Checklist based on best available techniques in the textile industry

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Checklist based on best available techniques in the textile industry

by

Dr. Norbert Reintjes
ÖKOPOL GmbH Institut für Ökologie und Politik, Hamburg

Dr. Claudia Schafmeister
CS Research, Dachau

Ismene Jäger
Hydrotox GmbH, Freiburg

On behalf of the Federal Environment Agency (Germany)

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Study performed by: ÖKOPOL GmbH
Institut für Ökologie und Politik
Nernstweg 32–34
22765 Hamburg

C S Research
Gottesackerstr. 15
85221 Dachau

Hydrotox GmbH
Bötzinger straße 29
79111 Freiburg

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Wörlitzer Platz 1
06844 Dessau-Roßlau
Germany
Phone: +49-340-2103-0
Fax: +49-340-2103 2285
Email: info@umweltbundesamt.de
Internet: http://www.umweltbundesamt.de
http://fuer-mensch-und-umwelt.de/

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Brigitte Zietlow

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1 INTRODUCTION

The checklist presented here has the objective to support the identification of improvement potential regarding the environmental impact in the textiles industry. It is based on a comprehensive technical analysis of the European textile industry and refers to currently available technologies.

Management based on environmental awareness and improved environmental standards results not alone in a positive impact on environment, health and working place conditions but also on operational costs, product quality and company image.

For the implementation of improvement measures, however, a good knowledge on the state of technology in a given industry sector is crucial. On this basis improvement potential and best available techniques (BAT) need to be identified and set into relation to technical, environmental and economical implications.

In Europe, this knowledge is compiled and regularly updated for several industry sectors in comprehensive documents (**B**est available techniques **ref**erence documents so called BREFs[1]). They derive from a stakeholder dialogue organised by the European Commission involving European industries, environmental non-government organisations and Member States.[2, 3] For the textile industry a BREF has been developed in 2003.[4]

In the BREFs, examples for benchmarks and concrete savings in different process steps are given. Stakeholders in the chain of custody are invited to make use of the knowledge compiled in the BREF documents for their own purpose. These BREF documents are detailed and industry specific sources for ideas on how to improve the production processes in regard of its environmental impact. The measures e.g. aim at

- reducing losses and increasing efficiency in the use of raw materials, chemicals etc.
- increasing product quality and reliability
- reducing the amount of energy need
- reducing the amount of water need
- avoiding or reducing pollution of air and water
- avoiding or reducing the amount of hazardous substances in the products

It has to be mentioned that the described BATs depend on the type of aggregates, products, and processing. Detailed information is given in the BREF chapter 4, section applicability.

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[1] BREF - Reference Document on Best available techniques

[2] The primary objective of the process was the analysis of best available techniques in industry sectors listed in the IPPC Directive (2008/01/EU). The Directive has been replaced by Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (Recast). Official Journal of the European Union 17.12.2010 L 334/17ff.)

[3] Additional information see http://eippcb.jrc.es/reference/

[4] European Commission, July 2003: „Integrated pollution prevention and control (IPPC): Reference document on best available techniques for the textiles industry“.

The motivations for improving the environmental performance of the production process are site specific and may be

- reducing production costs (e.g. via energy/water savings or reduction of operating resources (auxiliaries, chemicals, dyes etc.))
- improving health and working place conditions
- fulfilling national and international legal requirements
- fulfilling requirements within the chain of custody (e.g. brands, trade companies)
- avoiding conflicts with the factory's neighbourhood and/or environmental organisations
- enhancing reputation as „green" company

In a guideline document[5] it is illustrated how BREF documents may contribute to successful environmental management. The now developed checklist's objective is to transfer the knowledge and experiences accumulated in the BREF document for textile industries to an easy applicable instrument in the involved factories. It therefore extracts the suggested best available techniques from the BREF document and translates them into easy-to-answer questions. It is designed to be applied in the textile industries processing steps pretreatment, dying, printing and finishing. Within the companies the checklist targets those individuals responsible for managing daily operations or steering improvement processes. It furthermore addresses consultants and trainers active in the targeted industry.

It is expected that the checklist will not be the only instrument used by the company and staff but be a component in a company specific toolbox. Within this toolbox the checklist can play the role of supporting the analysis of improvement potential. On this basis and with the help of complementary instruments the company should develop specific action plans.

[5] Umweltbundesamt 2011: Environmental standards in the textile and shoe sector: A guideline on the basis of the BREFs – Best Available Techniques Reference Documents of the EU. www.umweltbundesamt.de/uba-info-medien/4128.html

2 CONTENT OF THE CHECKLISTS

The checklist is based on the 2003 version of the BREF for the textiles industries. The BREF is structured in the following chapters:

- Chapters 1 and 2 provide general information on the textile industry and on the industrial processes used within this sector.
- Chapter 3 provides data and information concerning current emission and consumption levels reflecting the situation in existing installations in operation at the time of writing.
- Chapter 4 describes in more detail the emission reduction and other techniques that are considered to be most relevant for determining BAT and BAT-based permit conditions. This information includes the consumption and emission levels considered achievable by using the technique, some idea of the costs and the cross-media issues associated with the technique.
- Chapter 5 presents the best available techniques and the BAT associated emission and consumption levels. The purpose is thus to provide general indications regarding the emission and consumption levels that can be considered as an appropriate reference point to assist in the determination of BAT for the permission of installations. It should be stressed, however, that this chapter does not propose emission limit values

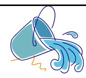
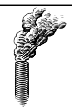
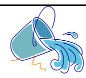
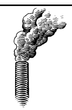
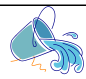
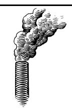
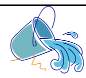
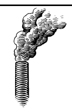
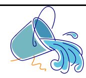
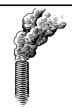
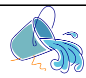
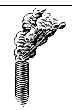
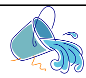
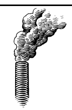
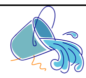
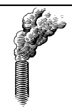
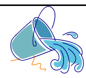
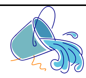
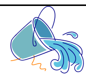
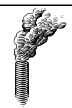
In the checklist presented here all best available techniques compiled in chapter 5 of the BREF are taken into account and dealt with in individual tables.

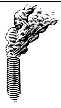
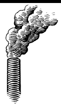
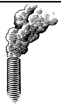
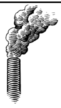
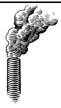
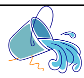
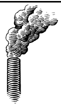
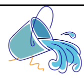
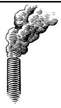
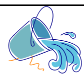
Since a company may only cover parts of the chain of custody and may be specialised on specific processes and/or products not all of the BATs apply to them. Furthermore, the environmental impact addressed by BATs differs. Whereas some are quite general (e.g. BATs on good house keeping), others are very specific. Table 1 helps to identify relevant BATs and sorts the BATs in regard of the impact categories waste water, energy consumption, use of resources (including fresh water), waste and air pollution.[6]

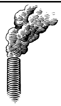
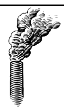
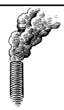
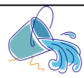
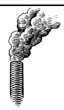
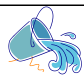
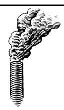
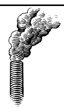
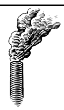
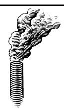
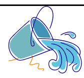
Priorities need to be set site specific, taking into account the particular situation of the factory under consideration. The impact achieved by implementing a particular measure obviously varies depending e.g. on the baseline or the quantities processed. Good housekeeping measures, nevertheless, are again considered as a basis and help implementing continuous and long-lasting improvements.

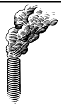
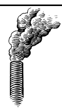
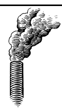
[6] Very often measures have influence on more than one impact category. Only the major impacts are indicated in the table.

Table 1: Topics covered in the checklist in chronological order with indication of process covered and impact categories addressed.

number	measure	process covered					impact categories				
		generic	pretreatment	dyeing	printing	finishing	waste water	energy consumption	use of resources	waste	air pollution
1	**[Generic BAT (whole textile industry)]**										
1.1	**Management/Good housekeeping**										
1.1.1	Input/output streams evaluation / inventory	x	x	x	x	x					
1.1.2	Implementation of environmental awareness and training programmes	x	x	x	x	x					
1.1.3	Good practices for maintenance and cleaning	x	x	x	x	x					
1.1.4	Storage and handling of chemicals	x	x	x	x	x					
1.2	**Dosing and dispensing of chemicals** (excluding dyes)	x	x		x	x					
1.3	**Selection & use of chemicals**										
1.3.1	General principles	x	x	x	x	x					
1.3.2	Surfactants	x	x	x	x						
1.3.3	Complexing agents	x	x	x							
1.3.4	Antifoaming agents	x		x							

number	measure	process covered					impact categories				
		generic	pretreatment	dyeing	printing	finishing	waste water	energy consumption	use of resources	waste	air pollution
											
1.4	**Selection of incoming fibre raw material**	x	x								
1.5	**Washing**	x	x	x	x						
1.6	**Water and energy management**	x	x	x	x						
1.7	**Management of waste streams**	x									
2	**Process-integrated measures for unit processes and operations** **Textile finishing and carpet industry**										
2.1	**Pretreatment**										
2.1.1	Removing knitting lubricants from fabric		x								
2.1.2	Desizing for cotton and cotton blends		x								
2.1.3	Bleaching		x								
2.1.4	Mercerising		x								
2.2	**Dyeing**										
2.2.1	Dosage and dispensing of dye formulations			x							
2.2.2	General BAT for batch dyeing processes			x							

number	measure	process covered					impact categories				
		generic	pretreatment	dyeing	printing	finishing	waste water	energy consumption	use of resources	waste	air pollution
											
2.2.3	BAT for continuous dyeing processes			x							
2.2.4	PES & PES blends dyeing with disperse dyes			x							
2.2.5	Dyeing with sulphur dyes			x							
2.2.6	Batch dyeing with reactive dyes			x							
2.2.7	Pad-batch dyeing with reactive dyes			x							
2.3	**Printing**										
2.3.1	Process in general				x						
2.3.2	Reactive printing				x						
2.3.3	Pigment printing				x						
2.4	**Finishing**										
2.4.1	Process in general					x					
2.4.2	Easy-care treatment					x					
2.4.3	Softening treatments					x					

number	measure	process covered					impact categories				
		generic	pretreatment	dyeing	printing	finishing	waste water	energy consumption	use of resources	waste	air pollution
											
3	**Effluent treatment**										
3.1	**Effluent/Waste water treatment**	x									
3.1.1	Effluent treatment in the textile finishing and carpet industry	x									
4	**Wool**										
4.1	**Selection of incoming fibre raw material**	x	x								
4.2	**Process integrated measures for unit processes and operations**										
4.2.1	Wool scouring		x								
4.2.1.1	Wool scouring with water		x								
4.2.1.2	Scouring with organic solvent		x								
4.2.2	Wool dyeing			x							
4.2.3	Wool finishing					x					
4.2.3.1	Mothproofing treatments in carpet industry					x					
4.3	**Effluent treatment and waste disposal**										
4.3.1	Effluent treatment in the wool scouring sector (water-based process)	x									
4.3.2	Sludge from waste water treatment of wool scouring effluent	x									

3 HOW TO USE THE CHECKLIST

Table 1 gives an overview over the BATs addressed in the checklist and refers to the detailed tables (in the electronic version with a hyperlink). These tables guide the user via questions (see explanation and illustration below).

(**1**) Headers are directly related to the structure of the BREF.

(**2**) A clear reference helps to follow directly to the BREF.

(**3**) Symbols indicate the impact category addressed by the measure.

(**4**) A literal copy of the measure is given.

(**5**) A justification for the BAT explains the purpose and the benefits of applying the BAT.

(**6**) In the core table for each BAT the user is guided by questions on 2-3 levels. The higher level question enters into the topic.

(**7**) and (**8**) They are amended with lower level questions giving more details. Consequently, lower level questions only need to be answered in case the answer to the higher level question indicates the necessity. In the example below, the question on raw materials/substrates only is relevant if the user positively answered the higher level question on having listings of input streams.

(**9**) In footnotes additional and important information is given.

(**10**) For all questions the user may answer by yes/no/partly or not applicable.

(**11**) He furthermore finds a field for own remarks.

(**12**) In the last columns the user may indicate whether he deems a follow-up appropriate.

(**13**) For the entire BAT he may indicate whether a follow-up seems appropriate by ticking a box besides the title of the BAT on top of the page. These tick-boxes are included in order to help identifying potential fields of activity and setting up a site and situation specific action plan.

If units are given, these are of indicative nature only. The user may of course deviate by applying the units commonly used in his individual context.

(1)	**1 Generic BAT** (whole textile industry)
	1.1 Management / Good housekeeping

(2)	**1.1.1 Input / output streams evaluation / inventory** See BREF chapters 4.1.2 and 5.1 (3)	Follow (13)
(4)	BAT is to implement a monitoring system for process inputs and outputs (both on-site and on-process level), including 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)	**BENEFITS: A good knowledge of the process inputs and outputs is a prerequisite for identifying priority areas and options for improving environmental performance.**	

	Details	Status (10)				Remarks (11)	Follow (12)	
		yes	no	partly	not appl.		yes	no
(6)	**Do you have listings of input streams?**							
(7) (8)	Are the raw materials / substrates listet? *Kind and quantity [t/a]?* *Make-ups [%]?*							

	Details	Status (10)				Remarks (11)	Follow (12)	
		yes	no	partly	not appl.		yes	no
(7) (8)	Are the chemicals / textile auxiliaries listed? Kind and quantity [kg/a]? If **yes**, what kind of listings exist? *Auxiliaries and finishing agents for fibres and yarns?* *Pretreatment agents?* *Textile auxiliaries for dyeing and printing?* *Finishing assistants?* *Technical auxiliaries for multipurpose use in the textile industry?* *Basic chemicals?* [1] *Dyestuffs and pigments?*							

(9) [1] all inorganic compounds, all aliphatic organic acids, all organic reducing and oxidising agents, urea

4 GET AN OVERVIEW OF YOUR SYSTEM

A good knowledge of the process inputs and outputs is a prerequisite for identifying priority areas and options for improving environmental performance. Therefore it is beneficial to implement a monitoring system for process inputs and outputs, including inputs of raw material, operational resources (auxiliaries, chemicals, dyes etc.), energy and water, and outputs of product, waste water, air emissions, sludge, solid wastes and by-products. Ideally, this input/output analysis is done on the level of the entire factory (on-site) as well as for individual processes.

All environmental impacts are directly related to mass flows. For controlling and better performance quality and quantity of the streams should be known as exactly as possible. High energy consuming aggregates or processes, high water consuming processes, processes with high impacts on waste water or off-gas can be detected directly. When analysing the production process, the checklist can be a potential help to solve the difficulties. For example: exceeding values of the COD load of the waste water are observed. If you have an input/output- mass flow sheet, the source can be localized directly (e.g. desizing). In this case solutions can be found in chapter 2.1.2 of the textile checklist.

In case such a monitoring system has not yet been implemented, the scheme in Figure 1 and the checklist on Management/Good housekeeping are a first step of structuring the process. Within the factory, processes with particular high in- or output can be identified. The results may indicate hot spots and savings potential e.g. that a particular process consumes by far more energy than another one. Focusing on measures to reduce energy consumption in this particular process may be a conclusion.

Understanding input/output streams may, however, be seen as a set of different elements. The entire picture results from many details. Where it is best to start compiling information depends on the individual situation. Besides trying to get an overview over the entire system it may thus also make sense to analyse

- individual processes
- individual machines/production lines

processes per individual product

- processes per batch
- processes for smaller time scales than a year
- the process using other units and indicators (e.g. weight/time)

Another approach than comparing processes within the own factory is to set the results obtained into relation with the ones compiled in similar sites. A question may be e.g. how high the COD load in waste water is in comparison to other factories. For such orientation benchmarks for environmental indicators for particular technical processes are compiled. Sources for such benchmarks may be

- chapter 3 „Emission and consumption levels" in the respective BREF
- specifications of brands, eco-labels etc.
- requirements of public authorities

- Environmental Health & Safety Guidelines (EHSG)[7]

Based on the described first analysis priorities for action may already become obvious and focus areas for additional analysis can be identified.

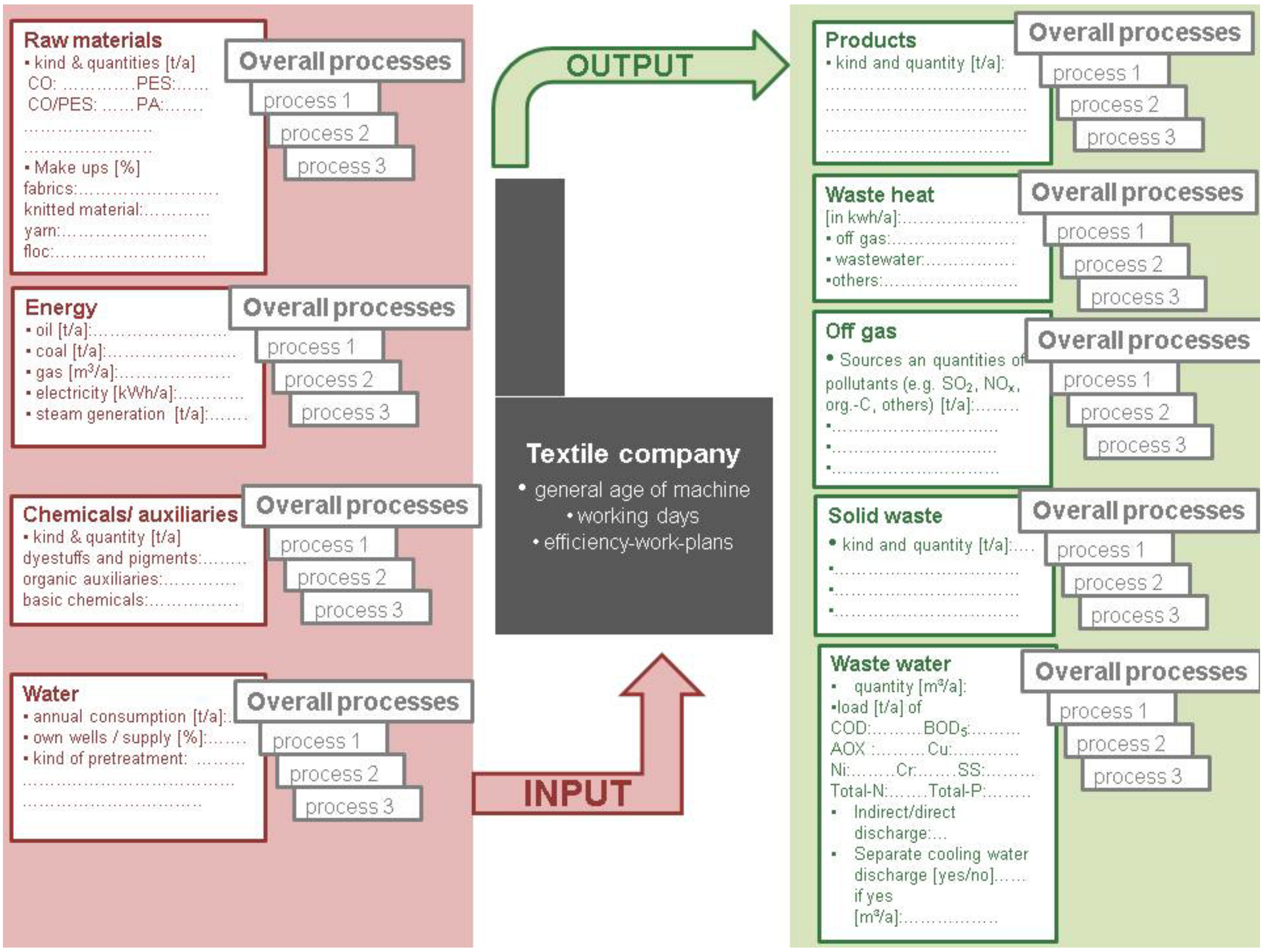


Figure 1: Input/Output analysis

[7] Source: http://www.ifc.org/ifcext/sustainability.nsf/Content/EHSGuidelines respective http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_TextilesMfg/$FILE/Final+-+Textiles+Manufacturing.pdf

5 TABLE OF MEASURES FOR FOLLOW-UP

While applying the checklist the user may find the template given in Table 2 helpful to list the measures he deems appropriate for follow up.

Table 2: Template for a table of measures that the user deems appropriate for follow-up.

number	measure	priority	who	when

6 GLOSSARY

The following glossary explains technical terms and abbreviations used in the checklist.

Airflow	Similar to a “jet” but with the impulse of a mixture of air and dye solution, which allows a more delicate treatment of the fabric. Water consumption is greatly reduced since only the necessary amount of dye is added, eliminating the concept of bath accumulation.
Adsorbable Organic Halogens (AOX)	A measure of the adsorbable organically bound halogens in water. The analytical test consists in adsorbing the organic substances contained in the water sample on activated charcoal (halogen-free). The charcoal is then eluted with sodium nitrate solution to completely remove chloride ions (non-organically bound halogen). Afterwards, the charcoal is burned in a stream of oxygen and the resultant hydrogen chloride is quantitatively determined. Only chlorine, bromine and iodine (not the ecologically important fluorine compounds) are determined with this analytical method. Bromine and iodine are calculated as Cl. The analytical values are expressed as AOX in: - mg Cl/l of water or - mg Cl/g of substance
Aquatic toxicity	A measure of the effects of a given pollutant on aquatic life. The most common parameters are: IC10 = inhibition concentration of bacterial growth (10 % inhibition). Concentrations above the IC10 value may strongly affect the efficiency of a biological treatment plant or even completely poison the activated sludge. LC50 = lethal concentration (50 % mortality). It is used for fish and represents the water concentration at which a given substance causes the mortality of 50 % of the population. EC50 = effect concentration (50 % effect). It is used for particularly sensitive organisms such as daphnia and algae. The level of aquatic toxicity of a given pollutant is defined as follows: - highly toxic: <0.1 mg/l - very toxic: 0.1 - 1 mg/l - toxic: 1.0 - 10 mg/l - moderately toxic: 10 - 100 mg/l - non toxic: >100 mg/l
Auxiliary	A textile auxiliary is a preparation of chemical substances, mostly delivered in an aqueous solution (e.g. softening agents, repellents, antimicrobial finishing agents containing biocides etc.) used in finishing processes.
Basic chemical	Chemicals as dyes, acids, salts and oxidizing and reducing agents
Biochemical Oxygen Demand (BOD)	A measure of the oxygen consumed by bacteria to biochemically oxidise organic substances present in water to carbon dioxide and water. The higher the organic load, the larger the amount of oxygen consumed. As a result, with high organic concentrations in the effluent, the amount of oxygen in water may be reduced below acceptable levels for aquatic life. BOD tests are carried out at 20 °C in dilute solution and the amount of oxygen consumed is determined after 5, 7 or, less commonly, 30 days. The corresponding parameters are called BOD_5, BOD_7 and BOD_{30}.The analytical values are usually expressed in: - mg O_2/l (effluent) or - mg O_2/g (substance)
Biodegradability	A measure of the ability of an organic substance to be biologically oxidised by bacteria. It is measured by BOD tests (OECD tests 301 A to F) and relates to the biodegradation mechanisms taking place in biological waste water treatment works. It is usually expressed in % (of the substance).

Bioeliminability	A measure of the ability of an organic substance to be removed from the effluent as a consequence of all elimination mechanisms that can take place in a biological plant (including biodegradation). It is measured by the bio-elimination test OECD 302 B, which determines the total effect of all elimination mechanisms in a biological treatment plant: - biodegradation (measured over a long period - up to 28 days - in order to account for the biodegradation of substances that necessitate the development of specially acclimatised bacteria capable of digesting them) - adsorption on activated sludge - stripping of volatile substances - hydrolysis and precipitation processes It is usually expressed in % (of the substance).
Bleaching agent	The active substance providing the bleaching effect. The bleaching agent is formed/produced by activating the bleach.
Chemical Oxygen Demand (COD)	A measure of the amount of oxygen required to chemically oxidise organic and inorganic substances in water. COD tests are carried out at ca. 150 ºC in the presence of a strong oxidant (usually potassium dichromate). To evaluate the oxygen consumption, the amount of chromium VI reduced to chromium III is determined and the obtained value is converted into oxygen equivalent. The analytical values are usually expressed in: - mg O_2/l (effluent) or - mg O_2/g (substance).
Desizing	Removal of size material from greige (gray, raw) goods to prepare for bleaching, dyeing, etc. As man-made fibres are generally sized with water-soluble sizes, removal is usually done by hot water wash or in the scouring process. Natural fibres are most often sized with water-insoluble starches or mixtures of starch and other materials. Desizing is often conducted through the use of enzymes capable of breaking starches into water soluble sugars. Sugars are then removed by washing before fabric scouring.
Dye	The formulation (commercial product) containing the dyestuff together with other dyeing auxiliaries
Dye carrier	A compound used to increase the rate of dye uptake and diffusion at a given temperature
Dyestuff	The colouring agent in the dye formulation: a planar molecule which contains chromophoric group(s) capable of interacting with light
Dyeing	Dyeing is the application and fixation of a dye to a substrate. The textile industry uses several dyeing techniques (e.g. yarn package dyeing, piece dyeing, spray dyeing, top [stock] and hank [skein] dyeing) and machines (e.g. winch, jet, paddle, overflow) to dye the fabric through a liquor. Dyeing is conducted in the textile manufacturing plant or by specialty dyehouses
Finishing	This term can address both the sequence of wet treatments that are carried out to give the fibre the required colour and final properties, and any specific operation to apply functional finishes (easy-care, anti-felting, mothproofing agents, etc.)
Finishing agent	A compound added to textiles after dyeing or bleaching to modify a physical or chemical characteristic of the textile
Fixation efficiency	Ratio of the dye fixed on the fibre to the dye exhausted from the bath
Fixation rate	Ratio of the dye fixed on the fibre to the total dye applied
Foulard	Universal application device that is used to impregnate the textile material with any liquid
Hazardous substances	Substances or groups of substances that have one or several dangerous properties such as toxicity, persistence and bioaccumulability, or are classified as dangerous to humans or environment according to REACh Ordinance (former EU - Directive 67/548 (Dangerous Substances Directive)); e.g. CMR substances
Liquor pick-up	Mass of padding liquor [kg] impregnated to the textile per mass of textile to be impregnated [kg] x 100 %

Liquor ratio	Mass of textile [kg] to be dyed per volume of water used in dye bath [l]
Mercerising	A process given to cotton yarns and fabric to increase lustre, improve strength and dye ability. Treatment consists of impregnating fabrics with cold concentrated caustic soda solution under tense stress
Overflow	The fabric and the bath are in motion. As in the case of the "jets", the bath acts on the fabric, but in this case, the fabric is dragged by a winder and not just by the action of the nozzle. It is usually used for the dyeing of many types of fabric in rope form, from the most resistant to delicate fabrics.
Padding	Impregnation of the textile in a padding machine (foulard) and removal of the liquor surplus by means of a squeeze roller
Pad-steam	This machine applies a steaming to a dye impregnation in a "foulard" machine. In this way, the dye is fixed on the fibre in a short period of time. It is often used in the dyeing of cellulosic fibres
Pretreatment	Pretreatment (also known as preparation) of dyed, printed, or finished fabrics consists of a series of treatment and rinsing steps, which are critical for the results in subsequent textile finishing processes. Pretreatment processes should ensure a) the removal of foreign materials from the fibres in order to improve their uniformity, b) hydrophilic characteristics and affinity for dyestuffs and finishing treatments, c) the improvement of the ability to absorb dyes uniformly (which is the case in mercerising), d) the relaxation of tensions in synthetic fibres (without this relaxation of tension, unevenness and dimension instabilities can occur). Typical pretreatment processes are singeing, desizing, scouring, mercerisation, bleaching.
Printing	Printing produces designs or motifs on the fabric by applying a colorant or other reagent, usually in a paste or ink. Techniques include screen printing (in which a print paste is forced through a mesh, in contact with the substrate), sublimation printing (in which dyes that sublime readily are applied), and ink-jet printing.
Scouring	Removal of natural and acquired impurities from fibres, yarns, or fabrics through washing in alkaline solutions
Sizing	Sizing involves applying sizing compounds to warp yarn to bind the surface fibre together and protect the yarn against abrasion during weaving. The primary sizing compounds include starch, gelatin, oil, wax and manufactured polymers (such as polyvinyl alcohol, polystyrene, polyacrylic acid, and polyacetates).

7 DETAILED CHECKLIST

1 Generic BAT (whole textile industry)

1.1 Management

1.1.1 Input/output streams evaluation/inventory

Follow

See BREF chapters 4.1.2 and 5.1

BAT is to implement a monitoring system for process inputs and outputs (both on-site and on-process level), including inputs of textile raw material, chemicals, heat, power and water, and outputs of product, waste water, air emissions, sludges, solid wastes and by-products.

BENEFITS: A good knowledge of the process inputs and outputs is a prerequisite for identifying priority areas and options for improving environmental performance.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you have listings of input streams?							
Are the raw materials/ substrates listed? *Kind and quantity [t/a]?* *Make-ups [%]?*							
Are the chemicals/textile auxiliaries listed? *Kind and quantity [kg/a]?* If **yes**, what kind of listings exist? *Auxiliaries and finishing agents for fibres and yarns?* *Pretreatment agents?*							

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Textile auxiliaries for dyeing and printing? *Finishing assistants?* *Technical auxiliaries for multipurpose use in the textile industry?* *Basic chemicals?* [8] *Dyestuffs and pigments?*							
Do you have all up-to-date Material Safety Data Sheets? *If **not**, ask your supplier.*							
Do you have forms for the listing of characteristics of auxiliaries etc.?							
Do you list the energy sources? *Oil [t/a]?* *Coal [t/a]?* *Gas [m³/a]?* *Electricity [kWh/a]?* *Steam generation [t/a]?*							
Do you measure the water consumption? *At site level?* *At specific process level/ aggregates?* *Do you have own wells?* *Do you have any kind of water pretreatment?*							

[8] all inorganic compounds, all aliphatic organic acids, all organic reducing and oxidising agents, urea

Do you have listings of output streams?							
Are the ready-made products listed? *Kind and quantity [t/a]?*							
Do you measure the waste *Water?* *Quantity?* *Load?*[9] *Indirect/direct discharge?* *Separate cooling water discharge?*							
Do you measure the solid waste? *Kind and quantities [t/a]?* *Do you segregate waste streams?* *Do you recycle certain waste streams?*							
Do you measure the off gas? *Sources and quantities?*[10]							
Do you measure the waste heat? *Off gas?* *Waste water?* *Others?*							

[9] COD, BOD_5, AOX, Cu, Ni, Cr, Total-N, Total-P[9], SO_2, NO_x, org. C, others

[10] SO_2, NO_x, org. C, others

1.1 Management	
1.1.2 Implementation of environmental awareness and training programmes See BREF chapters 4.1.1 and 5.1	**Follow**
BAT is to implement environmental awareness and include it in training programmes.	
BENEFITS: The success of management and good housekeeping measures is largely dependent on information and communication at company level. Staff training is an important element of environmental management. All staff should understand clearly the precautions needed to avoid resource wastage and pollution.	

Details	**Status**				**Remarks**	**Follow**	
	yes	no	partly	not appl.		yes	no
Does the senior management have a clearly expressed commitment to environmental improvement?							
Do you have an environmental policy?							
Do you have a strategy to implement your policy?							
Is it available to all staff?							
Do you train/educate your staff?							
Are the responsibilities for organizing and training established?							

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Is the training organized and fixed in the daily routine? *How often do you train your staff?*							
Is the training resource-[11] process- and machinery-specific?							

[11] chemicals, fibres, energy, water

1.1 Management

1.1.3 Good practices for maintenance and cleaning

See BREF chapters 4.1.1 and 5.1

Follow

BAT is to apply good practises for maintenance and cleaning.

BENEFITS: Machinery, pumps and pipe work (including abatement systems) should be well maintained and free from leaks. These measures results not only in savings in the consumption of chemicals, auxiliaries, fresh water and energy, but also in production time.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Are regular maintenance schedules established, with all procedures documented?							
Are the most significant components of the machinery[12] included in a maintenance checklist? *Are all aggregates included?*							
Do you conduct audits for broken and leaking pipes, drums, pumps and valves? *In the water/steam system?*[13] *From the oil heat transfer?* *From chemical dispensing systems?* *In compressed air systems?*[14]							

[12] pumps, valves, level switches and pressure and flow regulators

[13] Not only visible steam leakages must be corrected but also the invisible parts of the system must be checked.

[14] Compressed air is by far the most expensive form of energy.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you check and clean your filters regularly?							
Do you calibrate your measuring equipment?[15]							
Do you clean and maintain your thermal treatment units (e.g. stenters) regularly? *How long is the time period?*[16] *Does it include cleaning deposits from the exhaust gas conducting system and from the intake system of the burner air inlet?*							

[15] Chemical measuring and dispensing devices, thermometers etc.

[16] It should be at least once a year.

1.1 Management

1.1.4 Storage and handling of chemicals

Follow

See BREF chapters 4.1.1 and 5.1

BAT is to store each chemical according to the instructions given by the manufacturer in the Material Safety Data Sheets and follow the indications given in the horizontal BREF on Storage.

BENEFITS: Safety aspects and improved working place conditions are the main benefits.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Is each chemical stored according to the instruction given by the manufacturer in the Material Safety Data Sheet? Do you have all up-to-date safety data sheets?[17]							
Are all areas, where chemicals are stored or spillages are likely to occur, bunded? Do storage areas provide proper ventilation and soil protection? Is it impossible for spillage to enter surface waters or sewers?							
Are appropriate containers used?							
Are all containers labelled appropriately?							

[17] If not, ask your supplier.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Are toxic and dangerous[18] chemicals stored separately?[19]							
Do you have appropriate storage areas for waste?							
Do you have Material Safety Data Sheets for all chemicals and preparations used and stored on site available and easily accessible?							
Are first aid facilities available?							
Do you have contingency plans? Are evacuation and emergency procedures in place and rehearsed regularly?							
Do you monitor the operation of end-of-pipe abatement measures?							
Do you have clean-up materials readily available for dealing with spillages?							
Do you have efficient capture of waste water from clean-up operations?							
Do you have records of accidents and incidents (near-misses)?							

[18] Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances (CLP Regulation)
[19] More details on these issues will be found in the horizontal BREF on Storage.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you check the transfer of chemicals from storage to machine which are often prone to leakage or spillage?							
Are the pumps and pipe work used for transfer regularly inspected?[20]							
Are there provisions made to ensure the safety of manual transfer?							
Does it include appropriate training of workers, use of buckets with leak-proof lids, etc.?							

[20] see “1.1.3 Good practices for maintenance and cleaning” above

1.2 Dosing and dispensing of chemicals (excluding dyes)

See BREF chapters 4.1.1, 4.1.3 and 5.1	Follow

BAT is to install automated dosing and dispensing systems which meter the exact amounts of chemicals and auxiliaries required and deliver them directly to the various machines through pipe work without human contact.

BENEFITS: An automated chemical dosing and dispensing system offers some important advantages over the manual method: control of the process allows for improved right-first-time performance, which means minimising corrective measures such as reworks, redyes, stripping and shade adjustment; significant reduction of waste water pollution and wasted chemicals thanks to the minimisation/avoidance of liquor residues; minimises the chance of worker injury when handling hazardous chemicals, etc.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Have you installed an automatic dosing and dispensing system?							
If **yes,** is it fully automatic?							

1.3 Selection & use of chemicals	
1.3.1 General principles See BREF chapters 4.1.1, 4.3.2 and 5.1	**Follow**
BAT is to follow certain general principles in selecting chemicals and managing their use: · where it is possible to achieve the desired process result without the use of chemicals, avoid their use altogether · where this is not possible, adopt a risk-based approach to selecting chemicals and their utilisation mode in order to ensure the lowest overall environmental risk	
BENEFITS: Minimisation/optimisation of chemicals used results in savings in the consumption of chemicals and auxiliaries, and the minimisation of pollution loads in waste water and off-gas.	

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you regularly revise the recipes in order to identify unnecessary chemicals (dyes, auxiliaries) so that they can be avoided?							
Do you give preference in the selection of auxiliaries and chemicals to products with a low degree of environmental impact?[21]							
Do you optimise the process by improving the control of process parameters such as temperature, chemical feed, dwell times, moisture (for dryers), etc.?							

[21] high degree of biodegradability / bioeliminability, low human and ecological toxicity, low volatility and low smell intensity (see chapter 4.3.2)

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you use 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?							
Do you avoid/minimise any kind of surplus of applied chemicals and auxiliaries?[22]							
Do you optimise scheduling in production?[23]							
Do you give preference to low add-on devices for chemicals?							
Do you re-use mother-baths whenever possible?							
Do you recover vapour during delivery of volatile substances?							
Do you fill tanks with volatile compounds using the following precautions: · **use of vapour balancing lines that transfer the displaced vapour from the container being filled to the one being emptied?** · **bottom loading to avoid splashing (for larger tanks)?**							

[22] e.g. by automated dosing and dispensing of chemicals

[23] e.g. in dyeing: dyeing dark shades after pale shades reduces water and chemicals consumption for machine cleaning

1.3 Selection & use of chemicals

1.3.2 Surfactants

Follow

See BREF chapters 4.3.3 and 5.1

BAT is to substitute alkylphenol ethoxylates (APEO) and other hazardous surfactants with substitutes that are readily biodegradable or bioeliminable in the waste water treatment plant and do not form toxic metabolites.

BENEFITS: The use of APEO-free auxiliaries produces a reduction of the amount of potentially toxic substances in the receiving water. Moreover, the substitution of non-bioeliminable surfactants will result in improved treatability of the effluent.

Details	**Status**				**Remarks**	**Follow**	
	yes	no	partly	not appl.		yes	no
Do you check the Material Safety Data Sheets of your surfactants if they are APEO-free?[24]							
Do you check the Material Safety Data Sheets of your surfactants if they are readily biodegradable?[25]							
Do you check the Material Safety Data Sheets of your surfactants if they are readily bioeliminable?[26]							

---

[24] If you have no information, ask your supplier.

[25] Substances are considered readily biodegradable if in a 28-day period, with ready biodegradation studies (OECD 301 A-F), the following levels of degradation are achieved (values based on description in chapter 4.3.3) :

- for tests based on dissolved organic carbon (e.g. OECD tests 301 A, 301 E): ^{3} 70 % DOC reduction or
- for tests based on oxygen depletion or carbon dioxide generation (e.g. OECD test 301 B): ^{3} 60 % (of theoretical maxima)

[26] Substances are considered bioeliminable if the following levels of degradation are achieved (values based on description in chapter 4.3.3):

- OECD test 302 B, DOC reduction ^{3} 70 % in 28 days or
- OECD test 302 B, DOC reduction ^{3} 80 % in 7 days if an adapted “inoculum” is used in the treatment plant where the substance is treated

1.3 Selection & use of chemicals

1.3.3 Complexing agents

Follow

See BREF chapters 4.3.4, 4.5.6 and 5.1

BAT is to avoid or reduce the use of complexing agents in pretreatment and dyeing processes by a combination of

softening of fresh water; using a dry process to remove coarse iron particles from the fabric (before bleaching) (see chapter 4.5.6); removing the iron that is inside the fibre using acid demineralisation (before bleaching), or better, non-hazardous reductive agents (see chapter 4.5.6); applying hydrogen peroxide under optimal controlled conditions (see chapter 4.5.6) and

selecting biodegradable or bioeliminable complexing agents (see chapter 4.3.4)

BENEFITS: With the proposed techniques it is possible to bleach cellulose without damage to the fibre with:

- **no use of hazardous sequestering agents**
- **minimal consumption of peroxide (<50 % compared with uncontrolled conditions)**
- **(pre-)oxidation of the removed substances**

New complexing agents improve biodegradability of the final effluent and reduce risk of remobilisation of the heavy metals from sediments.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you try to avoid or reduce the use of complexing agent in pretreatment and dyeing processes by a combination of the following measures?							
Do you remove the iron and the hardening alkaline-earth cations from the process water?[27]							

[27] Magnesium hydrate has a stabilising effect and techniques that remove transition metals and calcium are therefore preferred.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
If you start the process with an oxidative scouring/ desizing step, do you remove rust or coarse iron particles on the surface of the fabric by using magnetic detectors/magnets?[28]							
Do you remove non ferromagnetic particles by acid demineralisation? *If **yes**, can you substitute this process for a reductive/extractive treatment before bleaching?*[29]							
If you bleach with hydrogen peroxide, do you control the process conditions?[30]							
If you have to use complexing agents, do you select them with regard to biodegradability or bioeliminability (see chapter 4.3.4)?							

[28] Modern continuous lines are equipped with magnetic detectors. The previous removal of coarse iron particles is not necessary when an alkaline scouring treatment is carried out as a first step before bleaching.

[29] Reductive treatment means that there is no need to use strong corrosive acids. Moreover, with the new non-hazardous reductive agents (see chapter 4.6.5), it is possible to avoid a drastic change of pH.

[30] Fully automated equipment is necessary for the application of hydrogen peroxide under controlled process conditions.

1.3 Selection & use of chemicals

1.3.4 Antifoaming agents

Follow

See BREF chapters 4.3.5, 4.6.21, 4.6.22 and 5.1

BAT is

- to minimise or avoid their use by:
  - Ø using bath-less air-jets, where the liquor is not agitated by fabric rotation (see chapter 4.6.21)
  - Ø re-using treated bath (see chapter 4.6.22)
- to select anti-foaming agents that are free from mineral oils and that are characterised by high bioelimination rates (see chapter 4.3.5))

BENEFITS: Using antifoaming agents, often based on mineral oils (hydrocarbons), charge the waste water and off-gas. Minimization or avoidance of their use or substitution by mineral oil-free defoamers results in a better environmental performance.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Can you minimize/avoid the use of antifoaming agents by · **using bath-less air-jets?** · **re-using treated bath?**							
If no, can you substitute them?[31]							

[31] Account must be taken that: silicones are eliminated only by abiotic processes in waste water; restrictions in the use of silicones in some sectors (automotive industry) have to be considered; tributylphosphates are odour-intensive and strongly irritant; high molecular-weight alcohols are odour-intensive and cannot be used in hot liquors.

1.4 Selection of incoming fibre raw material	
See BREF chapters 4.2.1, 4.2.2, 4.2.4, 4.2.5, 4.2.7, 4.2.8, and 5.1	**Follow**
BAT is to seek collaboration with upstream partners in the textile chain in order to create a chain of environmental responsibility for textiles.	
BENEFITS: Textile manufacturers are not well informed by their suppliers about the quality and quantity of substances (e.g. preparation agents, pesticides, knitting oils) applied on the fibre during the upstream processes. But the knowledge of these characteristics is essential to enable the manufacturer to prevent and control the environmental impact resulting from these substances.	

Details	**Status**				**Remarks**	**Follow**	
	yes	no	partly	not appl.		yes	no
Do you get information concerning your raw materials?							
Do you get it automatically? *In a written form like a goods/ part identification tag?*							
Do you have your own system to get information about the raw materials? *Is it established in a management system?* *Is it established in the purchasing department?*							

What kind of information do you get for **synthetic fibres**? *Do you get information about kind and amount of the preparation agents[32]?* *Do you ask your supplier for using resource conserving agents?* *Do you get information about kind and amount of monomers, metals in the fibres?*							
What kind of information do you get for **cotton**? *Do you know what kind of sizing agent is applied?[33]* *Do you know the amount of sizing agent applied?[34]* *Do you get information about possible contamination of the fibre material with the most hazardous chemicals such as PCP?[35]* *Is it possible to use organically grown cotton?*							

[32] BAT is to select material treated with low-emission and biodegradable/ bioeliminable preparation agents (see chapter 4.2.1)

[33] BAT is to select material with high-efficiency bioeliminable sizing agents (see chapter 4.2.4)

[34] BAT is to select material sized with low add-on techniques (pre-wetting of the warp yarn, see chapter 4.2.5)

[35] PCP: pentachlorophenol

What kind of information do you get for **wool**? *Do you get information about possible contamination of the fibre material with the most hazardous chemicals such as OC pesticides residues?*[36] *Do you get information about minimisation of ectoparasiticides on sheep?*[37] *Can you select wool yarn spun with biodegradable spinning agents instead of formulations based on mineral oils and/or containing APEO?*[38]							

[36] BAT is to use available information to avoid processing fibre material contaminated with the most hazardous chemicals such as OC (organochlorine) pesticides residues (see chapter 4.2.7)

[37] BAT is to minimise at source any legally used sheep ectoparasiticides by encouraging the development of low pesticide residue wool by continuing dialogue with competent bodies responsible for wool production and marketing in all producing countries (see chapter 4.2.8)

[38] BAT is to select wool yarn spun with biodegradable spinning agents instead of formulations based on mineral oils and/or containing APEO (see chapter 4.2.2)

1.5 Washing

Follow

See BREF chapters 4.9.1, 4.9.2, 4.9.3 and 5.2.2

BAT is

- to substitute overflow washing/rinsing with drain/fill methods or “ smart rinsing” techniques as described in chapter 4.9.1
- to reduce water & energy consumption in continuous processes by
  - Ø installing high-efficiency washing machinery (see chapter 4.9.2)[39]
  - Ø introducing heat recovery equipment

when halogenated organic solvent cannot be avoided[40], to use fully closed-loop equipment[41] (see chapter 4.9.3). It is essential that the solvent scouring equipment fulfil the requirements described in chapter 4.9.3.

BENEFITS: “Smart rinsing” and “rapid drain & fill” offer great potential advantages not only in terms of efficient use of water and energy, but also in allowing shorter production cycles, and thereby a reduction in total production costs. All measures described contribute to overall reduction of water and energy consumed.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you use overflow washing/rinsing?							
If yes, **can you substitute it by** **the drain and fill method[42]** **Do you install special time-saving devices as** **power draining and filling**							

[39] The associated values for high-efficiency continuous washing of cellulosic and synthetic fabric in open-width are reported in chapter 4.9.2, Table 4.38.

[40] e.g. with fabrics that are heavily loaded with preparations such as silicone oils that are difficult to remove with water

[41] It is essential that the equipment fulfil the requirements described in chapter 4.9.3 and provisions be taken for in-loop destruction (e.g. by advanced oxidation processes) of the persistent pollutants in order to avoid any possible contamination of groundwater arising from diffuse pollution and accidents.

[42] As far as the drain & fill method is concerned, by replacing each overflow rinse by 2 - 4 "drain and fill" cycles a reduction of 50 – 75 % water consumption can be achieved.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
combined cooling and rinsing **full volume heated tanks, etc.** **" smart rinsing" systems** **Do you use hot water for rinsing?**[43]							
Do you reduce water & energy consumption in continuous processes by · **installing high-efficiency washing machinery (see above chapter 1.6 and BREF chapter 4.9.2)** Have you installed water meters? Have you installed automatic stop valves? Do you have a countercurrent washing machine?[44] Do you have a washer configuration with internal countercurrent (and recycling) capabilities as the vertical counter-flow washer?[45] Have you installed squeeze rollers or vacuum extractors (more efficient) to reduce							

[43] This can be done in an efficient way by "combined cooling and rinsing", which allows simultaneous cooling and rinsing of the processed textile.

[44] This technique is relatively straightforward and inexpensive and can be applied for washing after continuous desizing, scouring, bleaching, dyeing or printing.

[45] Recirculated water is sprayed onto the fabric and rollers used to squeeze waste through the fabric into a sump, where it is filtered and recirculated. This construction allows for high-efficiency washing with low water use. Energy use decreases greatly because less water must be heated.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
drag-out and carry-over? · **introducing heat recovery equipment** Have you installed heat exchangers capable of handling fibrous material (e.g. self-cleaning elements)?							
If the use of halogenated organic solvent cannot be avoided[46] **Do you use fully closed-loop equipment (see chapter 4.9.3)?**							
Have you installed closed-loop active charcoal filters?							
Do you pretreat, extract and recover most of the water-dissolved PER, through a two-stage process involving stripping by means of an air-stream absorption through active charcoal cartridges, periodically changeable and rechargeable							
Have you drastically reduced the solvent residue in the sludge well below 10000 mg/kg (1 %)?[47]							
Do you redesign the sealing systems at the machine inlet and outlet sides to further improve the solvent vapours pick-up efficiency?							

[46] e.g. with fabrics that are heavily loaded with preparations such as silicone oils that are difficult to remove with water

[47] This produces a dry, thick waste resulting in reduction of collection and disposal problems and cost.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Is the total solvent consumption of the solvent treatment installation reduced to 0.8 - 1.5 % (by weight of fabric produced)?							
Have you taken provisions for in-loop destruction (e.g. by advanced oxidation processes) of the persistent pollutants in order to avoid any possible contamination of groundwater arising from diffuse pollution and accidents?							

1.6 Water and energy management	Follow
See BREF chapters 4…as mentioned below, and 5.1	
BAT is a variety of measures/techniques to minimize water and energy consumption in the production process. The following is a summary of the selected BAT for water and energy saving.	
BENEFITS: Water and energy savings are often related in the textile industry because the main use of energy is to heat up the process baths. Resource-conserving techniques result almost in cost savings.	

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you monitor water and energy consumption in the various processes, as mentioned earlier and described in 1.1.1 (see BREF chapter 4.1.2)?							
Have you installed flow control devices and automatic stop valves on continuous machinery (see chapters 4.1.4 and 4.9.2)?							

Do you reduce water consumption · by improved working practices *as during filling and rinsing, where machines are equipped with automatic water control valves* *as displacement of spillage/ over flow during immersion of the fibre/good in the machine in the dyeing process*[48] · reducing liquor ratio *as in continuous dyeing by using fluidyer, foam, flexnip application systems* *as by installing low- and ultra-low liquor ratio machinery in batch processes (see chapters 4.6.9 to 4.6.21)* *as in discontinuous dyeing by separation between the exhausted dye bath and the rinsing water* · increasing washing efficiency (see chapters 4.9.1, 4.9.2) *as using washing machines with counter current principle* *as reducing of carry over* *as using wash boxes with built-in vacuum extractors* · combining processes[49]							

[48] Spillage may account for up to 20 % of total operating volume of water over the course of a dyeing cycle (this may also lead to losses of dyes and hazardous chemicals if these are introduced before the displacement takes place).

[49] Combining and scheduling processes reduces the number of chemical dumps. This is often feasible for pretreatment operations (e.g. scouring / desizing, scouring / desizing / bleaching – see for example chapter 4.5.3).

Have you installed automatic controllers for control of fill volume and liquor temperature in batch machines (see chapters 4.1.1, 4.9.2)? *Have you installed flow control devices and automatic stop valves which link the main drive mechanism of the range to the water flow?*							
Have you established well-documented production procedures (see also combining processes above and chapter 4.1.4)? *Have you optimise scheduling in production and adjust processes in pretreatment to quality requirements in downstream processes (see section 4.1.1)?*[50]							
Do you re-use water? Do you re-use cooling water as process water (also allowing heat recovery) (see chapter 4.1.1)? Do you re-use final rinsing baths or dye baths? Do you re-use the second rinsing bath for making the bleaching/scouring bath in cotton bleaching (see chapter 4.5.8)? Do you re-use water for pre-washing carpets in after-washing? Do you re-use water in batch dyeing processes (see chapter 4.6.22)? Do you pump the dye bath							

[50] e.g. bleaching is often not necessary if dark shades are produced

to a holding tank (or to a second identical machine)?[51] Do you remove the product from the exhausted dye bath and place it *in another machine for rinsing?*[52], [53]							
Do you save energy by · insulating pipes, valves, tanks, machines to minimise heat losses (see chapter 4.1.5) optimising boiler houses by applying re-use of condensed water, preheating of air supply, and heat recovery from combustion gases (see *chapter 4.1.1, 4.4.3, 4.8.1)* *as in **wool scouring**:* *from reducing effluent flowdown (and consequent heat losses) to drain or to on-site effluent treatment plant, by the installation of a dirt/grease recovery loop?*[54] *as in **textile finishing**: using stenters with* *optimised exhaust airflow through the oven* *heat recovery* *insulation* *optimised heating*							

[51] While the product is rinsed in the same machine in which it was dyed. The dye bath is then returned to the machine for the subsequent batch of material.

[52] In this case no holding tank is required, but the material needs additional handling.

[53] Dye bath analysis can be performed using spectrophotometer and / or may be determined by production experience based on exhaustion level, volatilisation, and dye liquor drag-out.

[54] Technique includes fitting a heat exchanger to recover heat from the dirt / grease loop flowdown.

systems *optimised burner technology* · segregation of hot and cold waste water streams prior to heat recovery and recovery of heat from the hot stream · installing heat recovery systems on waste off-gases · installing frequency-controlled electric motors							

1.7 Management of waste streams

See BREF chapters 4.1.1 and 5.1	Follow
BAT is to collect separately unavoidable solid waste and to use bulk or returnable containers.	
BENEFITS: Responsible waste handling results in reduced environmental impact and cost savings.	

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you separate the collection of unavoidable solid waste?							
Do you use bulk or returnable containers?							

2 Process-integrated measures for unit processes and operations

Textile finishing and carpet industry

2.1 Pretreatment

2.1.1 Removing knitting lubricants from fabric

Follow

See BREF chapters 4.2.3, 2.3.1.3 and 5.2.2

BAT is to

- select knitted fabric that has been processed using water-soluble and biodegradable lubricants (see chapter 4.2.3[55])
- carry out the thermofixation step before washing and treat the air emissions generated from the stenter frame by an appropriate abatement system that allow energy recovery and separate collection of the oil (see chapter 4.10.9)
- remove the non-water soluble oils using organic solvent washing (see chapter 4.9.3)

BENEFITS: Unlike conventional mineral oil-based lubricants, hydrosoluble oils can be easily washed out from the fabric. This helps reduce water, energy and chemicals consumption along with processing time. The resulting effluent is suitable for treatment in a biological waste water treatment plant. One of the advantages of carrying out the washing step before thermofixation is that air emissions from the stenter can be significantly reduced without the need for air emission abatement equipment.

If scouring with organic solvent is necessary the requirements described in chapter 4.9.3 are then taken, along with provisions for the in-loop destruction of the persistent pollutants. This will avoid any possible contamination of groundwater arising from diffuse pollution and accidents. This technique is convenient when other non water-soluble preparation agents, such as silicone oils, are present on the fabric.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you know what kind of lubricant is applied on your knitted fabric?							

55 The alternative hydrosoluble knitting oils described in this section produce emulsions which remain stable for three days.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
If **yes**, can you influence it by · using yarns with water-soluble and biodegradable lubricants (integrated mills) · discussing it with your fabric supplier							
Do you carry out the thermofixation step before washing?							
If **yes**, do you treat the air emissions generated from the stenter frame?[56]							
Do you remove the non-water soluble oils using organic solvent washing[57]?							

[56] Dry electrofiltration systems that allow energy recovery and separate collection of the oil to reduce the contamination of the effluent are insufficient and should be used in combination with scrubbers.

[57] This technique is convenient when other non water-soluble preparation agents, such as silicone oils, are present on the fabric.

If **yes**, · are the new installations fitted with closed-loop active charcoal filters (exhaust air)[58] · do you pretreat, extract and recover most of the water-dissolved PER, through a two-stage process[59] to avoid any possible contamination of groundwater arising from diffuse pollution and accidents · is the solvent residue in the sludge well below 10000 mg/kg (1 %) · are the sealing systems at the machine inlet and outlet sides redesigned to further improve the solvent vapours pick-up efficiency?[60]							

[58] The exhaust duct has been eliminated and the purified air is now recycled to the fabric deodorising / cooling section of the machine: this avoids any air-stream exhaustion to the outside environment.

[59] Involving: stripping by means of an air-stream and absorption through active charcoal cartridges, periodically changeable and rechargeable. The closed-loop active charcoal filters are involved in purifying the polluted air-stream from the 1st stage and recovering the extracted solvent. The system is able to ensure a residual PER content into the draining water not higher than 1 mg/l (emission in the water ≤ 0.5 g/h PER).

[60] This results in a much safer environment and better preservation of human health. A typical TLV-TWA value all around the installation is now no higher than 50 mg/m³. The total solvent consumption of the solvent treatment installation has been reduced from the 3 – 5 % (by weight of fabric produced) typical of traditional equipment to 0.8 - 1.5 %. Further improvement is likely in the near future.

2.1 Pretreatment

2.1.2 Desizing for cotton and cotton blends

Follow

See BREF chapters 4.2.5, 4.2.4, 4.10.1, 4.5.2, 4.5.3, 4.5.1 and 5.2.2

BAT is to

- select raw material processed with low add-on techniques (see chapter 4.2.5) and more effective bioeliminable sizing agents (see chapter 4.2.4) combined with the use of efficient washing systems for desizing and low F/M waste water treatment techniques (see chapter 4.10.1) to improve the bioeliminability of the sizing agents
- adopt the oxidative route when it is not possible to control the source of the raw material (see chapter 4.5.2)
- combine desizing/scouring and bleaching in one single step (see chapter 4.5.3)
- recover and re-use the sizing agents by ultrafiltration (see chapter 4.5.1)

BENEFITS: In cotton finishing mills the desizing process accounts for 50 to 70 % of the total COD in the waste water. Minimising the amount of size applied on the warp yarn is one of the most effective pollution prevention techniques for reducing the organic load caused by sizing agents. Also the application of biodegradable/bioeliminable sizing agents leads to significant reduction of the COD-load that may pass undegraded through the waste water treatment plant and be discharged to natural waters. The reduction can be up to 35%. New polyacrylates have the additional advantage of being applicable as almost universal sizing agents. This means that they are potentially easy to re-use as sizes in weaving firms.[61]

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you know about kind and amount of sizing agent applied on your cotton fabric?							

[61] Although the application of optimised sizing recipes is technically feasible for all sizing departments, the world-wide organisation of the textile chain makes it difficult for non-integrated mills and in particular, for commission finishers to influence the up-stream weaving mills

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
If **yes**, can you influence the **amount** by · using pre-wetting of the warp yarn (see chapter 4.2.5) (integrated mills)[62] · on-line monitoring/ control of size add-on (integrated mills) · discussing it with your fabric supplier?							
If **yes**, can you influence the **kind** by · using more environmentally-optimised sizing agents (see chapter 4.2.4)[63] (integrated mills) · discussing it with your fabric supplier?							
If **no**, **do you adopt the oxidative route (see chapter 4.5.2)?**							

[62] Depending on the setting of the warp beam and the type of yarn processed (e.g. density of the yarn, type of fibres in the blend), a reduction of the size add-on of about 20 - 50 % is possible.

[63] Highly efficient with low add-on; completely and easily removed from the fabric; readily biodegradable or bioeliminable (>80 % after 7 days according to OECD-test 302 B).

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Can you use the following possible process sequence: 1 removal of metals[64] 2 oxidative desizing[65] 3 scouring (alkali) 4 demineralisation[66] 5 bleaching[67] 6 rinsing and drying							
Do you use an efficient washing system for desizing (e.g. counter current washing machine)?							
Do you use low F/M waste water treatment techniques (see chapter 4.10.1)?[68] (See also "Effluent treatment and waste disposal" below in 4.2)							
Can you combine desizing/scouring and bleaching in one single step by using the flash steam process (see chapter 4.5.3)?[69]							

---

64 modern pretreatment lines are equipped with metal detectors

65 peroxide and alkali

66 acid reductive or, better still, alkaline reductive / extractive

67 peroxide and alkali

68 Treatment of textile waste water in activated sludge system with low food-to-micro organisms ratio (F/M): F/M <0.15 kg BOD5/kg MLSS·d, adaptation of the activated sludge and temperatures higher than 15 °C

69 New auxiliaries' formulations and automatic dosing and steamers allow the so-called "Flash Steam" procedure which telescopes desizing, alkaline cracking (scouring) and pad-steam peroxide bleaching into a single step.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you recover and re-use the sizing agents by ultrafiltration (see chapter 4.5.1)?[70, 71] (integrated mills)							
Do you use water-soluble synthetic sizing agents such as polyvinyl alcohol, polyacrylates and carboxymethyl cellulose, or modified starches (e.g. carboxymethyl starch)?							
Do you remove fibres and fine particles before ultrafiltration in order to minimise scaling and fouling?[72]							
Is your staff qualified and the maintenance accurate to operate/manage the ultrafiltration units?							

[70] COD load of waste water from finishers of woven fabric is reduced by 40 – 70 %. Sizing agents are recovered by 80 – 85 %. In addition, sizing agents in waste water do not need to be treated. Thus energy consumption for treatment is reduced significantly as well as quantity of sludge to be disposed of.

[71] A cost / benefit assessment should take into account not only the costs of ultrafiltration, but also the recipe and overall process and treatment costs, especially when considering that changing over from starch and starch derivatives to synthetic sizing agents also has implications for weaving efficiency.

[72] A pre-filtration step is carried out for this purpose.

2.1 Pretreatment

2.1.3 Bleaching

Follow

See BREF chapters 4.5.5, 4.5.6, 4.3.4, and 5.2.2

BAT is to

- use hydrogen peroxide bleaching as preferred bleaching agent combined with techniques for minimising the use of hydrogen peroxide stabilisers (see chapter 4.5.5), or using biodegradable/bioeliminable complexing agents (see chapter 4.3.4)
- use sodium chlorite for flax and bast fibres that cannot be bleached with hydrogen peroxide alone (see chapter4.5.5)
- limit the use of sodium hypochlorite only to cases in which high whiteness has to be achieved and to fabrics that are fragile and would suffer depolymerisation.

BENEFITS: The presence of hazardous AOX such as trichloromethane and chloroacetic acid in the effluent is avoided.

Details	**Status**				**Remarks**	**Follow**	
	yes	no	partly	not appl.		yes	no
Do you use hydrogen peroxide bleaching as preferred bleaching agent (see chapter 4.5.5)?							
Do you combine it with techniques for minimising the use of hydrogen peroxide stabilisers (see chapter 4.5.6)? (see also 1.3.3)							
Do you use biodegradable/ bioeliminable complexing agents (see chapter 4.3.4)? (see also 1.3.3)							

If you bleach flax and bast fibres, **do you use sodium chlorite in a two-step hydrogen peroxide-chlorine dioxide bleaching process?**[73]							
Do you limit the use of sodium hypochlorite only to cases in which high whiteness has to be achieved and to fabrics that are fragile and would suffer depolymerisation?[74]							
Do you take particular attention for chlorite bleach, handling and storage of sodium chlorite because of toxicity and corrosion risks?							
Do you inspect machinery and equipment frequently because of the high stress to which they are subjected (see chapter 2.6.1.2)?							

[73] It must be ensured that elemental chlorine-free chlorine dioxide is used. Chlorine-free chlorine dioxide is produced using hydrogen peroxide as the reducing agent of sodium chlorate (see chapter 4.5.5).

[74] In these special cases, to reduce the formation of hazardous AOX, sodium hypochlorite bleaching is carried out in a two-step process in which peroxide is used in the first step and hypochlorite in the second. Effluent from hypochlorite bleaching is kept separate from the other streams and mixed effluents in order to reduce formation of hazardous AOX.

2.1 Pretreatment

2.1.4 Mercerising

Follow

See BREF chapters 4.5.7 and 5.2.2

BAT is to either:

- recover and re-use alkali from mercerising rinsing water (see chapter 4.5.7)
- or re-use the alkali-containing effluent in other preparation treatments

BENEFITS: The alkaline load of waste water is reduced drastically and acid required for waste water neutralisation is minimised. In companies where non-recovered caustic soda lye has to be neutralised with acid, payback time is less than six months. Thus, from the economic point of view, caustic soda recovery may be very attractive.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you recover and re-use alkali from mercerising rinsing water by caustic soda recovery process (see chapter 4.5.7)?							
Do you remove lint, fluff and other particles?[75]							
Do you purify the lye after evaporation?[76]							
Can you re-use the alkali-containing effluent in other preparation treatments?							

[75] By using self-cleaning rotary filters or pressure micro-filtration.

[76] The purification technique depends on the degree of lye contamination and can be simple sedimentation or oxidation/flotation with injection of hydrogen peroxide.

2.2 Dyeing

2.2.1 Dosage and dispensing of dye formulations

Follow

See BREF chapters 4.1.3 and 5.2.2

BAT is to do all the following

- reduce the number of dyes
- use automated systems for dosage and dispensing of dyes, only considering manual operation for dyes that are used infrequently
- in long continuous lines where the dead volume of the distribution line is comparable with the volume in the padder, give preference to decentralised automated stations that do not premix the different chemicals with the dyes before the process and that are fully automatically cleaned.

BENEFITS: Dyes are very expensive. Excessive amounts of dyes charge the waste water partially considerably. But first of all, tighter control of the process allows for improved right-first-time performance, which means minimising corrective measures such as reworks, redyes, stripping and shade adjustment.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Have you tried to reduce the number of dyes used?							
May-be by using trichromatic systems?							
Do you use automated systems for dosage and dispensing of dyes (see chapter 4.1.3)? (see also 1.2 above)							
If **yes**, do you consider manual operation only for dyes that are used infrequently?							

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
If **no**, is it due to long continuous lines where the dead volume of the distribution line is comparable with the volume in the padder? *Is it possible to give preference to decentralised automated stations that do not premix the different chemicals with the dyes before the process and that are fully automatically cleaned?*							

2.2 Dyeing

2.2.2 General BAT for batch dyeing processes

Follow

See BREF chapters 4.6.19, 4.9.1, 4.6.22, and 5.2.2

BAT is to

- use machinery fitted with: automatic controllers of fill volume, temperature and other dyeing cycle parameters, indirect heating & cooling systems, hoods and doors to minimise vapour losses
- choose the machinery that is most fitted to the size of the lot to be processed to allow its operation in the range of nominal liquor ratios for which it is designed[77]
- select new machinery according as far as possible to the requirements described in chapter 4.6.19:
    - Ø low- or ultra-low liquor ratio
    - Ø in-process separation of the bath from the substrate
    - Ø internal separation of process liquor from the washing liquor
    - Ø mechanical liquor extraction to reduce carry-over and improve washing efficiency
    - Ø reduced duration of the cycle
- substitute overflow-flood rinsing method in favour of drain and fill or other methods (smart rinsing for fabric)
- re-use rinse water for the next dyeing or reconstitution and re-use the dye bath when technical considerations allow.[78]

BENEFITS: Optimisation of the processes and the equipment, re-use of processing water results in energy, water and chemical/dye savings. Low bath-ratio dyeing machines conserve chemicals as well as water and energy and also achieve higher fixation efficiency.

[77] Modern machines can be operated at approximately constant liquor ratio whilst being loaded at a level as low as 60 % of their nominal capacity (or even 30 % of their nominal capacity with yarn dyeing machines).

[78] This technique (see chapter 4.6.22) is easier to implement in loose fibre dyeing where top-loading machines are used. The fibre carrier can be removed from the dyeing machine without draining the bath. However, modern batch dyeing machines are equipped with built-in holding tanks allowing for uninterrupted automatic separation of concentrates from rinsing water

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you use machinery fitted with: · **automatic controllers of fill volume** · **temperature and other dyeing cycle parameters** · **indirect heating & cooling systems** · **hoods and doors to minimise vapour losses**							
Do you choose the machinery that is most fitted to the size of the lot to be processed (see chapter 4.6.19)?[79]							
Can you reduce the liquor ratio? *Is your equipment defined in terms like "low" and "ultra-low" liquor ratio?* *Can it be operated at approximately constant liquor ratio whilst being loaded at a level as low as 60 % of their nominal capacity?*							
Do you optimise your washing efficiency by implementing a maximum cut-off between different batches and, in particular, the maximum separation between the exhausted dye bath and the rinsing water?							

[79] Modern machines can be operated at approximately constant liquor ratio whilst being loaded at a level as low as 60 % of their nominal capacity (or even 30 % of their nominal capacity with yarn dyeing machines)

Details	**Status**				**Remarks**	**Follow**	
	yes	no	partly	not appl.		yes	no
Do you use techniques as expression, suction and blowing air through the fabric?							
Do you use vacuum technology?[80]							
Have you substitute overflow-flood rinsing method in favour of drain and fill or other methods (smart rinsing for fabric, see chapter 4.9.1)?							
Do you re-use rinse water for the next dyeing?							
Do you reconstitute and re-use the dye bath when technical considerations allow it?[81]							

[80] Vacuum technology is the most efficient, but it is not applicable to all types of fabric and it consumes more energy than expression.

[81] This technique (see chapter 4.6.22) is easier to implement in loose fibre dyeing where top-loading machines are used. The fibre carrier can be removed from the dyeing machine without draining the bath. However, modern batch dyeing machines are equipped with built-in holding tanks allowing for uninterrupted automatic separation of concentrates from rinsing water.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
If you buy new machinery for batch dyeing, do you select them as far as possible to the following requirements · **low- or ultra-low liquor ratio** · **in-process separation of the bath from the substrate** · **internal separation of process liquor from the washing liquor** · **mechanical liquor extraction to reduce carry-over and improve washing efficiency** · **reduced duration of the cycle**							

2.2 Dyeing

2.2.3 BAT for continuous dyeing processes

Follow

See BREF chapters 4.6.7, 4.9.2, and 5.2.2

BAT is to reduce losses of concentrated liquor by:

- using low add-on liquor application systems and minimising volume capacity of the dip trough when using pad dyeing techniques
- adopting dispensing systems where the chemicals are dispensed on-line as separate streams, being mixed only immediately before being fed to the applicator
- using one of the following systems for dosing the padding liquor, based on measurement of the pick up (see chapter 4.6.7):
  - Ø measure the amount of dyeing liquor consumed by reference to the quantity of processed fabric (length of the fabric multiplied by its specific weight); the resulting values are automatically processed and used for the preparation of the next comparable batch
  - Ø use the rapid batch dyeing technique, where rather than being prepared for the whole batch before starting the dyeing batch, the dyestuff solution is prepared just in time, in several steps, based on on-line measurement of the pick up. This second technique is preferred when economic considerations allow (see 4.6.7)
- increase washing efficiency according to the principles of counter current washing and reduction of carry-over described in chapter 4.9.2

BENEFITS: Continuous and semi-continuous dyeing processes consume less water than batch dyeing, but highly concentrated residues are produced. The avoided wastage of expensive raw materials (dyes and auxiliaries) together with the increased reproducibility (right-first-time) and productivity achieved thanks to improved process control play an important role in the implementation of this technique.

Details	**Status**				**Remarks**	**Follow**	
	yes	no	partly	not appl.		yes	no
Do you use low add-on liquor application systems and minimise volume capacity of the dip trough when using pad dyeing techniques like **U-shaft or** **nip?**							

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you adopt dispensing systems where the chemicals are dispensed on-line as separate streams, being mixed only immediately before being fed to the applicator?							
Do you use systems for dosing the padding liquor, based on measurement of the pick up (see chapter 4.6.7)?							
If **yes**, do you measure the amount of dyeing liquor consumed by reference to the quantity of processed fabric (length of the fabric multiplied by its specific weight)?[82]							
If **yes**, do you use the rapid batch dyeing technique, where rather than being prepared for the whole batch before starting the dyeing batch, the dyestuff solution is prepared just in time, in several steps, based on on-line measurement of the pick up?[83]							
Have you increased washing efficiency according to the principles of counter current washing (see also 2.2.2) and reduction of carry-over (see chapter 4.9.2)?							

[82] The resulting values are automatically processed and used for the preparation of the next comparable batch.

[83] This second technique is preferred when economic considerations allow.

2.2 Dyeing

2.2.4 PES & PES blends dyeing with disperse dyes

Follow

See BREF chapters 4.6.2, 4.6.1, 4.6.5, 4.6.3 and 5.2.2

BAT is

- to avoid the use of hazardous carriers by (in order of priority):
    - Ø using non-carrier dyeable polyester fibres (modified PES or PTT-type) (see chapter 4.6.2), when product market considerations allow
    - Ø dyeing in HT conditions without use of carriers. This technique is not applicable to PES/WO and elastane/WO blends
    - Ø substituting conventional dye carriers with compounds based on benzylbenzoate and N-alkylphthalimide, when dyeing WO/PES fibres (see chapter 4.6.1)
- substitute sodium dithionite in PES aftertreatment, by applying one of the two proposed techniques (see chapter 4.6.5)
    - Ø replace sodium dithionite with reducing agent based on sulphinic acid derivatives[84]
    - Ø use of disperse dyes that can be cleared in alkaline medium by hydrolytic solubilisation instead of reduction (see chapter 4.6.5
- use optimised dye formulations that contain dispersing agents with high degree of bioeliminability (see chapter 4.6.3)

BENEFITS: The reduction of the quantity of environmentally problematic substances (carrier) is fundamental. Cost savings (higher productivity) and improvement of the environmental performance (especially with regard to sulphite content in the waste water) are the main reason for substitution sodium dithionite in PES aftertreatment by applying one of the two proposed techniques.

[84] This should be combined with measures in order to ensure that only the strict amount of reducing agent needed to reduce the dyestuff is consumed (e.g. by using nitrogen to remove oxygen from the liquor and from the air in the machine).

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you use carriers?							
If **yes**, do you check dyeing in HT conditions without use of carriers[85] (see chapter 4.6.1)?							
If **yes**, do you check using non-carrier dyeable polyester fibres (modified PES or PTT-type) (see chapter 4.6.2)?							
If you have to use carriers, do you use carriers based on[86] · chlorinated aromatic compounds[87] · biphenyl and other aromatic hydrocarbons[88] · phthalates[89]							
If **yes**, do you check to substitute them with compounds based on benzylbenzoate and N-alkylphthalimide[90] (see chapter 4.6.1)?							

[85] This technique is not applicable to PES/WO and elastane/WO blends.

[86] These substances are hazardous to health and are not allowed to charge the waste water and off-gas.

[87] mono-chlorobenzene, trichlorobenzenes etc.

[88] trimethyl benzene, 1-methyl naphtalene etc.

[89] diethylhexylphthalate, dibutylphthalate, dimethylphthalate

[90] especially when dyeing WO/PES fibres

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you use sodium dithionite in PES after treatment (see chapter 4.6.5)? If **yes,** have you checked to substitute it by applying one of the two proposed techniques: · replace sodium dithionite with reducing agent based on sulphinic acid derivatives[91,92,93] · use of disperse dyes that can be cleared in alkaline medium by hydrolytic solubilisation instead of reduction (see chapter 4.6.5)[94]							
Do you use optimised dye formulations that contain dispersing agents with high degree of bioeliminability (see chapter 4.6.3)?							

[91] This should be combined with measures in order to ensure that only the strict amount of reducing agent needed to reduce the dyestuff is consumed.

[92] This reducing agent can be applied in the acidic pH range, significant water and energy savings can be achieved. Compared to the conventional process, up to 40 % of water can be saved. Short-chain sulphinic acid derivatives are readily biodegradable (the product is non volatile and water-soluble).

[93] The technique can be used in all types of dyeing machines, not only for polyester fibres, but also for PAN, CA and their blends. The only limitation on applicability is with blends with elastane fibres.

[94] Alkali-clearable dyes are currently applied for both for PES and PES/cotton blends, with greater environmental and economic advantages being achieved with PES/cotton blends.

2.2 Dyeing

2.2.5 Dyeing with sulphur dyes

Follow

See BREF chapters 4.6.6 and 5.2.2

BAT is to

- replace conventional powder and liquid sulphur dyes with stabilised non-pre-reduced sulphide-free dyestuffs or with pre-reduced liquid dye formulations with a sulphide content of less than 1 %
- replace sodium sulphide with sulphur-free reducing agents or sodium dithionite, in that order of preference
- adopt measures to ensure that only the strict amount of reducing agent needed to reduce the dyestuff is consumed
- use hydrogen peroxide as preferred oxidant

BENEFITS: Worker health & safety, odour nuisance and waste water problems related to the presence of sulphides are the driving force for implementation.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you dye cotton in medium to dark shades (especially black) with sulphur dyes (see chapter 4.6.6)?							
If yes, have you replaced conventional powder and liquid sulphur dyes with · **stabilised non-pre-reduced sulphide-free dyestuffs** · **with pre-reduced liquid dye formulations with a sulphide content of less than 1 %**							

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Have you replaced sodium sulphide with sulphur-free reducing agents or sodium dithionite, in that order of preference?[95]							
Have you adopt measures to ensure that only the strict amount of reducing agent needed to reduce the dyestuff is consumed?							
Do you use hydrogen peroxide as preferred oxidant?[96]							

[95] Unlike the old sulphur dyes with low reduction potential, all these types of dyestuffs can be used without any sodium sulphide (in the pre-reduced liquid formulations a low amount of sodium sulphide is still present in the formulation). The following binary systems are in use:

- combination of dithionite and glucose
- combination of hydroxyacetone and glucose (seldom)
- combination of formamidine sulphinic acid and glucose (seldom).

[96] Bromate, iodate and chlorite are detected as AOX. Nevertheless, they are not organohalogen compounds and they are not likely to give rise to hazardous organohalogen products (only certain chlorite products that contain Cl_2 or use chlorine as activator are likely to give rise to hazardous AOX).

2.2 Dyeing

2.2.6 Batch dyeing with reactive dyes

Follow

See BREF chapters 4.6.10, 4.6.11, 4.6.12 and 5.2.2

BAT is to

- use high-fixation, low-salt reactive dyes as described in chapters 4.6.10 and 4.6.11
- avoid the use of detergents and complexing agents in the rinsing and neutralisation steps after dyeing, by applying hot rinsing integrated with recovery of the thermal energy from the rinsing effluent (see chapter 4.6.12)

BENEFITS: The high fixation yield of the new polyfunctional reactive dyes (only a small amount of unfixed dye needs to be washed off) and the fact that they have excellent wash-off properties are the main advantages. Savings of up to 40 % in water and energy consumption and more than 30 % of salt are claimed.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you use high-fixation polyfunctional reactive dyestuffs in exhaust dyeing of cellulosic fibres[97,98] (see chapter 4.6.10)?							
Do you check if you can use low-salt polyfunctional reactive dyes (see chapter 4.6.11)?							

[97] In the case of monofunctional dyes, the fixation rate is approximately 60 % (with an exhaustion rate of about 70 %) so that 40 % of the dye applied is lost in the effluent. In the case of bifunctional reactive dyes, 80 % fixation rate and over 90 % exhaustion rate is achieved. The immediate consequence is a significant reduction of unused dyestuff ending in the waste water stream (reduced colour and organic load).

[98] With new dyes (and processes) there is also potential for water, energy and chemicals savings. For example, the recently introduced Levafix CA dyes (Dystar) reach more than 90 % fixation with moderate salt quantities.

Do you avoid the use of detergents and complexing agents in the rinsing and neutralisation steps after dyeing by · **applying hot rinsing** · **integrated with recovery of the thermal energy from the rinsing effluent (see chapter 4.6.12)**							
Is rinsing carried out at 90 – 95 °C?[99]							
Do you recover energy by · heat exchange between the hot outgoing process water and the cold incoming clean water · reclamation of the hot water and re-use of both energy and water							

[99] Rinsing is more effective and faster at high temperatures. About 30 % more unfixed hydrolysed reactive dyestuff is rinsed out after 10 minutes of rinsing at 95 °C than at 75 °C.

2.2 Dyeing

2.2.7 Pad-batch dyeing with reactive dyes

Follow

See BREF chapters 4.6.13, 4.6.9 and 5.2.2

BAT is to

- use dyeing techniques that perform at equivalent levels to those described in chapter 4.6.13
- avoid the use of urea and to use silicate-free fixation methods (see chapter 4.6.9)

BENEFITS: The technique described is more cost effective than pad-batch dyeing in terms of total processing costs, but the initial capital investment in switching to the new technology is significant.[100] **Savings in chemical consumption result in less environmental impact and cost savings.**

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you think about substituting the conventional pad/continuous dyeing systems for a continuous dyeing process for cellulose fibres that uses selected reactive dyestuffs (see chapter 4.6.13)?							
If **no**, do you try to reduce the consumption of urea and silicate?							
Do you have problems with silicate deposits on the textile surface and on the equipment, increased salt in the effluent?							

[100] For new installations and those seeking to replace equipment the cost factor is not so significant.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
If yes, do you know about applying silicate-free highly concentrated aqueous alkali solutions for cold-pad-batch process (see chapter 4.6.9)?							
Have you installed modern dosing systems?[101]							
Do you use membrane techniques in waste water treatment?[102]							

[101] Membrane pumps such as the sera-pumps with 4:1 ratio (alkali solution to dyestuffs solution) are a prerequisite.

[102] No crystallisation in filters, pipes and valves and no membrane blocking, which is the case with sodium silicate.

2.3 Printing

2.3.1 Process in general

Follow

See BREF chapters 4.7.4, 4.7.5, 4.7.6, 4.7.7, 4.7.9, 4.7.8 and 5.2.2

BAT is to

- reduce printing paste losses in rotary screen printing (see chapters 4.7.4, 4.7.5, 4.7.6)
- reduce water consumption in cleaning operations (see chapter 4.7.7)
- use digital ink-jet printing machines for the production of short runs (less than 100 m) for flat fabrics.[103](see chapter 4.7.9)
- use digital jet printing machines described in chapter 4.7.8 for printing carpet and bulky fabrics.[104]

BENEFITS: Minimising production costs and problems with waste water disposal are the main driving forces to reduce printing paste losses and recycle residual printing paste. Ink jet printing machines will cover resource-conserving aspects in the future.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you reduce printing paste losses in rotary screen printing?							
Do you minimise the volume of printing paste supply systems (see chapter 4.7.4)? *Do you have minimum-volume supply systems?* *Do you recover paste from the supply system itself?* *Do you have pumps which can be operated in both directions?*[105]							

[103] when product market considerations allow

[104] except for resist and reserve printing and similar situations

[105] Thus, at the end of each run, the printing paste can be partly pumped back into the drum. The problem of air being drawn in via the holes in the squeegee can be solved by applying the technique described in chapter 4.7.5.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you use squeegees with an even paste distribution over the whole width? *Do you have manual stopping of printing paste supply shortly before finishing a run in order to minimise the residual printing pastes in the rotary screens?* *Especially for small run lengths:* *Do you use instead of the supply system the injecting of small quantities of printing paste (1 - 3 kg) directly into the squeegee manually or by manual insertion of small troughs?* *Do you minimise the pipes by supplying the printing pastes through funnels positioned directly above the pumps?*							
Do you recover the printing paste from the supply system at the end of each run by back-pumping an inserted ball (see chapter 4.7.5)?							
Do you recycle residual printing paste (see chapter 4.7.6)?							
Do you reduce water consumption in cleaning operations (see chapter 4.7.7)?							
Do you have a start/stop control of cleaning of the printing belt?							

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you use digital ink-jet printing machines for the production of short runs (less than 100 m) for flat fabrics (see chapter 4.7.9)?[106]							
Do you use digital jet printing machines described in chapter 4.7.8 for printing carpet and bulky fabrics?[107]							

[106] It is not considered BAT to flush with solvent to prevent blocking while the printer is not in use.

[107] except for resist and reserve printing and similar situations

2.3 Printing

2.3.2 Reactive printing

See BREF chapters 4.7.1, 4.7.2 and 5.2.2

Follow

BAT is to avoid the use of urea by either

- the one-step process with the controlled addition of moisture, where the moisture is applied either as foam or by spraying a defined quantity of water mist (see chapter 4.7.1)
- the two-steps printing method (see chapter 4.7.2)

BENEFITS: The printing section is the main source of urea and its decomposition products (NH3/NH4+). During waste water treatment, the nitrification of the excess ammonia involves high energy consumption. Discharge of urea, ammonia and nitrate contributes to eutrophication and aquatic toxicity. Minimisation/elimination of urea at source significantly reduces these adverse effects.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you substitute urea by controlled addition of moisture[108] (see chapter 4.7.1)?							
Do you substitute urea by reactive two-step printing[109] (see chapter 4.7.2)?							

[108] (10 wt-% for cotton fabric, 20 wt-% for viscose fabric and 15 wt-% for cotton blends). Moisture can be applied either as foam or by spraying a defined quantity of water mist. For silk and viscose, with the one-step process, the spraying technique is not reliable due to the low moisture add-on required for these fibres. The foaming technique with complete elimination of urea is proven for viscose, but not yet for silk.

[109] The two-step printing method: padding of the printing paste; intermediate drying; padding with alkaline solution of fixating agents (especially water-glass); fixation by means of overheated steam; washing steps (to remove thickeners and improve fastness properties).

2.3 Printing

2.3.3 Pigment printing

Follow

See BREF chapters 4.7.3 and 5.2.2

BAT is to use optimised printing pastes that fulfil the following requirements (see chapter 4.7.3):

- thickeners with low-emission of volatile organic carbon (or not containing any volatile solvent at all) and formaldehyde-poor binders/fixing agents[110]
- APEO-free and high degree of bioeliminability
- reduced ammonia content[111]

BENEFITS: Changing to optimised printing pastes results in less impact to the environment, especially to the air.

Details	**Status**				**Remarks**	**Follow**	
	yes	no	partly	not appl.		yes	no
Do you use thickeners based on polyacrylic acid or polyethylene glycol compounds instead of mineral oils?							
Do you use new low-formaldehyde products as fixing agents/binders?[112]							
Do you use optimised printing pastes which are APEO-free[113] and have a reduced ammonia content?[114]							

[110] Associated air emission value: <0.4 g Org. C/kg textile (assuming 20 m^3 air/kg textile)
[111] Associated air emission value: 0.6 g NH_3/kg textile (assuming 20 m^3air/kg textile)
[112] The cross-linking agents contained in these auxiliaries are largely based on methylol compounds (melamin compounds or urea-formaldehyde pre-condensates) that give rise to formaldehyde and alcohols (mainly methanol) in the exhaust air.
[113] Pigment printing auxiliaries may be found in the waste water as a result of cleaning operations, etc.
[114] Ammonia is used as additive in binders and is also a source of air pollution.

2.4 Finishing

2.4.1 Process in general

Follow

See BREF chapters 4.8.1, 4.3.2 and 5.2.2

BAT is to

- minimise residual liquor by
  - Ø using minimal application techniques (e.g. foam application, spraying) or reducing volume of padding devices
  - Ø re-using padding liquors if quality is not affected
- minimise energy consumption in stenter frames by (see chapter 4.8.1)
  - Ø using mechanical dewatering equipment to reduce water content of the incoming fabric
  - Ø optimising exhaust airflow through the oven, automatically maintaining exhaust humidity between 0.1 and 0.15 kg water/kg dry air, considering the time taken to reach equilibrium conditions
  - Ø installing heat recovery systems
  - Ø fitting insulating systems
  - Ø ensuring optimal maintenance of the burners in directly heated stenters
- use low air emission optimised recipes[115]

BENEFITS: Environmental advantages are

- **minimising residual liquor resulting in less waste water charge**
- **savings in energy consumption and therefore minimisation of emissions associated with energy production**
- **using optimised products to reduce the air emissions**

[115] An example for classification/ selection of finishing recipes is the “Emission factor concept” described in chapter 4.3.2.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you minimise residual liquor by · using minimal application techniques (e.g. foam application, spraying[116]) or reduce volume of padding devices (see also above 1.6)? · re-using padding liquors if quality is not affected							
Do you minimise energy consumption in stenter frames by (see above 1.5 and chapter 4.8.1) · using mechanical dewatering equipment to reduce water content of the incoming fabric by Ø vacuum extraction systems Ø optimised squeezing rollers · optimising exhaust airflow through the oven · automatically maintaining exhaust humidity between 0.1 and 0.15 kg water/kg dry air[117]							

[116] Spraying should be used only in combination with closed systems and collecting of the over-spray.

[117] considering the time taken to reach equilibrium conditions

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
· installing heat recovery systems as Ø air-to-water heat exchangers[118] Ø air-to-air heat exchanger if hot water is not required[119] · fitting insulating systems · ensuring optimal maintenance of the burners in directly heated stenters							
Do you use low air emission optimised recipes (see chapter 4.3.2)? Do you get the emission factors of your products? *If no, ask your supplier.*							

[118] Up to 70 % of energy can be saved. Hot water can be used in dyeing. Electrostatic filtration for off-gas cleaning can optionally be installed. Retrofitting is possible.

[119] Efficiencies are generally 50 to 60 % (BREF literature: 146, Energy Efficiency Office UK, 1997). Approximately 30 % savings in energy can be achieved (BREF literature: 179, UBA, 2001). An aqueous scrubber alone or with subsequent electrostatic filtration can optionally be installed for off-gas cleaning.

2.4 Finishing

2.4.2 Easy-care treatment

See BREF chapters 4.8.2 and 5.2.2

Follow

BAT is to use

- formaldehyde-free or formaldehyde-poor (<0.1 % formaldehyde content in the formulation) cross-linking agents in the textile industry (see chapter 4.8.2).

BENEFITS: Regulations concerning formaldehyde in the off-gas and compliance with various codes of conduct concerning consumer health (e.g. European Eco-label, etc.) are the main motivation for the use of the formaldehyde-free or low-formaldehyde products.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
If you apply easy-care finishing[120] on cellulosic fibres and their blends, **Do you use formaldehyde-free or formaldehyde-poor[121] cross-linking agents?** If not, ask your supplier.							

[120] Formaldehyde-based cross-linking agents may release free formaldehyde. Formaldehyde is thought to be carcinogenic and is a threat to the workforce. The presence of free formaldehyde or partly hydrolysable formaldehyde on the finished fabric also represents a potential risk for the final consumer.

[121] <0.1 % formaldehyde content in the formulation

2.4 Finishing

2.4.3 Softening treatments

Follow

See BREF chapters 4.8.3 and 5.2.2

BAT is to apply the softening agents by pad mangles or better, by spraying and foaming application systems, instead of carrying out this treatment by exhaustion directly in the batch dyeing machine (see chapter 4.8.3).

BENEFITS: The advantages of these techniques are that the use of cationic softening agents can be avoided and any chemical loss can be reduced to a few percent.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you apply softening agents in batch processing after the dyeing process directly in the dyeing machine (e.g. jet, overflow) using the exhaustion method (see chapter 4.8.3)?							
If yes, **can you apply the softening agents by** · **pad mangles** · **spraying[122] and foaming application systems**							
If you apply the softeners in separate equipment after the batch dyeing process, do you re-use the dyeing or rinse baths?[123]							

[122] Spraying should be used only in combination with closed systems and collecting of the over-spray.

[123] As there is no longer a problem with the presence of residual cationic softeners, which would otherwise limit the adsorption of the dye in the subsequent dyeing process.

3 Effluent treatment and waste disposal

3.1 Effluent/Waste water treatment

Follow

Waste water treatment follows at least three different strategies

- central treatment in a biological waste water treatment plant on site
- central treatment off site in a municipal waste water treatment plant
- decentralised treatment on site (or off site) of selected, segregated single waste water streams

All three strategies are BAT options when properly applied to the actual waste water situation. Well-accepted general principles for waste water management and treatment include

- characterising the different waste water streams arising from the process (see above 1.1.1 and chapter 4.1.2)
- segregating the effluents at source according to their contaminant type and load, before mixing with other streams[124]
- allocating contaminated waste water streams to the most appropriate treatment
- avoiding the introduction of waste water components into biological treatment systems when they could cause malfunction of such a system
- treating waste streams containing a relevant non-biodegradable fraction by appropriate techniques before, or instead of, a final biological treatment

BENEFITS: If you need end-of-pipe measures try to reduce and decontaminate your load.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you have a general diagram of all waste water sources?							
Do you have separate diagrams for special aggregates and processes?							

[124] This ensures that a treatment facility receives only those pollutants it can cope with. Moreover, it enables the application of recycling or re-use options for the effluent.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you have a waste water register (see above 1.1.1 and chapter 4.1.2)?							
Do you control and measure the waste water ingredients regularly? *Which parameters do you check?* *How often do you check them?* *Which sources do you check?*							
Do you separate the waste water streams?							
Do you separate them according to their load into the three classes high loaded/medium loaded/low loaded?							
Do you determine the contaminant type?							
Do you take measures to clean the waste water streams of specific sources? If yes: how?							
Do you take care to avoid the introduction of waste water components into biological treatment systems when they could cause malfunction of such a system? If yes: how?							

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you check biodegradation of waste streams by appropriate techniques before, or instead of, a final biological treatment?							

3.1 Effluent/Waste water treatment

3.1.1 Effluent treatment in the textile finishing and carpet industry

Follow

See BREF chapters 4.10.1, 4.10.7, 4.10.8, 4.10.3 and 5.3

According to the above mentioned approach, the following techniques are determined as general BAT for the treatment of waste water from the textile finishing and carpet industry

- treatment of waste water in an activated sludge system at low food-to-micro organisms ratio as described in chapter 4.10.1 under the prerequisite that concentrated streams containing non-biodegradable compounds are pretreated separately
- pretreatment of highly-loaded (COD>5000 mg/l) selected and segregated single waste water streams containing non-biodegradable compounds by chemical oxidation (e.g. Fenton reaction as described in chapter 4.10.7).[125]

Certain specific process residues, such as residual printing pastes and residual padding liquors are very strong and, where practicable, should be kept out of waste water streams.[126]

For the specific cases of waste water containing pigment printing paste or latex from carpet backing, precipitation/flocculation and incineration of the resulting sludge is a viable alternative to chemical oxidation (see chapter 4.10.5).

If concentrated water streams containing non-biodegradable compounds cannot be treated separately, additional physical-chemical treatments would be required to achieve equivalent overall performance. These include:

- tertiary treatments following the biological treatment process[127] (see chapter 4.10.1)
- combined biological, physical and chemical treatments with the addition of powdered activated carbon and iron salt to the activated sludge system with reactivation of the excess sludge by “wet oxidation” or “wet peroxidation” (if hydrogen peroxide is used) (see chapter 4.10.3)
- ozonization of recalcitrant compounds prior to the activated sludge system (see plant 3 in chapter 4.10.1)

[125] Candidate waste water streams are padding liquors from semi-continuous or continuous dyeing and finishing, desizing baths, printing pastes, residues from carpet backing, exhaust dyeing and finishing baths.

[126] These residues should be disposed of appropriately; thermal oxidation can be one suitable method because of the high calorific value.

[127] An example is adsorption on activated carbon with recycling of the activated carbon to the activated sludge system: this is followed by destruction of the adsorbed non-biodegradable compounds by incineration or treatment with free-radicals (i.e. process generating OH*, O_2*-, CO_2*-) of the excess sludge (biomass along with the spent activated carbon) (see plant 6 in chapter 4.10.1).

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you segregate concentrated highly loaded (COD>5000 mg/l) streams containing non-biodegradable compounds and pretreat them separately? **If yes: how?** In this case the treatment of waste water in an activated sludge system at low food-to-micro organism ratio as described in chapter 4.10.1 is possible.							
Do you segregate and dispose highly loaded residual printing pastes and residual padding liquors?							
Do you have waste water containing pigment printing paste or latex from carpet backing? In this case precipitation/ flocculation and incineration of the resulting sludge are a viable alternative to chemical oxidation (see chapter 4.10.5).							

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
If you cannot segregate concentrated water streams containing non-biodegradable compounds, · do tertiary treatments follow the biological treatment process as described in plant 6, chapter 4.10.1 · is the waste water treated by combined biological, physical and chemical treatments with the addition of powdered activated carbon and iron salt to the activated sludge system with reactivation of the excess sludge by “wet oxidation” or “wet peroxidation” (if hydrogen peroxide is used) as described in chapter 4.10.3 · is the waste water treated by ozonization of recalcitrant compounds prior to the activated sludge system as described in plant 3 in chapter 4.10.1							

4 Wool

4.1 Selection of incoming fibre raw material

	Follow
See BREF chapters 4.2.1, 4.2.2, 4.2.4, 4.2.5, 4.2.7, 4.2.8, and 5.1	

BAT is to seek collaboration with upstream partners in the textile chain in order to create a chain of environmental responsibility for textiles.

BENEFITS: Textile manufacturers are not well informed by their suppliers about the quality and quantity of substances (e.g. preparation agents, pesticides, knitting oils) applied on the fibre during the upstream processes. But the knowledge of these characteristics is essential to enable the manufacturer to prevent and control the environmental impact resulting from these substances.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you get information concerning your raw materials?							
Do you get it automatically? *In a written form like a goods/part identification tag?*							
Do you have your own system to get information about the raw materials? *Is it established in a management system?* *Is it established in the purchasing department?*							
What kind of information do you get for **wool**? *Do you get information about possible contamination of the fibre material with the most hazardous chemicals such*							

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
as OC pesticides residues?[128] *Do you get information about minimisation of ectoparasiticides on sheep?*[129] *Can you select wool yarn spun with biodegradable spinning agents instead of formulations based on mineral oils and/or containing APEO?*[130]							

[128] BAT is to use available information to avoid processing fibre material contaminated with the most hazardous chemicals such as OC (organochlorine) pesticides residues (see chapter 4.2.7)

[129] BAT is to minimise at source any legally used sheep ectoparasiticides by encouraging the development of low pesticide residue wool by continuing dialogue with competent bodies responsible for wool production and marketing in all producing countries (see chapter 4.2.8)

[130] BAT is to select wool yarn spun with biodegradable spinning agents instead of formulations based on mineral oils and/or containing APEO (see chapter4.2.2)

4.2 Process-integrated measures for unit processes and operations

4.2.1 Wool scouring

4.2.1.1 Wool scouring with water See BREF chapters 4.2.2, 4.2.7, 4.2.8, 4.3.3, 4.4.1, 4.4.3 and 5.2.1	Follow

BAT is to

- select raw wool fibre (see chapters 4.2.7, 4.2.8, and 4.2.2)
- substitute alkylphenol ethoxylates (APEO) detergents defined in chapters 4.2.2 and 4.3.3
- use dirt removal/grease recovery loops of high capacity as described in chapter 4.4.1
- reduce energy consumption to 4 - 4.5 MJ/kg for greasy wool processed as described in chapter 4.4.3

BENEFITS: The implementation of dirt removal/grease recovery loops allows:

- **a reduction in water consumption ranging from a minimum of 25 % to a maximum of more than 50 %**
- **a reduction in energy consumption**
- **the production of a valuable by-product: wool grease**
- **a reduction in detergent and builder consumption**
- **the conversion of suspended dirt into spadeable sludge**
- **a reduction of the load sent to the effluent treatment plant**

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
What kind of information do you get for raw wool? For detailed information see above 1.4							
Do you check your detergents if they are APEO-free? For detailed information see above 1.3.2							

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you use a counter current scouring plant and separate the liquid waste streams? **If yes, do you use dirt removal/grease recovery loops of high capacity?**[131, 132]							
Is your water consumption 2 to 4 l/kg of greasy wool for medium and large mills[133] or 6 l/kg for small mills?							
Is your grease recovery range between 25 and 30 % of the grease estimated to be present in the wool scoured?							
Do you reduce the energy consumption by · fitting covers to scour bowls to prevent heat losses · optimising the performance of the final squeeze press in order to improve mechanical removal of water before the drying process · running the last bowl at relatively high temperature[134] · controlling automatically the humidity in the dryer							

[131] For fine and extra-fine wool, when carried out using machinery that has a separate continuous sludge flow output, the wool grease recovery loop also allows the elimination of the very fine dirt fraction without the need for a separate loop for dirt removal.

[132] Disincentives are the high capital cost, high maintenance costs and complexity.

[133] processing 15000 tonnes/year of greasy wool

[134] Optimum temperature is shown to be 65°C, except when peroxide bleaching is carried out in the last bowl. In this case the optimum bleaching temperature is 48°C.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
via sensors which measure the humidity of the dryer atmosphere or of the wool itself · retrofitting heat recovery units to dryers							

4.2.1 Wool scouring

4.2.1.2 Scouring with organic solvent

Follow

See BREF chapters 2.3.1.3, 4.4.4and 5.2.1

BAT is scouring with organic solvent, provided that all measures described in chapter 2.3.1.3 are taken to minimise fugitive losses and prevent any possible contamination of groundwater arising from diffuse pollution and accidents.[135]

BENEFITS: Scarcity of water is probably the main driving force for the implementation of this technique. Since pesticides partition strongly to the solvent and leave with the grease, the clean wool is reported to be pesticide free. This has positive implications for the downstream processes where wool is finished. Another positive effect of this technique is reduced energy consumption, due to the low latent heat of evaporation of an organic solvent compared to water.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you take care for solvent losses into the air or the groundwater?							
Do you have a maintenance schedule?							
Are the residual traces of solvent in the water destroyed, using a free-radical process based on the Fenton reaction (iron and hydrogen peroxide) or others?							
Are the workers experienced and well skilled/ trained for operating the plant?							

[135] The referenced technique uses trichloroethylene as solvent. Trichloroethylene is a non biodegradable and persistent substance. Unaccounted losses of this solvent arising from spills, residues on the fibre, etc., if not adequately treated on site to destroy the solvent, may lead to diffuse emissions resulting in serious problems of soil and groundwater pollution. This has been taken into account in the latest design of the described technique.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Have you taken measures to protect workers and the environment in case of an accident?							
Do you know the Wooltech process who has prepared a Code of Conduct for operators with strict maintenance, quality control and management practices to address all the environmental, health and safety issues?[136]							

[136] Wooltech, (2001) "Detailed description of Wooltech Processes and Techniques - Document A1"

4.2.2 Wool dyeing

	Follow
See BREF chapters 4.6.16, 4.6.15, 4.6.17, 4.6.14 and 5.2.2	

BAT is to

- substitute chrome dyes with reactive dyes or, where not possible, use ultra-low chroming methods that fulfil all the following requirements as defined in chapter 4.6.15
- ensure minimum discharge of heavy metals in the waste water when dyeing wool with metal complex dyes (see chapter 4.6.17)
- give preference to a pH-controlled process when dyeing with pH-controllable dyes (acid and basic dyes) (see chapter 4.6.14)

BENEFITS: By changing over to reactive dyestuffs, the handling of hexavalent chromium, which requires special safety precautions, due to its chronic toxicity and carcinogenic effects, can be avoided.[137] As concerns waste water, the presence of chromium, not only in the chelated form, but more importantly as free metal, is avoided.[138] Furthermore, pH controlled dyeing results in maximum exhaustion of dyes and insect resist agents and minimum use of organic levelling agents.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Could you substitute chrome dyes with reactive dyes (see chapter 4.6.16)?							
If not, **could you substitute them with ultra-low chroming methods (see chapter 4.6.15)?**							
Do you use low-chrome dyeing or ultra-low chroming techniques? *Do you apply stoichiometric or substoichiometrically dosage of chrome (up to a maximum of 1.5 % o.w.f.) together with careful pH*							

[137] The use of chrome dyes is also discouraged by various initiatives at European level (e.g GuT label for carpets, Eco-label for textile products, etc.).

[138] In this respect, it has to be taken into account that dyehouses that accept dyeing without chrome dyes may still use the metal complex dyes. Nevertheless, in metal-complex dyes the metal is present in the chelated form, which brings about less risk than the same amount of chromium released from afterchroming.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
control (3.5 - 3.8) and optional addition of a reducing agent?							
Can the emission factor of 50 mg chromium per kg of wool treated be achieved?[139]							
Is no chromium (VI) detectable in the waste water?[140]							
If no, **could you substitute them with 1:2 metal-complex dyes by** · **using special auxiliaries** · **replacing acetic acid by formic acid (see chapter 4.6.17)**[141]							
Do you give preference to a pH-controlled process when dyeing with pH-controllable dyes (acid and basic dyes) (see chapter 4.6.14)?							
Do you recycle or recover the spent dye baths?							

[139] This corresponds to a chromium concentration of 5 mg/l in the spent chroming bath when a 1:10 liquor ratio is used.

[140] Using a standard method able to detect Cr VI at concentrations <0.1 mg/l.

[141] BAT associated values are emission factors of 10 - 20 mg/kg of treated wool, which correspond to 1 - 2 mg/l of chromium in the spent dye bath.

4.2.3 Wool finishing

4.2.3.1 Mothproofing treatments

Follow

See BREF chapters 4.8.4.1, 4.8.4.2, 4.8.4.3, 4.8.4.4 and 5.2.2

In process in general BAT is to

- adopt appropriate measures for material handling (see chapter 4.8.4.1)
- ensure that 98 % efficiency (transfer of insect resist agent to the fibre) is achieved (see 4.8.4.4)
- adopt the following additional measures when the insect resist agent is applied from a dye bath:
  - Ø ensure that a pH<4.5 is reached at the end of the process and if this is not possible, apply the insect resist agent in a separate step with re-use of the bath
  - Ø add the insect resist agent after dye bath expansion in order to avoid overflow spillages
  - Ø select dyeing auxiliaries that do not exert a retarding action on the uptake (exhaustion) of the insect-resist agent during the dyeing process (see chapter 4.8.4.1)

In mothproofing of yarn produced via the dry spinning route BAT is to use one or both of these techniques (see chapter 4.8.4.2)

- combine acid aftertreatment (to increase the uptake of mothproofer active substance) and re-use of the rinse bath for the next dyeing step
- apply proportional over-treatment of 5 % of the total fibre blend combined with dedicated dyeing machinery and waste water recycling systems to minimise active substance emissions to water.

In mothproofing of loose fibre dyed/yarn scoured production BAT is to (see chapter 4.8.4.3)

- use dedicated low-volume application systems located at the end of the yarn scouring machine
- recycle low-volume process liquor between batches and use processes designed specifically to remove active substance from spent process liquor[142]
- apply mothproofer directly to the carpet pile (when mothproofing during carpet manufacture) using foam application technology

In mothproofing of yarn dyed production BAT is to (see chapter 4.8.4.4)

- use a separate aftertreatment process to minimise emissions from dyeing processes which are carried out under less than optimum conditions for mothproofer uptake
- use semi-continuous low-volume application machinery or modified centrifuges
- recycle low-volume process liquor between yarn batches and processes designed specifically to remove active substance from spent process liquor[7]
- apply mothproofer directly to the carpet pile (when mothproofing during carpet manufacture) using foam application technology

BENEFITS: Avoidance and reduction in mothproofer residues discharged to waste water is the driving force for implementation.

Details	Status	Remarks	Follow

[142] These techniques may include adsorptive or degradative treatments.

	yes	no	partly	not appl.		yes	no
Do you apply insect resist agent active substances? **If yes,** **do you handle and transfer the concentrate to dyeing machines with regard to the following measures (see chapter 4.8.4.1)** · **bulk containers should be transferred to a safe bundled store on receipt** · **in the event of a fire, provision to inform the fire authority and sewage treatment undertaker of the presence and nature of the substance should be in place** · **concentrate should only be dispensed from bulk containers within the colour store** · **automated dispensing systems should be considered to minimise spillage and improve accuracy** · **concentrate should not be pre-dissolved in the colour room** · **concentrate should be transferred from the colour store to the point of addition to the process in sealed shockproof containers**							

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
· **concentrate should be added directly to the process liquor only when the dyeing is underway and the dye bath volume is stable (prevents displacement spillage)**							
Do you adopt the following additional measures when the insect resist agent is applied from a dye bath (see chapter 4.8.4.1) · **ensure that a pH<4.5 is reached at the end of the process.**[143] · **add the insect resist agent after dye bath expansion in order to avoid overflow spillages** · **select dyeing auxiliaries that do not exert a retarding action on the uptake (exhaustion) of the insect-resist agent during the dyeing process**							

[143] If this is not possible, apply the insect resist agent in a separate step with re-use of the bath.

Mothproofing of yarn produced via the dry spinning route (see chapter 4.8.4.2)							
Do you combine acid aftertreatment[144] and re-use of the rinse bath for the next dyeing step?							
Do you apply proportional over-treatment of 5 % of the total fibre blend combined with dedicated dyeing machinery and waste water recycling systems to minimise active substance emissions to water?							
Mothproofing of loose fibre dyed/yarn scoured production (see chapter 4.8.4.3)							
Do you use dedicated low-volume application systems located at the end of the yarn scouring machine?							
Do you recycle low-volume process liquor between batches and use processes designed specifically to remove active substance from spent process liquor?							
Do you apply mothproofer directly to the carpet pile using foam application technology?							

[144] to increase the uptake of mothproofer active substance

Mothproofing of yarn dyed production (see chapter 4.4.8.8)							
Do you use a separate aftertreatment process to minimise emissions from dyeing processes which are carried out under less than optimum conditions for mothproofer uptake?							
Do you use semi-continuous low-volume application machinery or modified centrifuges?							
Do you recycle low-volume process liquor between yarn batches and processes designed specifically to remove active substance from spent process liquor?[7]							
Do you apply mothproofer directly to the carpet pile using foam application technology?							

4.3 Effluent treatment and waste disposal

4.3.1 Effluent treatment in the wool scouring sector (water-based process)

Follow

See BREF chapters 4.4.2, 4.4.1 and 5.3

BAT is to

- combine the use of dirt removal/grease recovery loops with evaporative effluent treatment, with integrated incineration of the resulting sludge and full recycling of water and energy for: 1) new installations 2) existing installations with no on-site effluent treatment 3) installations seeking to replace life-expired effluent treatment plant (see chapter 4.4.2)
- use coagulation/flocculation treatment in existing mills already using it in conjunction with discharge to sewerage system employing aerobic biological treatment (see chapter 4.10.10)

BENEFITS: Reductions of the organic load discharged to the environment, water consumption, and the amount of sludge to be disposed off are the main advantages of the technique.

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
For new, existing installations with no on-site effluent treatment and installations seeking to replace life-expired effluent treatment plants: **Do you think about combining the use of dirt removal/grease recovery loops with evaporative effluent treatment, with integrated incineration of the resulting sludge and full recycling of water and energy?[145]**							

[145] The technique involves the closed-loop treatment of wool scouring effluents by evaporation / incineration with recovery of water and energy. Thereby the whole system of effluent and waste management is closely integrated with a dirt removal / grease recovery loop applied to the scouring process (see chapter 4.4.1).

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
In existing mills: **Do you use coagulation/flocculation treatment in conjunction with discharge to sewerage system employing aerobic biological treatment?**							

4.3 Effluent treatment and waste disposal

4.3.2 Sludge from waste water treatment of wool scouring effluent

Follow

See BREF chapters 4.10.12, 4.4.1 and 5.3

BAT is to

- use sludge in brick-making (see chapter 4.10.12) or adopt any other appropriate recycling routes
- incinerate the sludge with heat recovery[146]

Details	Status				Remarks	Follow	
	yes	no	partly	not appl.		yes	no
Do you try to use the sludge for recycling or additive in e.g. brick-making?							
If you incinerate the sludge, have you installed heat recovery systems (see above 1.5)?							

[146] Provided that measures are taken to control emissions of SO_x, NO_x and dust and to avoid emissions of dioxins and furans arising from organically bound chlorine from pesticides potentially contained in the sludge.