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Guideline of cleaner production for textile industries

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Foreword

This Ethiopian Standard has been prepared under the direction of Technical Committee for Textile-Dyeing and finishing (TC 71) and published by the Ethiopian Standards Agency (ESA).

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GUIDELINE OF CLEANER PRODUCTION FOR TEXTILE INDUSTRIES

1. SCOPE

This Ethiopian standard specifies the general guideline of cleaner production for textile industries.

2. NORMATIVE REFERENCE

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ES 6702: Sustainable textile production

ES ISO 14000 Series: Environmental Management System

ES ISO 50001: Energy Management system

3. TERMS AND DEFINITION

For the purpose of this standard the following definitions shall apply

3.1.
Adsorbable organic halogens (AOXs)
Adsorbable organically bound halogens (AOX) are a group of chemicals which can be adsorbed from water onto activated carbon. Most AOXs are compounds containing chlorine, but some also contain the similar elements bromine or iodine. The main sources of AOX are from the chlorine chemicals used to bleach fibres. Some AOXs are toxic to fish and aquatic organisms - even at low concentrations. Many are persistent and have a tendency to accumulate in the environment which causes concern at a regional (if not global) level.

3.2.
Alkylphenol ethoxylate (APEO)
Alkylphenol ethoxylate is the name of a group of surfactants that can improve the miscibility of different substances with water (surfactant). Among all the alkylphenol ethoxylates, nonylphenol ethoxylates (NPEO) are the most widely used in industry. NPEO are degraded in the environment into nonylphenols, which are endocrine disruptors.

3.3.
Biodegradable
Biodegradable refers to the ability of things to get disintegrated (decomposed) by the action of micro-organisms such as bacteria or fungi biological (with or without oxygen) while getting assimilated into the natural environment. There’s no ecological harm during the process. We can either speak of biodegradable solids (also called compostable) or liquids that biodegrade into water.

3.4.
Cleaner production
Cleaner production stands for preventive and proactive approach to industrial enviromental management and aims for process and/or product integrated solutions that are both economically and environmentally efficient (eco efficiency). Cleaner production is generally the four stages in the development of enviromental strategy (following dispersion, control, and recycle).

3.5.
Cleaner production practices
Cleaner production aims at making more efficient use of natural resources (raw material, water and energy) and reducing the generation of wastes and emissions at the source. This is generally achieved through – combinations- of product modification, input substitution, technology modification, and good housekeeping and onsite recycling and reuse.

3.6.
Cleaner Production Assessment (CPA)
A methodology to systematically identify and evaluate cleaner (less polluting, less toxic and less wasteful) production opportunities and facilitate their implementation.

Energy efficiency is determined by the highest ration of energy consumption to product output. Energy conservation, on the other hand, refers to the reduction of energy usage.

3.7.
Environmental management hierarchy
The environmental management hierarchy is maintained by the United State Environmental Protection Agency. The hierarchy places highest priority on source reduction and closed-loop recycling. After source reduction, emphasis is placed on recycling/reuse, treatment, and disposal in that descending order.

3.8.
Environmental Management Systems (EMS)
A framework that helps a company achieves its environmental goals through consistent control of its operations. The assumption is that this increased control will improve the environmental performance of the company.

3.9.
Eco-Efficiency
The relationship between economic output (product, service, activity) and environmental impact added caused by production, consumption and disposal.

3.10.
Material Safety Data Sheet
A technical document which provides detailed and comprehensive information on a controlled product related to: health effects of exposure to the product

- Hazard evaluation related to the product’s handling, storage or use.
- Measure to protect workers at risk of exposure.
- Emergency procedures.
- The data sheet may be written, printed or otherwise expressed.

3.11.
Input-Output Analysis
An economic tool used to measure the impacts of an existing, proposed, or anticipated business operation, decision, or event on the economy.

3.12.
Pollution
Residual discharges of emissions to the air or water following application of emission control devices.

3.13.
Pollution control
Pollution control, as opposed to pollution prevention, refers to the measures taken to manage pollution after it has been generated.

3.14.
Pollution prevention (P2)
Pollution prevention means source reduction preventing or reducing waste where it originates, at the source- including practices that conserve natural resources by reducing or eliminating pollutants through increased efficiency in the use of raw materials, energy, water, and land.

3.15.
Recovery
The extraction from a waste of some components which have a value in other uses.

3.16.
Recycling
The use by one producer of a waste generated by another.

3.17.
Reuse
The repeated use of a “waste” material in a process.

3.18.
Sustainable development
The Brundt land Report defines as “meeting the needs of the present without compromising the ability of future generations to meet their own needs.”

4. GENERAL PRINCIPLE FOR CLEANER PRODUCTION

4.1. Waste Reduction.
All types of waste including hazardous waste, solid waste, liquid waste, gaseous wastes and waste heat, should be minimized and prevented.

4.2. Non-Polluting Production.
Production processes should not release any contaminant.

4.3. Production Energy Efficiency.
Energy efficiency, that is; energy consumption to product output should be the highest ratio. Energy usage should be reduced.

4.4. Safe and Healthy Work Environments.
The risks of workers should be minimized in order to make the workplace a cleaner, safer, and healthier environment.

4.5. Environmentally Sound Products.

The final product and all marketable by-products should be as environmentally appropriate as possible. Health and environmental factors should be addressed at the earliest point of product and process design and should be considered over the full product life-cycle, from production through use and disposal.

4.6. Environmentally Sound Packaging.

Product packaging should be minimized wherever possible. Where packaging is necessary to protect the product, to market the product, or to facilitate ease of consumption, it should be as environmentally appropriate as possible.

5. GENERAL GOOD MANAGEMENT PRACTICES AND GOOD HOUSEKEEPING

5.1. Education/ training of employees

5.1.1. All staff should understand clearly the precautions needed to avoid resource wastage and pollution.

5.1.2. Training should be give on resources (chemicals, fibres, energy, water), process- and machinery.

5.1.3. Senior management should have a clearly expressed commitment to environmental improvement, preferably in the form of an environmental policy and an implementation strategy, made available to all staff.

5.2. Equipment maintenance and operations audit

5.2.1. Machinery, pumps and pipe work (including abatement systems) should be well maintained and free from leaks.

5.2.2. Regular maintenance schedules should be established, with all procedures documented. In particular, attention should be paid to the following areas:

5.2.3. **Machinery checking:** the most significant components of the machinery like pumps, valves, Level switches and pressure and flow regulators should be included in a maintenance checklist.

5.2.4. **Leak control**: audits should be carefully conducted for broken and leaking pipes, drums, Pumps and valves, not only in the water system but also from the oil heat transfer and Chemicals dispensing systems in particular.

5.2.5. **Filter maintenance**: regular cleaning and checking

5.2.6. **Calibration** of measuring equipment, such as chemicals measuring and dispensing devices, thermometers etc.

5.2.7. **Thermal treatment units (e.g. Stenters)**: all units should be regularly (at least once a year) cleaned and maintained. This should include cleaning deposits from the exhaust gas conducting system and from the intake system of the burner air inlet.

5.3. Chemicals storage, handling, dosing and dispensing

5.3.1. Each chemical should be stored according to the instruction given by the manufacturer in the Material Safety Data Sheet.

5.3.2. All areas where chemicals are stored or spillages are likely to occur should be bund ed and it should be impossible for spillage to enter surface waters or sewers.

5.3.3. Toxic and dangerous chemicals should be stored separately.

5.3.4. First aid facilities should be available and evacuation and em ergency procedures in place and rehearsed regularly.

5.3.5. Records of accidents and incidents (near-misses) should be kept.

5.3.6. Pumps and pipe work used for transfer should be regularly inspected and provisions should be made to ensure the safety of manual transfer (including appropriate training of workers, use of buckets with leak-proof lids, etc.)

5.3.7. Accurate weighing, di spensing an d m ixing should be done to a voiding/minimizing spillage in manual operation.

5.3.8. An automated chemical dosing and di spensing system should be there. (Better laboratory-to-dye, hou se correlation; minimizes t he c hance of w orker i njury w hen ha ndling h azardous chemicals; faster delivery times, etc.)

5.4. Improved knowledge of chemicals and raw materials used

5.4.1. The process inputs and outputs should be known and regularly monitored. (This includes inputs of textile raw material, chemicals, heat, power and water, and outputs of product, waste water, air emissions, sludges, solid wastes and by-products)

5.4.2. Prescreening of incoming raw materials (fibres, chemicals, dyestuffs, auxiliaries, etc.) S should be done.

5.4.3. The supplier should take the responsibility for providing adequate information that enables the mill to make responsible environmental evaluation, even on proprietary products.

5.4.4. Information from the supplier should include also the kind and amount of preparation agents and sizing agents, amount of residual monomers, metals, biocides (e.g. ectoparasiticides for wool) present on the fibre.

5.5. Minimization/optimization of chemicals used

5.5.1. In general the overall strategy for the minimization/optimization of the chemicals used should consider the following steps:

5.5.1.1. Where it is possible to achieve the desired process result without the use of chemicals, then avoid their use altogether

5.5.1.2. Where this is not possible, adopt a risk-based approach to selecting chemicals and their utilization mode in order to ensure the lowest overall risk.

5.5.2. That said, possible measures of general applicability should be:

5.5.2.1. Regularly revising the recipes in order to identify unnecessary chemicals (dyes, auxiliaries) so that they can be avoided

5.5.2.2. Giving preference in the selection of auxiliaries and chemicals to products with a high degree of biodegradability/ bioeliminability, low human and ecological toxicity, low volatility and low smell intensity.

5.5.2.3. Optimizing the process by improving the control of process parameters such as temperature, chemical feed, dwell times, moisture (for dryers), etc.

5.5.2.4. Using high-quality water (where needed) in wet processes in order to avoid/reduce the use of chemicals to prevent side effects caused by the presence of impurities

5.5.2.5. Avoiding/ minimizing any kind of surplus of applied chemicals and auxiliaries (e.g. by automated dosing and dispensing of chemicals)

5.5.2.6. Optimizing scheduling in production (e.g. in dyeing: dyeing dark shades after pale shades reduces water and chemicals consumption for machine cleaning)

5.5.2.7. Giving preference to low add-on devices for chemicals

5.5.2.8. Re-using mother-baths whenever possible

5.5.2.9. Recovering vapour during delivery of volatile substances

5.5.2.10. Filling of tanks with volatile compounds using the following precautions: being filled to the one being emptied - bottom loading to avoid splashing (for larger tanks).

5.6. Water and Energy Management

5.6.1. To utilize water energy efficiently, the following practices should be done:-

5.6.1.1. Control and record keeping of water and energy consumption.

5.6.1.2. The use of flow control devices and automatic shut-off valves in continuously running machines.

5.6.1.3. Using automatic equipment to check the volume and temperature of the baths in intermittent working machines.

5.6.1.4. To prevent waste of water and energy, documentation of the production procedures should be available and it should be used by employees.

5.6.1.5. Implementation of time optimization in production, regulation of all processes to ensure they are completed in the shortest time possible.

5.6.1.6. Investigating the possibilities of combining different operations in one step.

5.6.1.7. Use of low and very low float rate machines in intermittent processes.

5.6.1.8. Use of perpetual low input processes.

5.6.1.9. Improvement in washing efficiency.

5.6.1.10. Reuse of cooling water as process water (at the same time providing heat recovery).

5.6.1.11. Characterization of discrete wastewater streams and assessment of water/ material recovery and assessment of reuse possibilities.

5.6.1.12. Installation of steam insulation to prevent loss.

5.6.1.13. Insulation of pipes, valves, tanks and machinery to minimize energy losses.

5.6.1.14. Optimization of boiler rooms with applications such as the reuse of steam condensates.

5.6.1.15. Recovery of waste heat from waste gas and wastewater.

5.6.1.16. Use of frequency-controlled electric motors

5.7. Management of waste streams

5.7.1. The following general measures should be identified:

5.7.1.1. Separate capture of high-loaded waste streams from low-concentrated effluent to allow more efficient treatment

5.7.1.2. Separate collection of unavoidable solid waste

5.7.1.3. Reduction of packaging

5.7.1.4. Use of returnable containers

5.7.1.5. Recycling of textile wastes (textile residues, spoilt work, raising, etc.).

6. SPECIFIC CLEANER PRODUCTION PRACTICES FOR VARIOUS TEXTILE PRODUCTION PROCESSES

6.1. Yarn Production

6.1.1. The upstream environmental impacts of fibers should be considered and the raw material with the least impact should be selected.

6.1.2. For man-made fibers: Material treated with low-emission and biodegradable/ bioeliminable preparation agents should be selected.

6.1.3. Wool: should avoid processing fiber material contaminated with the most hazardous chemicals such as pesticide residues; minimize at source any legally-used sheep ectoparasiticides. Wool yarn spun with biodegradable spinning agents instead of formulations based on mineral oils should be selected.

6.1.4. Fiber wastes should be recycled/ reused.

6.1.5. Fiber lint and yarn waste should be segregated

6.2. Fabric Production

6.2.1. Material sized with low add-on techniques (pre-wetting of the warp yarn) and high-efficiency bioeliminable sizing agents should be selected; processing fiber material contaminated with the most hazardous chemicals should be avoided.

6.2.2. In the removal of knitting lubricants from fabric: Instead of using mineral oil-based lubricants for processing, selection of knitted fabrics produced by using biodegradable and water-based lubricants should be practiced.

6.2.3. Slasher and mix area equipment should be maintained to avoid leaks and spills.

6.3. Desizing

6.3.1. Selection of Sizing Agents with Improved Environmental performance should be practiced. (Modified starches, galactomannans, polyvinyl alcohol, and certain polyacrylates).

6.3.2. When the source of raw material cannot be controlled, desizing with oxidation should be applied.

6.3.3. Combination of desizing / washing and bleaching in a single step should be practiced.

6.3.4. Recycling and reuse of sizing materials by proper methods should be done.

6.4. Scouring

6.4.1. Mineral oil substitution in wool spinning lubricants: Conventional Spinning oils (mineral oils which are not fully biodegradable) should be replaced by formulations based on glycol.

6.4.2. Mineral oil substitution in Knitted fabric: conventional mineral oils, which require removal by emulsification using detergents, emulsifiers, and antiredeposition agents should be with hydrosoluble oils (offer an easily washed out, biodegradable alternative).

6.4.3. Substitution for hazardous surfactants: free of alkylphenol ethoxylate should be used – (APEO free).

6.4.4. Biodegradable/bioeliminable complexing agents should be selected.

6.4.5. Wool scouring with organic solvent should be practiced. (Results in pesticide free clean wool)

6.4.6. Enzymatic scouring: Replacement of traditional scouring agents by enzymes operating at mild conditions should be practiced. --reduces rinse water consumption, as well as biological oxygen demand (BOD) and chemical oxygen demand (COD) load.

6.5. Bleaching

6.5.1. Hydrogen peroxide should be used instead of hypochlorite --results in no generation of carcinogenic adsorbable organic halogens (AOXs).

6.5.2. The use of hydrogen peroxide stabilizers should be reduced.

6.5.3. The use of sodium hypochlorite should be limited to only those situations where high whiteness is desired, and to fragile &depolymerized fabrics.

6.5.4. Use of innovative chemicals where possible in bleaching processes (such as bleaching with enzymes, bleaching with ozone), which have lower environmental impacts.

6.6. Mercerization

6.6.1. Alkaline in the mercerization rinse water should be recovered and reused

6.6.2. Alkaline wastewater from mercerization should be reused in other pre-treatments.

6.7. Dyeing

6.7.1. General measures for batch dyeing should be:-

6.7.1.1. Use of dyes that are highly absorbed in/adsorbed on the fiber.

6.7.1.2. Use of auxiliary chemicals that will not prevent the dyes from being highly absorbed in/adsorbed on the fiber.

6.7.1.3. Reducing the number of dyes in the dosing and dispensing of paint formulations (e.g. by using trichromatic systems).

6.7.1.4. The use of automatic control mechanism equipment and a good insulation system to minimize steam losses.

6.7.1.5. Equipment optimization in batch dyeing: Conservation of energy, water and chemicals is improved by using new machine technologies. Key factors are: liquor ratio, rinsing efficiency, and cycle duration.

6.7.1.6. Automated dosing and cycle control, automated liquor level and temperature control, indirect heating and cooling, and full closure of machines should be in batch processing machines.

6.7.1.7. Equipment optimization applied to winch beck dyeing machines: Winch beck dyeing machines are important in dyeing in piece voluminous textiles, such as carpets, upholstery, terry towels, and tubular fabrics.

6.7.1.8. Equipment optimization applied to jet dyeing machines: New concepts have been introduced in jet machines, which can significantly improve not only the productivity, but also the environmental performance of the dyeing process for fabrics that are treated in rope form. These improvements according to the following categories:

a) Airflow jet dyeing machines
b) Soft-flow dyeing machines with no contact between the bath and the fabric
c) Single-rope flow dyeing machines

6.7.1.9. Use of liposomes as auxiliaries in wool dyeing: Using liposomes as auxiliary products in wool dyeing allows good dye bath exhaustion, eliminates the use of electrolytes, reduces energy consumption, and results in lower COD in the waste-water.

6.7.1.10. Instead of oversized washing method, application of filling and unloading systems.

6.7.1.11. Reuse of rinsing water in the next dyeing batch.

6.7.1.12. Reuse of the dye bath when technically feasible.

6.7.2. General measures for continuous dyeing should be:-

6.7.2.1. Reduction of concentrate float losses as listed below:

a) The use of less input processes and the minimization of the volume of the impregnation vat when impregnation and dyeing techniques are used.
b) Adoption of distribution systems, where the chemicals are distributed on-line in separate lines and mixed just before application.

6.7.2.2. The use of advanced systems for dosing of impregnation liquors.

6.7.2.3. The use of reverse flow washing.

6.7.2.4. Dirty residual water in the fiber should be removed before the next washing step via fiber wringing rollers and similar equipment.

6.7.3. Measures foe dyeing with disperses dyes should be:-

6.7.3.1. Avoidance of the use of dangerous carriers: Exhaust dying of polyester and polyester blends with carrier free dyeing techniques or with the use of environmentally optimized carriers.

6.7.3.2. The application of High Temperature (HT) dyeing processes avoids the use of carriers.

6.7.3.3. Due to the sensitivity of the wool substrate to high temperatures, it is still necessary to use carriers when dyeing polyester blends. In these cases chlorine-free substances based on benzylbenzoate and N-alkylpthalamide replace hazardous carriers.

6.7.3.4. Dispersing agents with higher bioeliminability in dye formulations:

6.7.3.5. After-treatment in PES dyeing: Using an alternative reducing agent or dyes that can be cleared in alkaline medium by hydrolytic solubilisation, instead of reduction, affords significant water and energy savings, and/or lower oxygen demand in the wastewater.

6.7.4. Measures for dyeing with sulphur dyes should be:-

6.7.4.1. The use of pre-reduced liquid dye formulations having sulfur content of less than 1% or stabilized pre-reduced sulfur-free dyes instead of conventional powder and liquid sulfur paints.

6.7.4.2. The use of sulfur-free reducing materials or sodium dithionite, rather than sodium sulphide.

6.7.4.3. Taking precautions to ensure that the reducing agent (sulphide) is only used at the required level for the reduction of the dye (for example, using nitrogen to flush out the machine and remove oxygen from the air).

6.7.4.4. Hydrogen peroxide is preferred as the oxidant.

6.7.5. Measures for dyeing with reactive dyes should be:-

6.7.5.1. Exhaust dyeing of cellulosic fibres with high-fixation polyfunctional reactive dyestuffs. Bifunctional reactive dyes offer improved levels of fixation in exhaust dyeing, resulting in reduced loss of dye in the effluent.

6.7.5.2. Exhaust dyeing with low-salt reactive dyes:

6.7.5.3. Avoiding the use of surfactants and complexing agents in rinsing and neutralization steps after painting by applying hot rinsing and energy recovery.

6.7.5.4. Main emissions in pad dyeing come from discharge of the residual dyeing liquor in the pad, pumps and pipes at the end of each lot. Reduction of these losses can be achieved by

a) Carrying out the impregnation step in a nip
b) Minimizing the capacity of the dip trough
c) Controlled dosage of the input raw materials
d) Dosing of the padding liquor based on measurement of the pickup.

6.7.5.5. Enzymatic after-soaping in reactive dyeing: In reactive dyeing and printing, unreacted and hydrolyzed dye is removed by a number of soaping and rinsing steps. These contribute significantly to energy, water, and chemical consumption.

6.7.5.6. Silicate-free fixation method for cold pad batch dyeing: Sodium silicate is often used in cold-pad batch dyeing, mainly to increase the pad liquor stability and to avoid selvage carbonization. Use of sodium silicate gives rise to a number of problems, both with the textile surface and the effluent. Silicate-free alternatives are now available.

6.7.6. Measures for wool dyeing with chrome dyes should be:-

6.7.6.1. Chromium-free dyeing of wool: Quite recently, new reactive dyestuffs have been put on the market that can provide levels of fastness comparable to those achievable with chrome dyes.

6.7.6.2. Emission reduction in dyeing wool with complex dyestuffs: In the dyeing of wool fibre and combed tops, in cases where after chrome substitution is not possible, metal complex dyes can be used under optimized conditions (especially pH control).

6.8. Measures for printing should be:-

6.8.1. In rotary screen printing, reduction of losses in print paste.

6.8.2. Reduction of water consumption in cleaning processes.

6.8.3. The use of digital ink-jet printing machines for short production (less than 100 meters) of flat fabrics.

6.8.4. Digital jet printing of carpet and bulky fabric: Jet printing today is a full digital technique, resulting in reduced water consumption, less trial and error and reduction of material losses.

6.8.5. The use, in pigment prints, of printing pastes with low volatile organic carbon emissions (emission value <0.4 g Org.-C/kg textile), that are alkyl phenol (APEO) ethoxylate-free and that are highly biodegradable or have reduced ammonia content (Emission value: 0.6 g NH3/kg of textile).

6.8.6. Urea substitution and/or reduction in reactive printing: The use of single-step printing or two-step printing with controlled moisture addition instead of urea in reactive prints. These results in reduction in the discharge of urea, ammonia, and nitrate.

6.8.7. Reduction of water consumption in cleaning operations: The equipment used around screen printing machines requires careful cleaning before it can be used for new colours. There are several ways of reducing water consumption, as follows:

a) Start/stop control of the printing belt

b) Mechanical removal of printing paste

c) Re-use of the cleanest part of the rinsing water from the cleaning of the squeegees, screens, and buckets

d) Re-use of the rinse-water from the cleaning of the printing belt.

6.9. Measures for finishing should be:-

6.9.1. Minimizing wastewater formation with technique applications such as foam and spraying.

6.9.2. The use of formulas optimized for low air emissions.

6.9.3. Ensuring that chemicals are retained by fiber with 98% efficiency, by using the appropriate material preparation procedures for mothproof processes.

6.9.4. Avoiding batch softening: In batch processing, softening agents are often applied after dyeing, directly in the dyeing machine. This limits the choice of softening agents to environmentally harmful cationic agents and also results in losses.

6.9.5. Alternative techniques are the application of softeners by pad mangles or by spraying and foaming applications. Cationic softening agents can be avoided and chemical losses are reduced.

6.9.6. Formaldehyde-free or formaldehyde-poor easy-care finishing agents: The European eco-label scheme sets a limit of 30 ppm for products that come into contact with the skin. Low-formaldehyde and formaldehyde-free products are available, along with optimized catalysts.

6.9.7. Minimization of energy consumption in stenter frames: It is estimated that in fabric finishing, each textile substrate is treated on average 2.5 times in a stenter (e.g. for heat setting, drying, thermosol processes and finishing). Energy savings are achieved by a number of techniques, as follows:

a) Optimising exhaust airflow through the oven
b) Heat recovery
c) Insulation
d) Choice of heating system (direct and indirect)
e) Burner technology
f) Optimized nozzles and air guidance systems.

6.10. Measures for washing should be:-

6.10.1. Water and energy conservation in batch washing and rinsing: In batch processes typical washing and rinsing techniques include: Drain and fill rinsing and Overflow or “flood” rinsing. Of these, drain and fill is the more efficient.

6.10.2. Water and energy conservation in continuous washing and rinsing: The main efficiency measures are:

a) Water flow control (e.g. water meters, automatic stop valves)
b) Increasing washing efficiency, including counter-current rinsing and reduction of carry-over into the next step
c) Use of heat recovery systems.

6.10.3. Instead of transferring to washing/rinsing processes, employ the use of single tank wash or smart rinse techniques.

6.10.4. Assessment of the cleanliness of the wastewater from relatively cleaner washing rinsing sources.

Annex A
(Informative)
Checklist for Background Information for Cleaner Production Assessment

Type of information	Available	Not available	Requires updating	Not applicable
Process Information				
Process flow diagram				
Material balance data				
Energy balance data				
Site plans				
Drainage diagrams				
Operating procedures*				
Equipment list & specifications				
Regulatory Information				
Waste license(s)				
Trade waste agreement(s)				
Environmental monitoring records				
Enviromental protection agency (EPA) license(s)				
Environmental audit reports				
Raw Material/Production Information				
Material safety data sheets				
Product & raw material inventories				
Production schedules				
Product composition & batch sheets				
Accounting Information				

Waste handling, treatment & disposal costs				
Water & sewer costs				
Product, energy & raw material costs				
Operating & maintenance costs				
Insurance costs				
Benchmarking data				

Annex B
(Informative)

List of toxic and harmful substances used by textile industry

Sr. No.	Textile process	Toxic substance used
1	*Cotton growing*	Banned pesticides such as DDT, Dieldrin, Aldrin etc.
2	*Sizing*	Pentachlorophenol as a preservative
3	*Scouring*	Chlorinated products
4	*Bleaching*	Hypochlorite(chlorine bleaching)
5	*Dyeing and printing*	i Azo-dyes containing aromatic amines ii Dyes containing traces of heavy metals such as arsenic, lead, cadmium, mercury, nickel, copper, chromium, cobalt and zinc iii Formaldehyde as a mordant
6	*Finishing*	Formaldehyde as a cross linking finish, urea formaldehyde as F.R. finish
7	*Garment manufacture*	Stain removers containing chlorinated products
8	*Packaging*	Wooden boxes treated with insecticides.

Annex C
(Informative)

Some of the suggested alternatives in textile processing

Sr.No.	*Chemicals used at present*	*Suggested alternatives*
1	*Chlorine bleaching*	Peroxide bleaching
2	*Benzidine based dyestuffs*	Mineral / pigment dyes
3	*Acetic acid*	Formic acid
4	*Starch based warp sizes*	Synthetic ones like PVA and acrylates
5	*Kerosene in pigment printing*	Synthetic thickness based on poly-carboxylic acids
6	*P/C two-stage dyeing*	Single class dyes like indigsol, pigments
7	*Carding oils and antistatic*	Non-ionic emulsifiers labricants
8	*Formaldehyde*	Polycarboxylic acid method
9	*Pentachlorophenol*	Benzothiazol
10	*Alkylphenol ethoxylate*	Fatty alchoholethoxylates
11	*Sodium sulphide*	Glucose based reducing agent

ANNEX D: (Informative)

Impacts of hazardous substances on human health and environment from textile production processes

Process	*Effect/purpose Description*	*Area of application*	*Chemicals employed*	*Possible impacts on health and environment*
Bleaching	Whitening	All fibres	– Hydrogen peroxide – Sodium hypochloride	– Large quantities of effluent
Optical brightening	Brilliant white	All fibres (white and pastel coloured articles)	– Organic substances	– Skin allergies – Pollution of waters
Dyeing	Diverse range of colours	All fibres	– Diverse dyestuffs – Heavy metals – Carriers	– Skin allergies – Carcinogenic (benzidine dyestuffs, carriers) – Environmental pollution – Large quantities of effluent
High-grade finishing	Prevention of shrinking and creasing	– Cellulosic natural and man made fibres – Blends with synthetics	– Urea formaldehyde – Melamine formaldehyde	– Skin allergies – Strong suspicion of carcinogenic properties – Environmental pollution
Sanforizing	Prevention of shrinking	Cellulosic natural and man made fibres	None, as only mechanical compression is employed	None
Sanforizing, Sanfor plus	Prevention of creasing and shrinking	– Cellulosic natural and man made fibres – Blends with synthetics	– Urea formaldehyde – Melamine formaldehyde	– Skin allergies – Strong suspicion of carcinogenic properties – Environmental pollution
Sanfor setting process	Prevention of creasing and shrinking	Cellulosic fibres	– Ammonia (mechanical compression)	– Environmental pollution by ammonia vapours
Mercerization	Permanent lustre	Cellulosic fibres	–Sodium hydroxide – Ammonia	None known
Abrasion-resistant finish	Increased abrasion resistance	Cellulosic fibres	– Silica gel – Plastic resins	– Large quantities of effluent
Anti-felt finish	Prevention of felting	Wool	– Chlorine – Polyamide – Epichchlorohydrin resin	– Large quantities of effluent
Weighting	Weight increase	Silk	– Stannic chloride – Sodium phosphate – Water glass	– Large quantities of effluent
Hydrophilizing	Faster spreading of water on the surface of fibres	Synthetic fibres	– Polyamide – Polyacrylic-Silicone	– Large quantities of effluent
Waterproofing	Water repellency	All fibres	– Paraffin – Aluminum salts – Zircon salts – Silicone – Fluorocarbon resins	– Fluorocarbon resins may cause disposal problems

Continued …

Process	*Effect/purpose Description*	*Area of application*	*Chemicals employed*	*Possible impacts on health and environment*
Delustring	Prevention of high-gloss finish	Synthetic fibres	– Phenol – Turpentine – Pine oil – Glauber salt – Barium chloride – Alkali sulphide – Chromium salts – Resins containing formaldehyde etc.	– Allergy inducing-In some cases carcinogenic substances – Environmental pollution (heavy metals)
Moth and beetle protection	Indigestible fibres	Wool	– Chlorinated sulphonamide derivatives – Biphenyl ether – Urea derivatives – Pyrethroids	– Weakly bound pyrethroids may cause neurotoxic effects
Antistatic finish	Prevention of electrostatic charging	Synthetic fibres	– Surface-active substances	– Possibly skin allergies
Antipilling finish	Prevention of burls, fluff	Synthetic fibres	– Acrylic polymers – Vinyl polymers	– None known, when no monomers are detectable
Dirt-repellent finish	Prevention of soiling and/or improved dirt removal	Synthetic fibres	– Polymeric fluorocarbon resins	– Disposal problems
Antimicrobial finish	Prevention of mould, athlete's foot, bacteria, body odour	All fibres	– Quaternary ammonium – Biophenols – Biphenyl ethers – Thiobisphenols – Salcyanide derivatives – Ethylene glycol – Chlorometacresols etc.	– Possibly skin allergies – Environmental pollution
Flame-proof finish	Prevention of flame formation	All fibres (protective clothing, floor coverings, decorative fabrics, baby wear)	– Halogenated hydrocarbons – Phosphorous compounds – Zircon and titanium complexes for wool	– Possibly carcinogenic – Allergenic substances
Softening	Improvement of the handle	All fibres	– Quaternary ammonium – Siloxanes – Fatty-acid-modified melamine resins	– Possibly skin allergies
Deodorisation	Pleasant smell	All fibres	– Perfume – Synthetic resinsking and creasing	– Possibly skin allergies

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Ethiopian Standards Agency

Organization and Objectives

The Ethiopian Standards Agency (ESA) is the national standards body of Ethiopia established in 2010 based on regulation No. 193/2010.ESA is established due to the restructuring of Quality and Standards Authority of Ethiopia (QSAE) which was established in 1998.

ESA's objectives are:-

- ❖ Develop Ethiopian standards and establish a system that enable to check whether goods and services are in compliance with the required standards,
- ❖ Facilitat the country's technology transfer through the use of standards,
- ❖ Develop national standards for local products and services so as to make them competitive in the international market.

Ethiopian Standards

The Ethiopian Standards are developed by national technical committees which are composed of different stakeholders consisting of educational institutions, research institutes, government organizations, certification, inspection, and testing organizations, regulatory bodies, consumer association etc. The requirements and/ or recommendations contained in Ethiopian Standards are consensus based that reflects the interest of the TC representatives and also of comments received from the public and other sources. Ethiopian Standards are approved by the National Standardization Council and are kept under continuous review after publication and updated regularly to take account of latest scientific and technological changes. Orders for all Ethiopian Standards, International Standard and ASTM standards, including electronic versions, should be addressed to the Documentation and Publication Team at the Head office and Branch (Liaisons) offices. A catalogue of Ethiopian Standards is also available freely and can be accessed in from our website.

International Involvement

ESA, representing Ethiopia, is a member of the International Organization for Standardization (ISO), and Codex Alimentarius Commission (CODEX). It also maintains close working relations with the international Electro-technical Commission (IEC) and American Society for Testing and Materials (ASTM).It is a founding member of the African Regional Organization for standardization (ARSO).

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