## 7.0 SOUND ENVIRONMENTAL PERFORMANCE THROUGH CLEANER PRODUCTION

### 7.1 Cleaner Production options

Mainly three different cleaner production options can be identified for the garment dyeing facility.

1. Minimization at source (Preventive Practice)
2. Recovering, Reuse and Recycling
3. Useful by products

Minimization at source is directly achievable by,

1. Good House Keeping
2. Good Process Control
3. Good Store Keeping
4. Quality Assurance
5. Systematic Maintenance
6. Input Substitution (Raw Material, Energy etc.)
7. Product Changes
8. Equipment Changes
9. Process Changes

**Good House Keeping**

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Untightened leaking valves, pipes etc. contribute to high amounts of leaking of water and steam. Turning off them when not in use and checking them for any leakage will help to minimize such leaks.

Dripping out of processing liquids and spillage causes wastage, contamination of the work place and health hazards, process variations etc. Process and machinery both has to be designed to avoid such wastage. When transferring liquids from containers, one should be careful to avoid such dripping of chemicals.

Process parameters must be optimized and steps should be taken to verify the treatment conditions while processing. Availability and timely calibrated meters are very vital. Thereby can optimize the energy and resource consumption, can minimize the 'seconds' by process standardization, reproducibility and quality standards can be upgraded. Improving material handling technique and practices can minimize incidences of spillage.

Proper maintenance is also a part of house keeping and calibration, cleaning and preventive maintenance should be conducted regularly.

Inventory control is vital in order to maintain the house in order.

Simply the implementation of the Japanese 5S System will enlighten the path for the good house keeping. In addition to that GTZ good house keeping guide and total productive maintenance are some other tools useful in effective house keeping.

A programme of maintenance, inspection and evaluation of production practices should be established. Significant water reductions can be made through such areas as minimizing leaks and spills, proper maintenance of production equipment, identification of unnecessary washing of both fabric and equipment, and by employee education on the importance of water conservation.

Some waste minimization techniques are not applicable because of their drawbacks and this should be kept in mind during implementation. Some of the techniques can adversely affect on quality of fabric and manufacturing processes, and be limited by physical plant constraints. As such detailed evaluation and close watch should be kept during all activities.

Savings brought about by instructing an operator to perform (or not to perform) some actions can be directly implemented. for example, by a decision to fill the machine only to some specified level or to dispense with overflow rinsing. Such measures are easy to initiate and very useful, may be introduced in simple steps.

Savings could be made by making some discrete change to the machine (to prevent overflowing) or the process redesigned, for example with the introduction of counter flow on a washing range and the final rinse of the washing machine can be utilized for the pre-desize rinse in the next washing sequence. At the same time untreated water (water directly from the ground) or final rinse can be used even for floor washing, floor cleaning, drain cleaning and machine cleaning etc. Thereby the cost of water treatment can be reduced to a considerable amount.

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It is important either to check that the water depth is the same each time the vessel is filled or to prepare a simple volume indicator in the form of a dip-stick or calibration marks on the side of the vessel. Level indicators are totally absent in vessels observed in the facility.

The permanent installation of a flow meter to measure either the total water input or effluent discharge is essential. The most important information to be derived from a permanently installed meter is the total water consumption over a given period. Instruments that give only a reading of the instantaneous flow rate are not suitable, a direct reading of the total quantity should be provided. The recording of flow rate on a chart is helpful for identifying periods of high or low consumption, but chart should not be the only output provided as the computation of the total water quality can be a tedious business. Management should understand the importance of measuring process parameters.

An automatic shutoff valve will control the flow of water into a process unit based on time, level or temperature. It was estimated that a reduction in water use of up

to 20% could be achieved with thermally controlled shutoff valves. For simple non-process applications these simple low cost self-closing taps are available.
A flow or pressure reduction valve can significantly reduce the quantity of water used in a wash or clean-up step. They are particularly useful in cleaning areas where operators are not always conscious of the need for water conservation. At present waste water streams if segregated could be implemented for this purpose. The flow washing is also carried out in an inefficient manner using high pressure pumps, hoses and manually by buckets. The use of high pressure cleaning could eliminate significant quantities being utilized for this purpose. Good house keeping practices along with preventive maintenance of machinery and equipment also helps to reduce the burden of cleaning.

### Good Process Control

Optimization of process conditions proper regulation of the same can improve the quality standards of the product, uniformity and reproduce ability of the product etc. It can lead to waste minimization in two ways.

1. Optimization of resource consumption
2. Avoiding 'seconds' or 'rejects'

Recipe modifications, eliminating unnecessary processes are some means of better process control.

### Good Store Keeping

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Wastages by deterioration, spillage evaporation etc. in storage contribute for a high percentage of resource wastage. Maintaining the records on chemicals etc. in the stores, clearly indicating the issuing dates and expiry dates, introducing proper methods and tools to ensure proper handling without any contamination, storing the substance under appropriate atmospheric and other conditions are to prevent from deterioration are some good store keeping practices.

### Quality Assurance

Quality Assurance practices will minimize the percentage rejects thereby the resource and energy wastage.

### Systematic Maintenance

Proper preventive maintenance will reduce the machinery and equipment breakdowns and extend the life span. It will lead to minimizing resource consumption in terms of machinery and equipment.

**Input Substitution**

Input substitution is an effective cleaner production technique. Dyestuffs and chemicals can be substituted by less toxic and hazardous low COD and BOD, more efficient products. Greening the supply chain and life cycle assessment and thinking are two main approaches for input substitution.

**Product Changes**

The design of the product can be changed in a way that resource consumption and wastage are low. Such products would be price competitive and have better market.

**Process Changes**

Implementation of more sustainable processes, eliminating unnecessary processes, in cooperation of process improvements through implementation of Environmental Management Systems (e.g. ISO 14001) and cleaner technologies are useful methods of process improvements.

**Equipment and Machinery Changes**

Modifications (redesigning) and replacements (alternative products) of machines in order to minimize energy and resource consumption is another effective mean.

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Introduction of low liquor consumption machines, repairable machines, insulation for the heat recovery installation of heat exchangers, automatic feeding systems etc. are some such means.

**Eliminating the need of equipment is also possible method.**

Products should be designed to change from stewardship concept to life cycle concept. Reducing packaging, increasing the durability and improving the repairability, etc. are also much needed improvements.

**Useful By Products**

Certain wastes generated could be effectively used to create some by products. Worn-out stones are a voluminous waste, which is difficult to dispose. But it can be used for gardening, land filling etc. because it does not have any chemical hazardousness.

**3Rs - Recovery, Reuse, Recycle**

*Recovery*

Most of the process baths are heated. In discharge of the bath, heat exchangers can be used to recover the heat. Process can be designed to recover sands used 100% in sandblasting.

*Reuse*

Softener are added in most of the process sequences as the final step, to improve the hand feel of the garments. Softeners are less substantive chemicals over dyes, therefore the amount of softener retained in bath at the end of the treatment is substantially high. As this final step does not use contamination, the softener baths can be reused with adjustment of its concentration by replacing the exhausted.

Some water used, e.g. final rinse water, contamination is very less therefore can be used for first rinses of new batch of garments.

*Recycle*

Treated water can be recycled to use for the process. Specially the condensated steam can be recycled and the special advantage is both heat and water recovery.

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Polythene packaging materials can be recycled. Therefore proper separation of them at the point of use and submission to any external party who is involved in recycling, can be practiced.

## 7.2 Implementation of CP options to improve the Environmental Performance

### Introduction

Cleaner Production is the continuous process of an integrated Preventive Environmental Strategy applied to Processes, Products and Services to increase efficiency and reduce risks to human and the environment.

This concept was coined by UNEP in September 1990.

CP Methodology involves following steps.

- collecting data on company and its process.
- drawing of process flow diagrams, identifying inputs and waste streams.
- qualification of inputs and wastes.
- analysis of causes of wastes and generation of CP options for better environmental performance.

**Scope**

Study was focused on principle inputs of garments, water, dyes and chemicals.

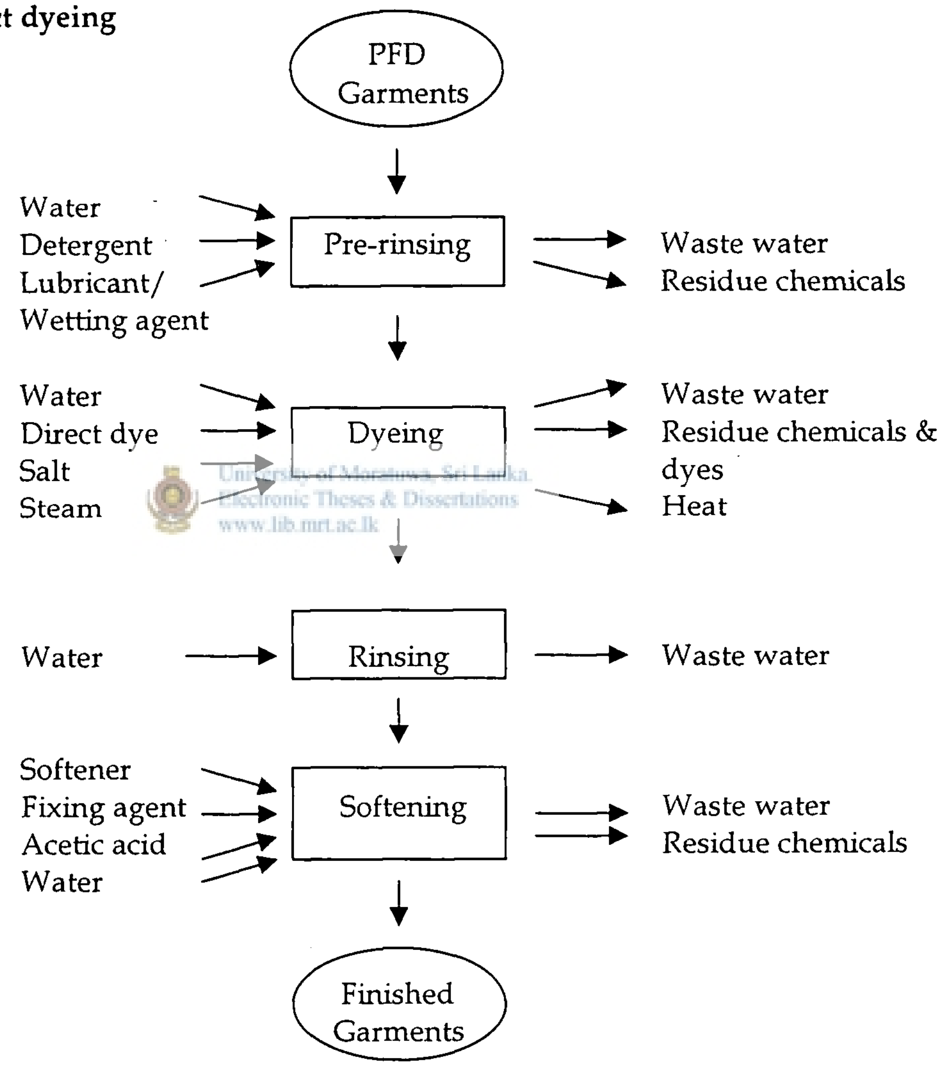
The data for a period of continuous one month was used for the analysis.

Three different dyeing processes were covered in the study.

**General Information**

**Process flow diagrams**

(a) **Direct dyeing**

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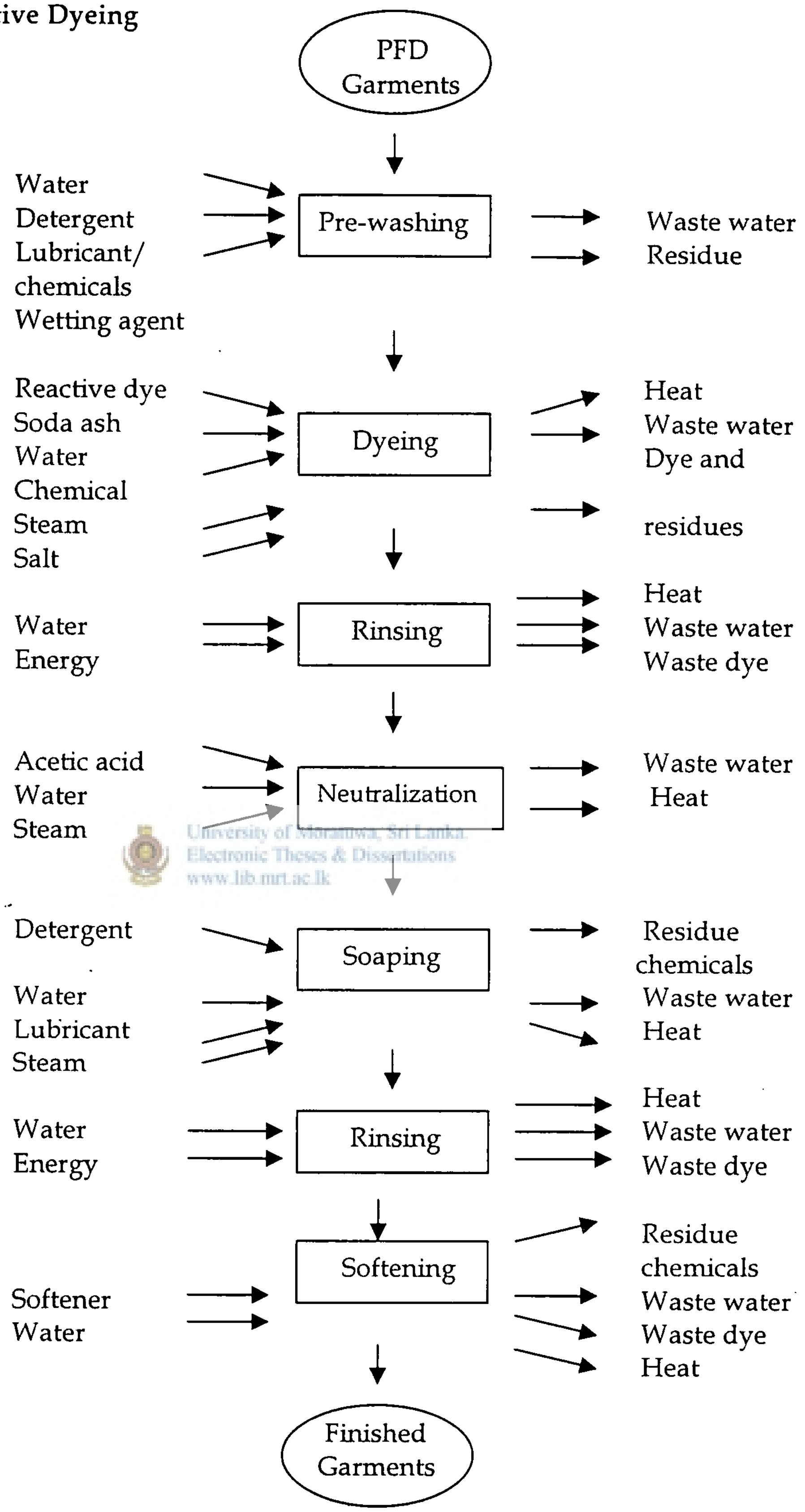
(b) **Reactive Dyeing**

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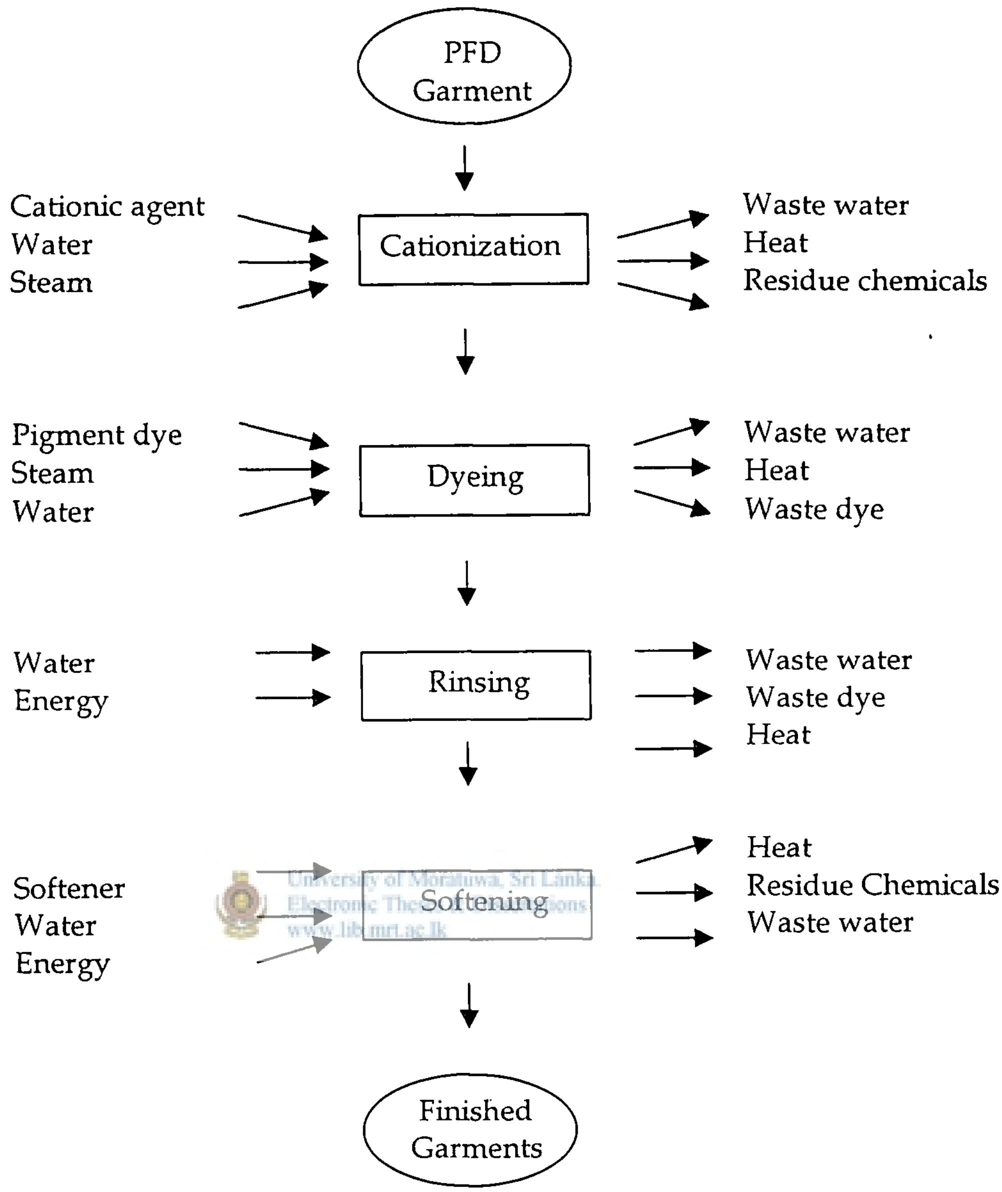
(c) **Pigment Colouration**

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## Cleaner Production Options

After a thorough study and analysis of the present processes and activities against the input consumption patterns, following options were selected as feasible for the improvement of environmental performance.

(1) **Good House Keeping Practices**

- To repair 2 leaking taps in the production area.
  The possible savings of water is 150l per day.
- To change the practice of the operators of closing the input valve of water only after running the machine.
  The possible savings of water is 0.2 l/kg of production.
- Fixing a small table at each machine to keep the chemical containers.
  The objective is to avoid spillages by accidents.
- To use containers of different colours for different chemicals to avoid frequent washing.
- Using lids for the containers used in carrying chemicals.
- Training the Operators on optimization of process conditions and process controls.

(2) **Input Substitutions**

- To substitute acetic acid with formic acid in order to reduce the organic load.
- To use softeners with maximum possible exhaustion in order to minimize the softener consumption/wastage
- Usage of high exhaustive and high reactive dyes to minimize the dye wastage.
- Usage of low salt type reactive dyes.
- Replace hypochlorite bleaching with peroxide bleaching.

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(3) **Process Control**

- Using reactive dyes applicable at low temperatures (40-50° C).
- Optimum process control with calibrated meters.
- Preventing over drying in the drying of the garments, by using proper sensors.

(4) **Technology Modifications**

- Ultralow liquor ratio machines can be installed. As the water consumption in this batch-wise method is very high the option is very effective. It serves not only to save water but also energy, dyes, chemicals etc.

- Peroxide killers can be used to remove $H_2O_2$ residues efficiently. It will reduce the number of rinses.

- 'Soaping' after reactive dyeing can be effectively done without soap or detergent but at $95^0C$ in clean water.

- Formula modification is another option of process modifications. A large quantity of auxiliary chemicals used in recipe can be reduced with modification of fomula.

(5) **Recovery and Reuse of Inputs**

- Water of final rinse can be used for the 1st rinse of the 2nd batch.
- Softener baths can be reused.
- Condensate of the boiler can be reused in the boiler. The condensate is more pure and more suitable for boiler.
- Heat of the processed bath can be recovered and used in heating water.
- All polythene and paper packaging materials can be reused or given for recycling.

(6) **Recycling**

- Adequately treated effluent can be reused for the process.
- All synthetic starches, polythene and other synthetic components also can be recycled.

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(7) **New products from Wastes (by products)**

- Flue gas emission can be used for neutralizing the alkaline waste of dyeing.
- Sludge can be used for producing bricks for construction work.
- Unusable damaged fabrics can be disintegrated in to fibres and used in making cushions, pillows etc.

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