SEAM *Proiect*

Guidance Manual
Eco-labelling for Textiles

Ministry of State for Environmental Affairs
Egyptian Environmental Affairs Agency
Technical Cooperation Office for the Environment

***En*tec UK Ltd**

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Eco-labelling for Textiles

SEAM Project
Implemented by:

Egyptian Environmental Affairs Agency
Technical Cooperation Office for the Environment
and
Entec UK Limited

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The SEAM Project - An Introduction

Support for Environmental Assessment and Management (SEAM), is a multi-disciplinary environmental project being funded by Britains Department for International Development (DFID). This Project is being implemented by the Egyptian Environmental Affairs Agency (EEAA) through the Technical Cooperation Office for the Environment (TCOE) and Entec, a UK based engineering and environmental consultancy.

The SEAM Project is made up of 5 components, focusing on environmental management issues. These include Industrial Pollution Prevention/Cleaner Production, Environmental Impact Assessment, Solid Waste Management, Environmental Action Plans and development of an Environmental Database.

The main goal of the Industrial Pollution Prevention/Cleaner Production component is to show that significant financial savings and environmental improvements can be made by relatively low-cost and straightforward interventions. These consist of pollution prevention through good housekeeping, waste minimisation, process modification and technology changes. This approach has two benefits - valuable materials are recovered rather than wasted and factories are moved towards legislative compliance. This work is being undertaken in support of the National Industrial Pollution Prevention Programme (NIPPP) and has focused on three sectors: textiles, food and oil & soap.

Industrial auditing was used as a systematic approach to identify pollution prevention measures. Industrial auditing of 32 factories led to identification of more than 200 low cost/no cost pollution prevention measures. Measures that had relevance across the sector, innovative contents and a high multiplier potential were then developed as demonstration projects. The idea of these demonstration projects was to show how the pollution prevention approach can lead to financial benefits while gaining improved environmental performance.

Thirteen demonstration projects have been implemented in 21 sites as follows:

Textile Sector

- Eco-friendly Processing for Securing International Eco-label.
- Water and Energy Conservation.
- Combined Processing: Desize, Scour and Bleach.
- Bleach Clean-Up using Enzymes.
- Sulphide Reduction in Sulphur Dyeing.

Food Sector

- Installation of Milk Tank Level Controls and Valves.
- Water Conservation in Food Factories.
- Energy Conservation in Food Factories.
- Reducing Waste by Improved Quality Control.
- Recovery and Use of Whey as Animal Feed.

Oil and Soap Sector

- Waste Minimisation in an Edible Oil Factory.
- Oil and Fat Recovery.
- Improving Raw Water Quality to Reduce In-Plant Losses.

Outputs from these projects include industry workshops and seminars, demonstration projects with supporting Guidance Notes and Manuals (to enable other factories to implement similar projects themselves), case studies incorporating cost-benefit analyses to demonstrate project feasibility, detailed Sector Reports and Guidelines describing how to carry out industrial audits.

Factories Participating in the SEAM Eco-Label Demonstration Project

The ecolabelling demonstration project was implemented in two different textile factories, as follows:

Misr Spinning and Weaving Co., Mahalla El-Kobra (Misr Mahalla):

Misr Mahalla is a large public sector company located at Mahalla El Kobra in Gharbeya Governorate. The factory, established in 1927, covers 600 feddans and employs 30,000 staff.

The factory carries out dry and wet processing of cotton, wool, and blends with synthetic fabrics and processes over 4,000 tonnes of fabric per month. Products include yarn, grey fabric, ready-made garments, surgical cotton and bandages. Over 55% of fabrics and ready-made garments are exported. Currently the main markets are Germany, France and USA. In the future, further expansion in the European Community market is anticipated.

Giza Spinning, Weaving, Dyeing and Garments Company, Giza (Giza Spinning and Weaving):

Giza Spinning and Weaving is a private company located at Kafr El Hakeim in Giza Governorate. The factory, established in 1984, covers 25 feddans and employs 2,400 staff.

The factory processes (wet and dry) and manufactures cotton and polyester/cotton garments. A total of 5 tons of fabric are processed per day, 90% of which are knitted, the remainder being woven. More than 90% of its products are exported as white and dyed-knitted T-shirts, the main export market being Europe (particularly Germany) and USA.

-Tex 100 Eco-labels were successfully obtained by both factories

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Part A

1. **The Need for an Eco-label**
2. **What is an Eco-label?**
3. **What are the Benefits of Eco-labelling?**
4. **Eco-labelling Schemes**
5. **How to Select an Appropriate Eco-label**

1. The Need for an Eco-label

Consumers are becoming more concerned with the adverse impacts of industrial pollution on the environment and their health. Mounting pressure on industry to adopt more ,eco-friendly, chemicals and manufacturing processes has led to an increased demand, particularly in the textile sector. Eco-labels that certify the ,eco-friendliness, of the textile product are now increasingly in demand by the consumers. While this will certify that their products do not contain chemicals which might be harmful to the consumer, the requirement for an eco-label is not uniform around the world. Currently, these are mainly required in Western Europe, with Germany being the most demanding. Other German and Nordic speaking countries follow closely behind.

With the removal of tariff barriers by the year 2005 under the World Trade Organisation Agreement on Tariff and Trade, exporters may increasingly face more stringent environmental standards in the international marketplace. Manufacturers wishing to protect their existing markets and expand into new markets may well be required to obtain an eco-label that is acceptable to their Client.

Experience at Giza Spinning and Weaving and Misr Mahalla has shown that without an eco-label:

- some buyer preferences were being directed elsewhere;
- where this was not the case then the lack of an eco-label was used as leverage to negotiate prices down.

Since obtaining the eco-labels both factories have obtained additional export orders.

2. What is an Eco-label?

An eco-label provides brief information on environment related product qualities. It enables consumers to identify: those products that are environmentally safe; that have been manufactured using eco-friendly materials and do not contain chemicals that are harmful to the user. Since ,eco-friendliness, is an additional product quality it can be used for marketing and advertising purposes.

3. What are the benefits of Eco-labelling?

These can be briefly summarised as follows:

Enhanced export market opportunities - manufacturers and retailers of textile goods are expected to be increasingly asked to comply with the international eco-labels. Given the scenario of open world-wide competition beyond 2005, securing of an eco-label will greatly assist the manufacturers and retailers in enhancing the export market opportunities.

Improved product quality - through the removal of substances in the fabric that may be harmful to the customer.

Financial savings - through process optimisation and improvements that result in saving of water, chemicals and energy. Often the processing time is reduced and the RFT (Right First Time) is improved. All these benefits generally offset the incremental costs of using eco-friendly chemicals or of adopting to modified processing.

Improved environmental performance - through phasing out of toxic and hazardous substances and conservation in water, energy and raw material usage. This leads to a reduction in the quantities and pollution potential of various emissions.

Step towards ISO 14000 - though implementation of quality control procedures that are an integral part of product eco-labelling, it becomes easier to adapt to ISO 14000 system

4. Eco-labelling Schemes

There is a wide range of eco-labelling schemes covering a variety of textile product groups. Each have developed criteria that vary in approach from full life cycle analysis to schemes that address only the quality of the final product. Types of organisations involved in eco-labelling schemes include:

	Organisation	Eco-label Examples
Private	Non-Governmental Organisations (NGOs)	Good Environmental Choice (Sweden)
	Institution Related	EcoTex) 100 (Germany) EcoTex) 1000 (Germany) EcoTex
	Producers association	AKN Trademark (Germany)
	Company related	Steilmann Otto Versand Hess Natur Green Cotton
Government	National	EKO-Seal (Holland) Environmental Choice (Canada) Eco-Mark (Japan) Green Mark (China-Taiwan) Eco-Mark (Korea), Environmental Labelling (China) Eco-Mark (India).
	Multinational	EU-label Nordic Eco-label

National eco-labels are generally established by the respective National Standards Organisation or Ministry of Environment. Multinational schemes are intended to facilitate trade within their common markets.

Private NGO and institution eco-labels set criteria that may be acceptable in a number of different countries. These tend not to be established in countries where a national eco-label already exists.

Within Egypt there are no national eco-labels for textiles nor are there any certifying bodies for internationally recognised eco-labels (as at December 1998). For the SEAM project the EcoTex) 100 eco-label was selected. Certification was undertaken in Vienna, through the Institute of the International Association for Research and Testing in the Field of Textile Ecology.

5. How to Select an Appropriate Eco-label

When selecting an eco-label consideration should be given by Egyptian textile manufacturers to the following factors:

Buyer requirements - these will vary from country to country and be influenced by consumer preferences. Identify what eco-labels are preferred by the buyer and that may be acceptable in more than one of the manufacturers export markets.

Major export products - eco-label certificates generally apply to single product lines only. In introducing eco-labelling, manufacturers may in the first instance wish to focus on their main export product as any loss in market share, as a result of not having an eco-label, may lead to adverse financial impacts.

Ease of implementation - select eco-labels where the criteria can be more readily achieved and sustained. Eco-labels based on final product quality only may be easier to gain than those based on the full life cycle analysis which take into consideration raw material use, environmental impacts of every stage of the manufacturing process (including wastewater characteristics, air pollution, and solid waste disposal), worker health and the use of child labour, packaging, return of goods, etc.

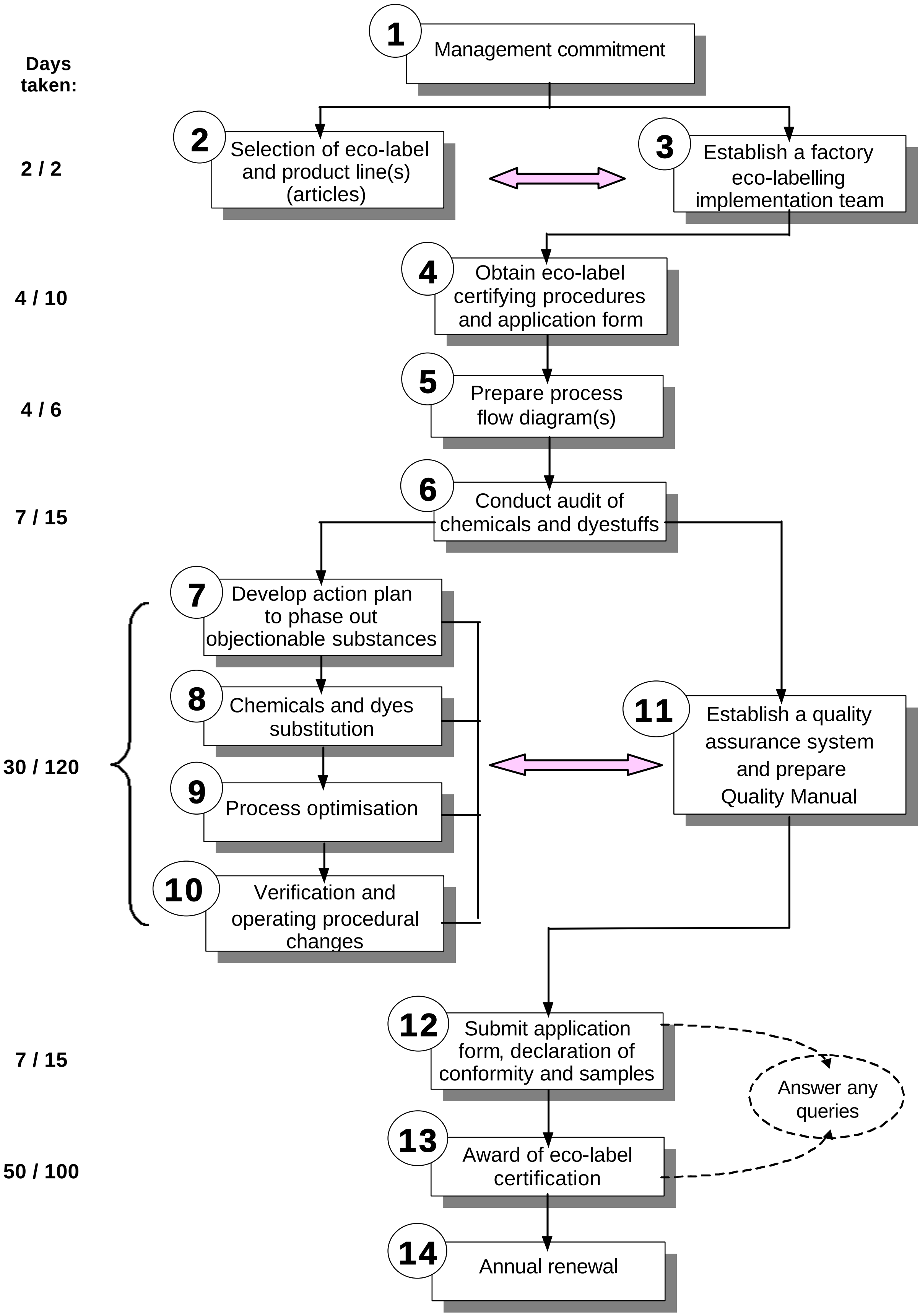
Appendix 1 provides a summary of the commonly known eco-labels. In the case of the SEAM project the oko-Tex (EcoTex) 100 eco-label was selected as:

- it was well recognised in Germany, a key market for both companies;
- it was widely accepted in other West European markets;
- it was relatively easy to implement for the main export product lines.

Part B

How to Obtain an Eco-label - A Step by Step Guide

Figure 1: Steps for Achieving an Eco-label: Textile Manufacturers



How to Obtain an Eco-label - A Step by Step Description

Introduction

Steps for implementing eco-labelling for wet processing textile manufacturers are summarised in Figure 1. Details on each step are outlined below together with information on the experience gained as a result of implementation at Giza Spinning and Weaving and Misr Mahalla.

Step 1: Management Commitment

From the outset it is important that the senior factory management recognise the value of an eco-label and are committed to implementing the eco-labelling requirements. This existed at both Giza Spinning and Weaving and Misr Mahalla. Understanding and commitment of top management was essential in:

- allocating appropriate human resources;
- encouraging the factory staff to implement the necessary changes in a timely fashion;
- providing the necessary financial resources for raw material substitution, testing and certification;
- seeking process optimisation changes that benefited the factory;
- developing a quality control culture that is an integral requirement of achieving and maintaining any eco-label.

Step 2: Selection of Eco-label and Product Line (Articles)

The following factors need to be considered in identifying which eco-label to obtain and what product line to start on:

1. Identify buyer preferences on the type of eco-label.
2. Select the eco-label that is able to maximise market penetration in potentially a number of different countries.
3. Balance market expectations with ease of implementation. Eco-labels based on final product quality are easier to gain, than those based on the full life cycle approach, and can be sufficient to satisfy most buyer requirements.
4. Identify main export product lines and initiate eco-labelling on that product line where it will yield the greatest return. This may have to be balanced against the complexity of changes and at times it may be more appropriate to start with the least complicated product line to enable the factory team to gain the necessary experience and confidence
5. Articles manufactured from the same raw material and being processed similarly can be certified at the same time. Multiple product lines will incur higher costs as each product line will have to be certified separately.

Selection of -Tex 100 Eco-label at Giza and Mahalla

The Oko-Tex 100 Eco-label was selected as it:

- Is best recognised in Germany which is an important market for both factories (900 certificates were issued by Deutche Oko-Tex to 500 manufacturers in 1997 alone);
- Is accepted in 12 other European countries with Western Europe accounting for around 75% of Mahalla exports
- Based on final product quality and was comparatively easy to implement at both factories

The oko-Tex 100 eco-label has four product classes Class 1 , Baby clothing; Class II ,Clothing having direct contact with the skin; Class III - Clothing having no direct contact with the skin; and Class IV - Decorative fabrics. Certification was achieved at both factories for Product Class II.

Article (Product Line) Selection at Misr Mahalla and Giza Spinning and Weaving	
***Misr Mahalla*:**	Cotton nightwear, shirts and trousers account for the largest volume of export garments. As they are manufactured on the same production line, using the same chemicals and dyes, the garments could be certified at the same time. It should be stressed that in addition to the fabric all accessories (buttons, zippers and cords) are subjected to certification testing.
***Giza Spinning and Weaving*:**	100% cotton T-shirts (white and dyed) were selected, as these amount to nearly 45% of the total export value. In addition, the factory had received numerous requests for an eco-label for this product from existing customers. Obtaining an eco-label was also seen as being a valuable tool for entering new markets with the product.

Step 3: Establishing a Factory Eco-labelling Implementation Team

Team members

To implement the eco-labelling requirements a factory team should be formed with senior members ideally being drawn from the following departments:

- The sales/marketing department who can provide advice on customer eco-label requirements and advise customers on proposed changes.
- implement and optimise required changes to the process and raw material usage. Including relevant production heads will ensure changes are made in a timely manner without undue interference with production schedules.
- The quality control department to ensure quality control procedures are addressed and maintained.
- The purchase department to ensure raw materials (dyes, process chemicals etc.) that are procured comply with the eco-label requirements.
- The finance department to provide information on costs of current operations and to fully evaluate the costs and benefits of any proposed changes.

Factory Team Members	
Misr Mahalla	**Giza Spinning and Weaving**
Head of Engineering Department (Leader)	Managing Director
Production Manager	Process Manager (Leader)
Processing Manager	Dyehouse Manager
Water Treatment & Environment Manager	Dyehouse Deputy Manager
Maintenance Manager	Laboratory Manager
Sales Manager	Quality Control Manager
Technical support from the Sizing Department, Dyehouse,. Bleaching Printing & Finishing Departments	Technical support from the Dyehouse and. Bleaching House

The use of an external consultant, experienced with eco-labelling, should also be considered. This will overcome any lack of experience in factory teams as well as being a source of advice on material substitution and process optimisation.

Team Responsibilities

The general responsibilities of the Factory Team would include: conducting the chemical audit; identifying and implementing recommended options; monitoring progress; verifying the results of any changes made; and ensuring Quality Assurance of the product. There should be a team co-ordinator, possibly the Production or Quality Control Heads, whose responsibility will be to co-ordinate the different responsibilities and tasks.

Awareness raising of all concerned employees should be undertaken by the factory team form the outset. Initial awareness meetings at Giza Spinning and Weaving and Mahalla greatly facilitated subsequent implementation.

Step 4: Obtain Eco-label Certifying Procedures and Application Form

For the selected eco-label, all necessary paperwork and background information should be requested from the certifying organisation including:

- A copy of the most recent application form.
- A copy of the eco-label standards. The Oko-Tex 100 standards used for this project are included as Appendix 2.
- A copy of the most recent declaration of conformity.
- A list of the certifying institutes that can carry out the required chemical analyses. At present, there are no certifying institutes in Egypt, therefore factories will need to use overseas organisations. A list of Institutes authorised to grant ko ,Tex 100 certificates are given in Appendix 3.
- A copy of the eco-label renewal form (although it will not be required at this stage).

Note: Eco-label requirements are being continually updated. The most recent information should therefore be obtained as soon as possible, to ensure that the Team know exactly which changes will be required.

Step 5: Prepare Process Flow Diagram(s)

An important task for the factory team is to prepare a process flow diagram for the selected product line(s). Process mapping will break down the operations into functional unit operations, each of which can be shown in terms of material inputs, outputs and losses. Developing the process flow diagram helps the factory team form a consensus about how the production process is organised and provides a focal point for identifying and prioritising areas of concern and opportunities for process optimisation.

As simple as process diagrams may appear, the effort needed to complete such a diagram is often surprising, as is the debate that can often develop on how the facility operates. Once the basic unit operations are identified and the sequence of operations is laid down in a working diagram, the factory team should walk through the facility to verify and validate the diagram.

Useful information for constructing the process flow diagrams may be obtained from sources such as those shown below.

Types and Possible Sources of Background Factory Information	
Type of Information	**Sources of Information**
Raw material use	Raw material purchases, product composition and batch sheets, Material Data Safety Sheets (MSDS), vendor information, inventory records.
Production information	Operating procedures, production schedules, flow diagrams, quality control guidebook, water and energy usage.
Regulatory information	Environmental audit reports, solid and liquid waste disposal records, laboratory analyses, licences.
Financial information	Costs for products, energy, water, raw materials and labour, operating costs for waste handling and disposal.

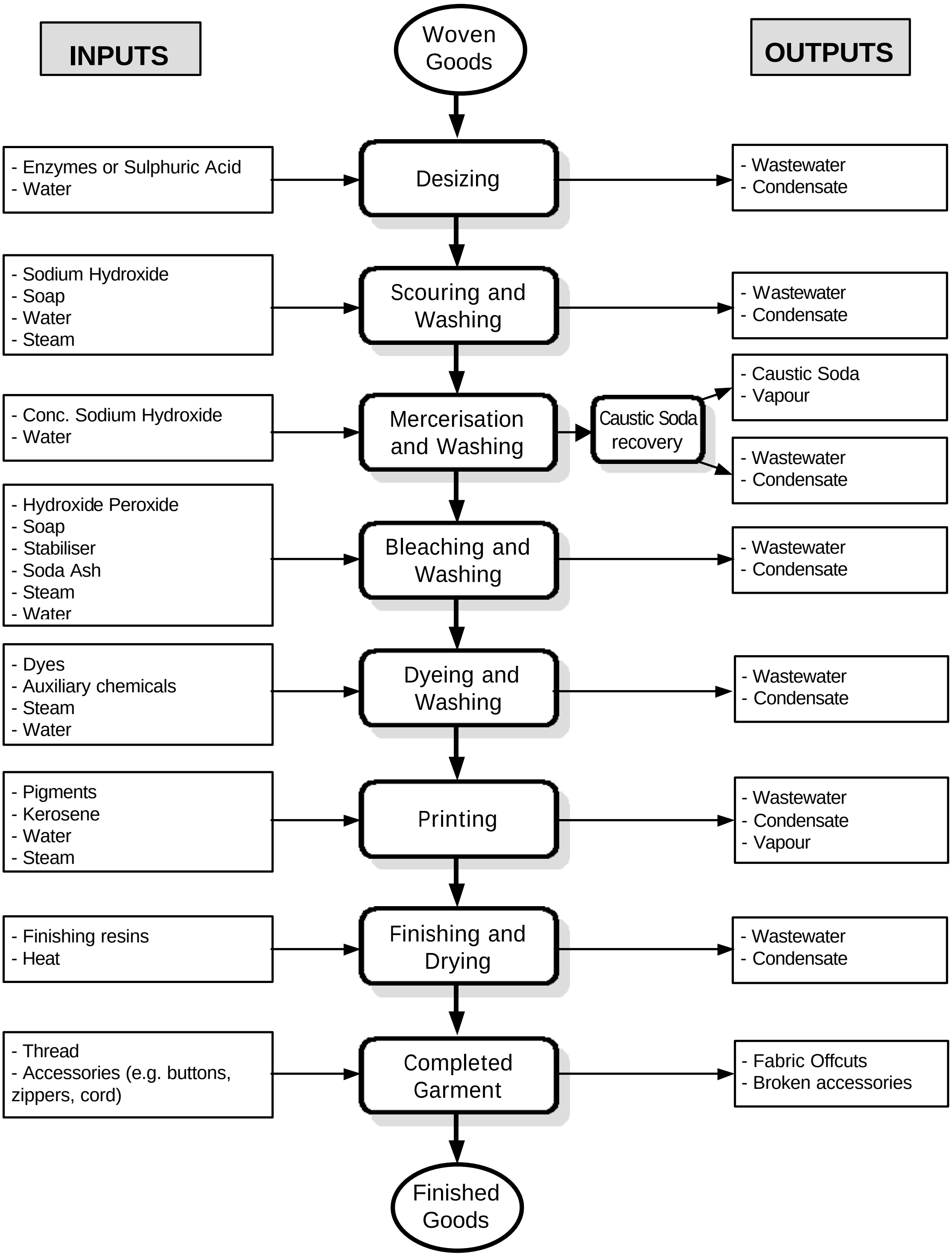
The final process flow diagram should clearly indicate:

- each relevant step showing the movement of the raw material through the manufacturing process;
- all inputs to each process step, including chemicals, dyes, water and energy;
- all outputs including solid and liquid waste generation;
- all accessories used in the final product (such as buttons, zippers, elastic and cord).

For the Oko-Tex 100 Eco-label it is not critical to fully quantify the inputs and outputs. although it required to facilitate process optimisation.

A simplified flow diagram for wet processing is included as Figure 2.

Figure 2: Simplified Process Flow Diagram for Textile Wet Processing



Step 6: Conduct Audit of Process Chemicals and Dyestuffs

Textile manufacturing uses a diverse range of chemicals some of which are potentially hazardous (e.g. formaldehyde, pentachlorophenol, volatile compounds such as solvents, flame retardants and some dyestuffs). Eco-labels set standards that ban the use of certain chemicals and limit the concentrations of others.

Using the process flow diagram, the audit is intended to identify chemicals and quantify the extent of their use in each of the process units. Emphasis is placed on identifying those substances that may not be in compliance with the Oko-Tex 100 standard.

This is the most important step of the eco-labelling process since all further actions are based on the audit findings.

How should this be done?

- Identify ***each and every*** chemical and dye used in the selected production line.
- Obtain Material Safety Data Sheets (MSDS) for all identified chemicals and dyes. MSDS are vital for determining whether or not a chemical or dye contains any banned substances. An example of a MSDS is include in Appendix 4.
- For chemicals or dyes, where MSDS cannot be provided by the supplier, it is advisable to discontinue their use, and seek alternate sources of supply.
- Identify which of the presently used chemicals and dyes are banned or contain substances that may exceed permissible limits set by the eco-label selected.
- For each substance banned, or likely to be banned in the near future, identify acceptable substitutes.
- Do baseline assessment of product quality (including pH, fastness, and formaldehyde levels of final product), resource usage and wastes generated.

Establish costs incurred during the production of the article including process chemicals, dyes, fuel, labour, water and steam consumption. This will allow the effect of the process modifications to be clearly identified in terms of costs and benefits.

The chemical and dye audit of the selected product lines at the two factories showed the following:

	Number of Chemicals and Dyes Used	Number Regarded as Objectionable
Misr Mahalla	76	12
Giza Spinning & Weaving	46	2

Objectionable chemicals and dyes are those that are banned, likely to be banned in the near future, or which contain substances in concentrations that may exceed permissible limits in the final product. A list of objectionable chemicals and dyes found in both the factories is shown below

To avoid possible future problems, recommendations were made to both factories to restrict the use of a stilbene-based optimal brightener and to replace the cationic softener (belfazin), used for the after treatment of the yarn, with a non-ionic softener.

<table>
<tr><th colspan="2">List of Objectionable Compounds found in the Chemical Audit</th></tr>
<tr><th>Misr Mahalla</th><th>Giza Spinning and Weaving</th></tr>
<tr><td>▪ Sodium hypochlorite.
▪ Kerosene in pigment printing.
▪ 8 pigment colours based on banned amines:
Isamament Yellow 2G.
Pigmatex Yellow TCGG.
Imperon Yellow K-R.
Pigmatex Golden Yellow TGRM.
Imperon Orange K-G.
Imperon Red KG3R.
Imperon Violet K-B.
Imperon Dark Brown K-BRC.
▪ Binder with high formaldehyde concentration (Imperon binder MTB).
▪ Resin with high formaldehyde concentration.</td><td>▪ Sodium hypochlorite.
▪ Copper sulphate used in after treatment of direct dyes.</td></tr>
</table>

Quality parameters, such as pH, fastness properties, and formaldehyde levels of the final product were assessed as part of the audit by conducting tests on production samples of Misr Mahalla and Giza Spinning and Weaving. These parameters were observed to vary and occasionally did not meet requirements. This emphasises the need for regular monitoring and follow up actions to ensure steps that the quality parameters remain within the prescribed limits.

Who should do this?

The Factory Team, in consultation with the Head of Production, the Head of Quality Control and the Head of the Purchase Department should conduct the chemical audit. At this stage, it may also be helpful to obtain the services of a suitable local consultant. A discussion with the chemical suppliers can also provide a wealth of information in terms of options. Information collected during the chemical audit will subsequently be incorporated in the Quality Manual.

An outline of the audit results for Misr Mahalla and Giza Spinning and Weaving are included as Appendices 5 and 6 respectively.

Step 7: Action Plan to Phase Out Objectionable Substances

An Action Plan should be developed to address the results of the chemical audit. This will be essential when there are a number of substances to be phased out, and/or when there is a range of options for doing so. Actions may fall into two groups:

Substitution requiring only minor modifications: This step involves the substitution of the chemicals and dyes on the banned list, with others that are eco-friendly. This step may not require changes in the processing or the recipe.

Substitution requiring major modification: This step involves introducing modifications to any of the production lines or the recipes used as a result of the previous substitution step.

Substitutions should be introduced in phases, which depending on the expertise available, may involve:

- ***Initial laboratory bench testing*** - which provides a low cost mechanism for checking the feasibility of the suggested substitutions and/or process modifications.
- ***Pilot scale tests*** - of the preferred laboratory bench options under conditions resembling production scale.
- ***Production scale tests*** - which fine-tunes the pilot scale tests to full-scale production while maintaining optimum conditions.

Throughout the various tests, monitoring of the eco-labelling parameters is essential and appropriate laboratory facilities should be identified to undertake these analyses. Misr Mahalla laboratory was able to do wetability tests, fastness and mechanical properties. The NRC laboratory was used for whiteness index, formaldehyde content and pH tests.

For each phase of testing it is essential that all inputs, outputs and operating conditions are recorded so that a full evaluation including cost analysis of alternatives can be made. This procedure allows the optimum substitutions and changes to be identified at minimum cost and with minimum disruption to production.

It is possible that due to the various substitutions it may become necessary to examine other processing sequences to maintain the desired product quality. It may also be possible to identify opportunities for cost savings.

Verification of the results of the substitutions and changes should be done to ensure that the fabric meets the requirements of the eco-label.

Step 8: Chemicals and Dyes Substitution

Objectionable chemicals at Misr Mahalla and Giza Spinning and Weaving to be phased out were:

Sodium hypochlorite used in the bleaching process	Misr Mahalla and Giza
Kerosene based thickener used in printing	Misr Mahalla
Pigments based on banned azo amines	Misr Mahalla
High formaldehyde containing resin	Misr Mahalla
Copper sulphate used in after-treatment for direct colour dyeing	Giza

Details of the bench, pilot and production scale tests undertaken are included as Appendix 7. A summary of the result is given below.

8.1 Chemical and Dye Substitution at Misr Mahalla

Substitution of Sodium Hypochlorite by Hydrogen Peroxide

Several trials were conducted at production level to substitute sodium hypochlorite, used in the bleaching process, with hydrogen peroxide. The effects on fabric quality were tested in the subsequent dyeing and printing process and it was found that the sodium hypoclorite could be eliminated without any difficulty. It was also possible to shorten the processing sequence as well as reducing chemical consumption.

Substitution of Kerosene

Under the Oko-Tex standard, fabrics should have no artificial odour (e.g. mould, white spirit, fish, and aromatics). Hence trials were conducted to replace kerosene in pigment printing through use of aqueous based synthetic thickener. Complete substitution of kerosene was found to have three disadvantages:

- Lower rubbing fastness, which comes on the border line of Oko-Tex standard;
- Reduced speed of printing machine, leading to loss in production;
- Higher printing cost.

Factory trials showed that up to 80% of the kerosene could be substituted with the synthetic thickener. Odourless kerosene was used for the remaining 20%.

Substitution of Pigments Based on Banned Azo Amine

To date, the use of any pigment colour has not been banned, however some of the pigments that contain banned amines may be at a future date. These included:

- Ismament Yellow 2G (pigment yellow 14)
- Pigmatex Yellow TCGG
- Imperon Yellow K-R
- Pigmatex Golden Yellow TGRM
- Imperon Orange K-G
- Imperon Red KG3R
- Imperon Violet K-B
- Imperon Dark Brown K-BRC

As a precautionary measure, the yellow colours were replaced by the following safe pigments that do not contain banned azo amines:

- Imperon Yellow K-GX (pigment yellow 44)
- Imperon Yellow K-RE(safe)

Other suspected colours (Imperon Orange K-G, Imperon Red KG3R, Imperon Violet K-B and Imperon Dark Brown K-BRC) were discontinued and replaced by safe alternatives.

Replacement of High Formaldehyde Resin

The resin (Fixapret CPN), used in finishing trousers and shirts, contains high amounts of formaldehyde, which resulted in the finished fabric exceeding the limit of the Oko-Tex standard. A low formaldehyde resin (Fixapret Eco or ARKOFIX NEC) replaced this resin and the formaldehyde content of the fabric could be kept below 75 ppm, the limit prescribed by Oko-Tex.

A comparison of results is given below:

Fabric article	Formaldehyde Concentration (ppm)	
	Old resin	New resin
2890 (shirt)	75	29
3276 (shirt)	87	27
3237 (shirt)	80	25
2081 (trouser)	351	65
2857 (trouser)	628	70

8.2 Chemical and Dye Substitution at Giza Spinning and Weaving

Substitution of Sodium Hypochlorite by Hydrogen Peroxide

Several pilot scale tests and production trials were conducted to replace sodium hypochlorite in the bleaching process by hydrogen peroxide and to shorten the processing sequence. It was successfully introduced into full scale production and resulted in improved production efficiency and lower consumable costs. Details of the trials are given in Appendix 7.

Elimination of Copper Sulphate

Copper sulphate used for after treatment of direct dyeing needed to be completely eliminated. A resin based polymeric fixing agent, Dalton Fix N62, was successfully introduced to replaced the copper sulphate.

Step 9: Process Optimisation

In some cases, changes implemented may result in the use of higher cost chemicals and dyes. However the overall cost may be reduced as often, lesser amounts of better quality products are needed to maintain product quality.

It is also possible that costs may be reduced by optimising existing production techniques, both in the modified process and in downstream processes. Optimisation is achieved by inspecting all recipes and procedures and identifying where excess raw materials are being used and where process steps can be reduced.

An example of process optimisation benefits is in the substitution of sodium hypochlorite by hydrogen peroxide at Giza Spinning and Weaving. The processing sequences were shortened by combining the scour and bleaching process resulting in:

- 60% savings in water usage and wastewater treatment;
- 14% savings in steam consumption;
- 73% savings in the processing time;
- Elimination of hazardous sodium hypochlorite, thereby avoiding the formation of halogenated organic compounds (AOX) in the wastewater;
- Improved working conditions by avoiding the release of chlorine gas during hypochlorite bleaching.

Step 10: Verification and Operating Procedural Changes

Ongoing testing, or verification, is required after any substitutions or process changes are made to ensure that the final fabric is in compliance with the Oko-Tex 100 standard. Of particularly importance has been the regular testing of:

- pH.
- Colour fastness properties.
- Free formaldehyde content.

In Misr Mahalla factory, different samples of pyjama fabric were tested to verify the results against the standards given for Oko-Tex 100 Class II. Some samples showed inferior dry rubbing, wet rubbing and washing fastness as compared to the standard. Some samples of dark shades were on the borderline with the requirement. This was corrected by modifying the recipe by increasing the binder concentration and optimising thermo-fixation.

When all substitutions and changes have been verified it is essential that:

- Previous work instructions are revised accordingly and are incorporated in the Quality Manual to ensure ongoing quality assurance.
- Necessary training is provided to the relevant operators/supervisors on the modified work instructions.

Step 11: Establish a Quality Assurance System and Prepare Quality Manual

The factory must ensure to the certifying institute that all products manufactured have the same properties as any test sample sent to the institute. The certifying institute can carry out random tests and persistent deviations will result in cancellation of the eco-label certificate.

The factory should therefore operate and maintain an effective quality assurance system that must include the following:

- Regular testing of all incoming raw materials to assess their suitability and minimise variations within the prescribed limits.
- Round the clock process control checks on all processes with a scheduled frequency to minimise deviations from predetermined standard conditions.
- Regular testing of the final article to provide assurance of quality.

All items, all process control checkpoints and all analytical requirements for the final product, along with test methods to be followed, must be identified for routine monitoring. Frequency of these tests and the permissible working range should be decided jointly by the Production and Quality Department Heads.

The Quality Control Department is expected to ensure strict adherence to periodical counterchecks and maintain proper records of all tests conducted. This will form an important basis and a demonstrative tool for the Declaration of Conformity required by the certifying institute.

All of these activities must be reflected in the Quality Manual. For simplicity, the Quality Manual may be divided into various sections dealing with:

- Dyes and pigments in use along with their CI number.
- Chemicals in use.
- Material Safety Data Sheets (MSDS) for all items.
- Processing sequence used.
- Process control check points.
- Quality parameters of the final product.
- Test methods for each of the items.
- Frequency at which each test needs to be conducted.
- Eco-label requirements.
- Mode of verification, in case of correction, if any.

In order to maintain the quality system, each factory should have a laboratory facility which incorporates the following basic equipment:

- colour fastness tester;
- pH meters (portable and/or bench);
- perspirometer;
- crock meter (to test rubbing and colour fastness);
- washing and dry-cleaning colour fastness tester and
- formaldehyde measurement kit.

Other parameters such as heavy metals, pesticides, PCP and banned azo dyestuffs require more expensive and sensitive equipment. Some of these can be measured by local laboratories (e.g. Textiles Research Division, National Research Centre, Egypt and Textiles Consolidation Fund, Alexandria) or by external certifying institutes.

Note: If the factory has already secured an ISO9000 series certification, the relevant information can be copied from here into the Quality Assurance Manual. Conversely, implementing the eco-label is a good starting point for achieving ISO9000 series certification.

Step 12: Submit Application Form, Declaration of Conformity and Samples

After all chemical, dye and process changes have been implemented the Application Form (refer Appendix 8) should be completed (answer every question) and signed. Additional information as requested in the enclosure of the Application Form must be given to minimise the necessary tests and costs of the procedure. A completed and signed Declaration of Conformity (refer also Appendix 8) should also be sent, as without it, the eco-label certification will not be issued.

Representative samples of the production line and material safety data sheets for chemicals and dyes used in each stage of processing should be sent with the application. Sample requirements may change and hence should be checked with the concerned institute before sending in the application.

The minimum sample size currently required by the certifying institute for testing are as follows:

- In the case of a made-up garment: one complete article.
- In the case of fabric, a full width sample of 0.5m length.
- A specimen of all the accessories used, such as buttons, zips, labels etc.
- For dyestuffs and pigments, where material safety data sheets are not available, it is advisable to send a sample of the darkest shade used (by dyeing or printing). Samples of 5x30cm dimension are suitable.

Care should be taken in completing the Application Form with special attention given to the following:

- Clearly define and describe the article to be certified.
- List of dyestuffs and chemicals should be of the safe category.
- Attached lists must have the same serial number as that in the application form.
- Submit the Material Safety Data Sheets in the same order as mentioned in the application.
- In the case of using dyes or pigment without a Safety Data Sheet, a representative dyed and/or printed samples (in strips and of the darkest shades) should be enclosed for analysis.
- Declaration of Conformity should be signed and attached to the application form.

- Answer all points by ticking the appropriate place.
- Include the selection of representative samples and verification of the test results with respect to eco-label requirements.

During transportation to the eco-labelling institute, all samples must be carefully wrapped, to avoid possible contamination. Each should be separately wrapped in polyethylene foil or inserted in polyethylene bags of high tensile strength, all of which should then be double wrapped and sealed with adhesive tape.

Step 13: Award of Eco-label Certification

If the testing institute is satisfied that all necessary information has been provided and that the fabric samples submitted are of an acceptable quality, then the results and eco-label certificate will be forwarded to the applicant, usually after about two months.

Delays will occur if:

- The Application Form has not been satisfactorily completed and clarifications are sought;
- Any dye, pigment or process chemical listed in the Application Form is not represented in a fabric sample;
- Samples of all accessories (buttons, zips, cord, elastic etc.) are not submitted.

Any requests for clarification or additional samples must be responded to promptly by the factory. Applications will be rejected if the samples submitted do not meet the eco-label standard.

Copies of the certificates acquired by two Egyptian textile mills through the SEAM Project are attached as Appendix 9.

After the eco-label has been obtained any changes proposed to the production line may invalidate the certificate and hence should be checked with the certifying institute in advance. To minimise the testing and certification costs it may be more appropriate to make any changes around the time of annual renewal.

Step 14: Annual Renewal

Eco-label certificates are only valid for one year and must be renewed annually. To ensure continuity, the Renewal Application Form (refer Appendix 10) should be submitted to the certifying institute well in advance of the expiry date of the certificate.

If no changes to the production line are proposed, then renewal is straightforward. Information required is a completed Renewal Form, details of the existing certificate, confirmation that neither the raw materials nor the chemicals have been changed. Representative samples will also be required.

If any changes are proposed, then clarification should be sought from the certifying institute to determine whether a new Application Form is required.

Note: If any changes are made to the production line, the quality assurance system must be updated and the Quality Assurance Manual revised.

Part C

Cost Benefits

1. **Cost Benefit Issues**
2. **Analytical Costs and Staff Resources**
3. **Cost Benefits at Misr Mahalla**
4. **Cost Benefits at Giza Spinning and Weaving**

1. Cost Benefit Issues

Export Markets

The most significant beneficial impact for textile manufacturers to have an eco-label is in respect of their export markets, where it:

- **Facilitates the potential to expand or develop new markets particularly in Western Europe** - this was evident at both Misr Mahalla and Giza Spinning and Weaving, where both factories were able to generate interest with new German buyers following their eco-label award.
- **Enhances ability to protect existing markets** - this is very important in a world of increased global competition and increasing demands among West European buyers for products with an eco-label. Without it there is a risk that existing clients may purchase textile goods from other suppliers. At both factories it was noted that requests for eco-labelled products had increased significantly in recent years.
- **Reduces negotiation pressures by some buyers to reduce prices** - it had been indicated that some buyers seek price cuts from manufacturers whose products are not considered eco-friendly. Securing an eco-label thus reduces the chances of price bargaining.
- **May allow a price premium in selected markets** - some sources believe that a price premium of 5-10% is possible in very selected niche markets however the scope to do so, at present, would seem to be limited.

It is very difficult to place a financial value on the benefit of eco-labelling for the export market. However at both factories a 5% increase or conversely a 5% drop in the existing German market would have a marked impact.

Operating Costs

It is often considered that eco-friendly substitution of traditionally used dyes and chemicals significantly increases the processing costs. This is not necessarily true. The table below shows that dyes, processing and sizing chemicals account for only 5% of the total cost. Hence while the cost per kilogram of eco-friendly dyes and chemical may be higher, the effect on the overall manufacturing cost is not that significant.

Typical Cost Structure of a Textile Manufacturer

Constituents	% Contribution to Total Cost
Raw material (mainly cotton)	50-55
Sizing chemicals	1
Dyes and process chemicals	4
Packaging	1
Salary and wages	17-18
Fuel oil, water and power	14-15
Stores and spares	5
Interest on depreciation	10

,Eco-friendly, dyes and chemicals tend to be of higher quality and smaller amounts are needed to achieve the same, or sometimes better, results. This also tends to increase the percentage of Right First Time (RFT) production. Improved RFT means that less reprocessing has to be carried out, reducing the usage of chemicals, water and energy, as well as saving time previously lost in the correction of off-shade dyeing.

Process optimisation will also provide financial benefits by reducing water and energy usage and wastewater treatment requirements and increasing productivity.

2. Analytical Costs and Staff Resources

A summary of the analytical and certification costs and resources required to implement the eco-labelling systems at each factory is given in the table below.

Analytical Costs and Staff Resources

Costs and Resources	Misr Mahalla (LE)	Giza (LE)
Factory analytical costs	10,000	5000
Certifying Institute analytical costs	41,700	10,670
Certification costs	2,700	2,700
Fabrics and chemicals for trials	2,000	NA
Total	56,400	18,370
Factory Staff Time (person weeks)	13	5
Egyptian Consultancy Inputs (person weeks)	35	17

The SEAM Project also provided both factories with international specialist support and financial assistance to purchase some of the laboratory equipment required to maintain the quality assurance system.

3. Cost Benefits at Misr Mahalla

Effects of Chemical and Dye Substitution

The following table shows that chemical substitution and process modifications in these processes resulted in annual savings of LE30,456 (after incorporating values for chemicals purchase, optimisation of water, steam and electricity consumption). The bulk of these savings resulted from modifications to the bleaching process, with total annual savings of LE89,820. Conversely, purchasing ,eco-friendly, process chemicals and dyes resulted in a yearly increase of LE59,364. A detailed breakdown of operating costs before and after substitutions is provided in Appendix 11.

Summary of Cost Changes for ‚Eco-friendly, Substitutes					
Process	**Banned Substance**	**‚Eco-friendly, Substitute**	**Cost Change (LE)**	**Consumption (t/annum)**	**Annual Cost Savings (LE)**
Half Bleaching (1ton basis)	Sodium Hypochlorite	Hydrogen Peroxide	- 260.10	300	78,030
Full Bleaching (1ton basis)	Sodium Hypochlorite	Hydrogen Peroxide	- 39.30		11,790
Pigment Printing	Kerosene	Synthetic thickener (partial substitution)	+ 36.00	276	(9,936)
(1ton basis)		Synthetic thickener (full substitution)	+ 66.00		(18,216)
(Pigments)	Ismament Yellow 2G	Imperon Yellow K5G110	+ 53.40	69	(18,540)
	Imperon Yellow KR	Imperon Yellow KGX	+ 53.40		
	Pigmatex Yellow TCGG	Imperon Yellow KRE	+ 56.20		
	Pigmatex Gold. Yellow TGRM	(eliminated)			
	Imperon Orange KG	(eliminated)			
	Imperon Red KGBR	Imperon Red K-60	+ 52.80		
	Imperon Violet KB	(eliminated)			
	Imperon Dark Brown KBRC	Imperon Dk. Brown KBR	+ 52.90		
Finishing	High formaldehyde binder	Low formaldehyde binder	+ 288	44	(12,672)
TOTAL					**30,456**

Note: - indicates a decrease in cost.
+ indicates an increase in cost.

Reduced Shipment Analytical Costs

Previously a number of German clients required that all shipments without an eco-label had to be tested, resulting in analytical costs of LE1,000 per shipment. This requirement is not required for articles with an eco-label so that the net annual savings to the company in analytical costs is around LE20,000.

Potential Export Market Gains

The current annual value of the factory export market is around LE383million. Of this, almost 15%, or LE57.5 million in value, goes to Germany, a country which is increasingly placing demands for eco-labelled products. While it is difficult to quantify at this stage the export benefits of the eco-label, a 5% increase or conversely a 5% drop in the German market share would be equivalent to LE2.9 million per annum.

Improved Production Efficiency

Financial benefits also result from a:

- 5% improvement in the Right First Time in the dyeing process;
- 20% reduction in the processing time;
- 14% reduction in steam consumption.

Improved Product Quality

There has also been a noticeable improvement in product quality. When sodium hypochlorite was used for bleaching, there were occasional incidences of low tensile strength, which at times was 20% lower than the required standard. Since the elimination of hypochlorite with hydrogen peroxide such incidences have not occurred.

Environmental Improvements

- Complete phase-out of sodium. This resulted in the elimination of AOX and a reduction of Total Dissolved Solids (TDS) in the effluent.
- Improvement in working conditions through the elimination of hazardous chlorine compounds.
- Reduction in water consumption leading to reduction in volume of generated effluent.
- Reduction in energy requirements.

4. Cost Benefits at Giza Spinning and Weaving

At Giza Spinning and Weaving, only sodium hypochlorite and copper sulphate had to be substituted.

Effects of Chemical Substitution

The table below shows the impact on annual costs of modifying these processes (incorporating values for chemicals purchase, optimisation of water, steam and electricity consumption). The bulk of these savings resulted from modifications to the bleaching process, with total annual savings of LE32,700. Conversely, purchasing ‚eco-friendly‚ dyes resulted in a yearly increase of LE1,728. Overall, implementing these actions resulted in annual savings of LE30,972. A detailed breakdown of operating costs before and after substitutions is provided in Appendix 12.

Summary of Cost Changes for ‚Eco-friendly‚ Substitutes.

Process	Banned Substance	‚Eco-friendly‚ Substitute	Cost Change (LE)	Consumption (ton/annum)	Annual Cost Savings (LE)
Half Bleaching (winch) based on 1ton of knitted fabric	Sodium Hypochlorite	Hydrogen Peroxide	- 55.15	384.5	32,700
Full Bleaching (winch) based on 1ton of knitted fabric	Sodium Hypochlorite	Hydrogen Peroxide	- 29.90		
Direct Dyeing based on 1ton of knitted fabric	Copper Sulphate	Polymeric Agent	+ 120	14.4	(1,728)
TOTAL (LE)					**30,972**

Note: - indicates a decrease in cost.
+ indicates an increase in cost.

Potential Export Market Gains

The current annual value of the factory export market is around LE32.7million, of which about 20%, or LE6.5 million in value, goes to Europe. While it is difficult to quantify the export benefits of the eco-label at this stage, a 5% increase or conversely a 5% drop in European market share would be equivalent to LE0.3 million per annum.

Improved Production Efficiency

Processing time in the half bleaching process has been reduced by more than 47% and by 27% in the full bleaching process. In June 1998, this allowed the factory to process a 9ton/day order for whites, compared to an earlier capacity of 4.5ton/day.

Other benefits included:

- Reduced water consumption leading to corresponding reduction in the volume of effluent generated. The modified method consumes approximately 60% less water than that of the conventional method.,
- Steam consumption reduced by approximately 14% in comparison with the conventional method.

Improved Product Quality

Previously, Giza Spinning and Weaving used sodium hypochlorite for bleaching. While it tends to be cheaper, the whiteness is not permanent and fabrics eventually turn yellow. By substituting hydrogen peroxide for sodium hypochlorite, an improvement in overall quality of material was noted in terms of more permanent and uniform whiteness.

Environmental Improvements

- Complete phasing out of sodium hypochlorite and the anti-chlor agent sodium bi-sulphite lead to the elimination of AOX and a reduction of Total Dissolved Solids (TDS) in the effluent.
- Improvement in working conditions through the elimination of hazardous chlorine compounds in the workplace.
- Elimination of copper sulphate, which is toxic to aquatic life.

Part D

Helpful Hints

1. **Do s and Do nots**
2. **Frequently Asked Questions**
3. **Suggestions for Eco-Friendly Processing**
4. **Some Non Eco-Friendly Chemicals and Potential Substitutes**

1. Do s and Do nots

Do . . .

☺ Procure dyestuffs, pigments and textile auxiliaries from reputable manufacturers only. A list of reputable dye manufacturers is available from the Ecological Toxicological Association of Dyestuffs (ETAD), Basel, Switzerland.

☺ Insist on the supplier providing the materials safety data sheet (MSDS) for the dyes and textile auxiliaries procured. Study of these safety sheets will reveal whether the materials procured are free from banned amines and prohibited heavy metals and chemicals.

☺ Use only the latest shade cards of reputable manufacturers - most will have already withdrawn harmful dyes and have provided alternatives wherever possible.

☺ Use the safe alternatives of the problematic dyes. In some cases where exact matching is not possible, it is recommended to use the nearest possible shade with a safe dyestuff only, and discontinue the problematic shade.

☺ Make a list of all dyes and chemicals currently used along with their C.I. number and check it with the available banned list. Prepare a new list of safe dyes along with C.I. number.

☺ If possible, use reactive dyes for cellulose fibres. They are not based on the banned amine (some reactive dyes, which are based on banned amines, are now not commercially manufactured).

☺ Send the sample to a reputed laboratory for testing to ensure the safety of dyes or chemicals in case of doubt.

☺ Use only certified and safe accessories.

☺ As a precautionary measure, avoid metal contamination in the feed water during the use of hydrogen peroxide bleaching, otherwise problems of pinhole formation may be observed.

Do not . . .

☹ Do not procure loose dyes and chemicals, as these are very easily contaminated. Chemicals and dyestuffs should be purchased in sealed packages only.

☹ Do not perform chlorine bleaching.

☹ Do not use the kerosene-based thickener in pigment printing. If it,s use is unavoidable, use only odourless kerosene.

☹ Do not top (over dye) unless it is absolutely necessary, in which case use only safe dyes.

2. Frequently Asked Questions

1. What is an eco-label? Is it applicable to textiles?

An eco-label is used to guarantee the consumer an ‚eco-friendly‚ product and to distinguish the product from competitors in a positive ‚greener‚ way. The importance of eco-labels to trade varies between product groups and countries. Eco-labels for textiles are widely recognised and they are relatively important. This is illustrated by the fact that there are many eco-labels in this field.

2. Who grants it?

Certifying institutions, a number of which are listed in Appendix 3
labels.

3. What are the benefits of eco-label?

- Commercial benefits: for example entry / improve the export market.
- Social benefits: e.g. reduce environmental pollution.
- Sense of security in providing a high quality product.
- Maintaining the lead over others in the highly competitive buyers global market.
- Enhancement of image of the company.
- Improvement of skill, confidence and motivation of employees.
- Scope for further Improvement in a continuous manner.

4. Is an eco-label for an article or for the fabric?

An eco-label be granted to yarns, fabrics and garment as well as to decoration materials (e.g. curtains, carpets).

5. What type of chemicals need to be phased out?

- Formaldehyde based products;
- Pesticides (for natural fibers);
- Pentachlorophenol (PCP, used in sizes);
- Heavy metals (Arsenic, Lead, Cadmium, Mercury, Cobalt, Copper, Zinc and Chromium);
- Azoic dyes that could release any of the 20 listed prohibited amines through cleavage;
- Halogenated carriers in polyester dyeing;
- Chlorine bleaching;
- Kerosene based thickeners (partially or totally);
- Surfactants based on phenols (e.g. alkylated phenols ethoxylates ‚APOE‚, Nonyl phenol ethoxylate ‚NPO‚).

6. Do we have to change the dyes used?

Yes, if they are azoic and release any of the 20 banned amines through cleavage. Also, if their contents of free heavy metals are high.

7. Do we have to change the processing sequence?

The process sequence can be modified to phase out harmful chemicals as well as to upgrade the product quality.

8. Which sizing agents are harmful and need to be avoided?

Those containing PCP as a preservative.

9. Which preparation chemicals are harmful and needs to be avoided?

- Chlorine based bleaching agents
- Phenol based surfactants (can be checked through safety data sheet).

10. Can it be done without management commitment?

Management commitment is a must.

11. Who are involved in Eco-labelling?

The top management, the managers of purchasing, production and quality control as well as processing people.

12. How long is the eco-label certificate valid for?

One year.

13. Does it need to be renewed?

It needs to be renewed annually.

14. What is the renewal process?

A renewal application needs to be submitted before the expiry period for continuing the authorisation without any break. The renewal form seeks information about any changes proposed in the production line. Fresh representative samples need to be sent along with the renewal application. Renewal becomes simple, if there are no changes in the production line.

15. From where should we get an application form?

The certifying institution.

16. Are there any special precaution necessary in completing the application form?

- The article to be certified should be clearly defined.
- List of dyestuffs and chemicals should be of the safe category.
- Attached lists must have the same serial number as that in the application form.
- Material safety data sheets should be attached to the application form.
- In case of using dyes and or pigment without material safety data sheets, representative dyed and or printed samples (in strips form and of the darkest shades) should be enclosed for analysis.
- Declaration of conformity should be signed and attached to the application form.

17. Is it a difficult job or manageable?

It is a manageable job particularly if all documents are kept in one place.

18. What is a material safety data sheet?

Material safety data sheets for dyes indicate their CI Number, absence of banned amines and limiting values of heavy metals, whereas material safety data sheets for various textiles auxiliaries ascertain their human ecological suitability. Examples of safety data sheets are shown in Appendix 4.

A material safety data sheet includes the following information: the name of the product, CI Number of dye or pigment, hazardous identification, first aid measures, fire fighting measures, handling and storing, personal protection, physical and chemical properties, toxicological information, ecological information, and disposal information.

19. Who will supply the material safety data sheet?

The supplier of chemicals, dyes and auxiliaries.

20. Is it possible to carry out complete testing job by in-house laboratory?

No.

21. If not, what parameters can be tested by in-house laboratory and who can test the remaining parameters?

- In house testing parameters: pH and fastness properties.
- Formaldehyde and heavy metals at NRC laboratory, or Textiles Consolidation Fund, Alexandria.
- Pesticides (PCP), and banned azoic dyestuffs at any of the certifying institutes.

3. Suggestions for Eco-friendly Processing

- Replace conventional sizing agents such as starch with water soluble sizing agents such as modified starches and polyvinyl alcohol and CMG.
- Bleach with hydrogen peroxide using organic stabilisers.
- Fully or partly substitute kerosene with aqueous polymeric thickeners wherever possible.
- Avoid stannous chloride and zinc sulfoxylate formaldehyde during discharge printing.
- Water/fire proofing agents should not contain phosphorous compounds, fluoro compounds or heavy metal catalysts.
- Use permanent adhesive on tables and screen-printing (or Rotary) in place of conventional gumming wherever possible.
- Use single class dyestuffs (eg. indigosol and pigment), for dyeing blended variety in pale shades instead of two stage dyeing (e.g. polyester with disperse dye & cellulose with vat, reactive etc.).
- Follow a single stage preparatory process (i.e. one step desizing, scouring and bleaching) especially for cellulose/polyester blends.
- Dyeing-cum-sizing of warp yarns for denims.
- Use the padding method of dyeing instead of exhaust dyeing wherever possible.
- Use the dry heat fixation technique for the development of rapidogen prints instead of the conventional acid steaming method.
- Avoid the use of stain removers/scouring assistants which contain chlorinated hydrocarbon solvent emulsions.
- Avoid the use of copper/zinc salts in the after treatment of direct/reactive dyed goods.
- Use neutral reactive dyes in combination with disperse dyes to avoid two stage dyeing process in polyester/cotton blends.
- Use sulphuric acid or formic acid in place of acetic acid for achieving an acidic pH.
- Use dyes in the paste or liquid form - this is less harmful to factory workers.
- Wherever possible, use biodegradable dyes, chemicals, detergents and auxiliaries.
- Avoid the use of chromium salts for oxidation during dyeing with Vat and Sulphur dyes.
- Use a sugar based reducing agent during sulphur dyeing.

4. Some Non Eco-Friendly Chemicals and Potential Substitutes

Non Eco-friendly Chemical	Use	Alternative Chemicals
■ Pentachlorophenol ■ Formaldehyde	Size preservatives	Sodium silicofluride
Nonyl phenyl ethylene oxide adducts (APEO)	Detergent, emulsifier	Fatty alcohol ethylene oxide adduct
Silicones and amino silicones and APEO emulsifier	Softening, water- repelling	Anionic/cationic/non-ionic softeners wax emulsion
■ Bleaching powder ■ Sodium hypochlorite	Cotton bleaching	Hydrogen peroxide
■ Sodium silicate ■ Phosphorous based compound	Hydrogen peroxide stabilisers	Nitrogenous stabilisers
■ Dichlorobenzene ■ Trichlorobenzene	Carriers in polyester dyeing	Butyl benzoate Benzoic acid
Kerosene (as emulsion thickener)	Pigment printing	Water-based thickeners
Formaldehyde	■ Crease resisting of cotton and its blends	Polycarboxylic acid non-formaldehyde cross-linking agent
	■ Dye fixing for direct and reactive dyeing	Non-formaldehyde based products
	■ Dispersing agent for disperse dyeing and vat dyeing	--
	■ Reactive softener (Methylol stearamide type)	--
Sodium dichromate	Vat dyeing	Hydrogen peroxide

Appendices

1. Eco-labels and Product Groups Covered by each Eco-label
2. Oko-Tex 100 Standards
   a. Criteria and Limit Values of Oko-Tex Standard 100
   b. Non-Permissible Individual Substances as per Oko-Tex Standard 100
   c. List of Safer Alternatives for Some Banned Dyes
3. List of Institutes Authorised to Grant Oko-Tex 100 Certificate
4. Illustrative Material Safety Data Sheets (MSDS)
5. Chemical Audit Findings for Misr Mahalla
6. Chemical Audit Findings for Giza Spinning and Weaving
7. Phase-out of Harmful Chemicals and Processes Modifications at Misr Mahalla
8. Application Form of Oko-Tex Standard 100 and Declaration of Conformity
9. Copy of Oko-Tex Certificate Acquired by the Factories under the SEAM Project
10. Renewal Application Form for Oko-Tex Standard 100
11. Detailed Breakdown of Operating Costs at Misr Mahalla
12. Detailed Breakdown of Operating Costs at Giza Spinning and Weaving

Appendix 1

Eco-labels and Product Groups Covered by each Eco-label

Eco-labels and Product Groups Covered by each Eco-label

Eco-label	Products	Country
Eco-label	T-shirts (cotton), bed-linen, bed sheets, pillow cases, valances, removable. Washable quilt or duvet covers. In future: Other cotton/ polyester garments, clothes made of other fibres and eventually other textile products.	European Union
Oko-Tex		Germany
Product Class: I II III IV	 For babies and infants With skin contact Without skin contact For furnishing material	
Toxproof		Germany
Toxproof with permanent skin contact	Baby clothing, shirts, blouses, sports clothing, underwear, stockings, nightwear, bed clothing, bedding, bathroom fabrics, blankets	
Toxproof baby clothing	Clothing for babies up to 36 months of age	
Ecoproof	Certification of an ecological production method for textiles	Germany
Schadstoff gepr fft	Leather or plastic materials in textiles	Germany
1000	Certification of eco-management within a given company	Germany
Oko	All textile products	Germany
AKN trademark and members	Clothing, bedding	Germany
Otto Versand	Clothing, home textiles	Germany
Brita Steilmann	Casual wear	Germany
Hess Natur	Underwear, outer wear, baby clothing, bed-linen	Germany
Nordic Environmental Labelling (Milijomarkt)	The criteria apply to textiles made from cotton, sheep wool, flax, polyamide polyester, viscose, lyocell (tencel) or acetate	Sweden, Norway , Iceland , Finland

Eco-label	Products	Country
Swan A Swan B Swan C Swan D Swan E Swan F Swan G Swan H	Yarns; ply-yarns, loose stock, staple fibres, Baby clothing Clothing Outerwear Curtains Furnishing textiles Bed linen Other kind of textiles	
Good environmental choice	All textile products containing at least 95% by weight of textile fibre	Sweden
KRAV	Textile from organic fibres	Sweden
EKO-Seal	Clothing, underwear, cloth diapers, towels and household textiles	The Netherlands
Stichting Milieukeur		The Netherlands
Milieukeur clothing/ textile	Textile for use in clothing and clothes	
Milieukeur curtains and lace curtains	Lace curtains and textile for curtains	
Milieukeur bed-linen	In future	
EKO-Seal	Textile from organic fibres	The Netherlands
Environmental Choice	Organic cotton products	Canada
Eco Mark Japan	Cloth diapers, unbleached clothes, bed-linen, towels, cloth shopping bags, textiles made of waster fibres, clothing made of used PET	Japan
Green Mark Taiwan province	Reusable diapers, unbleached towels, cloth shopping bags	Taiwan
Eco-Mark Republic of Korea	Reusable diapers, unbleached towels, cloth shopping bags	Korea
Eco-Mark India	Textiles of cotton, wool, silk, man-made fibres, jute	India
China Environmental Labelling	Silk product	China
Good Environmental Choice	Clothes, home textiles	Sweden

Appendix 2

Oko-Tex 100 Standards

a) Criteria and Limit Values of Oko-Tex Standard 100

Product class	I Baby	II with skin contact	III without skin contact	IV furnishing materials
pH value [1]	4,0-7,5	4,0-7,5	4,0-9,0	4,0-9,0
Formaldehyde				
Law 112	20	75	300	300
Emission[2]	0,1			0,1
Extractable heavy metals (ppm)[3]				
As (Arsenic)[4]	0,2	1,0	1,0	1,0
PB (Lead)	0,2	1,0	1,0[5]	1,0[5]
Cd (Cadmium)	0,1	0,1	0,1[5]	0,1[5]
Cr (Chrome)	1,0	2,0	2,0	2,0
Cr (VI)				
Co (Cobalt)	1,0	4,0	4,0[5]	4,0[5]
Cu (Copper)	25,0[5]	50,0[5]	50,0[5]	50,0[5]
Ni (Nickel)	1,0	4,0	4,0	4,0
Hg (Quicksilver)[4]	0,02	0,02	0,02	0,02
Pesticides (ppm)[4]				
Total (incl. PCP/TeCP)[7]	0,5	1,0	1,0	1,0
Chlorinated phenols (ppm)				
Pentachlorphenol (PCP)	0,05	0,5	0,5	0,5
2,3,5,6-Tetrachlorphenol (TeCP)	0,05	0,5	0,5	0,5
Dyes				
Cleavable arylamines[7]		Not used[5]		
Cancerogenic		Not used		
Allergenic		Not used		
Chlorinated organic carriers (ppm)[7]	1,0	1,0	1,0	1,0
Biocidic finish	none	none	none	
Flame resistant finish	none	none	none	
Colour fastness (staining)				
Water resistance		3	3	3
Sweat resistance, acidic		3-4	3-4	3-4
Sweat resistance, alkaline		3-4	3-4	3-4
Resistance to rubbing, dry[8]	4	4	4	4
Resistance to rubbing, wet[8]	2-3	2-3	2-3	2-3
Saliva and sweat resistance	Resistant			
Emission of volatiles (mg/m^3)[2]				
Toluol	0,1			0,1
Styrol	0,005			0,005
Vinylcyclohexen	0,002			0,002
4-Phenylcyclohexen	0,03			0,03
Butadien	0,002			0,002
Vinylchloride	0,002			0,002
Aromatic hydrocarbons	0,3			0,3
Organic volatiles	0,5			0,5
Determination of odours				
In general[9]		No abnormal	odour[10]	
SNV 195 651[11]	4			4

1 A pH value of 4,0-10,5 is permitted for products which must subsequently undergo wet treatment
2 Only for carpets, mattresses and articles coated foam material
3 Using artificial saliva solution for Class I, using artificial sweat solution for Classes II-IV
4 For natural fibres only
5 No requirements formetallic accessories
6 Qualification limits: 0.5 ppm for Cr (VI), 20 ppm for aryl amines. 0,006% for allergenic dyes
7 See Annex 6 for a compilation of the individual substances
8 A minimum grade of colour fastness to rubbing of 3 (dry) and 2 (wet) is permitted for pigment, vat or sulphurous dyes
9 For all articles with the exception of textile floor coverings
10 No odours from mould, heavy benzene, fish, aromatic compunds or perfume finishing agents
11 For textile floor coverings only

100

Non-permissible individual substances

Pesticides

2,4,5-T
2,4-D
Aldrine
Carbaryl
DDD
DDE
DDT
Dieldrine
Endosulfan,-
Endosulfan,-
Endrine
Heptachlor
Heptachlorepoxide
Hexachlorbenzene
Hexachlorcyclohexane, a-
Hexachlorcyclohexane, b-
Hexachlorcyclohexane, c-
Lindane
Methoxychlorine
Mirex
Toxaphene (Camphechlorine)
Trifluralin

List of arylamines which are not allowed to be split off from dyes under reductive conditions

MAK III A1
4-Aminobyphenyl
Benzidine
4-Chloro-o-toluidine
2-Naphthylamine
MAK III A2
o-Aminoazotoluene
2-Amino-4-nitrotoulene
p-Chloroaniline
2,4-Diaminoanisole
4,4 Diaminobiphenylmethane
3,3 Dichlorobenzidine
3,3 Dimethoxybenzidine
3,3 Dimethylbenzindine
3,3 Dimethyl-4,4 diaminobiphenylmethane
p-Credidine
4,4 -Methylene-bis-(2-chloraniline)
4,4 Oxadianiline
4,4'-Thiodianiline
o-Toludiene
2,4-Yoluylendiamine
o-Ainisidine

Dyestuffs classified as carcinogenic

C.I. Generic Name

C.I. Basic Red 9
C.I. Disperse Blue 1
C.I. Acid Red 26

Dyestuffs classified as allergenic

C.I. Disperse Blue 1
C.I. Disperse Blue 2
C.I. Disperse Blue 7
C.I. Disperse Blue 26
C.I. Disperse Blue 35
C.I. Disperse Blue 102
C.I. Disperse Blue 106
C.I. Disperse Blue 124
C.I. Disperse Yellow 1
C.I. Disperse Yellow 3
C.I. Disperse Yellow 9
C.I. Disperse Yellow 39
C.I. Disperse Yellow 49
C.I. Disperse Orange 1
C.I. Disperse Orange 3
C.I. Disperse Orange 37
C.I. Disperse Orange 76
C.I. Disperse Red 1
C.I. Disperse Red 11
C.I. Disperse Red 17

Chlorinated organic carriers

Dichlorobenzenes
Trichlorobenzenes
Tetrachlorobenzenes
Pentachlorobenzenes
Hexachlorobenzenes
Chlorotoluenes
Dichlorotoluenes
Trichlorotoluenes
Tetrachlorotoluenes
Pentachlorotoluenes

c) Safer Alternatives for Some Banned Dyes

Table 1: Safer Alternatives for Banned Acid Dyes

Banned acid dye	C.I. number	Alternative	C.I. number
Acid Orange 45	22195	Acid Orange	1914690
Acid Red 4	14710	Acid Red 157	17990
Acid Red 150			
Acid Red 114			
Acid Red 5	14905	Acid Red 191	14730
Acid Red 158	20530		
Acid Red 24	16140		17900
Acid Red 73	27290		
Acid Red 128	24125		
Acid Red 85	22245		
Acid Red 26	16150	Acid Red	24785
Acid Red 115	27200	Acid Red 37	17045
Acid Red 148	26665		
Acid Violet 49	42640	Acid Violet 72	42665
Acid Violet 12	18075	Acid Violet 13	16640
Acid Black 94	30336	Acid Black 24	26370

Table 2: Safer Alternatives for Banned Direct Dyes

Banned Direct dye	C.I. number	Alternative	C.I. number
Direct Yellow 48	23660	Direct Yellow 15	
Direct Orange 8	22130	Direct Orange 102	29156
Direct Red 2	23900	Direct Red 81	28160
Direct Red 72	29200		
Direct Red 10	22145	Direct Red 120	25275
Direct Red 13	22155		
Direct Red 24	29185	Direct Red 23	9160
Direct Red 37	22240		
Direct Red 46	23050	Direct Red 31	29100
Direct Red 62	29175	Direct Red 4	29165
Direct Violet 1	22570	Direct Violet 66	29120
Direct Brown 2	22311	Direct Brown 112	29166
Direct Brown 31	35660		
Direct Brown 95	30145		
Direct Black 29	22580	Direct Black 51	27720

Table 3: Safer Alternatives for Banned Disperse Dyes

Banned Disperse Dye	C.I. number	Alternative	C.I. number
Disperse Yellow 7	23660	Disperse Yellow 15	
Disperse Yellow 23	22130	Disperse Orange 102	29156
Disperse Blue 12	3900	Disperse Red 81	28160
Disperse Red 151	29200		
Disperse Orange 50	22145	Disperse Red 120	25275
Disperse Yellow 13	22155		
Disperse Yellow 24	29185	Disperse Yellow 23	29160
Disperse Yellow 37	22240		
Disperse Yellow 46	23050	Disperse Yellow 31	29100
Disperse Yellow 62	29175	Disperse Yellow 4	29165
Disperse Yellow 1	22570	Disperse Violet 66	29120
Disperse Yellow 2	22311	Disperse Yellow 112	29166
Disperse Yellow 31	35660		
Disperse Yellow 95	30145		
Disperse Yellow 29	22580	Disperse Yellow 51	27720

Source: Environmental Quick Scan Textiles, compiled for CBI and SIDA by Consultancy and Research for Environmental Management, Published by CBI, SIDA, VIVO, 1996

Appendix 3

List of Institutes Authorised to Grant Oko-Tex 100 Certificate

Institutes Authorised to Grant Oko-Tex 100 Certificate

Some of the institutions dealing with Oko-Tex 100 are as follows:

- Osterreichisches Textil-Forschungsinstitut
  A-1050 Wien, Spengergasse 20, Postfach 117
  Tel. +43-1-544.25.43.0 Telefax +43-1-544.25.43.20

- Forschungsinstut Hohenstein
  D-74357 Bonnigheim, Schloβ Hohenstein
  Tel. +49-7143-271.0 Telefax +40-7143-271.51

- Schweizer Textilpfinstitut TESTEX
  CH-8027 Zurich, Gotthardstr. 61, Postfach 585
  Tel. +41-1-201.17.18 Telefax +41-1-202.55.27

- Institut Textil de France ITF-Lyon
  Fasness-69132 Ecully Cedex, Avenue Guy de Collongue, B.P. 60
  Tel. +33-78-33.34.55 Telefax +33-78-43.39.66

- Centexbel
  B-9052 Gent/Zwijnaarde, Technologiepark-Zwijnaarde 7
  Tel. +32-9-220.41.51 Telefax +32-9-220.49.55

- DTI Beklaednings-og Textilinstitut
  DK-2630 Taastrup, Gregersensvej, Postboks 141
  Tel. +45-43-50.42.80 Telefax +45-43-50.72.45

- IFP, Institute for Fiber-och Polymerteknologi
  S-402 29 Goteborg, Box 5402
  Tel. +46-31-82.40.00 Telefax +46-31-82.31.19

- Norsk Tekoinstitutt
  N-5028 Bergen, Hθyteknologisenteret, Postboks, 4298
  Tel. +47-5-54.38.00 Telefax +47-55-31.06.09

- CITEVE, Centro Tecnologico das Industrias Textil
  P-4760 Vila Nova de Famalikao
  Tel. +351-52-31.43.35/7.67.22 Telefax +35-1-52-7.67.48/7.65.69

- AITEX, Instituto Tecnologico Textil
  E-03801 Alcoy, Plaza Emilio Sala 1
  Tel. +34-6-554.22.00 Telefax +34-6-554.34.94

- BTTG, British Textile Technology Group
  Shirley House, GB-Manchester M20 8RX, 856 Wilmslow Road, Disbury
  Tel. +44-61-445.81.41 Telefax +44-61-434.99.57

- Centro Tessile Cotoniero e Abbigliamento S.P.A
  1-21052 Busto Arsizio-VA, P.za Sant'Anna 2
  Tel. +39-331-68.00.40 Telefax +39-331-68.00.56

Appendix 5

Chemical Audit Findings for Misr Mahalla

Chemical Audit Findings for Misr Mahalla

1 Product Line

During the orientation program with the senior staff members of the company it was decided that the scope of work will be confined to one of the major articles produced for export.

After detailed discussions pyjama suit (night wear) was selected. This article is made using Giza 75 and 85 Egyptian cotton in counts ranging from 16 s to 40 s. Major identification numbers of the fabrics are 27/57, 3032, and 2786.

These varieties are produced in plain (27/57) or twill weave (3032 and 2786) and processed as (a) bleached, (b) dyed, (c) printed (on white or dyed ground) and (d) colour woven (plain weave article No. 3121 and 3276), to make the pyjama suit garment. Hence, chemical audit was carried in sizing, wet preparatory processes (desizing, scouring, bleaching and mercerizing) dyeing (including yarn dyeing), printing, finishing and garment making departments.

1.1 Sizing

Annex 1 gives the list of sizing materials, etc. used for sizing warps for grey fabric production for pyjama.

Sizing is conducted in two different units; (a) housed in the mill compound and (b) Sammanoud Factory.

1.2 Preparatory Process

A list of chemical items used in several preparatory processes (desizing, scouring, bleaching and mercerizing) is given in Annex 2.

After grey mercerizing, the fabric of a, b, and c categories is subjected to enzymatic desizing, then processed into one of the rope form bleaching ranges.

The company has three bleaching ranges, namely Storke, Brugman and Gaston County. Cloth for pyjamas is being processed in one of the first two ranges, where the process sequence is as follows:

- Washing
- Double scouring with intermediate and subsequent washing
- Hypochlorite bleaching followed by washing
- H_2O_2 bleaching followed by final washing

After bleaching the fabric is scutched and dried. The third range, that is Gaston County range, does not have hypochlorite bleaching, at present fabric processed for pyjama does not go on this range.

White pipes (pyjama accessories) are also bleached by route which includes hypochlorite.

1.3 Dyeing (Including Yarn Dyeing)

A list of chemicals and dyestuffs used for fabric and for yarns for colour woven fabrics is given in Annex 3.

Fabric is dyed in jiggers using reactive and vat colours. For colour woven fabric (d category) yarn is dyed in vat colour and for white bleached yarns are after weaving without sizing, the fabrics go directly for soft finishing as accessory in garment making are dyed using some reactive and vat dyestuffs.

1.4 Printing

Printing is done on white or dyed ground using rotary or roller printing machines

Fabrics for pyjama are printed by use of pigment colours. Pigments and auxiliaries, such as binders, thickeners, solvents, catalysts, emulsifiers, etc., is given in Annex 4.

Pigment colours are fixed using curing treatment.

1.5 Finishing

Fabric meant for raising is given a softener treatment prior to raising and subsequent printing.

Chemical finishing is conducted using several softeners prior to final pre shrinking (sanforizing) operation.

A list of chemicals used for finishing of pyjama fabric is given in Annex 5.

White pipes used as accessory for pyjama is finished using optical whitener and softener.

1.6 Garment Making

Out of several accessories used, the colour and chemicals used for pipes are included in the lists given in the Appendices.

2 Chemicals and Auxiliaries

Examination of the lists of chemicals and auxiliaries used for the pyjama fabric reveals the following objectionable chemicals, which needs to be omitted or restricted:

- NaOCl
- Kerosene
- High Formaldehyde containing binders (e.g. Imperon Binder MTB)
- Stilbene based optical brighteners
- Cationic softeners for dyed yarns

3 Dyestuffs and Pigments

Colour Index Numbers of some of the dyes and pigment used were not available. The mill has agreed to supply them as soon as getting them from the suppliers.

As per the banned list available to date none of the reactive and vat colours used for pyjama fabric fall in the banned category.

As per the information available, pigment colours have not yet been covered in the banned category. However, some pigment colours which contain banned azo amines may be banned at a future date. They are:

- Ismament Yellow 2 G
- Pigmatex Yellow TCGG
- Imperon Yellow K-R
- Pigmatex Golden Yellow TGRM
- Imperon Orange K-G

- Imperon Red KG3R
- Imperon Violet K-B
- Imperon Dark Brown K-BRC

4 Recommendations and Action Plans

1. It is recommended to conduct a qualitative test for absence of PCP in sizing agents. The procedure is given in Annex 6.
2. Hypochlorite bleach needs to be totally avoided, hence it is advised to conduct trials by eliminating this process from the bleaching sequence. After obtaining satisfactory results, the modified process without NaOCl bleaching should be implemented for regular production of pyjama cloth and consequently other articles.
3. Optical brightener (used in bleaching and finishing) should be checked to ascertain that they are not based on stilbene or other harmful chemicals.
4. It was observed that a large number of dyestuffs and pigments are in use, it is advisable to reduce the number for reducing inventory, improving the reproducability and fastness characteristics as well as minimizing corrections.
5. For improving the fastness of dark shades, the dyeing conditions must be optimized and the fastness tests must be conducted prior to over printing. Use of bifunctional reactive dyes of high fixation properties can be attempted to achieve the goal.
6. It is advisable to replace cationic softener (Belfazin) used for after treatment of dyed yarns with a non ionic softener.
7. Kerosene based thickener in printing should be restricted by its replacement with proper synthetic thickeners. Replacement must be implemented after necessary trials.
8. To reduce the formaldehyde content and to improve the rubbing fastness of the printed articles, formaldehyde based binders must be replaced with others containing less formaldehyde and after careful study of available alternate binders.
9. It is advisable that the factory team should explore the possibility of reducing the cost without affecting the product quality and the environment. For example Roberto (high squeeze rollers) can be used on cylinder dryers in bleaching department to minimize the residual water before drying and hence drying cost.

Annex 1 - Sizing Materials

1. Native rice starch
2. Polyvinyl alcohol
3. Carboxymethyl cellulose
4. Sulphonated tallow
5. Glycerin
6. Treflix PWET
7. Oinor 4007

Notes

1:	is the main sizing ingredient
2 and 3:	are mainly used for warps in case of high speed air jet looms
4:	is the softener
5:	is the hygroscopic agent
6 and 7:	are after waxing agents

Annex 2 - Chemical Items Used in Preparatory Processes

1. NaOH
2. NaOCl
3. H_2O_2
4. Na_2SiO_3
5. CH_3COOH
6. Reductol KB (antioxidant for scouring)
7. Espycon 1030 (wetting agent)
8. Egyptol PLM (wetting agent)
9. Peroxide stabilizer HOET
10. Kamilaze (starch enzyme)

Annex 3 - Chemicals and Dyestuffs Used for Fabric and Yarn Dyeing

A Chemicals

- NaOH
- $Na_2S_2O_4$
- H_2O_2
- NaCl
- Na_2CO_3
- CH_3COOH
- Organic stabilizer
- Aspekone 1030
- Welfazin (cationic softener)
- Sequestal B
- Leveling agent (solidigal GLET)

B Dyestuffs

B.1 Reactive

- Levafix Yellow EGA (reactive yellow 25)
- Appolofix Golden Yellow SF3R
- Rotmazol Red F3B
- Triactive Blue R Special
- Ismative Black B
- Procion Turquoise MXG
- Triactive Violet 5 R
- Reactafix Yellow H4G (and H4GL)
- Reactafix Yellow HRML
- Chlorazol Yellow BRS

B.2 Vat

- Ismanthrene Yellow GCN
- Ismanthrene Yellow RK
- Ismanthrene Green FB
- Ismanthrene Brown BR
- Ismanthrene Olive R (Vat Black 27)
- Ismanthrene Olive Green B
- Ismanthrene Black BBN
- Ismanthrene Blue CLF
- Ismanthrene Blue RS (Vat Blue 4)
- Indanthrene Violet 3B (Vat Violet 9)
- Indanthrene Green FB
- Indanthrene Green 6705
- Indanthrene Red FBB
- Nivaron Navy TRR
- Hydron Blue 3RC

Annex 4 - Pigments and Auxiliaries Used in the Printing Department

A Pigment Dyestuffs

1. Helizarin Orange R (Pigment Orange 5)
2. Minedaico Red GRL (Pigment Red 2)
3. Imperon Red K-B (Pigment Red 146)
4. Minedaico Red BB (Pigment Red 146)
5. Minedaico Violet 2BTL (Mix Violet 23, Red 146)
6. Ismament Blue M2G (Pigment Blue 15)
7. Imperon Blue K-B (Pigment Blue 15)
8. Imperon Blue K-RR
9. Imperon Turq. Blue K-3G
10. Imperon Green K-G (Pigment Green 7)
11. Imperon D. Brown K-BR
12. Ismament Black C
13. Imperon Black KGF (Pigment Black 7)
14. Imperon White BF (Pigment White 6)
15. Daico White 51
16. EBCA Discharge S (Ready to print pastes)
17. EBCA White H-S (Ready to print pastes)

B Auxiliaries of Pigment Colours

1. Imperon Binder M/ET
2. Minerdaico Binder SME
3. Helizarin Binder ET
4. Solegal WW-ET
5. Daico Emulsifier P/L
6. NSD EMVL
7. Lutexal HVW
8. Imperon Thickener N-2282
9. Urea
10. Diamm Phosphate
11. Ammonia
12. Kerosene or other solvent

Annex 5 - Chemicals Used for Finishing

1. Leomin NI (non ionic fatty acid softener)
2. Adaline (Polyethylene softener)
3. Finish PE (Polyethylene softener)
4. Siligen MM (Silicon softener)
5. Lebeurosoft NNSL (Silicon softener)
6. Polysoft (polyethylene emulsion softener)
7. Belsoft (Fatty acid softener)
8. Ismawhite 2BL (Optical Brightener)
9. Hostalux (Optical Brightener)
10. Acetic Acid
11. Aspekone (Wetting Agent)

Annex 6 - Test of PCP

1. Take 5 - 10 g of sizing material
2. Dissolve in water
3. Acidify with conc. 5 - 10 ml HCl, if PCP present in Na form it will precipitate.
4. Add 3 - 15 ml of conc. HNO_3, and allow to stand for 10 - 15 min at room temperature
5. The reddish or orange pigmented colour indicates the presence of PCP
6. For comparison of colour, you can test known samples of PCP for the colour

Appendix 6

Chemical Audit Findings for Giza Spinning and Weaving

Chemical Audit Findings for Giza Spinning and Weaving

1 Chemical Audit

1.1 Product Line

After detailed discussions with the chairman (Dr. Maged Marzouk) and the general production manager (chem. Magdy Hassan), it was decided to select T-Shirts designated for export and made from 100 % cotton knitted fabric fully bleached or dyed in different colours.

Yarn counts ranging from 20 S to 30 S, using 100 % Egyptian cotton (Giza 70 and Giza 85) and 100 % Indian cotton is used to produce knitted fabric which is further subjected to preparatory processes (scouring and bleaching), dyeing, soft finishing and garment making.

Accordingly chemical audit was carried out on the preparatory, dyeing, finishing and garment making departments.

List of chemicals and dyestuffs used for preparatory treatments, dyeing and finishing of knitted fabric (used for T-Shirt making) as well as polyester threads, (for stitching) is given in Annex 1

It is to be noticed that all wet processes are carried out in batches using either winch or jet dyeing machines.

1.1.1 Preparatory processes

The fabric is scoured (using two commercial agents), followed by two hot wash and a cold wash.

After scouring the fabric can be dark shade dyed or bleached.

There are two kinds of bleaching:

1. Full bleaching: which begins with hypochlorite bleaching:-followed by cold washing, antichlorination (using sodium bisulphite), cold washing and hydrogen peroxide bleaching followed by hot wash and cold wash. After full bleaching the fabric is soft finished. An optical brightener can be added during H_2O_2 bleaching or prior to soft finishing.
2. Half bleaching: which is intended for light shade dyeing process, where no hypochlorite bleaching is performed and the fabric is subjected to H_2O_2 bleaching, followed by hot and cold washing, then acetic acid treatment (H_2O_2 killer) before light shade dyeing.

1.1.2 Dyeing (Including Thread Dyeing) and Soft Finishing

Knitted fabric is reactive dyed, mostly using vinyl sulphon or by functional reactive dyestuffs. Black colour is achieved using Direct Black 22, followed by after treatment either with copper sulphate or a commercially available non formaldehyde containing fixing agent (namely Dalton Fix N 62 of DAICO Co.).

Dyed fabric (reactive or direct dyed) is then soft finished using a cationic softener.

Polyester Stitching threads are disperse dyed at 130 °C in a small pressurized vessels

1.1.3 Garment Making

Most accessories used are supplied by the European customers. However, polyester stitching threads are dyed in the company using disperse dyestuffs that are listed in Annex 1.

1.2 Investigation of Chemicals and Dyestuffs Used

1.2.1 Chemicals and Auxiliaries

Investigation of Annex 1 reveals the following objectionable chemicals, which need to be omitted or restricted:

1. NaOCl
2. $CuSO_4$

1.2.2 Dyestuffs

Colour Index No. of all dyes used, except Disperse Black EX 300 %, were supplied by the company.

The company has agreed to supply it as soon as getting it from the supplier.

As per the banned list available till date, none of the dyestuff (of known C.I. No.) falls in the banned category.

1.3 Recommendations and Action Plan

1. Hypochlorite bleach needs to be totally avoided. It is advised to conduct trials by eliminating this process from bleaching sequence.
2. For improving the fastness of dark shades, the dyeing conditions must be optimized
3. It is recommended to avoid the use of $CuSO_4$ or copper containing compounds in the after treatment of the dyed fabrics (direct). Use of safe resinous compounds is advisable.
4. It is advisable that the factory team should explore the possibility of reducing the cost without affecting the product quality and the environment.
5. The quality control department should prepare a manual of test methods for testing raw materials, in process checks and for finished products to meet the Oko-Tex requirements. Heavy metal content, (specially for dark shades) must be tested at a reputable laboratory.

Annex 1 - Chemicals, Auxiliaries and Dyestuffs used for Fabric (and Threads) Processing

A Chemicals and Auxiliaries

1. Soda ash
2. Sodium hydroxide
3. Hydrochloric acid
4. Acetic acid
5. Common salt
6. Sodium hydrosulphite
7. Sodium meta bisulphite
8. Sodium hypochlorite
9. Copper sulphate
10. Hydrogen peroxide
11. Nonil N (detergent for scouring)
12. Invandin NF (scouring agent)
13. Invatex CRA (wetting agent)
14. Humactol C30 (wetting detergent after dyeing)
15. Antifoam (silicon based)
16. Stabilizer 2000 SK (organic stabilizer)
17. NSD sequest (EDTA)
18. Tricolene PES (dispersing agent, thread dyeing)
19. Persoftal UK (Cationic softener)
20. Kint softener WA (softener for whites)
21. Tricot silicon LEA(softner for threads)
22. Dalton Fix N62 (cationic fixing agent after direct dyeing)
23. Uvilex 2 B optical (optical brightener, stilbene based)
24. Hostalux polyester (optical brightener for polyester)
25. Lubrisoft CULS/G

B Dyestuffs

1. Reactive Yellow MERL (India, Reactive Yellow 145)
2. Reactive Yellow KE3G (China, Reactive Yellow 81)
3. Reactive Yellow HE4R (India, Reactive Yellow 84)
4. Reactive Yellow GR (India, Reactive Yellow 15)
5. Reactive Orange M2R (India, Reactive Orange 14)
6. Reactive Orange ME24L (India, Reactive Orange 122)
7. Reactive Orange 3R (India, Reactive Orange 16)
8. Reactive Red M5B (India, Reactive Red 2)
9. Reactive Red ME4BL (India, Reactive Red 195)
10. Reactive Blue 19 (England, Reactive Blue 19)

11. Reactive Blue 3R (India, Reactive Blue 28)
12. Reactive Blue XBR (China, Reactive Blue 18)
13. Reactive Turq. Blue G (India, Reactive Blue 21)
14. Reactive Navy Blue HE2R (India, Reactive Blue 172)
15. Reactive Black B ((India, Reactive Black 5)
16. Disperse Yellow G (England, Disperse Yellow 134)
17. Disperse Orange 2RFS (England, Disperse Orange 30)
18. Disperse Red 2B (England, Disperse Red 60)
19. Disperse Ruben FL (England, Disperse Red 73)
20. Disperse Blue R (England, Disperse Blue 56)
21. Disperse Turq. BGL (local, Disperse Blue 65)
22. Disperse Black EX 300 % (England)
23. Disperse Scarlet 2GH (England, Disperse Red 54)
24. Direct Black 22 (India, Direct Black 22)

Appendix 7

Phase-Out of Harmful Chemicals and Processes Modifications at Misr Mahalla

Phase-out of Harmful Chemicals and Processes Modifications at Misr Mahalla

1 Phasing out of Harmful Chemicals

Based on the chemical audit, the working group consisting of the consultancy team and the company team decided to phase out the following harmful chemicals within pyjama line:

1. Hypochlorite
2. Pigment colours which contain banned azo amines, namely:
   Ismament Yellow 2G
   Pigmatex Yellow TCGG
   Imperon Yellow K.R
   Pigmatex Golden Yellow TGRM
   Imperon Orange K.G
   Imperon Red KG 3R
   Imperon Violet K-B
   Imperon Dark Brown K-BRC
3. Kerosene, totally or partially

2 Replacement of Hypochlorite by H_2o_2 in Bleaching of Pyjama Fabric

Four semi-production trials were carried out in order to replace hypochlorite by H_2O_2 in bleaching of pyjama cloth. The conventional hypochlorite bleaching method includes the following steps:

1. Grey mercerization
2. Kamilaze desizing (16 - 18 h storing)
3. Hot wash (90 °C)
4. Double scouring with intermediate and subsequent washing, each scouring recipe is as follows:

NaOH	25 g/L
Reductol KB	2 g/L
Espycon 1030	2 g/L

5. Hypochlorite bleaching: (using 1.5-2 g/L active chlorine)
6. H2O2 bleaching using the recipe:

H_2O_2 (35%)	15 g/L
NaOH	1.5 g/L
Na_2SiO_3	6 g/L
Organic stabilizer	2 g/L
Espycon 1030	2 g/L

followed by hot and cold washing

These processes are conducted on either Stork or Brugman bleaching range.

2.1 First trial

2.1.1 Preparation

The grey mercerized fabric (57/27) was treated with Kamilaze enzyme and entered into the Gaston County Range, where it was subjected to the following preparatory steps:

1. Hot washing (90 °C)
2. Scouring using the following recipe:

NaOH	25 g/L
Reductol KB	2 g/L
Espycon 1030	2 g/L

(storing in the J-box for 2.5 h at 90 ° -95 °C)

3. Hot (90 °C) and cold washes
4. Half bleaching, using the recipe:

H_2O_2 (35%)	5 g/L
NaOH	5 g/L
Na_2SiO_3	3 g/L
Organic stabilizer	1 g/L
Espycon 1030	1 g/L

(storing in the J-box for 2 h at 95 ° -100 °C)

5. Hot wash (90 °C) and cold wash.
6. At this end, the fabric can be taken either for dyeing and/or printing or full bleaching, using the following recipe:

H_2O_2 (35%)	10 g/L
NaOH	5 g/L
Na_2SiO_3	5 g/L
Organic stabilizer	2 g/L
Espycon 1030	2 g/L

The fabric is then hot and cold washed.

The result of this trial showed that:

- The half bleached fabric has a satisfactory degree of whiteness as well as wettability, that copes with those needed for dyeing and/or printing.
- The full bleached fabric has an unsatisfactory degree of whiteness.

Accordingly, the half bleached fabric was sent to the dyehouse for dyeing and to the printing house for printing.

2.1.2 Dyeing

In the dyehouse, the fabric was dyed with special dark shades as follows:

Sample 1 - colour number 885 (Dark Blue) using the following mixture of reactive dyes:

- Ismative Black T
- Triactive violet 5 R
- Apolofix Yellow 5F 3R

the shade was 6.25 %

Sample 2 - colour number 883 (Blue) using the following vat dyes mixture:

- Indanthrene Blue CLF
- Ismanthrene Black BBN
- Ismanthrene Olive Green B
- Indanthrene Red FBB

the shade was 6%

Sample 3 - colour number 882 (Dark Green) using the following vat dyes mixture

- Indanthrene Green FB
- Ismanthrene Black BBN
- Ismanthrene Olive Green B

The depth of colour coped with the standard samples within the allowed tolerance.

The fastness properties of these samples are given in Table 1, where it can be noticed that all the fastness properties comply with the Oko-Tex Standard 100, except that of wet rubbing fastness.

This problem disappears upon further washing the samples in the washing department. Accordingly the process manager decided that all dyed fabric should be given further washing operation in the washing department before printing and/or finishing.

Table 1: Fastness Properties of Samples 1, 2 and 3

Sample	Wash	Rubbing		Alkaline	Water
		Wet	Dry	Perspiration	
1	3-4	2	4	4	4
2	3-4	2-3	4-5	4	4
3	3	2	4-5	4	4

2.2 The Second Trial

The second trial was conducted using fabric 27/57 on Brugman bleaching range. Gaston County bleaching range was not available during the time of the second trial, and the production people of the company desired to check if Brugman range can be an alternative of Gaston County range (in case of shut down or repair).

However, the design of Brugman range necessitates that the fabric is subjected to double scouring followed by half bleaching to produce half bleached fabric.

Accordingly, the grey mercerized - kamilaze treated fabric was processed on Brugman range as follows:

1. Hot wash (90 °C)
2. Double scouring using the following recipe:

   NaOH 25 g/L
   Reductol KB 2 g/L
   Espycon 1030 2 g/L

(storing in the J-box for 1.5 h at 95 ° -100 °C) with intermediate and subsequent hot (90°C) washing.

3. Cold washing
4. Half bleaching, using the following recipe:

H_2O_2 (35%)	16-18 g/L
Na_2SiO_3	3 g/L
Organic stabilizer	2 g/L
Espycon 1030	2 g/L

5. Hot (80 °C) and cold washing

The degree of whiteness of fabric was slightly higher than that of half bleached fabric on Gaston County range. However, the process was more lengthy and consumed more chemicals than that on Gaston County Range.

So, it was decided not to use Brugman range as an alternative for Gaston County range.

2.3 The Third and Fourth Trial (Gaston County)

The third trial is the same as the first one, with a slight modification of the recipes. The fabric types were 27/57 and twill 2786.

- Scouring recipe:

NaOH	25 - 28 g/L
Reductol KB	2 g/L
Espycon 1030	2 g/L

- Half bleaching recipe:

H_2O_2 (35%)	7.5 - 8 g/L
Na_2SiO_3	3 g/L
Organic stabilizer	1 g/L
NaOH	5 g/L

- Full bleaching recipe:

H_2O_2 (35%)	10-12 g/L
Na_2SiO_3	2 g/L
Organic stabilizer	2 g/L
NaOH	3 g/L
Espycon 1030	3 g/L

The performance properties of the fabric are shown in Table 2.

Table 2: Performance Properties of 27/57 and 2786 Fabric Type Processed According to the Third Trial

Sample	27/57		2786	
	W.I.	Wettability (sec.)	W.I.	Wettability (sec.)
Raw fabric	25	> 180	26	> 180
Desized	30	> 180	27	> 180
Scoured	30	90	29	1
Half bleached	58	10	63	1
Full bleached	65	1.5	76	0.5

W.I. = white index

Obviously, Table 2 shows that the response of the twill fabric (2786) to the treatment was better than that of the plain fabric (27/57). The properties of the twill fabric were acceptable by the production and quality control people. The properties of the plain fabric had to be improved.

The reason for that was that the twill fabric was not subjected to grey mercerization during its processing. Accordingly, a fourth trial was conducted using 27/57 fabric omitting the grey mercerization step and proceeding the same way as that of the third trial.

Table 3 shows the fabric properties according to the fourth trial.

Table 3: Performance Properties of 27/57 Fabric According to the Fourth Trial

Sample	W.I.	Wettability (sec.)
Raw fabric	28	> 180
Desized	32	> 180
Scoured	37	50
Half bleached	64	2
Full bleached	70	1.5
Optical brightened	87	1.5

Table 3 shows that the wettability and the white index were improved too much according to the fourth trial.

Moreover, optical brightened fabric was accepted from the production and quality control people as compared to hypochlorite - optical brightened fabric.

2.4 Conclusions

Based on the above trials, the most suitable way to process cotton fabric of articles 27/57 and 2786 to get optimal white index and wettability on Gaston County range is as follows:

1. Omission of grey mercerization
2. Desizing as usual (kamilaze)
3. Hot washing (90 °C)
4. Scouring using the recipe:

NaOH	25 - 28 g/L
Reductol KB	2 g/L
Espycon 1030	2 g/L

(Storing in J - box for 2.5 h/95 - 100°C)

5. Hot (90 °C) and cold wash
6. Half bleaching using the formula:

H_2O_2 (35%)	7.5 - 8	g/L
Na_2SiO_3	3	g/L
Organic stabilizer	1	g/L
NaOH	5	g/L
Espycon 1030	3	g/L

(Storing in J - box for 2.5 h / 95 - 100°C)

7. Hot (90 ° C) and cold wash
8. Full bleaching using the formula:

H_2O_2 (35%)	10-12	g/L
Na_2SiO_3	2	g/L
Organic stabilizer	2	g/L
NaOH	3	g/L
Espycon 1030	3	g/L

9. Hot (90 ° C) and cold wash
10. Drying

It is to be noticed that the fabric can be dyed and/or printed after half bleaching.

The fabric should be thoroughly washed after dyeing to achieve the fastness properties as demanded by Oko-Tex Standard 100. This should be achieved in the washing department.

3 Kerosene Substitution

3.1 Printing on White Ground

Half bleached fabric of 27/57 was sent to the printing department, and pigment printed using two different pastes. The pattern and colour numbers were 10240 and 51 respectively.

1. The first paste has no kerosene at all (full substitution) and consists of:

Imperon thickener N2282	30 g/kg
Ammonia	5 g/kg
Imperon Binder MTB	100 g/kg
Miner Daico Binder SME	100 g/kg
Water	x g/kg
Dye	50 g/kg
Total	**1 kg**

2. The second paste is of low content kerosene (partial substitution) and consists of:

Imperon thickener N2282	20 g/kg
Ammonia	5 g/kg
Imperon Binder MTB	100 g/kg
Miner Daico Binder SME	100 g/kg
White spirit	150 g/kg
Water	x g/kg
Solegal WET	5 g/kg
Dye	50 g/kg

In the mean time, scaling up to pilot trial should be done.

3.2 Printing on Dark Dyed Ground

Fabric article 27/57 was half bleached and dark dyed with three colours (see 1.2 of replacement of hypochlorite by H_2O_2 in bleaching of pyjama fabric), namely:

1. Colour No 885 (Dark Blue, reactive)
2. Colour No 883 (Blue, vat)
3. Colour No 882 (Dark Green, vat)

These fabrics were printed using aqua printing paste (mock discharge), which is ready to use printing paste based on silicon dioxide and has highly covering power. The commercial name of the paste is Ebca discharge S.

Samples 1 and 2 were printed using pattern no. 10256, colour no. 10005, whereas sample 3 was printed using pattern 10256 and colour no. 10004.

Formation of the green colour on the printed fabric was conducted using the recipe:

Ebca discharge S	980 g/kg
Imperon Green KG	20 g/kg

The fabrics were dried and cured as usual (160 °C/ 5 min). Table 4 shows the fastness properties of these fabrics as compared with those of the conventional one (full emulsion).

Table 4 Fastness Properties of Fabrics Printed using Different Thickening Agents

Sample	Water	Rubbing		Alkaline	Washing
		Wet	Dry	Perspiration	
Full substitution	4-5	2	2	4-5	4
Partial substitution	4-5	2	2-3	4-5	4-5
Full emulsion	4-5	1-2	2	4-5	4-5

Evidently, all the samples have practically the same fastness properties; however the dry rubbing fastness is slightly lower than that demanded by Oko-Tex Standard 100 (which is 3).

This trial shows that it is feasible to substitute kerosene, partially or fully, on lab scale, without affecting the fastness properties. Accordingly other trials should be carried out to improve the dry rubbing fastness (either through increasing the binder or optimizing the thermofixation step).

Formation of the red colour:

Ebca discharge S	990 g/kg
Imperon Red KB	10 g/kg

and the yellow colour:

Ebca discharge S	980 g/kg
Helezarin Orange R conc.	10 g/kg
Imperon Yellow KRE	10 g/kg

Three samples of white ground were also printed as comparative samples. The fastness properties are given in Table 5.

Table 5: Fastness Properties of Fabric Printed with Ebca Discharge S on Dyed and White Ground

Ground of sample	Wash	Rubbing		Alkaline perspiration	Water
		Wet	Dry		
Dark blue	4	1-2	2-3	4-5	4-5
White	4-5	2-3	2-3	4-5	4-5
Blue	4	2-3	2-3	4-5	4-5
White	4-5	2-3	3	4-5	4-5
Dark Green	4	1-2	2	4-5	4-5
White	4	1-2	2	4-5	4-5

It is evident that the fastness properties of the samples cope with Oko-Tex Standard 100. However, the rubbing fastness is, in general, not satisfactory.

3.3 Conclusion

Trials should be conducted to improve the rubbing fastness, either by:

1. Optimizing binder concentration, or
2. Optimizing thermofixation step, or
3. Final finishing step

4 Ecofriendly Processing of Shirt and Trouser Fabrics - Pretreatment

4.1 Fabric Specifications

Given below are the articles and specifications of various fabrics (pyjama, pant and shirt) that are subjected to the pretreatment step.

Article	Yarn count wxf	Weight per g/m^2	Width (cm)	Type	% size add-on
3081	30x30	259.3	162	synthetic	11
2786	24x12	176.3	104	natural	13
3237				natural	13
3057				synthetic	11
3084	20x20	227.4	158	synthetic	11
3097	20x20	231.9	160	natural	13
2257	40x40	116	98	natural	13
2257	40x40	116	98	natural	13

* grey mercerized; synthetic: PVA and CMC; natural:

4.2 Pretreatment Processes

1000 m of desized fabric, were processed on Gaston County Bleaching Range as follows:

1. Hot wash (90 - 95 °C)
2. Scouring using recipe:

NaOH	25 - 28 g/L
Reductol KB	2 g/L
Espycon 1030	2 g/L

(Storing in J-box for 2.5 h / 95 - 100 °C)

3. Hot (90 °C) and cold wash
4. Half bleaching using the recipe:

H_2O_2	7.5 - 8 g/L
Na_2SiO_3	3 g/L
Organic stabilizer	1 g/L
NaOH	5 g/L
Espycon 1030	3 g/L

(storing in J-box for 2.5 h / 95 - 100 °C)

5. Hot (90 °C) and cold wash
6. Drying

Table 6 shows the performance properties of these fabrics.

Table 6: Properties of Fabrics

Article	Pretreatment step							
	Raw		Desized		Scoured		Half Bleached	
	Wettability (sec.)	W.I	Wettability (sec.)	W.I	Wettability (sec.)	W.I	Wettability (sec.)	W.I
3081	> 180	34	> 180	33	4	46	2	65.5
2786	> 180	35	> 180	36	5	48	2	67.5
3237	> 180	30	> 180	31	3	48	2	71.1
3057	> 180	23	> 180	26	5	38	2	63.6
3084	> 180	35	> 180	36	4	39	2	65
3097	> 180	38	> 180	39	2	49	2	70.2
2289	> 180	33	> 180	37	120	47	2.5	69.5
2257*	> 180	33	> 180	38	> 180	44	> 180	56

* grey mercerized.

Obviously, except the grey mercerized fabric article 2257, all the half bleached fabrics have wettability and acceptable white indices, that cope with those required for dyeing. The grey mercerized fabric has got poor wettability and manifests the lowest whiteness index in comparison with other samples.

4.3 Conclusion

Based on the aforementioned results, it is clear that: -

1. The suggested recipes of pretreatment are valid to all types of fabrics used for production of shirt, pant as well as pyjama articles.
2. It is recommended to stop carrying out grey mercerization, as mentioned in the previous report, to get high performance properties for fabric article 2257.

5 Dyeing and Printing

Pretreated Shirt Fabric were printed on white or dyed background using synthetic thickener. These samples were thermofixed and their properties were tested according to Oko-Tex Standard 100. These properties are shown in Table 7, where it can be seen that all the fabric properties coped with the Oko-Tex Standard 100, though the rubbing fastness are at the border, but it is still acceptable.

N.B. These samples were taken to OTI in Vienna, and tested for formaldehyde, where it showed values in the range of 18 ppm.

Table 7: Fabric Properties of Printed Shirt or Trouser Fabric

Article	Color No	Design No	pH	HCHO content (ppm)	Fastness properties				
					Water	Rubbing fastness		Perspiration	
						Wet	Dry	Alkaline	Acidic
3237	60	10240	6.2	21	4	2-3	2	4	4
2257	121	10242	6.4	20	4	3	2	4	4
2257	53	10072	6.5	27	4	3	2	4	4
2786	444	10156	6.3	18	4	3	2	4	4
3237	46	10141	6.4	22	4	3	2	4	4
3081	1	10224	6.4	35	4	3	2	4	4
Oko-Tex Standard 100			4-7.5	75	3	3	2	3-4	3-4

Appendix 11

Detailed Breakdown of Operating Costs at Misr Mahalla

Detailed Breakdown of Operating Costs at Misr Mahalla

a) Replacement of sodium hypochlorite by hydrogen peroxide

Table 1
Half-Bleaching - Comparison of Conventional and Modified Processes
(on the basis of 1 ton)

Item *	Conventional Half Bleach		Modified Half Bleach		Cost Difference (LE)
	Requirement	Cost (LE)	Requirement	Cost (LE)	
Chemicals					
Sodium Hydroxide (Kg) Scour: 25-28 mg/L Half bleach: 5 g/L	61.8	136.0	38.4	84.50	-51.5
Espycon 1030 (Kg) Scour: 2 g/L Half bleach: 3 g/L	7.2	17.1	4.8	11.4	-5.7
Reductol KB (Kg) 2 g/L	4.8	16.8	2.4	8.4	-8.4
NaOCl (Kg)	38.5	5.0	-	-	-5
H_2O_2 (35%) (Kg) 7.5-8 g/L	18.0	31.5	9.6	16.8	-14.7
Organic Stabiliser (Kg) 1g/L	2.4	13.6	1.2	6.8	-6.8
Sodium Silicate (Kg) 3 g/L	2.4	0.9	3.6	1.4	+0.5
Water (m^3)	63.3	28.5	31.1	14	-14.5
Wastewater treatment costs	50.6	20.2	24.9	10	-10.2
Steam (Tons)	6.3	160	3.2	81.3	-78.7
Electricity (kWh)	425	80.8	184	35	-45.8
Labour	-	33.3	-	14	-19.3
Time (minutes)	100	-	56	-	
Total cost	-	543.7	-	283.6	-260.1

* Optimal recipes are given in italics

Table 2
Full Bleaching - Comparison of Conventional and Modified Processes (on the basis of 1 ton)

Item *	Conventional Full Bleach		Modified Full Bleach		Cost Difference (LE)
	Requirement	Cost (LE)	Requirement	Cost(LE)	
Chemicals:					
Sodium Hydroxide (Kg) Scour: 25-28 g/L Full bleach: 3 g/L	61.8	136	42	92.4	-43.6
Espycon 1030 (Kg) 3 g/L	7.2	17.1	7.2	17.1	0
Reductol KB? (Kg)	4.8	16.8	2.4	8.4	-8.4
H_2O_2 (35%) (Kg) 10-12 g/L	18	35.5	22.8	39.9	+4.4
Organic Stabiliser (Kg) 2 g/L	2.4	13.6	3.6	20.3	+6.7
Sodium Silicate (Kg) 2 g/L	2.4	0.9	6	2.3	+1.4
Water (m^3)	46.6	21	46.6	21	0
Wastewater costs (m^3)	37.3	14.9	37.3	14.9	0
Steam (Tons)	4.8	121.9	4.8	121.9	0
Electricity (kWh)	403	76.6	403	76.6	0
Labour		20.3		20.5	+0.2
Time (minutes)	82		82		0
Total cost		474.6		435.3	-39.3

* Optimal recipes are given in italics

b) Replacement of kerosene by synthetic thickener in pigment printing

Table 3
Cost-Benefit Analyses of Kerosene Substitution

Constituent	Full Emulsion Paste (full kerosene)		Low Kerosene Paste (partial substitution)		Zero Kerosene Paste (full substitution)	
	Quantity (kg)	Cost (LE)	Quantity (kg)	Cost (LE)	Quantity (kg)	Cost (LE)
Imperon thickener N2282	-	-	20	350	30	525
Ammonium Hydroxide	-	-	5	15	5	15
Imperon Binder MTB	80	412	100	515	100	515
Miner Daico Binder SME	80	409.6	100	412	100	412
Kerosene	675	472.5	150	105	-	-
Solegal WET (emulsifier)	150	120	5	40	-	-
Diammonium hydrogen phosphate (1/2)	30	50	38	63	38	63
Water	120	0.06	582	0.3	727	0.36
Total	1,135	1,464*	1,000	1,500*	1,000	1,530*
% increase in cost (relative to full emulsion paste)		0		2.5%		4.5%

* to the nearest unit

c) **Elimination of six pigment colours and substitution of two pigment colours through alternate safe combinations to get similar shade to avoid formation of banned amines**

Table 4

Data on the Rates of Substitution of Pigments in Printing

No	Substituted pigment	Price per kg (LE and US$)	No	Replacement pigment	Price per kg (LE and DM)
1	Ismament Yellow 2G5	LE 15	1	Imperon Yellow K5G110	LE 29
2	Imperon Yellow KR	LE 44	2	Imperon Yellow KGX	DM 295
3	Pigmatex Yellow TCGG	$ 6.65	3	Imperon Yellow KRE	DM 52
4	Pigmatex Golden Yellow TGRM	$ 6.50	-	n/a	-
5	Imperon Orange KG	LE 45	-	n/a	-
6	Imperon Red KGBR	LE 60	-	Imperon Red K-60	DM 30
7	Imperon Violet KB	LE 89.50	7	n/a	-
8	Imperon Dark Brown KBRC	LE 38	8	Imperon Dark Brown KBR	DM 20

Table 5 illustrates the costs incurred for three different printing conditions: 100% kerosene, using banned pigments; low percentage of kerosene, using ,safe, pigments and zero percentage of kerosene, using ,safe, pigments.

Table 5

A Comparison in Cost between 3 Different Printing Conditions

Cost of 1,000 kg printing paste before substitution		Cost of 1,000 kg printing paste after substitution		
Pigment No.	Full Emulsion Paste (full kerosene) (LE)	Pigment No.	Low Kerosene Paste (LE)	Zero Kerosene Paste (LE)
1	1171.8	1	1201	1225.2
2	1173.0	2	1202.4	1226.4
3	1172.0	3	1204.2	1228.2
6	1173.6	6	1202.4	1226.4
8	1172.7	8	1201.6	1225.6

It can be seen that substitution is accompanied by only a marginal increase in cost:

- Partial substitution (low kerosene paste) - increase of 2.5 - 2.7%.
- Full substitution (zero kerosene paste) - increase of 4 - 4.8%.

d) Replacement and substitution of high formaldehyde resin with low formaldehyde resin

In the finishing section, at Misr Mahalla factory, Arkofix NGET and Fixapret CPN were replaced by Arkofix NEC and Fixapret ECO. Table 6 shows the constitution and the cost of one ton of a typical finishing formula before and after substitution.

Table 6
Substitution of Finishing Agents

Constituent	Finishing formula before substitution		Finishing formula after substitution	
	Quantity (kg)	Cost (LE)	Quantity (kg)	Cost (LE)
Arkofix NG-ET* or Fixapret CPN*	120	696	-	-
Arkofix NEC** or Fixapret Eco.**	-	-	120	984
Leomin NI SI ET (softener)	30	366	30	366
Magnesium Chloride (catalyst)	12	33	12	33
Egyptol PLM (wetting agent)	2	12.8	2	12.8
Acetic acid	2	6.5	2	6.5
Water	834	0.42	834	0.42
Total	1,000	1,115	1,000	1,403

* High formaldehyde finishing agent

** Low formaldehyde finishing agent: It can be seen from the above table that the cost of 1 ton of finishing formula after substitution is about 26% more than that before substitution. Assuming a wet pick up of 80%, the cost of finishing 1 ton of fabric before substitution is about LE 892 compared to a cost of LE 1,122 after substitution.

Appendix 12

Detailed Breakdown of Operating Costs at Giza Spinning and Weaving

Detailed Breakdown of Operating Costs at Giza Spinning and Weaving

a) Replacement of sodium hypochlorite with hydrogen peroxide along with process modification in bleaching

A comparison between these methods for chemicals, water, steam, time and cost for processing 1 ton of knitted fabric on a winch machine is shown in Tables 1 - 6.

Table 1
Material Balance for the Conventional Method of Half Bleaching of 1 ton Knitted Fabric at Giza Spinning and Weaving

MATERIAL BALANCE			
Inputs (kg)		**Outputs (kg)**	
Fabric	1,000	Wet fabric:	
Nionil N	10	Dry Fabric	950
Na_2CO_3	30	Water	950
H_2O_2	30	Wastewater (67°C)	69,175
Organic Stabiliser	5	Condensate (98%)	4,500
Water	70,000		
Steam	4,500		
Total	75,575	Total	75,575

Table 2
Material Balance for the Conventional Method of Full Bleaching and Finishing at Giza Spinning and Weaving

MATERIAL BALANCE			
Inputs (kg)		**Outputs (kg)**	
Fabric	346	Wet fabric, (45 °C) assuming 150% wet pick up	830
Water	52,500	Wastewater (45 °C)	52,205.95
Nionil N	4.15	Condensate (98%)	2,700
NaOH (47%)	27.68		
NaOCl	103.8		
$NaHSO_3$	0.69		
H_2O_2 (50%)	20.76		
Organic stabiliser	3.46		
Uvitex 2B	1.73		
Net soft	10.38		
Acetic acid (11%)	17.3		
Steam	2,700		
Total	55,735.95	Total	55,735.95

Table 3

Material Balance for the Modified Method of Half Bleaching of 1 ton Knitted Fabric at Giza Spinning and Weaving

MATERIAL BALANCE			
Inputs (kg)		**Outputs (kg)**	
Fabric	1,000	Wet fabric:	
NaOH (47%)	75	Dry fabric	950
H_2O_2 (50%)	30	Water	950
Organic Stabiliser	10	Wastewater (74°C)	28,175
Water	28,960	Condensate (98%)	2,700
Steam	2,700		
Total	32,775	Total	32,775

Table 4

Material Balance for the Modified Method of Full Bleaching and Finishing at Giza Spinning and Weaving

(Basis: 346kg/batch on a winch machine. LR: 1/10)

MATERIAL BALANCE			
Inputs (kg)		**Outputs (kg)**	
Fabric (25°C)	346	Wet fabric (45 °C) 150% wet pick up	830
Water (25°C)	20,400	Wastewater (45 °C)	20,031.91
Nionil N	3.46	Condensate (98%)	2,300
NaOH (47%)	36.33		
H_2O_2 (50%)	36.33		
Organic Stabiliser	10.38		
Uvitex 2B	1.73		
Acetic acid	17.3		
Net soft	10.38		
Steam	2,300		
Total	23,161.91	Total	23,161.91

Table 5
A Comparison between the Conventional and Modified Methods for Half Bleaching of 1 ton of Knitted Fabric on a Winch Machine at Giza Spinning and Weaving

Parameter		Conventional		Modified	
		Requirement (kg)	Cost (LE)	Requirement (kg)	Cost (LE)
A.	Chemicals:				
	Nionil N	10	25.63	10	25.63
	NaOH (47%)	-		75	45
	Na_2CO_3	30	24	-	
	H_2O_2 (50%)	30	66	30	66
	Organic stabiliser	5	11	10	22
	Cost of chemicals		126.63		158.63
B.	Water (m^3)	70	35	28.96	14.50
C.	Steam (t)	4.50	109.60	2.70	65.80
D.	Electricity (kWh)	30	5.90	13.10	2.80
E.	Time (h)	7.45	-	3.50	-
F.	Labour	-	37.25	-	17.50
	Total cost		**314.38**		**259.23**

Table 6

A Comparison between the Conventional and Modified Methods for Full Bleaching of 1 ton of Knitted Fabric on a Winch Machine at Giza Spinning and Weaving

Parameter		Conventional		Suggested	
		Requirement (kg)	Cost (LE)	Requirement (kg)	Cost (LE)
A.	Chemicals:				
	Nionil N	12	30.76	10	25.63
	NaOH (47%)	80.52	48.32	105	63
	NaOCl	300	105	-	-
	$NaHSO_3$	2	10	-	-
	H_2O_2 (50%)	60	132	105	231
	Organic stabiliser	10	22	30	66
	Uvitex 2B	5	57	5	57
	Knit Soft	30	100.32	30	100.32
	Acetic acid (11%)	50	37	50	73
	Cost of chemicals		542.40		615.95
B.	Water (m3)	151.734	75.86	58.96	29.48
C.	Steam (t)	7.803	190.39	6.647	162.18
D.	Electricity (kWh)	69.2	14.53	50.44	10.60
E.	Time (h)	18.45	-	13.45	-
F.	Labour		92.25	-	67.25
	Total cost		915.43		885.46

b) Replacement of Copper Sulphate ($CuSO_4$) with a Polymeric Agent for Fabrics dyed with Direct Dyes

Table 7
Cost Breakdown of $CuSO_4$ Substitution

	Substituted ($CuSO_4$)	Substitute (Dalton Fix N62)
Price per kg	3 LE	7 LE
Amount used per ton of fabric 3% owf	30 kg	30 kg
Cost of treatment of ton of fabric	90 LE	210 LE

Assuming that production is 40t/month, the cost of treatment before substitution works out to 40 x 90= LE3,600. After substitution, the cost works out to 210 x 40 = LE8,400, with a net increase in operating costs of LE4,800 per month.

Useful References

1. Smith, B., *Identification and Reduction of Pollution Sources in Textile Wet Processes,* Pollution Prevention Pays Program, Department of Natural Resources and Community Development, Raleigh, North Carolina, USA, 1986.
2. *Textile Industry and the Environment*, Technical Report No 16, United Nations Environment Program - Industry And Environment Office (UNEP IEO), 1992.
3. Criteria in Environmental Labelling: A Comparative Analysis of Environmental Criteria in Selected Eco-labelling Schemes, Environment and Trade, UNEP, June 1995.
4. *Environmental Quick Scan Textiles,* compiled for CBI and SIDA by Consultancy and Research for Environmental Management, published by CBI, SIDA, VIVO, 1996.