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for the Assistance in
the Industrial Pollution Reduction Programme:

Review of the Opportunities for Waste Minimization/Cleaner Production within the Textile Processing Sector in Sri Lanka

FINAL REPORT

Project No. : DG/SRL/91/019
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INDUSTRIAL POLLUTION REDUCTION PROGRAMME
DG/SRL/91/019

REVIEW OF THE OPPORTUNITIES FOR WASTE MINIMISATION/CLEANER PRODUCTION WITHIN THE TEXTILE PROCESSING SECTOR IN SRI LANKA

FINAL REPORT - DECEMBER 1997

CEYLON INSTITUTE OF SCIENTIFIC AND INDUSTRIAL RESEARCH
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FOREWORD

Cleaner production/Waste minimization is a new concept in Sri Lanka and we greatly acknowledge the initiative taken by the UNIDO and the CEA in establishing the IPRP project to introduce and promote this vital idea among the local industrial community, particularly the textile processing sector which is facing a major economic and environmental crisis at present.

As a result of carrying out this project, the CISIR was able to strengthen its expertise in waste audits and we are thankful to the UNIDO for financial support. We also wish to thank Mr. Andrew Milsted, Chief Technical Advisor to the IPRP project for his technical inputs and guidance throughout this project.

Our heartfelt appreciation is also due to UNIDO Textile Experts, Dr. Bernd Weimann and Mr. Chittaranjan N. Desai for their contribution to the programme.

Thanks are also due to the National Project Director, Mr. K. G. Bandaratilake, National Programme Managers, Dr. Weerakoon and Dr. V.U. Ratnayake, the National Project Coordinator, Mr. Bandulasoma Wijegunasekera and Associate Expert, Mr. Tien M. Pham for their support in this project.

We also wish to thank Mr. A. S. Wijetunga, textile consultant, Textile Training and Services Centre and UNIDO Consultant for their inputs.

Finally we record our sincere thanks to the Backstopping officers of the project, Mr. E. Heijndermans, Mr. Miqdadi and Prof. T. de Silva for their support.

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LIST OF ABBREVIATIONS

CEA	Central Environmental Authority
CISIR	Ceylon Institute of Scientific and Industrial Research
COD	Chemical Oxygen Demand
CTMA	Ceylon Textile Manufacturers Association
g	Gram
GDP	Gross Domestic Product
GNP	Gross National Product
JICA	Japan International Cooperation Agency
kg	Kilogram
kg/mth	Kilogram per month
m	Metre
m^2	Squared metre
MIST	Ministry of Industries, Science & Technology (before 1994)
mth	Month
NEA	National Environmental Act
sq. km	Squared kilometre
TTSC	Textile Training and Services Centre
UNIDO	United Nations Industrial Development Organisation
y	year

sq. km	Squared kilometre
TTSC	Textile Training and Services Centre
UNIDO	United Nations Industrial Development Organisation
y	year

PHASE I

SURVEY REPORT ON WASTE/POLLUTION OF THE TEXTILE PROCESSING INDUSTRY IN SRI LANKA

1 INTRODUCTION

1.1 Economy and Industry

Sri Lanka is a pear shaped island, separated from the Indian continent by the Palk Strait, which at the closest point has a width of 18 miles. The island covers an area of about 65.610 sq. km and is approximately 430 km, long 225 km wide at its maximum extremities. The estimated population is 18.1 million.

Sri Lanka has made considerable economical and social progress since gaining independence in 1948. Such factors like literacy rate (89 per cent), population growth (1.4 per cent), or life expectancy (72 years) are significantly superior to those of countries showing comparable level of economic development. Its per capita GNP of US $ 713 in 1995 though highest among the South Asian countries is far behind that of industrial nations and the fast growing Asian countries.

During the past decade the economy of Sri Lanka has shown a slow but steady shift from its agricultural base to industry. In the early 1960's the share of agriculture in GDP was around 40 per cent. It declined to 23 per cent by 1990 and further to 20 per cent in 1995. On the other hand the rapid growth of the manufacturing sector in Sri Lanka has been a recent phenomenon, a direct result of the liberalisation of the economy which started in the late 1970's. The share of the manufacturing sector in GDP rose from 11.5 per cent in 1960's to 21 per cent in 1995. [1]

Industrial development that has taken place so far in the country has been mainly small and medium scale, and confined to only a few sub-sectors like food and beverages, textiles and garments, non-metallic minerals etc. Large manufacturing industries are represented by cement, paper, steel, petroleum refining, sugar, ceramics, and textiles. They are few in number and are for the most part established outside the main urban areas. The urban sector is dominated by small and medium sized manufacturing industries including tanneries, textiles, garments, food processing, paints, varnishes, cosmetics and other chemical products, glass, asbestos products, etc. Industries in the rural area are small, cottage scale units using traditional technology. They include foundries, hand loom, handicraft, brick and tile, and agro-based industries like rubber processing, rice milling, coir and coconut processing, and essential oil extraction.

Colombo and Gampaha districts form the most developed region in the country, accounting for nearly 80 per cent of the industrialisation (Fig 1). Two major industrial areas are the Ratmalana-Moratuwa area located south of Colombo, and the Ekala-Jaela area located in the Gampaha District, about 20 km north of Colombo. Other industrial areas such as Biyagama, Homagama, Oruwila, and Kalutara are relatively small. Figure 2 portrays these industrial areas and also the proposed future areas for industrialisation. [2]

1.2 Industrial Pollution

At first, the problem of industrial pollution may not appear serious due to the low level of industrialisation in the country. However, in localities where industries are present, degradation of the environment is quite serious and warrants urgent attention. Water pollution is the predominant form of environmental degradation from industry.

Liquid effluent from polluting industries undergo little or no treatment before discharge. There are a few exceptions, notably a few medium and large scale operations which could afford treatment, and the two export processing zones at Katunayake and Biyagama where wastewater is centrally treated.

Colombo and its hinterland, spanning the districts of Colombo and Gampaha, is the most developed region in the country. There is no treatment for the majority of the industrial effluent produced in these areas and most of them are discharged to the surface drainage system. Industrial solid wastes are generally collected by private contractors but the final disposal site of these wastes is not known.

FIG 1 - Map of Western Sri Lanka

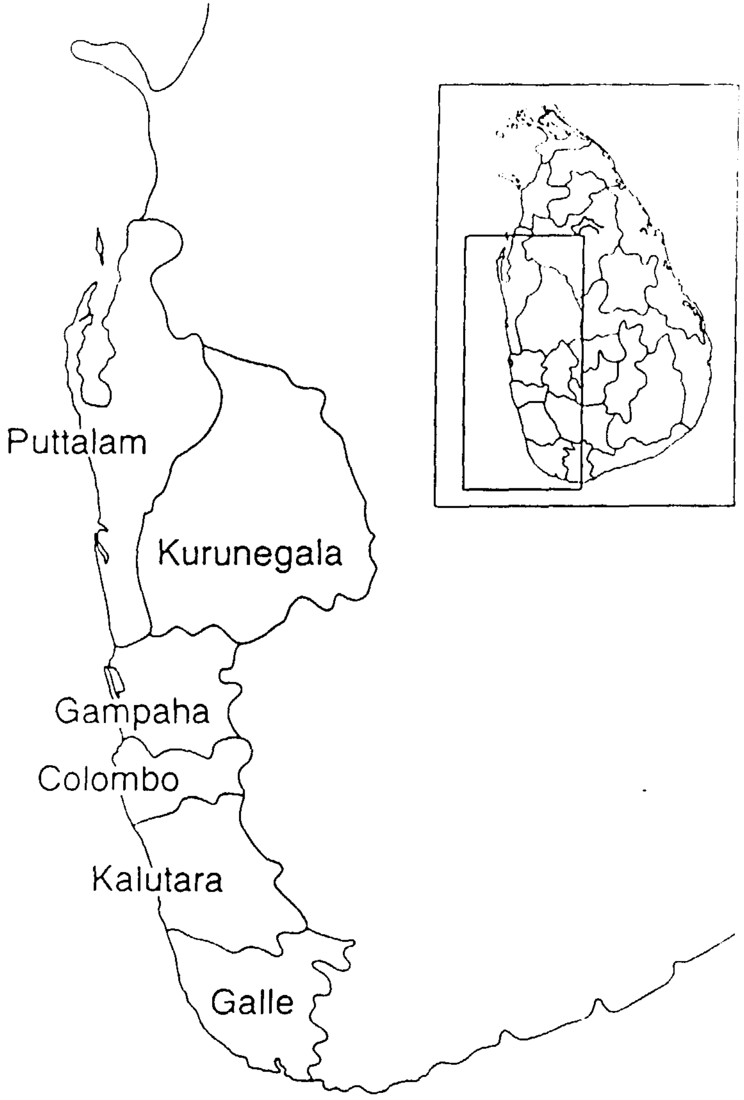
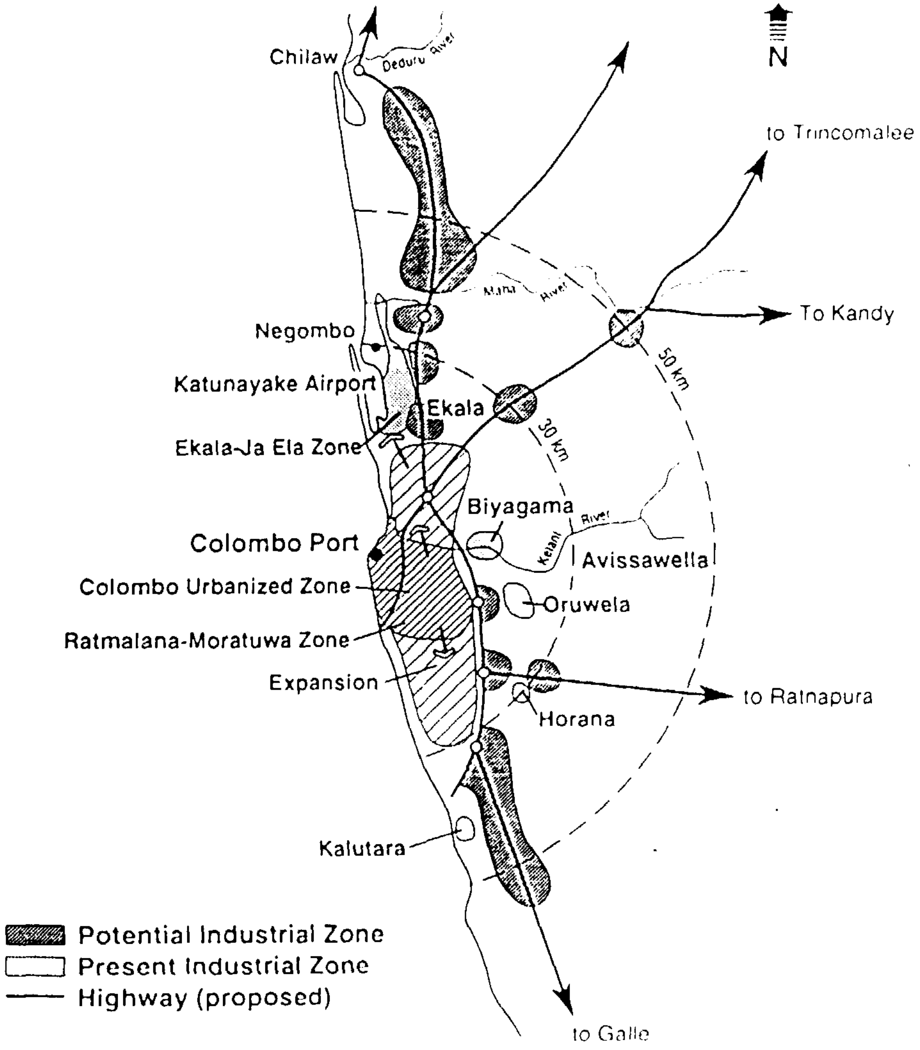


FIG. 2 - PRESENT AND FUTURE POTENTIAL INDUSTRIAL AREAS IN SRI LANKA



SOURCE - JAPAN INTERNATIONAL COOPERATION AGENCY (JICA/MIST) REPORT 1993

The wastes, mainly liquid, from these industries, have degraded water bodies in the area considerably. For example, the aquatic life of the Lunawa lagoon in Morotuwa has been seriously degraded due to the continued discharge of wastewater into its tributaries. The lagoon which supported a significant fisheries industry a decade ago is totally devoid of aquatic life today.

Plans are now afoot to construct two central treatment facilities with World Bank aid: one in Ratmalana and the other in Jaela-Ekala to overcome the pollution problem in these two urban areas. Feasibility studies are also being carried out to set up a solid waste disposal site within Colombo or Gampaha district to assist the industries to dispose their solid wastes.

1.3 Environmental legislation

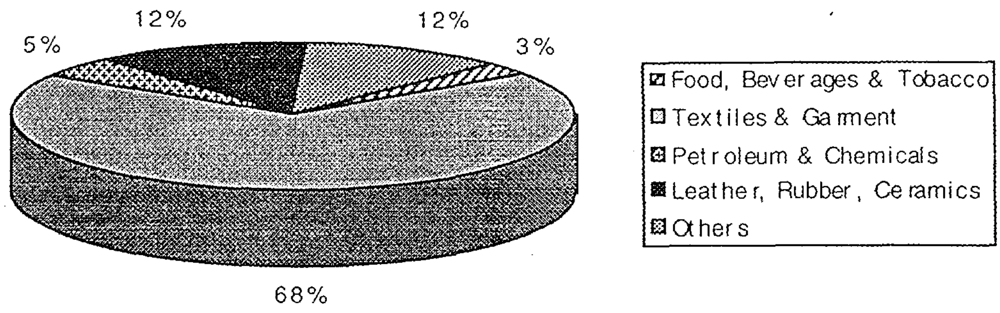
The National Environmental Act (NEA) No 47 of 1980 is the first comprehensive legislation on environment in Sri Lanka to control and regulate the discharge of pollutants into the environment. The NEA established the Central Environmental Authority (CEA) as a policy making and coordinating body. This Act was amended later in 1988, Amended Act No 56, to transform the CEA as an enforcement and implementing Agency. The Act stipulates regulatory controls for discharge of pollutants from existing industries or prior approval for the siting of prescribed industrial ventures.

A National Definition on Hazardous wastes and regulations for storage, handling, transport and disposal are now being formulated and will be gazetted soon for implementation.

2 THE STATUS OF THE TEXTILE SECTOR

The textiles, garments and leather products sector is considered as a lead sub-sector in the country. In 1995 this sub-sector accounted for 47 per cent of the total industrial production of Rs. 221,440 million. Further, the textile and garment exports contributed, in value terms, to about two thirds of the total industrial exports (Fig. 3) and 40 per cent of the total exports. [1]

Fig. 3 Sectoral Composition of Industrial Exports - 1995



Source: Central Bank of Sri Lanka, Annual Report 1995

The textile industry in Sri Lanka can be categorised broadly into two sectors:- the textile processing sector which includes, spinning, weaving, knitting, bleaching, dyeing, printing and finishing and the garment sector.

The textile processing industry, the so called 'power loom sector', started in the 1960's and there was a sizable upsurge of textile production because then the Government aggressively pursued a policy of restricted imports as a means of encouraging domestic production. This import substitution policy did encourage domestic industries but the industrial sector as a whole remained confined to a low tech, labour intensive small scale industry. However, major expansion took place in the 1970's with the establishment of three large scale state sector textile processing factories, namely Thulhiriya, Veyangoda and Pugoda with aid from Soviet bloc countries. During the 1980's and with the introduction of the open economy, all three of them were privatised with the idea of modernising the technology and improving productivity. Subsequently, several medium to large scale private sector industries were established to boost the country's fabric production but overall the growth in this sector has been sluggish and far below expectations. Presently, there are about 191 textile processing units, employing about 40,000 people and producing approximately 223 million metres of finished fabric primarily for the domestic market (Table 1).[3]

Table 1. Number of units and personnel employed in the textile processing sector - 1994

Activity	No. of Units	No. of employees
Spinning (excluding integrated mills	07	3356
Weaving (power looms only)	98	19,377
Integrated mills	03	9086
Knitting	47	6182
Finishing (excluding integrated mills)	36	2745
TOTAL	**191**	**40,746**

Source: Textile statistics of Sri Lanka - 1995, Ministry of Industrial Development (Textile Division)

However, the export of textiles, particularly yarn and gray and finished cloth, has shown a significant growth in the recent past. The value of these exports eventhough low in value, has increased notably from Rs. 14 million in 1982 to Rs. 2263 million in 1995.[1]

The garment sector has shown an unprecedented growth during the last two decades. As at 1995 there are 629 firms involved in garment production and majority of them cater to the export market. The value of garment exports increased from Rs. 3.4 billion in 1982 to Rs. 85 billion in 1995. However, in 1995 the value of textile and clothing imports alone accounted for Rs. 58 billion. The value addition in this sector is also low and stands around 25 per cent. Even with the high import content and low value addition, the garment sector, which contributes 40 per cent of the industrial production, 43 per cent of the total export earnings and direct employment to 232,000 people, mostly women, has now become a flagship sector in the Sri Lankan economy.[1]

The total requirement of finished fabric for the garment sector in 1995 is estimated to be 700 million m^2 almost all of which are now imported. The expectation was that the market forces will motivate the local textile industries to increase their production to meet this demand and eventually reduce the country's dependence on imported fabrics. However, for a variety of reasons this backward linkage did not materialise. Reasons are diverse: outdated technology, low productivity, poor quality, weak chemical industry base necessitating imports of all chemicals at high prices, labour disputes and inflow of smuggled textiles to the local market. In the past, the power loom sector operated under heavy protection. However, the recent reduction in tariffs from 100 per cent to 35 per cent has also adversely affected their competitiveness. The Government rationale is that the enhanced competition would improve resource allocative efficiency and compel firms to be more cost-effective and improve product quality. The local textile processing industry therefore needs to invest in modern technology and become more dynamic to be cost effective and competitive as further tariff cuts are expected in the medium term..

Increasing environmental awareness and enforcement of environmental legislation in the country is also pressurising industries to implement pollution control systems. However, for the textile processing industries who are struggling to maintain their competitiveness, allocation of funds for end-of-pipe treatment technology seems impossible. The concept of cleaner production/waste minimisation is therefore good news to the textile processors. Any attempt to minimise or recycle waste will not only help to reduce production costs, but also reduce their pollution problem. This is the only way the industry can maintain sustainable development while safeguarding the environment and survive in the open market economy.

The UNIDO sponsored Industrial Pollution Reduction Programme was therefore initiated by the Central Environmental Authority (CEA) in 1994 with the main purpose of reducing pollution from industrial operations in Sri Lanka with an emphasis on source reduction. Under this Programme, the Ceylon Institute of Scientific and Industrial Research (CISIR) was sub-contracted as per the TOR (Annex 1) to review the present state of the textile processing industry in Sri Lanka and identify specific opportunities for waste minimisation. Details of the review is described in Section 3.

3 REVIEW OF THE TEXTILE PROCESSING INDUSTRY

3.1 Objective

Objective of this study is to review the textile processing industry in Sri Lanka on a short time scale with a view to obtain the following information for each factory.

- Name, address and telephone number of factories and head offices and name of Director, Owner or Chairman
- Types of products, production capacity and actual production quantities.
- Brief description of the processes and equipment used.
- Total water, materials and energy use.
- Approximate water, materials and energy use per unit production.
- Approximate total waste outputs in terms of degree of pollution.
- Approximate waste outputs per unit production.
- Nature of bodies receiving effluents and condition of these.
- Estimate of potential for implementing successful waste minimisation procedures.
- Any possibility of recycling or reuse.

3.2 Survey methodology

Detailed questionnaires (Annex 2) with a covering letter indicating the purpose of the survey and relevance of waste minimisation were sent by mail to 83 textile processing industries. Names and addresses were obtained from different sources viz.; CISIR, Telephone Directory, Ministry of Industrial Development and Ceylon Textile Manufacturers Association (CTMA). This was followed up by both postal and telephone reminders. The following sources of information were also utilised in the survey.

- CTMA, Directory of Members - 1995; 61 small, medium and large scale units are listed (includes industries carrying out only dry processes as well).
- Textile Training and Services Centre (TTSC) Report on the Status of the Textile Processing Industry in Sri Lanka (1995); Lists 30 fabric processing plants comprising 8 large scale mills, 10 medium scale and 12 small scale commission factories. In addition, 8 yarn/sewing thread and 20 garment washing units also have been listed as units generating wastewater. A large number (unspecified) of cottage scale printing units, including batik industries are also classified as generators of highly coloured wastewater.
- Ministry of Industrial Development (Textile Division); According to the Ministry statistics for 1994 there are 10 large scale (>6 million m/y), 9 medium scale (>3-6 million m/y) and, 18 small scale (<3 million m/y) processing units in the country. Garment washing and sewing thread/yarn dyeing industries are not included in this list.
- Central Environmental Authority (CEA) Industrial Pollution Control Guidelines No. 6: Textile Processing Industry 1992/93

Further, since 1977 with the liberalisation of the economy many small scale textile production units have been established of which no centralised track is kept by any government authority about their production activities. It was difficult therefore to ascertain the exact number of textile processing industries in Sri Lanka.

4 RESULTS AND ANALYSIS

4.1 Response and quality of information

Of the 83 questionnaires sent out, 5 returned, indicating that these industries no longer existed or had been re-located. Only 14 completed questionnaires were received, and of these 3 were eliminated from the survey as they had only dry processes. Of the questionnaires received, many did not contain all the information that had been requested, particularly information on equipment and use of utilities.

The poor response indicates the lack of awareness and interest of the industry in environment related programmes. The lack of records, unwillingness to provide details and poor availability of information with the industry was also seen.

Information about industries who did not respond to our questionnaire was therefore collected from other sources (list given in Section 3.2), and via telephone. Information was collected for 44 industries and the data received are summarised in Table 2. However, complete details about production and utilities is presented for only 12 industries (Table 3).

4.2 Analysis of survey information

4.2.1 Location of industries

Location of the industries surveyed was classified into three zones, namely rural (villages, small towns), urban and industrial zones (only the zones provided with common waste treatment facilities, are considered as industrial i.e. Biyagama and Katunayake) according to their addresses. It was seen that 29 per cent (13 Nos.) were in rural areas, 64 per cent (28) in urban areas, and 7 per cent (3) in industrial zones.

4.2.2 Types of products and production volume

There is a significant increase in both yarn and fabric production during the past five years. Yarn production has increased from 11.4 million kg in 1990 to 26 million kg in 1994, while during the same period the fabric production has gone up from 144.5 million metres to 223 million metres (Table 4). [3]

Table 4. Yarn and Fabric Production

Item	1990	1991	1992	1993	1994
Yarn x 10^6 kg	11.4	19.6	22.0	24.4	26.2
Fabric x 10^6 m	144.5	181.4	187.3	211.2	223.2

Source: Textile statistics of Sri Lanka-1995, Ministry of Industrial Development (Textile Division)

Table 02

Summary of information received from survey of textile processing industries.

	Name	Address	Telephone Head Off. /Factory	Name of Director/ owner/chairman	Type of product	Processes	Equipment / Machinery	Production capacity/ Actual production	Total water consumption	Material consumption	Energy consumption	Approx. total waste output	Receiving water bodies
1	Asian Cotton Mills Ltd.	No.7, De Soysa Mw. Off Templers Rd. Mt. Lavinia	716911 716912	M.D. Mr.N.M.Jabeer	Polyester spun yarn, Polyester blends Cotton yarn	Scouring, dyeing, reduction clearing, fixing & soaping of polyester blends & cotton yarn.	-	25,000 kg/M	Domestic - 4500 gal/d. Process - 7500 gal/d	-	-	3000 gal/d	Marshy land
2	Veyangoda Textiles Mills Ltd.	Bandaranaika Rd. Veyangoda 323, Galle Rd. Colombo 4	Tel. 033-5435 5438, 5440 Fax 033-5437	Chairman Mr.Dan S.Mukundan	Cotton Fabrics	Weaving, De-sizing, Pre washing, Bleaching, Post washing, Mercerizing, Dyeing, Printing	Washing ranges, Pad dyeing, Flat bed & Rotary printing	cotton yarn 6000kg/d finished cloth 40,000 m/d	Domestic- 50000 gal/d Process- 20,0000 gal/d	* Raw cotton 6000 kg/d	-	20,0000 gal/d	River
3	Texlinen (Pvt) Ltd.	Phase 1, Block 1, BIPZ, Biyagama.	655917, Fax.686922 571603-4, 571856 Fax.571670/ 571707	M.D. Mr.Ali Ather Ahmed	Processing of 100% Cotton towels	Weaving, Bleaching, Dyeing, curing Printing, Finishing	Weaving power looms, Bleaching /Dyeing/ Juki/ Printing/ Drying/ Cutting	70,000kg/M	200,000 l/d	Cotton yarn- 70,000kg/M	*Electricity-500kW *Furnace oil-2100l/d	-	Central Treatment Plant
4	Textile Processing Industries Ltd.	6, Gampaha Rd. Ekala, Ja-ela.	548664, 432608	Chairman Mr.P.H. Mohideen	Cotton	Scouring, Bleaching, Dyeing, Washing	-	-	12,000 gal/d	-	-	10,000 gal/d	Common sewer

MD - Managing Director
DG - Director General
GM - General Manager
MM - Mills Manager
m/cs - Machine/s

Table 02

	Name	Address	Telephone Head Off. /Factory	Name of Director/ owner/ chairman	Type of product	Processes	Equipment/ Machinery	Production capacity/ Actual production	Total water consumption	Material consumption	Energy consumption	Approx. total waste output	Receiving water bodies
5	Star Textile Processing Industries	21, Kadirana, Thimbirigaskatuwa, Negombo.	326745 3208015 031/8037	President Mr.Haji Mohomed Iqbal	Finished Fabric Cotton & Polyester	Bleaching Dyeing Printing Finishing	Jigger m/c Jet m/c Stenter Calender Printing m/cs	375 kg/M	$3937.5m^3/M$	Grey cloth-500,000 m/M *Chemical/M H_2O_2 10kg Sodium silicate-2kg NaOH-10kg Wetting agents-20kg Dyes-55kg	Elec-20kW/M Furnace oil-800l/M	Liquid-25,000 l/d Solid-50 kg/d	Ela through Open canal
6	Tharanga Textiles Ltd.	23,Borupana Rd. Ratmalana.	582264 636834	Mr.C.Abewickrama	Dyed & bleached towels, Yarn	Dyeing Bleaching	Dyeing m/c-03 Drying m/c-02	15,000 kg/d	$563\ m^3/d$	Dyes Hydrogen peroxide	-	-	Public road drain
7	Fair line Textile mills	584,Galle Rd. Mt.Lavinia.	607457 607746 Fax.698923	-	Manufacture of dyed & printed Cotton & Polyester fabrics	Desizing Scouring Bleaching Whitening Dyeing Soaping Printing	-	-Fabric-12,000m/d		-		27,000 gal/d	
8	Eskimo Fashions Knitwear (Lanka) Ltd.	P.O.Box.30 Negombo	031-3234, 3235 3236	-	Dyed garments	Dyeing,	-	Gloves-$2x10^6$ pairs/y Tights-$5x10^6$ pairs/y Pantyhose-250,000/y -	.	-	-	$350\ m^3/d$	land

Table 02

	Name	Address	Tel. Head Off. /Factory	Name of Director/ Owner/ Chairman	Type of product	Processes	Equipment/ Machinery	Production capacity/ Actual production	Total water consumption	Material consumption	Energy consumption	Approx. total waste output	Receiving water bodies
9	Duro synthetic Textile mills Ltd.	P.O.Box 13 Old Kandy Rd.,Dalugama Kelaniya.	521-325 521-326	-	Polyester, Nylons(Laces, Mosquito nets)	Sizing Scouring Bleaching Whitening Dyeing Soaping Printing	-	10,000m/d	-	-	-	88001/d	Stream
10	Bakson Textile Industries Ltd.	11,Maligawa Rd. Ratmalana.(F) 49,Bankshall Street, Colombo-11 (HO)	633256 637945 (F) 449048 (HO)	Director Mr.B.K. Bakshani	Printed & Dyed textile-Cotton & Synthetic	Mercerizing Scouring Dyeing Bleaching Printing Garment washing	-	Fabrics-10,000m	2813m3/d	-	-	25000 gal/d	Road drain
11	Maghooras Industries Pvt. Ltd.	Hekitta Rd. Wattala.	324824 325841	GM MR.K.P. Thevarapperuma	Manufacture of tetron silk & Synthetic textils	Bleaching Dyeing	-	-	-				
12	Kuruwita Manchester Textile Mills Ltd.	Makandura Gonawila.(F) Gregorys Rd. Colombo-07 (HO)	699212,689371 071/33228 Fax.699212 031-9664,9665, Fax.078-68294	Chairman Mr.M.H.Omar GM Mr.Anthony Mudalige	Textile processing Cotton synthetic & blends	Bleaching Dyeing Singering Desizing Scouring Bleaching Mercerizing Drying Dyeing Washing Finishing Sanforizing Printing Packing -	Singeing m/c Mercerizing Jiggers Jet dyeing m/cs Stenter Printing m/c Boiler Heater Washing Shrinkage m/cs	Finished fabrics-(Cotton blended & synthetic)-150 tones/M	18530 m3/M	Grey fabric Dyes	Elec-150,000 kW/M Furnace oil-70001/M	Liquid-60,0001/d Packing (Paper +Plastic) 500kg/M	River (Through a pipe line)
13	Kabool Lanka Pvt Ltd.	Thulhiriya (F) 23, Lillie Street, Colombo-02 (HO)	035-7146(F) 448111	MM Mr.J.C. Sethi	Cotton & Semi synthetic textiles	Spininng to Weaving, Knitting to finishing	-	Yarn 90,000 kg/M Grey cloth-1,487,000m/M Finished fabrics-400,000m/M	-	-	-	200m3/d	River (Mahaoya)

Table 02

	Name	Address	Tel. Head Office/ Factory	Name of Director/ Owner/ Chairman	Type of Production	Processes	Equipment/ Machinery	Production Capacity/Actual Production	Total Water Consumption	Material Consumption	Energy Consumption	Approx. Total Waste Output	Receiving water bodies
14	Inter Fashion Co. Ltd.	P.O.Box 15, Nuwara-Eliya	2920-1 Fax 2386			Sewing, Garment Washing				60,000 Pices/y	Elec- 560 kW/M Furnace oil- 33,000l/M Diesel- 11,000l/M	Liquid- 6000l/d Solid off cuts- 600kg/M Air emissions	Stream through a channel
15	Oacianic knitters Co Ltd	4, Kandawela Mw Ratmalana	637721	Chairman Mr. Maduraiweeran	Knitted fabric	Knitting, bleaching Dyeing	-		-	-	-	-	Public drain
16	J B Textile Industries Ltd.	133, Meetotamulla Rd. Wellampitiya	572219 572213, 572339, 572025	Miss N. Baldsing (Director)	Polyester and polyester blend fabric	Scouring, dyeing & finishing	-	Synthetic textiles- 8500 m/d Nylon net- 600 kg/d	13,050 m^3/M	-	-	200 m^3/d	Canal/Marshy land
17	Sascon Knitting Co. Ltd.	76/2, Minuwangoda Rd. Ekala Ja-Ela	697948 698051 536624 537413	G.M. Mr. S. Selladoray	Knitted fabrics Garments	Scouring, Bleaching, Dyeing, Fixing, Washing	High and low pressure jets, winches	25,000 m/M 50,000 m/M	59,000 m^3/M	Yarn- 211,867 kg/y Dyes-19,416,625 kg/y Chemicals- $6.8x10^6$ kg/y	Elec- 75060kW/h Furnace oil- 3.831 l/min	2,070,701 l/d	Agricultural land through a channel
18	Sanitory Textile Industries Ltd.	32, Wimala Estate Nugegoda	573661 552274	Mr. Vipula Perera	Surgical cotton, Bandages, Feminine towels	Scouring, Bleaching, Washing	Kier boiler Carding m/c Rolling m/c Band knife cutter	-	394 $m^{3/M}$	Cotton-182kg/d $NaOH$-9kg/d Na_2CO_3-4kg/d Detergent- 1.75kg/d H_2O_2-.5kg/d	Fuel oil-40 gal/d	Liquid- 12,500l/d Solid (Paper)- 10kg/M Noise-Very low	* liquid- Drain * solid- sold/ incinerater Dust collector
19	Prasanna Batiks	203, Kolonnawa Rd Wellampitiya	438462 572311	Owner- Mr. S. D. Wickramanayake	Hand made batiks	Washing, Ironing, Waxing, dyeing, Boiling	Sewing m/cs	100 Pieces /d	68 m^3/d	Poplin -300m/d Dyes & Chemicals-3kg/d Paraffin wax- 10kg/d	Elec-850kWh /M Kerosine oil- 30l/week Firewood-10 cuts/Week	600 l/d Smoke from the fire	Open channel
20	Oshani Textile Processing Industries	9, Holycross Lane, Moratuwa	647087	Managing Partner Mr. O M G Fernando	Dyed fabrics	Bleaching, Scouring	-	25,000 kg/M	158 m^3/M	Fabrics-1000 kg/d	-	1400 gal/d	River

Table 02

	Name	Address	Telephone Head Off. /Factory	Name of Director/ owner/ chairman	Type of product	Processes	Equipment / Machinery	Production capacity/ Actual Production	Total water consumption	Material consumption	Energy consumption	Approx. total waste output	Receiving water bodies
21	Nelum Fashions Pvt.Ltd.	81/41, Negombo Rd. Peliyagoda.	530340 531354	-	Garment manufacturing & Washing	Dyeing Washing	-	1,000 Pieces/d	1406 m^3/M	-			Kelani River
22	Sinotex Lanka Ltd.	Spur Rd. IPZ Zone, Phase 1 Katunayaka	453081 452228 453512 453508 Fax.453082	Maintenance Engineer Mr.G.D.U.S. Sandanayaka	Garments & Sweaters washing	Dyeing	-	-	-	-	-	49,100 l/d	
23	Tri-Star Apparel Exports Pte. Ltd.	182,Galle Rd. Colombo-04	503256, 508986 503934 Fax.508758	MD-Admin. MR.A.K.P. Peiris		Washing	Washing m/cs	-	-				Sewer
24	Sigiri Weaving mills Ltd.	227, Galle Rd. Katubedda Moratuwa	329347 449331 634423 635351 Fax.625193	Director Mr.A.R.A. Kareem	Cotton & synthetic textiles	Weaving Knitting Processing	-	-	-	-	-	-	Road drain
25	Melbourne Textile Washing Plant Ltd.	809/4, Bangala watta, Mabole, Wattala	686391-4 699713 Fax.699513	-	Washing	-	-	-	-	-	-	-	-

Table 02

	Name	Address	Tel. Head Office/ Factory	Name of Director/ Owner/ Chairman	Type of Product	Processes	Equipment/ machinery	Production capacity/ Actual production	Total water consumption	Material consumption	Energy consumption	Approx. Total waste output	Receiving water bodies
26	Nagindas Industries Ltd.	105, Pallidora Rd. Dehiwala.	727500 715485 715586	Manager Mr.M.S.Gunaratnam	Fabrics and curtain materials	Dyeing & finishing	-	-	-	-	-	-	Canal
27	Velona group of Companies	Galle Rd. Katubedda Moratuwa.	647183 645236	D/G Managing Mr.P.A.Fernando	Fabrics Garments Cotton & synthetic	Knitting Processing	-	-	-	-	-	-	Lunawa Lagoon/ Sea
28	Hybro Industries	2, Maligawa Rd. Ratmalana. (F) 10A, Glen Aber Place, Colombo-04 (HO)	633651-2 (F) 694964 (HO)	-	Fabric	Dyeing & finishing textile	-	-	-	-	-	-	Road drain
29	Swastik Textile Industries Ltd.,	105, Pallidora Rd. Dehiwela.	541198 541199 449458 727500 715485	-	Fabrics	Weaving to finishing	-	-	-	-	-	-	Canal
30	Kundanmal Industries Ltd.	7,Postmasters place, Ratmalana	71-4371 71-4372	Director Mr. Gope Geewaratne. MD-Mr.Muni Kundanmal	fabrics Synthetic & blends	Wrapping to finishing	-	-	-	-	-	-	Road drain

Table 02

	Name	Address	Tel. Head Office/ Factory	Name of Director/ Owner/ Chairman	Type of Product	Processes	Equipment/ machinery	Production capacity/ Actual production	Total water consumption	Material consumption	Energy consumption	Approx. Total waste output	Receiving water bodies
36	Jaffersons Pvt.Ltd.	23/10, Bishops Terrace, Laxapathiya Moratuwa	607898	Director Mr.Susantha de silva	Garment	Garment Washing	Washing machincs	-	-	Hydrogen peroxide HAC Detergents, Softeners, Brightners, Silicate, NaOH, Sodium carbonate, Bleaching powder, KMnO4	-	35,000 l/d	Nearby canal to Bolgoda Lake
37	Hayleys ADC Textile Ltd.	Narthupana estate, Neboda. 25, Foster lane, Colombo-10	034-72053-58 72047-35 699087-100 696331-6 Fax. 691679 699299	Director Mr.M.J.C. Amarasooriya Cont.Person Mr. D.B. Weerasinghe	Knitted Fabrics	Knitting Scouring Dyeing Bleaching Finishing	* High pressure Jetflow Dye m/c *Atmosphere Jet flow Dyeing m/c, * Stenter * Hydro extractor	140 T/M	1,8000,000 l/d	Combed yarn-144 T/M	Elec-258,000 kW/M Furnace oil-31/M Diesel-31/M	Liquid-1,400m^3/d Exhaust from boiler & Dryer-	River
38	Alexandra Industries (Cey) Ltd.	76, Minuwangoda Rd., Ekala, Ja-Ela.	501495-6 Fax. 501950 536416 Fax. 537411	Director Mr.M.M. Selvaratnam	Heavy knitted garments, Sweaters	Washing Knitting Linking Mending Buttoning Labelling Packing	Winding m/c Knitting m/c Linking m/c Washing/ Hydro extractor Boiler	150,000 Pieces/M	36,000 gal/d	Yarn-45,455kg/M Chemicals-27100kg/Y Stain removers-2001/Y	Elec-665,000 kWh/Y Furnace oil-132001/M Diesel-16501/M LP Gas-2394 kg/Y	Liquid-81,0001/d Solid-(waste yarn) 454.5 kg/M Paper-500 kg/M	Sewer
39	Accessories Pvt.Ltd.	10th Mile Post Avenue Colombo-03	576006 Fax. 576150	Mr.Aboo Yusoof	Dyed yarn Manufacture from Rayon	Bleaching Dyeing Washing	Dyeing m/cs Washing m/cs	120 kg Dyed yarn/ 08 hours	675 m3/M 1 shift/d	NaOH Hydrogen peroxide NaCl Sodium carbonate, Soaping agents Fixing agents Dyes	-	-	River
40	Manchester Yarn & Thread Pvt. Ltd.	Ambatale	438949 434261	Mr. Prins Attiken	Yarn & Thread	Dyeing Rinsing	-					15,000 gal/d	Canal

Table 02

	Name	Address	Tel. Head Office/ Factory	Name of Director/ Owner/ Chairman	Type of Product	Processes	Equipment/ machinery	Production capacity/ Actual production	Total water consumption	Material consumption	Energy consumption	Approx. Total waste output	Receiving water bodies
41	Pathma Weaving mills (Pvt) Ltd.	Minuwangoda Rd. Kotugoda.	437138 449740 Fax.448636	Manager Mr.M.Wilson	Manufacturing & processing of polyester & Cotton fabrics	Bleaching Dyeing Finishing	Jiggers Jet dyeing m/c JT-10s Cylinder dryer Starter	158000 m/M	2050 m3/M	Polyester viscose Yarn-400kg * Chemicals-725 kg/M * Dyes-1260kg/M	Furnace oil-39,000l/M		Land within the premises
42	J.L.Industries (Pvt) Ltd.	765, Galle Rd. Nalloruwa, Panadura 45, Mada Para Thalpitiya Wadduwa	034/32218	M.D. Mr.W.B.J. Liyanage	Weaving & Processing of towels	Weaving Dyeing Printing Scouring Bleaching	-	60,000 towles/M	1750 m3/M	-	-	1750m3/M	-
43	Coats Tootal Lanka	33,Staples Street, Colombo-02 (HO) Yahalakele Estate Moragahahena, Horana.	332091, 332988/9, 423195 034/61042	Chief Engineer Mr.Chulaka Perera	Thread	Dyeing	Jets (Auto control)	125,000 kg/M	7,500 m3/M	-	-	7,500 m3/M	Marshy Land
44	Hiyalka Textile Mills (Pvt) Ltd.	23/12, Central Rd. Thalpitiya Wadduwa	034/33342		Textile processing	Bleaching Dyeing & Printing of fabric	Rotary Printer	15,000 kg/M	500 m3/M	-	-	500 m3/M	Canal

Table 3 Production and utility figures for textile processing industries

No	Type	Size	Production kg/mth	Water m^3/mth	Effluent m^3/mth	Water l/kg	Electricity kWh/mth	Electricity kWh/kg	Fuel l/mth	Fuel l/kg	Source of information
2	Fabric	L	170,000	46,800	46,800	275	1.2×10^6	7	332,000	1.9	A
4				1,125	1350						F
5		S	5,000	5,625	5,625	1125	200	0.04			F
7		M	30,000	2500	2500	83					S/F
9		S	20,000	1000	1000	50					S/F
10		L	147,500	14,870	14,870	101	112,000	0.8	25,500	0.17	A
11				1,250							F
12		L	150,000	22,000	18,000	120	150,000	1	7000	0.05	Q
13		M	40,000	6,000	6,000	150					S/F
15		L	62,000	10,000	10,000	161	34,000	0.5	33,000	0.5	A
16		M	37,400	4,600	4,600	124	44,500	4.3	45,000	4.3	A
17		M	30,000	4,400	4,400	147	75,000	2.5	42,570	1.5	A
25		S	12,500								F
26				11,250							F
27		L	56,500								S
28		L	120,000								S
29		S	6,600								S
30		S	11,000								S
31		L	180,000	30,000	30,000	167					S

Table 3 continued

No	Type	Size	Production kg/mth	Water m^3/mth	Effluent m^3/mth	Water l/kg	Electricity kWh/mth	Electricity kWh/kg	Fuel l/mth	Fuel l/kg	Source of information
32	Fabric	M	26,000	15,800	15,800	577	154,000	6	59,000	2.3	A
33		L	66,000								S
37		L	140,000	42,000	54,000	386	25,800	0.2			Q
41		S	16,000	2000	2000	125			39,000	0.24	Q
44		S	15,000	500	500	33					F
1	Yarn	M	25,000	338	1,350	54					F
39		S	3,000	675	675	225					F
40	Thread	M	45,000	1,740	1,740	38					F
43		L	125,000	7,500	7,500	60					F
3	Towel	L	70,000	5,000	5,000	71	500	0.007	52,500	0.75	Q
6		S	15,000	563	563	37.5					F
34				9,500	9,500						F
42		S	12,000	1750	1750	146					F
8	Garment	S	15,000		350	23					F/S
14		S	30	2,750	1,500	92,000			33,000	1000	Q
21		S	3,750	1100	1100	290					F
22				1200							F
23				4500							F
25		L	54,000	2,875	2,875	53					F
36				875	875						F

Table 3 continued

No	Type	Size	Production kg/mth	Water m^3/mth	Effluent m^3/mth	Water l/kg	Electricity kWh/mth	Electricity kWh/kg	Fuel l/mth	Fuel l/kg	Source of information
38	Garment	S	22,500	2,000	4,320	90	2,200	0.1			Q
19	Batik	S	750	6	1.5	0.8	850	1.1			Q
35		S	200	135	135	675					F
18	Cotton wool	S	4,000	350	275	90			180	0.05	Q
20	Canvas	M	25,000	160	160	6					F

A - Audit F - CISIR files S - Reference 5 Q - Questionaire

Of the 43 industries surveyed in this study 55 per cent (24) were fabric manufacturers, 18 per cent (8) garment washing and dyeing plants, 9 per cent (4) yarn and thread dyeing plants, 9 per cent (4) towel manufacturers and 9 per cent (4) other categories. This mix represents the variety of textile related wet processes recorded for Sri Lanka. Almost all fabric manufacturers produce a mix of products, i.e. cotton, synthetics including polyesters and polyester blends, viscose etc. and very few specialised in a single product. Three of the 24 industries were seen to focus on synthetics like saris, nylons, suiting, two were seen to focus on knitted fabrics but, in general, it seemed beneficial for the industry to have a mixture of products.

Production data is available for only 37 of the 44 industries. Values obtained for production for each industry did not however indicate whether it was the production capacity or the actual production. Further, production figures which were given in both metres and kilograms have been converted to kg to enable comparison (Table 3). An average value of 100 g/ m fabric was utilised for this conversion, except for industries known to manufacture only light fabrics (Nos. 9, 16 & 32) where a value of 80 g/m was utilised. Average weight of a towel was taken as 200 g and a garment as 150 g. However, for industry No. 8, where light garments like panty hose tights and gloves are dyed, average weight was taken as 25 g. Utilising these figures, and using the classification that >50,000 kg/mth production is large scale, 25,000 - 50,000 is medium scale and <25,000 is small scale, it is noted that 32 per cent (12) of the industries are large, 22 per cent (8) medium and 42 per cent (17) small scale.

4.2.3 Technology status

The total investment in textile machinery has remained somewhat stagnant after an initial upsurge in the early 1990's (Table 5). [3]

Table 5. **Textile machinery investment in Rs. million**

Item	1985	1988	1990	1991	1992	1993	1994
Yarn	1.68	10.86	134.8	139.4	446.6	300.1	346.8
Fabric	60.7	56.2	158.1	302.0	463.9	766.0	655.3
Processing	38.0	94.8	77.6	172.8	333.5	528.2	436.2

Source: Textile statistics of Sri Lanka - 1995, Ministry of Industrial Development (Textile Division)

Information that could be collected about the machinery being utilised from this survey was very limited. This was not available even in any of the other sources. According to the survey reports dyeing in most industries is being carried out utilising jiggers and jets, while printing is carried out using both rotary and flat bed printers.

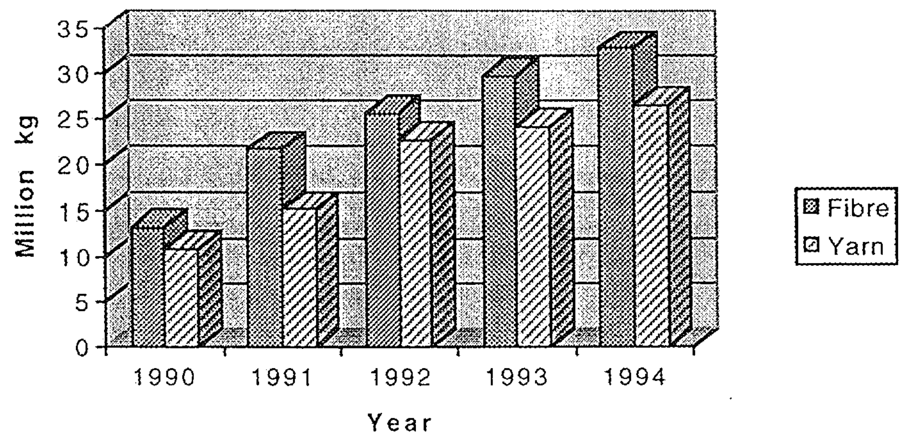
The TTSC report states that upto 1980's most of the mills produced and processed narrow fabrics of 36 inch and 44 inch in width. But in the 1990's to meet the local and export requirements, many of the large/medium scale processing units have been modernised to process fabrics of width 60 inch or more. Along with this new technologies like open width bleaching, pad batch dyeing, sanforizing, etc. have been introduced. Process control has also been automated in most industries, but full automation has yet to be introduced.

Many mills are already using colour matching computers in obtaining dye recipes. High pressure/high temperature dyeing effected on polyester fabrics, yarn and sewing thread, are being controlled with micro-processors. Some industries have introduced new technologies of flat bed screen printing and rotary screen printing in their effort to modernise their processes.

4.2.4 Raw material use

Fibre, yarn and chemicals, the three major raw materials are almost wholly imported, and so the textile industry is all but completely dependent on the international market. The import volume of fibre and yarn from 1990 to 1994 shows an increasing trend as shown in Fig. 4. [3]

Fig. 4 Import volume of fibre and yarn



Information on the volume and type of chemicals used in various textile processes was not available from other sources. Data from the questionnaires was inadequate to comment on chemical consumption pattern.

Values obtained for the use of water and energy (electricity and fuel) were utilised to obtain figures for utility consumption/kg of fabric (Table 3). It is seen that there is a wide range for these values even for the same product category (fabric, garments etc.). This could be due to wrong values being provided (source of information for each industry is indicated in the Table), or other differences in the processes and methodology being utilised. e.g. type of equipment, product, re-cycling being carried out etc. In addition records of water and energy use generally do not distinguish between use for production and use for domestic purposes by the workers.

4.2.5 Waste outputs

Values obtained for volume of wastewater output were seen to be in most cases the same as the input water. Generally, no measurements of wastewater flow are carried out in industry, and so it is assumed that water input is equal to water output. As such, it could be assumed that wastewater generated per kg of product is equal to water consumed per kg of product. Present environmental regulations require that quality of wastewater generated is analysed every quarter and a treatment plant be installed if it does not conform to required standards. Most textile industrialists have initiated some action but not adequate. The government has stipulated industrial emission standards only recently and is in the process of formulating guidelines and regulations for the disposal of solid waste, hence industries did not have information on solid wastes and stack emissions.

4.2.6 Nature of effluent receiving bodies.

The five largest mills in this sector are located in the rural zone, in the vicinity of rivers. All carry out some treatment before discharge to the river. However people who utilise the river for bathing, washing and even drinking complain about the colour and other health effects. Generally the 1:8 dilution required is provided by these large rivers, except in the drought. The majority of the medium scale industries which are generally located in the urban areas are either in the Ratmalana/Moratuwa area or in the Ja-ela/Ekala area. Those located in the former, discharge raw effluent to the road drains, which finally fall into canals, marshy lands, Bolgoda lake, Lunawa lagoon or the sea. Lunawa lagoon is considered as a 'dead' lagoon, as it is extremely polluted, while studies indicate that the effects of pollution in Bolgoda lake are seen in low fish productivity and other changes in the aquatic fauna and flora. The industries located in the Katunayake and Biyagama industrial zones discharge to the common treatment plants of the zone.

4.2.7 Potential for waste minimisation including recycling and reuse

Comparison of the utility use for the industries indicates a large range suggesting that there is a potential for reducing water and energy use, in many of the industries. This could be due to wastage of condensate and cooling water and excessive use of water for washing etc. However a detailed waste audit would be required to confirm the values utilised in this survey and determine which processes generate this water and consume the energy and how it could be minimised. Attempts were made to compare WHO norms[4] for the textile industry for utility use and waste volume with the Sri Lankan values computed in this survey. However it was seen that different norms exist depending on the type of product, processes, equipment etc. further indicating the necessity for more detailed information to determine if such values are high. Variation in energy consumption suggests that options for reducing energy losses as heat, and recycling energy could be looked into.

5 CONCLUSIONS

Majority of the industries are small - medium scale industries and located in urban areas. This has led to pollution of the receiving bodies and many discomforts to the population in these areas. The problem is aggravated by the fact that population density is high in these areas. Most industries carry out a variety of processes and generate a range of products. The textile industry needs to develop and expand to face the challenges and demand of the apparel sector. The concept of waste minimisation is new and unknown to the textile industry. Industrialists are discreet of any matters related to the environment and try to evade this issue considering it as an unnecessary burden. Industries do not have a well organised system of planning and recording information and the survey indicates that there is a high potential for waste minimisation in the textile processing industries. However, a detailed study is required to collect necessary information and determine areas of waste generation and suitable waste minimisation options.

PHASES II & III

IN-DEPTH WASTE AUDITS AND IMPLEMENTATION OF PRACTICAL WASTE REDUCTION MEASURES IN SELECTED FACTORIES

6 IN-DEPTH WASTE AUDITS

Six industries were selected for detailed waste audits to review waste minimisation opportunities underthe Phase II of the project. It was attempted to obtain a mixture within these six industries i.e. in terms of size, location and type of processes and products. The most important criterion for the selection of industries was the management eagerness and interest in the project. The six industries comprised of one large scale industry from the rural area and five medium scale industries from urban areas with a mixture of processes and products (Table 6).

Table 6. Industries selected for detailed waste audits

Industry	Location/District	Size	Processes	Products
Baksons Textile (Pvt.) Ltd.	Colombo, Urban industrial	Medium	Dyeing, printing, & garment washing	Cotton, polyester blend, dyed & printed fabrics, washed garments
J.B. Textiles Co. Ltd.	Colombo, Urban residential	Medium	Weaving, dyeing & printing	Cotton, polyester blend, nylon, dyed & printed fabrics
Sascons Knitting (Pvt.) Ltd.	Gampaha, Urban semi- industrial	Medium	Knitting, dyeing, manual printing & garment	Polyester, cotton & polyester blend, dyed fabric & garments
Veyangoda Textile Ltd.	Gampaha, Rural	Large	Spinning, weaving, dyeing, & printing	Cotton & polyester blend yarn, dyed and printed fabrics
Oacianic Knitters (Pvt.) Ltd.	Colombo, Urban industrial	Large	Knitting & dyeing	Cotton & polyester blend, dyed fabrics
Ceylon Synthetic Textile Ltd.	Colombo, Urban commercial	Medium	Weaving, dyeing & printing	Cotton, polyester blend, nylon, rayon blend, dyed & printed fabrics

After carrying out in-depth study in these industries detailed reports were prepared for each of the above six industries, identifying Cleaner Production options which would bring financial and environmental benefits, to the. industry on implementation. These reports are Annexed separately to this report.

Comparison of some of the information obtained in the wate audits viz. water and fuel consumption, organic load of effluent streams, waste and emission costs and, utilities costs for these six industries (Table 7) showed that there are opportunities for resource conservation in these organisations with economic benefits. The following important points emerges from the analysis.

- A large per cent of the water consumption for most of the industries was undefined, indicating that there is no proper control on the use of water. This is mainly due to the fact that industry in general in Sri Lanka does not consider water as a valuable raw material.
- Total water consumption per kg fabric was highest in Cyntex and Veytex. High water consumption in Veytex is due to the humidification and spinning process which accounts for 26 per cent of total water consumption, while in Cyntex the undefined category (33 %) contributes to the high use.
- Baksons has a low water consumption for printing compared to other industries but their printing waste has a high COD and high waste cost indicating that wastage at printing is relatively high.
- Cost of utilities, in particular water, vary substantially between industries depending on the source. In most cases high cost of water caused a reduction in water consumption per kg fabric produced (Baksons & JB). However in the case of Cyntex high cost did not reflect on reduction in water consumption mainly due to poor management.
- Water requirement for dyeing can be reduced considerably by introducing cold pad dyeing as seen in Veytex.

TABLE 6
COMPARISON OF UTILITIES CONSUMPTION, WASTES GENERATED & THEIR COSTS FOR THE SIX INDUSTRIES

	CYN	JB	OKL	SASCON	VEY	BAK
1. Water Consumption						
Washing	9%	4%	27%	27%	29%	47%
Dyeing	3%	0.6%	7%	6%	0.1%	1%
Scouring, bleaching & other cleaning operation	3%	6%	6%	5%	1%	12%
Printing	14%	--	--	--	12%	2%
Domestic	28%	14%	2%	23%	5%	9%
Boilers	3%	0.5%	3%	7%	5%	--
Others	7%	11%	--	3%	29%	--
Undefined	33%	14%	49%	29%	19%	30%
Consumption l/kg fabric processed	224	133	161	145	275	110
2. COD						
Washing	4%	--	50%	42%	55%	6%
Dyeing	13%	18%	15%	20%	--	0.7%
Scouring,bleaching & other cleaning operation	3%	16%	27%	32%	--	48%
Printing	14%	28%	--	--	28%	45%
Others	66%	38%	8%	5%	17%	--
Average COD mg/l (process effluent only)	1045	851	1760	1015	1214	2635
Average COD mg/l (considering all effluent)	545	590	862	440	797	1588
3. Fuel consumption l/kg fabric processed	1.3	1.4	0.6	1.9	2.0	0.2
4. Waste and emission costs						
Process wise						
Washing	15%	--	20%	11%	12%	10%
Dyeing	31%	14%	42%	60%	5%	3%
Scouring, bleaching & other cleaning operations	25%	3%	26%	19%	12%	72%
Printing	10%	--	--	--	8%	14%
Others	4%	--	11%	10%	63%	--
Material wise						
Chemicals	61%	71%	46%	67%	55%	56%
Steam	17%	6%	33%	24%	15%	12%
Water	4%	13%	3%	2%	9%	14%
Treatment	18%	--	18%	6%	30%	18%

5. Utilities costs (Rs.)						
Water /m^3	20	21	7.8	8.27	11.0	33
Water / kg fabric	4.47	2.2	1.17	1.20	3.03	3.35
Steam /kg	0.8	0.75	1.2	1.15	0.45	1.5
Steam /kg fabric	4.65	6.6	5.46	9.5	13.1	3.27
Electricity /k Wh	4.5	4.0	6.34	4.96	3.66	4.98
Electricity /kg fabric	15.5	4.5	3.45	2.5	26.3	3.64
Fuel /l	6.0	6.66	6.98	7.17	6.25	6.43
Fuel/kg fabric	7.79	8	3.74	10.1	12.2	1.11
Treatment /kg COD	30	30	30	30	30	30
Treatment /kg fabric	8.25	1.9	3.2	1.52	5.01	4.91
Total production kg/month	26,000	37,000	62,000	30,000	170,000	147,000

Details about the figures presented in the above table are available in the detailed waste audits for each industry (Annexure 4 - 9) in the following chapters

- Water Consumption - Chapter 6
- COD - Chapter 7A
- Waste cost - Chapter 7B
- Utilities cost - Annexure I

- High consumption of fuel/kg product for Veytex is also probably related to the larger number of processeses carried out by them.

Due to industry's limited capability for providing finance, manpower and other resources, it was not possible to take up all the measures for implementation at one go. Profits being most important to the company, low or no investment options with short pay back period were given priority for implementation.

7 IMPLEMENTATION OF PRACTICAL WASTE REDUCTION MEASURES

Out of these six mills, three mills did not implement any of the cleaner production options identified due to a variety of reasons. Baksons Textile Mills was closed down due to financial and labour problems. Ceylon Synthetic Textile Mills Ltd. did not show much interest in implementing cleaner production options due to lack of commitment from the top management. In the case of Veyangoda Textile Mills eventhough the factory staff was keen on implementing the options, due to labour unrest and insufficient backing from the top management progress made so far is far from satisfactory. Eventually only three mills, namely, Sascon Knitting (Pvt.) Ltd., Oacianic Knitters (Pvt.) Ltd., and JB Textiles Company Ltd. participated in Phase III of the Project, viz. implementation of practical waste reduction measures.

A summary of the implementation status of the ten cleaner production options identified of high priority is given in the in-depth waste audit report for the three industries (Annexes 4, 5 & 7). The annual savings that have been achieved by the options implemented have been calculated. Since all three industries do not have effluent treatment plants at present, the savings in treatment cost has been given separately, which will be experienced by the industries only in the future.

Of the ten options only one option, i.e. chemical substitution, has been implemented by Sascon Knitting Co., to date. In addition they have done the power factor improvement which is not listed under priority options. The reason given by the industry for their poor response is lack of funds. Oacianic Knitters Ltd., has implemented two out of ten options identified. Much progress has been made under the chemical substitution option. Oacianic Knitters have requested for financial assistance from the IPRP to implement the low liquor ratio jet dyeing set up. JB Textiles Co. has implemented two options and four more are in progress.

8 CONCLUSIONS AND RECOMMENDATIONS

The project had two main objectives: a) to train CISIR staff on Cleaner Production methodologies, and b) to demonstrate the benefits of cleaner production to the textile processing industries.

With respect to the first objective the CISIR officers are now adequately trained and experienced to carry out waste audits and facilitate cleaner production among the industries. In addition to the "on the job" experience gained during the waste audit exercises, CISIR officers were also sent on study tours/short courses in cleaner production. Annex 3 highlights some of the more important benefits accrued to CISIR via this project.

The demonstration of cleaner production concept among the textile sector did not progress as expected. The following could be attributed to the slow and negative response from the industry, particularly the textile sector for cleaner production.

- During the last two years, the textile processing sector in Sri Lanka has been in a crisis situation due to a variety of reasons such as labour unrest, smuggled goods and produce from free trade zones entering the local markets at lower prices, outdated technology, and low quality products. The industry in general is therefore not in a mood to try out a newer concept which needs money, manpower and other resources.
- No sustained effort was made by the project to sensitize the top management of the industries about environmental issues and their economic implications and consequently the importance of managing the organisational activities in an environmentally responsible manner. Hence the importance of cleaner production in today's context has still not been realised by the industry.

- Since one of the project objectives was on developing the methodology, the waste audit exercise took a fairly long period of time which did not go well with the industry who, for obvious reasons, were interested in quick results.
- Most industries were only interested in options that had a pay-back period of less than three months. Further they were also reluctant to implement options which involve changes in present practices as they are not convinced that the benefits which will arise by implementing such options, will compensate for the risk taken.
- Majority of the SMI sector is not aware of the environmental aspects of their production processes/activities and the significance of the environmental impacts of such activities. Thus they do not see the urgency to alleviate such problems by implementing cleaner production.
- Since the whole study was done at no cost to the industry there was little commitment from them to ensure the success of the project.
- Growing international pressure to protect the environment and human health is one of the major driving forces for industries in the west to improve their environmental performance. However such environmental pressure, both from the public and government, is insufficient in Sri Lanka to coerce industries towards cleaner production.
- Policy measures and economic instruments are not sufficiently developed in the country for industries to reap the full benefit of cleaner production activities.

The study has clearly indicated that without commitment and active participation from the industry nothing can be achieved at this end. The most important task ahead in promoting cleaner production in Sri Lanka is to get the industry understand the various environmental issues arising from developmental activities and to act in a responsible manner so as to maintain the quality of the environment. Therefore sensitising the industrial community to the environmental problems faced by the world and country in particular should be number one in the agenda for promoting Cleaner Production concepts in Sri Lanka.

The major driving force for organisations in the developed world to adopt environmental management systems for better environmental performance is the growing international pressure to maintain and improve the quality of the environment and protect human health. However, in developing countries like Sri Lanka environmental pressure alone would not suffice to force organisations to divert their attention to improve their environmental performance. Industries have to be cajoled by demonstrating the economic benefits of cleaner production with relevant case studies and study visits.

Initial environmental review to identify the potential for cleaner production should be done by the industry themselves. The top management should realise the importance of environmental performance of their organisation and initiate the process by allocating finance, manpower and other resources. The first environmental review should be of short duration, less than a week, focused on areas which would bring in economic benefits and compliance to regulations. If necessary, CISIR or other institutions could act as facilitators of the whole process for a subsidised fee to start with. The industry personnel who are involved in the programme should be technically qualified and well versed with the environmental aspects and impacts of the organisation activities and the environmental regulations of the country. If they are not familiar with the environmental issues the facilitators should arrange a series of lectures in the relevant areas.

The Government should work out some policy measures and economic instruments to prevent waste generation and to reward better performers. Some of the areas for consideration are, realistic rates for pipe borne water to minimise excessive use of water, a rebate in water bills for achieving set targets, to implement a charging mechanism if groundwater is tapped for industrial use, to charge industries according to the pollution load they are discharging.

It is suggested that a "Cleaner Production Centre", with the vision to assist the industry to achieve international competitiveness and environmental excellence through consultation, education and technology transfer be established to serve as a one stop shop to the industry. This Centre could, among others, promote cleaner production by organising seminars and training workshops in collaboration with the industrial chambers, disseminate cleaner production information via newsletters, publications etc., undertake waste audits and facilitate organisations to implement an EMS.

9 REFERENCES

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3. Textile Statistics of Sri Lanka 1995, Ministry of Industrial Development (Textile Division).
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5. Central Environmental Authority, Industrial Pollution Control Guidelines No. 6: Textile Processing Industry.

ANNEXURE 1

UNIDO ONUDI

Industrial Pollution Reduction Programme

TERMS OF REFERENCE
Sub Contract DG/SRL/91/019/21-01

Contractor services for reviewing opportunities for waste minimization/cleaner production within the textile processing sector in Sri Lanka.

1. BACKGROUND

The purpose of the projects is to reduce pollution from industrial operations in Sri Lanka, with an emphasis on source reduction.

The project will include the demonstration of waste minimization/cleaner production techniques and technologies and strengthening of Government institutions in their respective roles in the reduction of industrial pollution.

The main project activities will improve the operation of selected demonstration factories in various industrial subsectors and demonstrate the effectiveness and cost benefits of such measures.

2. THE CONTRACTOR'S RESPONSIBILITIES

The contractor will be responsible for reviewing the present state of the textile processing industry in Sri Lanka and identify specific opportunities for waste minimization.

Specific tasks:

The contractor will, in close cooperation with the National Project Director (NPD), the Chief Technical Advisor (CTA) and the textile sector experts and others, undertake the following duties:

Phase 1 Review the textile processing industry in Sri Lanka, on a short time scale with a view to obtaining the following information for each factory.

- Name, address and telephone number of factories and head offices and name of Director, Owner or Chairman
- Types of products, production capacity and actual production quantities.
- Brief description of the processes and equipment used.
- Total water, materials and energy use
- Approximate water, materials and energy use per unit production.

- Approximate total waste outputs in terms of degree of pollution
- Approximate waste outputs per unit production.
- Nature of bodies receiving effluents and condition of these.
- Estimate of potential for implementing successful waste minimization procedures.
- Any possibility of recycling or reuse.
- Prepare a comprehensive report on the above.

Phase 2 Based on the above and in association with UNIDO and CEA, to select 6 factories for in-depth waste audits using standardised IPRP methodology and undertake these audits providing a minimum of 2 staff per audit and working with others as necessary.

Phase 3 Based on the waste audits, to select 4 factories to be assisted in implementing practical waste reduction measures as a demonstration exercise, to cost and estimate the benefits in quantitative terms of these waste reduction measures.

Reporting Prepare a comprehensive report on the above, with separate reports after stages 1 and 2.

ANNEXURE 2

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இலங்கை விஞ்ஞான கைத்தொழில் ஆராய்ச்சி நிலையம்
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Telex 2124[illegible] R.
දුරකථනය / தொலைபேசி / Telephone: 93807 / 598620

Dear Sir,

WASTE MINIMISATION-SURVEY OF TEXTILE INDUSTRIES

The management of industrial wastes presents special problems in a rapidly industrialising country such as Sri Lanka. These problems primarily relate to limited technical and economical resources available for environmental protection at both industry and government levels.

What is abundantly clear, however, is that if we delay in implementing effective industrial waste management policies and continue to dumping and discharge of toxic wastes, we will soon be caught in the same Catch-22 situation faced by most industrialised nations. In the US there are more than 20,000 abandoned chemical waste sites and the bill for clean up is estimated at hundreds of billions of dollars.

The traditional way of waste management, the end-of-pipe strategy, is now being considered too costly and is being gradually replaced by pollution prevention and waste minimisation concepts. This is due to the simple fact that waste treatment costs are directly related to volumes and flow rates of waste stream rather than to absolute quantities of pollutant. Consequently it makes sound economic sense to reduce waste generation at source and thus minimise the size of the required waste treatment system.

CISIR has therefore initiated a Waste Minimisation Programme, with the assistance of UNDP/UNIDO, to promote waste minimisation practices and systems that enable industries in Sri Lanka to save money, improve productivity, and reduce pollution. Some of the more important benefits of Waste Minimisation Programme are;-

Increased profits	using less raw materials, cheaper waste disposal and avoiding litigation and fines,
Improved public image	attracting better employees, increased consumer demand for product and premium price for eco-friendly product in the international market.

To start with we have identified textile processing industries for our pilot study and a survey is being undertaken to identify potential areas where this concept could be implemented in a cost-effective manner.

A successful Waste Minimisation progamme demands a strong commitment from you. It would mean your direct involvement and supervision when filling out the attached questionnaire as oppotunities for waste minimisation in your organisation will be largely based on this data.

Since we are working on a very tight schedule I shall be grateful if you will return the completed questionnaire before ... 1995. All information given will be kept strictly confidential. If you need any clarification or assistance in completing the questionnaire please contact one of the following:

Mr. H.N. Gunadasa/ Mr. W.R.K. Fonseka/ Ms. S.de. Costa

Phone 698622/693807

I thank you in anticipation of your wholehearted cooperation.

Yours sincerely

A.M. Mubarak
Head, Chemical and Environmental Technology Division
24 May 1995.

INDUSTRIAL POLLUTION REDUCTION PROGRAMME
WASTE REDUCTION AUDIT - TEXTILE SECTOR
QUESTIONNAIRE FOR INDUSTRIAL SURVEY

1.	Name of Industry:		
2.	Address		
	i)Factory:		
		Phone:	Fax:
	ii) Head Office		
		Phone:	Fax:
3.	Name		
	i) Owner/Chairman/Director		
	ii) Contact Person & designation		
4.	Location of factory (Give route from the nearest city or map):		
5.	Site description (Factory floor area, site area & local authority to be provided):		
6.	**Land use of the surrounding area**		
	i) North		
	ii) East		
	iii) West		
	iv) South		

7.	Main Activities (give nature of industry)	
8.	Date commenced	
9.	Operating periods	
	i) No. of shifts	
	ii) Hours/shift	
	iii) Working days/week or month	
10.	Number of workers	
	i) Office	
	ii) Daytime	
	iii) Shift	
11.	List of products, and out puts	
	Product	**Output - tonnes/year or month**
i)		
ii)		
iii)		
iv)		
v)		
vi)		
vii)		
viii		

12.	Raw materials used	
	Raw material	**Consumption Kg/day or month**
i)		
ii)		
iii)		
iv)		
v)		
vi)		
13.	Dyes, chemicals and other materials consumption	

Chemical or common name	Trade name	Quantity Kg/y	Purpose

14. Manufacturing process (Include all process operation carried out for each product)

eg. Dyeing of cotton:

Scouring → Bleaching → Dyeing → Finishing

15.	Water requirements		
Use			Quantity- gal/ day or litres/ day
i)	Processing		
ii)	Cooling		
iii)	Washing		
iv)	Domestic		
vi)	Other		
16.	Source of water		
	Source		Quantity - gal/day or litre/day
i)	Dug well		
ii)	Tube well		
iii)	Municipal supply		
iv)	River		
vi)	Tank		
vii)	Other		
17.	Energy consumption		
i)	Electricity	kW/m or yr	-
ii)	Fuel	Furnace oil - l/m	-
		Diesel - l/m	-
		Other	-
iii)	Other		-

18.	Machinery used		
	Machinery	**Capacity**	**Power rating**
i)			
ii)			
iii)			
iv)			
v)			
vi)			
19.	Description of waste		
i)	**Liquid waste**	Process effluent - liters/day	-
		Floor washing - litres/day	-
		Domestic effluent - litres/day	-
ii)	**Solid waste**	Off cuts - kg/m	-
		Packaging/containers (plastic) -kg/m	-
		Packaging (paper) - kg/m	-
		Metal containers - kg/m	-
iii)	**Air emission**	Boiler exhaust	-
		Exhaust from dryers	-
		Other	-
iv)	**Noise**	Specify noise generating operations	-

20.	Description of treatment facilities	
i)	**Liquid waste**	
	Is water recycled or reused? Yes/No. If yes specify	
	Capacity of effluent treatment plant	
	Treatment process	
	Quality of raw effluent, if available	BOD- COD- pH- Suspended solid- Other-
	Final point of discharge-agricultural land/ marsh/ sewer/ stream/river/sea/other (specify)	
	Method of discharge - open channel/pipe line/ covered drain/other (specify)	
ii)	**Solid waste**	
	If any kind of solid waste is being recycled/reused/sold. Yes/No. If yes specify.	
	Method of disposal - municipal collection/ land fill/ incineration/ composting/ other (specify)	
iii)	**Atmospheric emission**	
	Number of stacks and height	
	Are there any emission control system? - dust collector/ cyclone/ scrubber/ etc. If yes describe.	
	Does the industry emit odour. If yes indicate source.	

Date.............. Signature of authorised officer...................

ANNEXURE 3

BENEFITS TO CEYLON INSTITUTE OF SCIENTIFIC AND INDUSTRIAL RESEARCH (CISIR)

(1) CISIR officers got trained in many aspects of waste minimisation , on the job while carrying out the waste audits, and by participation in training programmes (list is attached). This knowledge is being utilised in carrying out our service to other industries

(a) Methodology of carrying out waste audits (waste audits are now being carried out for other industries, eg. a leading export industry processing herbal products, Link Natural Products (Pvt) Limited).

(b) Cleaner Production options in the textile processing industry (with assistance of Mr. Desai, UNIDO Expert) eg. Flue gas neutralization of alkaline effluent has been suggested for Veyangoda Textile Mills, a textile dyeing and printing industry in our proposal for effluent treatment.

(c) How waste minimisation and re-cycling could be looked into and incorporated while designing pollution control treatment systems.

e.g. (1)<u>Coats Tootal Lanka</u> - A yarn and thread dyeing industry. Incorporation of a waste heat recovery unit into the effluent treatment system Waste exchange scheme has also been initiated between this industry and Lanka Transformers Limited , a galvanising industry. Existing yarn lubrication system was changed to a new lubricant for the reduction of oil wastage

e.g (2) <u>Provincial Carriers Limited -</u> manufactures powdered granules of dolomite and feldspar. Waste minimisation system was included with our design for a pollution control system .

It is expected that CISIR staff will continue to promote Cleaner Production among industries in Sri Lanka.

(3) Training was provided to CISIR Laboratory Services Group staff on sampling and analysis related to environmental parameters.

(a) Workshop on Effluent Sampling and Analysis for Reliable Effluent Treatment Plant Design on 21 February 1997 (conducted by Dr. N. Hill, UNIDO expert)

(b) Workshop for laboratory Technicians' (2nd December 1997) and Laboratory Managers (4th December 1997) on QA/QC Procedures in the laboratory conducted by Dr. Jens Folke, UNIDO expert.

(4) A proposal has been submitted to the World Bank to relocate 'Çleanet', Cleaner Production Clearing House at CISIR.

(5) Recommendations were made for consideration of funding through the UNIKDO/IPRP revolving fund for a flue gas neutralisation system for Veyangoda Textile Mills and a low liquor ratio dyeing machine for Oacianic Knitters (Pvt) Limited.

EQUIPMENT RECEIVED

Portable pH Meter (2)
Pocket Digital Thermometer
Surface Measurement Thermometer
Infra-red Thermometer
Pentium with laser printer
Parshall flames
Flow-meter for partially discharged pipes
Ultrasonic effluent level detector
Automatic non-invasive water flow monitor
Timer/stopwatch
Portable Dissolved Oxygen Meter (4 nos.)

EQUIPMENT REQUESTED (AWAITING ARRIVAL)

PM-10 High Volume Sampler
Handy Stack Sampler

TRAINING PROGRAMMES

Foreign

1. Study Tour on Cleaner Production in the Netherlands, Denmark and India (October-November, 1996).

   Mr. H.N. Gunadasa, Ms. S. Wickramaratne and Ms. D. Attanayake

2. Cleaner Production Workshop, New Delhi, India, 6-7 December, 1994.

   Mr. W.R.K. Fonseka and Mr. G.M.S. Jayatilake

3. Study Tour on Cleaner Production in Australia, 19 May - 15 June, 1997.

   Dr. A.M. Mubarak

4. International Short Course on Anaerobic Waste Water Treatment, Netherlands, one week in July 1997.

   Ms. K.D. Attanayake and Mr. K. Pavananthan

Local

5. IPRP Cleaner Production Audit Training Programme, 24-28th June, 1996 (2 officers).
6. IPRP Workshop on Cleaner Production, 15th September, 1997 (1 officer).

Annex. 10

OPPORTUNITIES FOR WASTE MINIMISATION IN THE TEXTILE SECTOR

Sri Lanka is pursuing the path of rapid economic growth with greater emphasis being placed on industrialisation. The textile sector has been contributing to achieve this target since the country won independence fifty (50) years ago. However, the industry at the initial stages of its inception had been concerned only on two major issues, namely, competitive pricing and quality of goods produced. During the late 80's, this industry, as any other industrial sector was compelled to take adequate environmental safeguards in order to stay in business. This situation created a need to upgrade their in-house capability to introduce in-house technical capability for the well being of the entire textile sector.

At this stage the Industrial Pollution Reduction Programme introduced waste audit study programmes for the textile sector, when the entire sector was in difficulties, specially when it came in search of environmental technology in order to continue to manufacture textile products in an environmentally friendly manner.

The Ceylon Institute of Scientific and Industrial Research (CISIR) was awarded the sub-contract to carry out the waste audit programme for the textile industry in close participation with visiting textile experts identified and posted by in Sri Lanka by UNIDO on several short missions. This study identified a number of very simple and no cost opportunities that could be implemented within their own organisations without any major process change nor any additional sophisticated machinery and equipment. The study also noted that the major cause of pollution generated by the textile industry was due to bad material handling and management. There had also been some areas where the technical aspects of processing needed upgrading in keeping with the developments in the rest of the world. These changes, however, warranted substantial financial commitments by the companies in order to introduce newer techniques to improve the performance, quality and minimise waste.

The CISIR team has completed such in-depth waste audit programmes in respect of six major manufacturing companies. It is very encouraging to note that all these companies participated in the programme were appreciative of the work done by the sub-contracting CISIR team. Although initial intention of the waste audit programme was designed to identify the areas where modern technological inputs were needed in order to improve their performance, quality and minimise waste, some of the participating companies were found some what reluctant to invest further towards upgrading their existing production outfits due to serious marketing and financial problems.

In any event, we are happy to note that the participating companies have fully realised the importance of following the cleaner production technology carried out by the CISIR team because the low cost simple techniques proposed by the team have had great impacts on their quality performance and environmental safeguards. We do hope that the team will continue to work in these lines in order to establish new corporate cultures in manufacturing organizations with built in environmental safeguards during their manufacturing processes.

Dr. V.U. Ratnayake,
National Programme Manager, IPRP (on behalf of UNIDO, CEA and Project Monitoring Unit)
17 December, 1997