment programme have been implemented in the expansion project. A total of 300,000 US $ has been invested in CP related activity during the expansion. This expansion has only been completed recently and the plant is not fully stabilized, therefore, an economic and environmental analysis of these changes has not been carried out.

5.2 COMPANY PROFILE

Xuan Duc is a medium size paper mill having an installed capacity of 3000 T/year of duplex and cartoon paper. After expansion, the production capacity will be increased to 5000 T/year. The company's production is mostly consumed in the domestic market as industrial paper, and the turnover of the company is around 10 Million US $.

5.3 PROCESS DESCRIPTION

- *RAW MATERIAL PROCUREMENT, STORAGE & SORTING* Different raw materials like imported pulp and recycled white paper are collected separately, and black recycled paper is sorted manually, to remove unwanted impurities like plastics, metals, styrofoam etc.

- *PULPING*: Fibres are freed from raw material in the hydropulper, using partly fresh water and partly recycled wastewater. The desired quality of stock is prepared by dispersing and diluting in the hollander/beater.

- *STOCK PREPARATION*: Stock from the hollander is transferred to storage, and chemicals for sizing and other purposes are added. From the storage chest, stock goes through a series of cleaning operations, like screening to remove fibre bundles, plastic etc. and than passes through a sand trap to remove heavier impurities by sedimentation. Cleaned stock flows to the dilution box, for adjustment to the required consistency of pulp by mixing with recycled white water.

- *PAPER MAKING*: Diluted stock is fed to the "former drum" where fibres form a uniform mat on the former drum screen. Excess white water along with drum cleaning water is discharged into the drain, contributing the main wastewater discharge from the unit. The wet paper is dewatered mechanically using suction (vacuum) and pressing. The remaining moisture (more than 60%) is dried using thermal energy in the dryer rolls. Dried paper is rolled onto a reel.

- *CONVERTING SECTION*: Paper rolls are cut and rewound to the required width. After quality checking, rolls are wrapped, strapped and stored for despatch.

- *UTILITIES*: Utilities include boiler house, boiler feed water treatment unit, and a maintenance workshop.

5.4 RESOURCE CONSUMPTION

Resource consumption and waste generation quantities are outlined below in Table 5.1.

TABLE 5.1 **EVALUATION OF RESOURCE CONSUMPTION & WASTE GENERATION**

S.No.	***RESOURCE***	***ANNUAL CONSUMPTION***	***SPECIFIC CONSUMPTION PER TONNE OF PAPER***	***REMARKS***
1.	Water Consumption	339,800 m^3	130m^3	Very High consumption.
2.	Fibrous Material	3310 Tonne	1.27 T	Higher than standard value for this quality
3.	Fuel Oil	832 T	320 Litres	High cons.
4.	Electrical Energy	1,958,360 kWhr	740 KWhr.	High cons.
5.	Chemicals a. Alum b. Rosin	 42 T 28.5 T	 16 kg 10.8 kg	 O.K. Very High Consumption
WASTE GENERATION				
1.	Wastewater	283,000 m^3	105 m^3	High
2.	COD/BOD	NQ	NQ	Unbleached paper having low organic pollution
3.	Gaseous Emission	NQ	NQ	Significant due to inefficient boiler
4.	Solid Waste	243 T	92 kg	
5.	Fibre Loss	104 T	40 kg	
6.	Off-cut paper (Break)	380 T	150 kg	Very High

- Material consumption and waste generation figure is taken on the basis of annual production of 2650 T.
- There is only primary wastewater treatment facility, after part fibre removal wastewater is discharged into the city drain.

Excess water consumption in the unit is due to several causes, such as, only partial recycling of fibre rich white water, once through usage of former drum & felt cleaning water and poor maintenance of water supply line etc. The higher consumption of fuel, is mainly due to poor steam generation efficiency, a faulty distribution system and poor utilization of condensate and flash steam. Specific electrical consumption is high, due to poorly balanced load distribution, low capacity utilization, old and inefficient motors and drivers and a low power factor. Very high consumption of rosin for the grade of paper manufacturing is mainly due to the quality of rosin and a faulty dosing system.

Gaseous emissions, though not monitored, are higher than necessary, as furnace oil consumption is high, due to higher stack heat losses and distribution losses. The percentage break from finished paper is high due to improper production scheduling and no control over paper width within the paper machine stage.

5.5 CP METHODOLOGY

Due to the non-availability of enough data on waste characteristics, it was not possible to quantify the waste volume and related costs. A different approach used in this case was cause analysis for excess consumption of input materials and energy, rather than cause analysis of wastes generated.

The input materials are important both from their profit enhancement potential as well as improving the environmental performance by reducing quantity & quality of wastes. The causes of the excess consumption of materials & energy, were used for identifying opportunities to reduce the input material consumption, and hence the quantity and quality of waste generation.

All of the identified CP options were screened carefully to ascertain that no option should have a negative impact on product quality, nor the environment. After detailed analysis of CP options for technical feasibility, economic feasibility and environmental acceptability an implementation plan was prepared and depending upon the company's production and resources, CP solutions were taken for implementation.

5.6 CP OPPORTUNITIES

A total of 44 CP measures were selected for implementation, and after evaluation they were categorized under following headings:

a) Reuse/recycle of maximum possible waste sources like white water, clean water, fibre, steam condensate and flash steam etc.

b) Proper routine maintenance of equipment & motors, drives, belts & felt etc.

c) Proper production scheduling to avoid excessive trimming to achieve desired widths (break)

d) Rationalization of thermal energy supply line & optimization of steam generation, supply & usage efficiency

e) Energy audit and power factor correction for major power consuming equipment.

5.7 CLEANER PRODUCTION APPLICATIONS

During the assessment and implementation stage, particular attention was paid to those improvements which could be carried out at low, or no cost to the unit. These were given a higher priority as they are easy to implement and often yield significant savings.

Few of the CP measures which have already been implemented by the unit are briefly outlined in Table 5.2

5.8 BENEFITS AND ACHIEVEMENTS

Major benefits achieved in terms of economics & environmental savings are presented in Table 5.3.

5.9 CONSTRAINTS IN CLEANER PRODUCTION

The absence of clear programme objectives, and poor co-ordination of the CP team and the allocation of responsibilities, were the major constraints in late implementation of viable CP solutions. Except for one team member who was trained in CP in India, other members' interest were low in the beginning - lack of financial resources was cited as the other principal constraint in the implementation of CP. However, the early benefits of options with low cost investment, enabled the company to overcome the mental block, and a radical change was seen in management attitude. Most of the feasible options have been implemented or are being implemented. Some of the more costly CP measures are taken up for implementation in a plant expansion.

5.10 CONCLUSIONS

The case study has clearly demonstrated that a rational approach, creative thinking and a positive attitude, can result not only in financial benefits to the unit, but has also contributed to reducing the environmental pollution load and improving compliance with regulatory requirements.

TABLE 5.2: **SALIENT CP SOLUTIONS IMPLEMENTED AND THEIR BENEFITS**

SL NO.	***CP SOLUTIONS***	***ENV. BENEFITS***	***INVEST-MENT***	***ANNUAL SAVINGS***	***REMARKS***
1.	Substitution of fresh water by white water in pulper, hollander & cartoon section stock dilution	Reduced waste water volume by 33% & org. pollution load significantly	NIL	50 MVND 3500 US $	Costs related to reduction in WWTP has not been accounted
2.	Optimization of Hollander design & pulp beating time	-Reduced fine fibres to WWTP -Reduced energy consumption	NIL	NQ	Taken for implementation in expansion plan also
3.	Installation of high frequency vibrating screen to remove shives and fibre bundles	-Reduced pollution load & volume due to reduced rejection rate	30 MVND	50 MVND	Better quality paper with uniform weight (installed in New P/M)
4.	Installation of suction hood for faster withdrawal of moisture from dryer drum	-Reduced steam consumption leading to reduced gaseous emission	300 MVND	240 MVND	Improved P/M speed (Installed in new P/M)
5.	Thermal insulation & rationalization of steam supply line	-Reduced fuel consumption and gaseous emissions	5 MVND	94 MVND	
6.	Collection of condensate and flash steam and use them as boiler feed water	-do-	10 MVND	100 MVND	Feed water quality improved
7.	Reduction in % break by adjusting paper width on machine as per market demand	-Reduced reprocessing energy, steam water & reduced fibre losses (org. pollution load) during reprocessing	NIL	650 MVND	Has resulted into 5% increase in production
8.	Reduced consumption of rosin by mechanical dosing in chest	-reduced organic pollution load	NIL	100 MVND	Partly implemented, dosing pump yet to be installed.
9.	Improvement of power factor by proper load balancing between 3 phases and installation of inverters & sensors	-Reduced energy consumption (off-site pollution load reduction)	300 MVND	420 MVND	Partly implemented in new P/M
10.	Changing of motor drives and pullies by direct coupling	-do-	NA	NQ	Accounted into expansion programme
11.	Recovery of fibre by using sedimentation save all (Presently recovered partly in primitive bags filters)	-Reduced wastewater volume and organic & inorganic pollution load	70 MVND	62 MVND	Additional benefit will accrue due to reduced WWT costs

TABLE 5.3 ENVIRONMENTAL & ECONOMIC BENEFITS

PARAMETER	***BEFORE***	***AFTER***	***% CHANGE***	***ECONOMIC BENEFITS***
1. Production Capacity	3000 T/year	3200T/year	> + 5%	405 MVND*
2. Water Consumption	130 m^3/T	85 m^3/T	- 33%	50 MVND
3. Fuel Oil	320 kg/T	250 kg/T	- > 21%	325 MVND
4. Electrical Energy	740 kWhr/T	662kWhr/T	- > 10%	156 MVND
5. % Break	150 kg/T	78 kg/T	- > 7%	680 MVND
6. Rosin Consumption	10.8 kg/T	8.8 kg/T	- 20%	45 MVND
7. Fibre Recovery	-	40 kg/T	+ 4%	32 MVND
			TOTAL	1288 MVND (excl. benefits from increased production)
<u>ENVIRONMENTAL BENEFITS</u>				
a. Wastewater volume m^3/T	105	70	34%	
b. Pollution load BOD/COD	NQ	NQ	Estimated to be 20%	
c. Gaseous emission	NQ	NQ	>30% estimated based on flue gas analysis	
d. Solid Waste kg/T	132	92	30%	

* Anticipated benefits from reduced wastewater vol. & pollution load not accounted for.

TABLE-5.4 : RESULT OF THE CP DEMO PROJECT AT A GLANCE

SL. NO.	*ITEM*	*NO.*	*%AGE SHARE*
1.	Total number of CP solutions identified	45	-
2.	No. of CP solutions implemented so far	21	47%
3.	No. of CP solutions under implementation	6	13%
4.	No. of solutions to be implemented	10	22%
5.	Needs detailed technical information and analysis	7	16%
6.	Presently rejected	1	2%
7.	***DISTRIBUTION OF CP MEASURES***		
	a. Good housekeeping	12	27%
	b. Process control/optimization	8	18%
	c. Equipment modification	14	31%
	d. Technology change	2	4%
	e. Recycle/Reuse/Recovery	8	18%
	f. By Product/useful product	1	2%
8.	***SAVING OF INPUT CONSUMPTION/YEAR***		
	Water Consumption m^3	13,000	33%
	Fuel oil (Tonnes)	200	>21%
	Electricity KWhr.	234,000 KWhr	>10%
	Fibrous RM (Tonnes)	62	0.2%
	Rosin (Tonnes)	6	>20%
9.	***REDUCTION IN ENVIRONMENT POLLUTION/YEAR***		
	Wastewater volume m^3	13,000	33%
	BOD load T/year	NQ	Estimated to be 20%
	COD Load T/year		
	Gaseous Emission	NQ	30%
	Solid Waste T/year	126	30%
10.	Total Investment Made	200 MVND 15,000 US $ (4 BVND in expansion)	
11.	Total Savings	1288 MNVD 96,000 US $	
12.	Pay Back Period	<0.2 year	

6. CASE STUDY-2: LINH XUAN PAPER COMPANY

6.1 INTRODUCTION

A wide range of cleaner production opportunities have been identified, and are currently being implemented by LINH XUAN Paper Company in Ho Chi Minh City. To date, this company has invested a total of US $ 220,000 including a new paper machine and boiler, and accrued a direct annual savings of US $ 100,000 and significant reductions in pollution volume and load. Anticipated savings in wastewater treatment operation costs as a result of the reduced pollution load, have not been included in economic calculation.

6.2 COMPANY PROFILE

Linh Xuan is a state owned enterprise located in Linh Xuan, Thu Duc district of Ho Chi Minh City. The company is a medium scale unit having a production capacity of 5000 T/annum of joss paper, (ceremonial paper used in Taiwan) and 2000 T/annum of tissue paper. Recently the joss paper section has been transferred to another Company. The unit was commissioned in 1973 and has a workforce of around 240 employees. The turnover of the company (only tissue paper accounted) is approx. US $ 2 million. The source of the company's water supply is an on-site bore-well.

6.3 PROCESS DESCRIPTION

The major process steps employed to produce tissue paper are briefly outlined below:

- *Raw material sorting*: Waste paper is procured from local suppliers and sorted manually to segregate soiled paper, laminations and plastic etc.

- *Pulping*: Fibres are freed from waste paper in the hydropulper by using recycled and fresh water, and heavy impurities like pins are removed.

- *Beating and bleaching*: Pulp from the hydropulper and break paper from the paper machine and converting section is refined in the hollander, and bleaching chemicals, whitening agents and brightening chemical are added.

- *Stock preparation*: Bleached pulp is pumped to the storage chest and diluted using fresh water. In the storage chest, pulp softening chemicals are added. Stock from the chest is pumped into the level box for screening to remove fibre bundles and shives. Screened pulp passes through a sand trap to settle heavy impurities like sand by gravity. Cleaned stock flows by gravity to the dilution box, to be brought to the required consistency by mixing with fibre rich white water.

- *Paper making*: Cleaned and diluted stock flows by gravity to the paper machine former drum. A thin mat of paper is formed at the former drum and white water is removed and collected in a tank for recycle. The wet paper is further dewatered using vacuum suction and mechanical pressing. Remaining water is removed by using steam in the dryer drum. Dried paper is rolled on a pope-reel.

- *Converting section*: The paper roll are slit and cut according to the required size and packed as a roll or bulk bundles.

- *Utilities:* Utilities included boiler feed water treatment unit, boiler house, warehouses and maintenance workshop.

6.4 RESOURCE CONSUMPTION

Input material and energy important from economic and environmental view and major waste generated in unit is quantified and listed below in Table 6.1.

TABLE 6.1 : EVALUATION OF RESOURCE CONSUMPTION & WASTE GENERATION

(A) INPUT MATERIAL

NO.	***PARAMETER***	***TOTAL ANNUAL CONSUMP-TION***	***CONSUMPTION Per Tonne of Paper***	***REMARK***
1.	Water consumption (m^3)	500,000	250	-Very high
2.	Fibrous raw material (T)	2,560	1.28	-Higher than standard
3.	Fuel oil	1,036 T	518 L.	-High
4.	Electrical energy (KWh)	2,800,000	1400	-High
5.	Bleaching chemical	680 m^3	340 L.	Very high + Env. Sensitive
6.	Dye for colour tissue	80 kg	80 gm	O.K.

(B) WASTE GENERATION

	WASTES	***ANNUAL GENERATION***	***SPECIFIC GENERATION Per T of Paper***	***REMARK***
1.	Waste water (m^3)	440,000	220	-Very high
2.	Organic Pollution load	NQ	NQ	-High due to excess Bleach chemicals.
3.	TSS	NQ	NQ	
4.	Gaseous Emission	NQ	NQ	-High due to excess F.O.cons.
5.	Fibre loss	180 T	90 kg	-High
6.	Break paper	300 T	150 kg	-High

- Remark on resource consumption & waste generation is based on the experience of the author from similar projects elsewhere
- Input material consumption and waste generation figures are computed on basis of 2000 T/annum production.
- Unit does not have WWTP. Untreated waste water is discharged into the city drains.

6.5 APPROACH TO CLEANER PRODUCTION

Data collection and analysis was done by the CP team adopting a structured CP assessment methodology presented in Chapter 2. Data on various inputs and outputs were collected and a detailed cause analysis was done to identify CP measures. Some of inputs/waste may not have significant profit enhancement potential but are highly detrimental to the environment, such as bleaching chemicals. Such inputs were given special attention during the study.

A detailed feasibility analysis of CP options were done to ensure technical feasibility, economic viability and environmental desirability. Any CP measure having an adverse impact on product quality and/or environment was rejected at this stage. Based on a weighted index- matrix analysis, an implementation plan was prepared.

6.6 CP OPPORTUNITIES

A total of 38 CP options were identified, and 36 of them were found to be viable CP solutions. CP measures for Linh Xuan can be categorized the into following programmes.

a) Collection of white water, cleaning water, steam condensates and escaped fibre for reuse/recycle in the process.

b) Replacement of old equipment viz. Paper machine and, boiler with high efficiency equipment

c) Improved stock cleaning to improve paper quality and enable the production of low weight twin ply tissue.

d) Improved moisture withdrawal from paper to reduce energy consumption and increased production by increasing paper machine speed

e) Power factor correction by installing inverter and sensors in major power consuming areas to reduce electrical energy consumption

f) Re-flooring of the paper machine, converting and warehouse section to reduce accidents and soiling of paper.

6.7 CLEANER PRODUCTION APPLICATION

During the assessment and meetings with the CP team, major areas of CP priority were selected and due to market pressures, emphasis was given to improve product quality without increasing the production cost. In addition low cost/no cost options were given high priority for implementation.

A detailed feasibility analysis of higher cost measures was also taken and given priority for implementation. To-date, most of the cost intensive measures have been implemented, or are being implemented.

TABLE 6.2 : MAJOR CP MEASURES IMPLEMENTED AND BENEFITS ACHIEVED

SL NO	***CP SOLUTIONS***	***ENVIRONMENTAL BENEFITS***	***INVEST-MENT***	***ANNUAL SAVINGS***	***REMARK***
1.	Sorting of Raw Material to segregate unwanted impurities	Reduced Solid waste in Pulper & Screening	NIL	120 MVND	Significant
2.	Collection of white Water for stock dilution & hydro pulping	Reduced waste water vol. & pollution load	50 MVND US$3600	110 MVND US$8000	Direct water cost
3.	Installation of high frequency vibrating screen for proper screening and properly designed sand trap	Reduced spillage and foam overflow	30 MVND US$2100	200 MVND US$14300	Uniform weight Paper and Reduction of paper break
4.	Replacing old Paper Machine with new Paper Machine	-Reduced wastewater generation - Red.Poll.load - Red. Gaseous emission	2 BVND US$143000	1.1BVND US$ 76,000	Increased production & product quality
5.	Power factor correction of major motors by installing inverter-sensors	Red. Electrical energy (red. Off-site emissions)	150 MVND US$11,000	72 MVND US$5,100	Recently installed
6.	Adjustment of paper width by masking former drum	Red. Pollution volume & load	NIL	200 MVND US$14,300	Easy to implement & practice
7.	Installation of suction hood at paper machine for rapid withdrawal of steam vapours	Red. Gaseous emission due to thermal energy conservation	12 MVND US$900	70 MVND US$5,000	Will also Increase paper M/C speed of production
8.	Replacement of old worn out steam pipe & insulation	Red. Gaseous emission	10 MVND US$700	20 MVND US$1400	
9.	Replacement of over size motors	Off-site red. In emission	80 MVND US$5700	160 MVND US$11000	
10.	Optimization of bleaching chemical dosage and process of dosing	Significant reduction in organic pollution load	NIL	75 MVND US$5300	Toxic AOX emission has reduced significant
11.	Re-flooring of production section, warehouse, converting section	Housekeeping improved	170 MVND	NIL	Reduced paper soiling and accidents

6.8 BENEFITS & ACHIEVEMENTS OF THE PROJECT

Major benefits in terms of direct financial gains and reduced pollution load are presented in Table 6.3 below:

TABLE 6.3 ECONOMIC BENEFITS

S.NO.	***PARAMETER***	***BEFORE CP***	***AFTER CP***	***% CHANGE***	***ECONOMIC BENEFITS***
1.	Production capacity (actual)	1650 T/year	2000T/Y	+20%	NQ
2.	Water Consumption	250m^3/T	140m^3/T	-44%	60 MVND
3.	Fuel oil	518L/T	390L/T	-33%	400 MVND
4.	Electrical energy	1400 kwh/T	1140kwh/T	-18%	430 MVND
5.	Fibrous Raw material	1310 kg/T	1280 kg/T	-2%	330 MVND
6.	Bleaching chemical	340 l/T	208 l/t	-39%	80 MVND
7.	Break	150 kg/T	120 kg/T	-20%	100 MVND
				TOTAL	1400 MVND

ENVIRONMENTAL BENEFITS

1.	Waste Water Volume	225m^3/T	126m^3/T	-44%	Reduce waste water treatment costs
2.	Org. Pollution Load	NQ	NQ	-	Significant red. Due to 40% Red. In bleach chemicals cons.
3.	Gaseous emissions	NQ	NQ	>35%	Estimated based on reduced F.O. cons.
4.	Solid waste	NQ	NQ	-	Insignificant

- Based on 2.000T/annum of production

TABLE 6.4 RESULT OF CP DEMO PROJECT AT A GLANCE

NO.	***ITEM***	***NO. OR VALUE***	***% AGE SHARE***
1.	Total No. of CP solutions identified	38	
2.	No. of Cp solutions implemented so far	19	50
3.	No. of CP solutions under implementation	5	13
4.	No. of CP solutions to be implemented	10	27
5.	No. of CP solutions requires detailed technical & financial details	2	5
6.	Rejected	2	5
7.	<u>CP Technique-wise distribution of CP measures</u>:		
	a) Good Housekeeping	9	24
	b) Input Material Change	4	10
	c) Process Control	11	29
	d) Technology Change	2	5
	e) Recycle/Reuse/Recovery	4	10
	f) Equipment Modification	8	22
8.	<u>Savings in Resource Consumption year</u>		Reduction
	a) Water consumption (m3)	220,000	44%
	b) Furnace oil cons. (MT)	256,000	33%
	c) Electricity cons. Kwhr	520,000	18.5%
	d) Bleaching chem. (hypochlorite (m3)	264,000	39%
	e) Fibrous Raw Material (MT)	60,000	2%
9.	<u>Reduction in Pollution Load/year</u>		
	a) Waste water volume m3	198,000	45%
	b) Organic Pollution load (BOD&COD)	NQ	significant red. due to reduction in bleaching chemicals >35 estimated
	c) Gaseous emissions	NQ	Estimated to be 35%
10.	Improved quality of the product	Positive	Enable to produce twin ply tissue
11.	Total investment made MVND US $	700 50,000	
12.	Direct savings MVND US $	1,400 100,000	
13.	Pay back period	6 months	
14.	Impact on the production capacity	Increased by 20%	

- Excluding New P/M-2 Nos.
- Production of 2000T/annum is taken for computation

6.9 CONSTRAINTS IN CLEANER PRODUCTION

The commencement of the project was hampered by several constraints. The major constraints were limited understanding of the benefits of the CP concept, and a lack of CP assessment approach and attitude. None of the plant personnel were ever exposed to CP. The attitude of the personnel was to blame obsolete technology, and, assume that technology change was the only remedy. As usual, there was a belief that whatever is being done by the company is best. No information was available on pollution load and concentration, and no effort was made to collect it, as the unit is presently incurring no costs for pollution control. However, involvement in the project and with the experts, and the success stories from other units, brought about a radical change in attitude of the management and CP team. As mentioned earlier the company has now done an excellent job, and a large number of CP solutions have been identified with about 50% already being implemented. The benefits of CP are well understood, and the company is positive and fully geared toward the implementation of the remaining options.

6.10 LONG-TERM SUSTAINABILITY OF CP WITHIN THE COMPANY

The company is on its way towards long-term sustainable cleaner production. The management has already identified more areas where CP is necessary.

Although a new boiler was installed, due to the sale of the joss paper section, the reduced demand of steam by the new machine and the CP options implementation, the company has already planned to replace the existing boiler with a small capacity boiler, preferably close to the paper machine to reduce distribution losses. On the whole, the company has become environmentally conscious and CP should continue on long-term basis.

6.11 CONCLUSION

The cleaner production programme in Linh Xuan has helped the company not only in improving economic and environmental performance, but also with improving product quality. Even in difficult market conditions with strong competition from neighbouring countries, the unit was able to survive and upgrade their production quality and quantity. The company, in addition to implementing most of the low cost feasible CP options, has also implemented the high and medium cost options upon realizing the benefits.

7. CASE STUDY-5 : PHUOC LONG TEXTILE COMPANY.

7.1 INTRODUCTION

The CP assessment programme commenced in January 1998, and this case study deals with results achieved up to June 1999. To date, this company has invested a total of US $ 360,000 in new equipment for heat setting, calendering and high pressure jet dyeing. Economical and environmental impact of the investment on additional equipment has not been assessed as they are in different stages of commissioning. An investment of US $ 4400 for the implementation of low cost CP options, has resulted in direct benefits of US $ 40,000/annum and a moderate reduction in waste generation. Frequent change in production, and tough competition faced by the company from neighbouring countries has also effected the progress of the project.

7.2 COMPANY PROFILE

Phouc Long is a state owned, integrated textile company located in Phuoc Long B Ward, District 9, HCMC. Phuoc Long is a large scale unit comprised of weaving, knitting and wet processing facilities, using varying types of fibres and fabrics. The installed capacity of the unit is approx. 20,000,000 meter of fabric equivalent to 5000 T, however, the present capacity utilization is under 2000 T/annum. The present unit is a merger between two textile factories brought about in 1978, and has a permanent workforce of 1283 employees supported by almost equal number of contract workers.

7.3 PROCESS DESCRIPTION

In view of the large number of operations and the diversity in processing, fancy tolle processing in Section B was selected as the audit focus, and henceforth only fancy tolle production along with utilities is discussed in this case study.

The major process steps involved in wet processing of fancy tolle (fabric having 65% polyester and 35% polyamide) is briefly discussed below:

- *Scouring & Bleaching*: Both the steps are done in alkaline medium, to remove the natural and acquired impurities and to increase the optical brightness of fabric.

- *Heat Setting*: To stabilize the fibre at higher temperature, molecular free movement is allowed giving the fabric a stable texture.

- *Deweighing*: Deweighing of synthetic fibre is done to reduce the weight of fabric using alkali. The deweighing process makes the fabric soft, flexible and enhances its appearance.

- *Dyeing:* Dyeing of fabric is done to give a permanent shade, which offers a reasonable fastness to washing, rubbing, oxidation, sublimation, perspiration etc. The requisite fastness and shade is obtained by using dyestuffs and auxiliary chemicals as dyeing aids.

- *Finishing*: To provide luster, evenness, dust- proofing, anti-creasing, anti-static and other required properties. Finished fabric is dried, packed and despatched.

During the entire process large quantities of water and chemicals are used, and spent baths and wash water are discharged as wastewater, producing a high pollution load.

7.4 INVENTORY OF RESOURCE CONSUMPTION

Due to lack of experience in CP, and the difficulties encountered by the CP team in collecting factual information on input material consumption, it was not possible to use the actual consumption figures. One batch was used as a unit, and a detailed material & energy balance was carried out for one batch. The data from one batch, and total monthly production figures are used in this case study. However, on comparing the consumption figures of material, fuel & electrical energy before and after CP (supplied by the unit), it was found that using one batch as a unit for CP, is neither representative nor useful to get the desired information for a CP assessment.

Based on discussion with the CP team, management and data collected for a few months production and consumption, the following computation was arrived at (For fancy tolle section).

TABLE 7.1 RAW MATERIALS

S.No.	***Input Material***	***Total Annual Consumption***	***Specific Consumption Per Tonne of Product***	***Remark***
1.	Water Consumption m^3	175,000	320	Very high
2.	Electricity Kwhr	3,250,000	6000	Not reliable
3.	Furnace Oil (MT)	670	1.22	Very high
4.	Dyestuff (Acid dyes) kg	2000	6.2	O.K.
5.	Chemicals			
	NaOH kg	20,000	44	High
	Na_2S_204	12,000	27	Very high

No information was available on waste generation quantity and quality.

The high consumption of input resources, such as water and chemicals is mainly due to low cloth to liquor ratio, resulting from the use of older technologies as well as operating practices. Cooling water from various machines is discharged into the drain, and washing operations are done in series, using continuous wash and/or open machine washing practices. Leakage of water, overflows and open hose-pipes, also contributes to excess water consumption.

The sections high fuel consumption, is due to low efficiencies in steam generation due to old/worn out boiler insulation, use of high TDS boiler feed water and un-lagged and sagging insulation on steam supply lines. Due to poor layout and probably low awareness about losses, condensates are not collected, leading to excessive heat losses. Poor maintenance of steam traps also lead to steam losses.

Electrical supply for the whole company is from a single feeder, therefore, electrical consumption for the audit focus could not be quantified. However, obvious causes of energy losses like over-designed motors, inefficient drive systems, and low power factors were identified by the team.

7.5 APPROACH TO CLEANER PRODUCTION

The information provided by the unit and the CP assessment report may not be reliable due to the complexity of operations and frequent changes in production. Causes mentioned above and observations made during several visits, were used to identify opportunities to optimize resource consumption. Some of the data provided was not authentic due to the common pool of supplies to the whole unit, and the CP team could not assess section data for the audit focus. Detailed study of several batches and their consumption also, was not found to be representative. Therefore the areas where CP opportunities were obvious were taken up for implementation.

TABLE 7.2 SALIENT CP MEASURES IMPLEMENTED AND THEIR BENEFITS

S.No.	***CP OPTION***	***ENVIRONMENTAL BENEFITS***	***INVESTMENT***	***ANNUAL SAVINGS***	***REMARKS***
1.	Maximum possible (9 times) recycle of deweighing chemical (NaOH)	-Reduced Wastewater volume & pollution load	NIL	100 MVND	Can be further reduced
2.	Accurate weighing of dyestuffs chemicals, installation of precision electronic balance	-Reduced organic pollution load	14 MVND	20 MVND	
3.	Optimization of cloth: Liquor ratio from 1:15 to 1:10	-Reduced wastewater volume & pollution load	NIL	160 MVND	To sustain training of operator is necessary
4.	Combined bleaching & scouring process	-Reduced pollution load & volume	NIL	210 MVND	Processing time also reduced
5.	Installation of water flow meter & level indicators	-Reduced wastewater volume	6 MVND	NQ	
6.	Installation of primitive SPM collection device (boiler stacks)	-Reduced SPM (black soot) from flue gases	5 MVND	NQ	Soot deposition on fabric avoided

7.6 BENEFITS & ACHIEVEMENTS OF PROJECT

The major benefit of Cleaner Production related to economic and environmental performance is given below

TABLE 7.3 ECONOMIC BENEFITS

S.NO	***PARAMETER***	***BEFORE CP***	***AFTER CP***	***% CHANGE***	***ECONOMIC BENEFITS***
1.	Water consumption m^3	320	240	25%	14.0 MVND
2.	Dyestuffs kg	6.2	4.3	30%	145.0 MVND
3.	Auxiliary chemicals MT (Total)	391	330	15%	240.0 MVND
4.	Furnace oil MT	1.22	1.09	10%	166.0 MVND
				TOTAL	565.00 MVND

ENVIRONMENTAL BENEFITS

S.NO.	***PARAMETER***	***BEFORE CP***	***AFTER CP***	***% CHANGE***	***ECONOMIC BENEFITS***
1.	Wastewater generation m^3	285	211	26%	
2.	Organic pollution load	NQ	NQ	NQ	Moderate reduction expected
3.	Gaseous Emissions	NQ	NQ	NQ	Reduced significantly
4.	Solid Waste	NQ	NR.	--	--

Based on 800 T/annum production in Section B.

TABLE 7.4: RESULT OF CP DEMO PROJECT AT A GLANCE

S.NO.	***ITEM***	***NO. OR VALUE***	***%AGE SHARE***
1.	Total No. of CP solutions identified	45	
2.	No. of CP solutions implemented so far	19	42%
3.	No. of CP solutions under implementation	5	11%
4.	No. of CP solutions to be implemented	9	20%
5.	No. of CP solutions requires detailed technical & financial details	10	22%
6.	Rejected	2	5%
7.	<u>CP Technique-wise distribution of CP Measures</u>		
	a. Good Housekeeping	5	11%
	b. Input Material change	8	18%
	c. Process modification/control	11	24%
	d. Technology Change	2	5%
	e. Recycle/reuse/recovery	7	15%
	f. Equipment Modification	12	27%
8.	<u>Savings in Resource Consumption/year</u>		
	a. Water consumption m^3	70,000	25%
	b. Furnace oil consumption MT	70	10%
	c. Electricity consumption kwhr.	NQ	NQ
	d. Chemicals MT	48	15%
	e. Dyestuffs kg	1520	30%
9.	<u>Reduction in Pollution Load/year</u>		
	a. Wastewater volume m^3	61,000	26%
	b. Organic pollution load BOD & COD	NQ	NQ
	c. Gaseous emissions	NQ	Significant
10.	Total investment made Mill. VND US $	61 4400	5 BVND* 3,60,000
12.	Direct savings MVND US $	565 40,000	1.6 BVND** 110,000
13.	Pay back period	<2 months	3 years
14.	Impact on production capacity	*New product range added	

* New M/C. Note yet calculated in project performance

* Expected savings from new machine

7.7 CONSTRAINTS IN CLEANER PRODUCTION

Project progress was hampered by a series of barriers from the CP assessment phase, through to the implementation phase. Major constraints are detailed below:

a) Due to a lack of understanding of the CP concept, and not realizing the necessity for data and its compilation, poor baseline data was available to compare and extrapolate financial and environmental improvements.

b) Due to frequent changes of products and widely varying shades & colour depth, detailed data collected for a few batches was not representative.

c) Poor organization of the CP team and its approach. The resignation a of key CP team members in the middle of the project also hampered data collection and compilation.

d) The intention of the management was more geared to changing the old equipment/technology rather than improving the existing one. Any investment in the existing system was considered as uneconomic.

The CP implementation started very well, but suffered later, particularly due to market conditions and increasing competition.

7.8 CONCLUSION

The CP demonstration at Phouc Long Textile Co. illustrated a number of valuable lessons with respect to the implementation of cleaner production. The project lost momentum when a key CP team member (champion), left the company. While a champion is an important person in CP, it is vital that the whole team has commitment to the project, and that management continues to reinforce that commitment to the project.

This case study also reaffirmed that appropriate monitoring is crucial in identifying, assessing and driving CP implementation. Finally, Phouc Long was restricted in implementing some feasible CP measures due to the present recession in the textile industry in the country. However, as demonstrated by the implemented options, CP does not necessarily need significant investment up-front. Moreover, CP could be a used as an effective tool to sustain the unit in tough economic conditions.

8. CASE STUDY-6 : THUAN THIEN BLEACHING & DYEING UNIT

8.1 INTRODUCTION

A wide range of cleaner production opportunities have been identified and viable opportunities have either been implemented or are under implementation. To date this unit has invested 100,000 US $, including a new boiler and jet dyeing machines, resulting in direct savings of US $ 75,000 and a significant reduction in soot, gaseous emissions and reduced waste water volumes. A summary of these improvements is presented in this case study.

8.2 COMPANY PROFILE

Thuan Thien Bleaching & Dyeing Unit is a privately owned small scale, job work unit located in Thai Phien District 11, Ho Chi Minh City. As the unit is located in a densely populated residential area, gaseous emissions from unit (particularly blacksoot) have become a major concern for the company and its neighbours. The unit has an installed capacity of 1000 T/annum of fabric processing, with an average mix of 70% only bleaching and 30% bleaching & dyeing. The unit employees a direct work force of 20 employees.

8.3 PROCESS DESCRIPTION

The major processing steps employed for wet processing of fabric are briefly discussed below:

- *SCOURING:* Scouring is done to remove natural and acquired impurities from fabric under alkaline conditions, to saponify fatty acids and solubilize pectins.

- *BLEACHING:* The bleaching process is performed to whiten the fabric and to remove natural coloring. Bleaching is done at higher pH to avoid cellulose degradation.

- *SIZING OR STARCHING:* Dyed fibre, after de-watering, is sized using waxes, oil & softener to give the required shape to the fabric.

- *DYEING:* The dyeing process is carried out to give a permanent and required shade to the fabric which retains a reasonable fastness to washing, rubbing, oxidation, sublimation, perspiration etc. The fastness of the dye is obtained by treating the textile with dyestuff and other auxiliary chemicals. The type of dye & chemicals used, depend upon the required end product.

- *HEAT SETTING:* For fabrics made of heat sensitive fibres, heat setting is done to stabilize the fibre by allowing free movement of molecules at a high temperature. For polyester fibres a temperature of 200^{o}C is attained for heat setting.

- *FINISHING:* To give luster, evenness, dust proofing & fire proofing, different types of finishing chemicals are used. Finished fabric is dried for despatch.

8.4 INVENTORY OF RESOURCE CONSUMPTION AND WASTE GENERATION

Major material and energy inputs in the unit and major wastes generated during processing are listed below in Table 8.1 Due to poor records and non-availability of measurement and analytical equipment, the quantification of a material balance and pollution load was not possible.

TABLE 8.1: MATERIAL CONSUMPTION & WASTES GENERATION CONSUMPTION

A. INPUT MATERIALS

S.No.	***PARAMETER***	***TOTAL ANNUAL CONSUMPTION***	***SPECIFIC CONS. PER TONNE OF FABRIC***	***REMARK***
1.	WATER CONSUMPTION (m^3)	52,000	104	Very High
2.	FUEL OIL (MT)	795	1.59	Very High
3.	ELECTRICAL ENERGY (KWhr)	500,000	1,000	High
4.	DYESTUFF kg AUXILLARY CHEMICALS kg	1,312 28,000	8.2 56	Higher than standard for (70-30% Mix)

B. WASTE GENERATION

S.NO.	***PARAMETER***	***ANNUAL GENERATION***	***SPECIFIC GENERATION PER TONNE OF CLOTH***	***REMARK***
1.	WASTE WATER	45,000	90	High
2.	POLLUTION LOAD - ORGANIC - TSS	 N.R N.R	 N.R. N.R.	
3.	GASEOUS EMISSIONS	N.R	N.R	Very High due to poor combustion
4.	% REJECTION	70 T.	20 kg	Higher than standard
5.	% RESIZING	16 T.	42 kg	High

- Figures are computed based on actual consumption/day & extrapolated for total 500 T/annum production.

- Waste water analytical figures are not reliable hence not used for computation.

8.5 APPROACH TO CLEANER PRODUCTION

Based on the information in Table 8.1, gathered by the CP team after comprehensive data collection & compilation, a detailed cause analysis was done for envisaged excess consumption of resources within the sector. Cause analysis and observations made during company visits, were used as a base to identify CP options for reduced resource consumption. Particular attention was paid to gaseous emissions mainly due to persistent pressure from local residents.

8.6 CP OPPORTUNITIES

A total of 43 CP opportunities were identified and 36 of them were agreed by the management as viable solutions. However, so far only 14 options (30%) have been implemented and two are under implementation. The reason for the low percentage of implementation was explained as insecurity about permission to continue the unit at the same location.

In accordance with the company's priorities, measures related to fuel consumption/gaseous emissions were implemented first, followed by low cost options. A summary of major CP options implemented so far, and the direct financial and environmental benefit achieved is given in Table 8.2.

TABLE 8.2 SALIENT CP MEASURES IMPLEMENTED AND THEIR BENEFITS

S.No.	***CP OPTION***	***ENVIRON-MENTAL BENEFITS***	***INVEST-MENTS***	***ANNUAL SAVING***	***REMARKS***
1.	Optimize cloth liquor ratio from 1:15 to 1:10	-Reduced Wastewater volume & pollution load	10 MVND	70 MVND	Needs attitudinal change
2.	Combining scouring & bleaching process	-Reduced waste water generation and load	NIL	NQ	Reduced process time & improve quality of fabric
3.	Reversal of fabric before processing	-Reduced reprocessing chemicals	2 MVND	40 MVND	Improved quality of fabric & reduced rejection rate
4.	Installation of condensate/hot water coll. Tank with insulation & flash steam recovery provision	-Reduced gaseous emissions	70 MVND	105 MVND	-
5.	Replacement of old boiler with high efficiency boiler	Reduced gaseous emission	900 MVND	540 MVND	Increased production capacity 30%
6.	Replacement of winches by jet machine	-Reduced waste generation volume & load	365 MVND	140 MVND	Jet Machine capacity under utilized

8.7 BENEFITS & ACHIEVEMENTS OF PROJECT

Major benefits in terms of economic and environmental performance are presented below:

TABLE 8.3 ECONOMIC BENEFITS

S.NO.	*PARAMETER*	*BEFORE CP*	*AFTER CP*	*% CHANGE*	*ECONOMIC BENEFITS*
1.	PRODUCTION CAPACITY (INSTALLED) MT.	770	1000	30%	NQ
2.	WATER CONSUMPTION m^3/TONNE PRODUCT	104	70	33%	3 MVND
3.	FURNACE OIL LIT./TONNE PRODUCT	1590	435	62%	942 MVND
4.	ELECTRICAL ENERGY KWhr/T	1000	1000	No	Nil
5.	% REJECTION	2-3%	Nil	100%	36 MVND
6.	AUXILLARY CHEMICALS kg	56	49	14%	22 MVND
				TOTAL	1003 MVND

TABLE 8.4 ENVIRONMENTAL BENEFITS

S.NO.	*PARAMETER*	*BEFORE CP*	*AFTER CP*	*% CHANGE*	*ECONOMIC BENEFITS*
1.	WASTE WATER GENERATION m^3/T	94	61	34%	Reduced WTP size and costs
2.	ORGANIC POLLUTION LOAD	NR	NR	NQ	Significant reduction due to process Modification
3.	GASEOUS EMISSIONS	NQ	NQ	NQ	Significant reduction due to 62% reduction in fuel cons.
4.	SOLID WASTE	Insign.	Insign.	--	--

- Based on 500 T/annum production.
- Anticipated savings in wastewater treatment not included in economic analysis

8.8 CONSTRAINTS IN CLEANER PRODUCTION

From the commencement of the project, up until the implementation phase, several constraints were encountered and are listed below:

a. No understanding the of CP concept & philosophy by the CP team. The approach was to control the gaseous emissions, a priority for the units' survival

b. Non-availability of proper records & reports for production, product mix, input material consumption, analytical procedures, log sheets etc.

c. Organization structure of the company, managed by the owner who is solely responsible for everything.

d. Frequent change in processing according to job order demands

e. Insecurity of continuing production at the present site, due to environmental pressures.

However, the last constraint was also used as a catalyst to implement CP and the company has improved its environmental performance remarkably.

8.9 CONCLUSIONS

The company participated in the programme to control the emissions, which was a threat to their survival. However, the CP programme in addition to gaseous emissions reduction, emerged as a profit increasing activity, a win-win situation. The company now has reported that they are meeting the required environmental standards at the point of discharge, as well as the ambient air quality standards.

TABLE 8.5 RESULT OF CP DEMO PROJECT AT A GLANCE

S.NO.	***ITEM***	***NO. OR VALUE***	***%AGE SHARE***
1.	Total No. of CP solutions identified	43	
2.	No. of CP solutions implemented so far	14	33%
3.	No. of CP solutions under implementation	2	5%
4.	No. of CP solutions to be implemented	10	23%
5.	No. of CP solutions requires detailed technical & financial details	10	23%
6.	Rejected	7	16%
7.	CP Technique-wise distribution of CP Measures		
	a. Good Housekeeping	5	11%
	b. Input Material change	6	14%
	c. Process modification/control	16	37%
	d. Technology Change	4	10%
	e. Recycle/reuse/recovery	5	11%
	f. Equipment Modification	7	17%
8.	Savings in Resource Consumption/year		
	a. Water consumption m^3	17,000	33%
	b. Furnace oil consumption MT	575	62%
	c. Electricity consumption kwhr.	NIL	-
	d. Chemicals MT	3.5	14%
9.	Reduction in Pollution Load/year		
	a. Wastewater volume m^3	16,500	34%
	b. Organic pollution load BOD & COD	NQ	Estimated more than 30%
	c. Gaseous emissions	NQ	Estimated more than 70%
10.	Improved quality of the product	Positive	No rejects
11.	Total investment made Mill. VND US $	1400 100,000	
12.	Direct savings MVND US $	1000 75,000	
13.	Pay back period	>1.5 year	
14.	Impact on production capacity	Increased	30%

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Annex 2 List of Abbreviations

BOD_5	Five Day Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
DOSTE	Department of Science, Technology and Environment
ENCO	Environment Committee
GNP	Gross National Product
HCMC	Ho Chi Minh City
kg	Kilogram
kWhr	Kilowatt- hour
MOSTE	Ministry of Science, Technology and Environment
Mg/L	Milligrams per liter
J	Diameter (mm)
VND	Vietnamese Dong (1 $ = 13,900 VND)