COMMISSION IMPLEMENTING DECISION (EU) 2022/2508

of 9 December 2022

establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions, for the textiles industry

(notified under document C(2022) 8984)

(Text with EEA relevance)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) ([1]), and in particular Article 13(5) thereof,

Whereas:

(1) Best available techniques (BAT) conclusions are the reference for setting permit conditions for installations covered by Chapter II of Directive 2010/75/EU and competent authorities should set emission limit values which ensure that, under normal operating conditions, emissions do not exceed the emission levels associated with the best available techniques as laid down in the BAT conclusions.

(2) In accordance with Article 13(4) of Directive 2010/75/EU, the forum composed of representatives of Member States, the industries concerned and non-governmental organisations promoting environmental protection, established by Commission Decision of 16 May 2011 ([2]), provided the Commission on 10 May 2022 with its opinion on the proposed content of the BAT reference document for the textiles industry. That opinion is publicly available ([3]).

(3) The BAT conclusions set out in the Annex to this Decision take into account the opinion of the forum on the proposed content of the BAT reference document. They contain the key elements of the BAT reference document.

(4) The measures provided for in this Decision are in accordance with the opinion of the Committee established by Article 75(1) of Directive 2010/75/EU,

HAS ADOPTED THIS DECISION:

Article 1

The best available techniques (BAT) conclusions for the textiles industry, as set out in the Annex, are adopted.

Article 2

This Decision is addressed to the Member States.

([1]) OJ L 334, 17.12.2010, p. 17.
([2]) Commission Decision of 16 May 2011 establishing a forum for the exchange of information pursuant to Article 13 of Directive 2010/75/EU on industrial emissions (OJ C 146, 17.5.2011, p. 3).
([3]) https://circabc.europa.eu/ui/group/06f33a94-9829-4eee-b187-21bb783a0fbf/library/fdb14511-4fc5-4b90-b495-79033a1787af?p=1&n=10&sort=modified_DESC

Done at Brussels, 9 December 2022.

For the Commission

Virginijus SINKEVIČIUS

Member of the Commission

ANNEX

1. BEST AVAILABLE TECHNIQUES (BAT) CONCLUSIONS FOR THE TEXTILES INDUSTRY

SCOPE

These BAT conclusions concern the following activities specified in Annex I to Directive 2010/75/EU:

6.2. Pre-treatment (operations such as washing, bleaching, mercerisation) or dyeing of textile fibres or textiles where the treatment capacity exceeds 10 tonnes per day.

6.11. Independently operated treatment of waste water not covered by Directive 91/271/EEC, provided that the main pollutant load originates from activities covered by these BAT conclusions.

These BAT conclusions also cover the following:

— The following activities when they are directly associated with activities specified in point 6.2 of Annex I to Directive 2010/75/EU:

  — coating;

  — dry cleaning;

  — fabric production;

  — finishing;

  — lamination;

  — printing;

  — singeing;

  — wool carbonising;

  — wool fulling;

  — spinning of fibres (other than man-made fibres);

  — washing or rinsing associated with dyeing, printing or finishing.

— The combined treatment of waste water from different origins, provided that the main pollutant load originates from activities covered by these BAT conclusions and that the waste water treatment is not covered by Directive 91/271/EEC.

— On-site combustion plants that are directly associated with the activities covered by these BAT conclusions, provided that the gaseous products of combustion are put into direct contact with the textile fibres or textiles (such as direct heating, drying, heat-setting) or when radiant and/or conductive heat is transferred through a solid wall (indirect heating) without using an intermediary heat transfer fluid.

These BAT conclusions do not cover the following:

— Coating and lamination with an organic solvent consumption capacity of more than 150 kg per hour or more than 200 tonnes per year. These are covered by the BAT conclusions on surface treatment using organic solvents including preservation of wood and wood products with chemicals (STS).

— Production of man-made fibres and yarns. This may be covered by the BAT conclusions covering the sector of polymers production.

— Unhairing of hides and skins. This may be covered by the BAT conclusions for the tanning of hides and skins (TAN).

Other BAT conclusions and reference documents which could be relevant for the activities covered by these BAT conclusions include the following:

— Surface Treatment Using Organic Solvents including Preservation of Wood and Wood Products with Chemicals (STS);

— Waste Incineration (WI);

— Waste Treatment (WT);

— Emissions from Storage (EFS);

— Energy Efficiency (ENE);

— Industrial Cooling Systems (ICS);

— Monitoring of Emissions to Air and Water from IED Installations (ROM);

— Economics and Cross-Media Effects (ECM).

These BAT conclusions apply without prejudice to other relevant legislation, e.g. on the registration, evaluation, authorisation and restriction of chemicals (REACH), on the classification, labelling and packaging of substances and mixtures (CLP), on biocidal products (BPR) or on energy efficiency (energy efficiency first principle).

DEFINITIONS

For the purposes of these BAT conclusions, the following definitions apply:

General terms	
Term used	Definition
Air-to-textile ratio	The ratio of the total exhaust gas volume flow (expressed in Nm^3/h) from the emission point of a textile treatment unit (e.g. stenter) to the corresponding throughput of the textile to be treated (dry textile, expressed in kg/h).
Cellulosic materials	Cellulosic materials include cotton and viscose.
Channelled emissions	Emissions of pollutants to air through any kind of duct, pipe, stack, etc.
Continuous measurement	Measurement using an automated measuring system permanently installed on site.
Desizing	Pre-treatment of textile materials to remove sizing chemicals from woven fabric.
Diffuse emissions	Non-channelled emissions to air.
Direct discharge	Discharge to a receiving water body without further downstream waste water treatment.
Dry cleaning	Cleaning of textile materials with an organic solvent.
Existing plant	A plant that is not a new plant.
Fabric production	Production of fabric, e.g. by weaving or knitting.
Finishing	Physical and/or chemical treatment aiming at giving the textile materials end-use properties such as visual effects, handle characteristics, waterproofness or non-flammability.
Flame lamination	Bonding of fabrics using a thermoplastic foam sheet, exposed to a flame located before the laminating rolls.
Hazardous substance	Hazardous substance as defined in point 18 of Article 3 of Directive 2010/75/EU.
Hazardous waste	Hazardous waste as defined in point 2 of Article 3 of Directive 2008/98/EC of the European Parliament and of the Council [1]
Indirect discharge	Discharge that is not a direct discharge.
Liquor ratio	For a batch process, weight ratio between the dry textile materials and the process liquor used.
n-Octanol/water partition coefficient	The ratio of the equilibrium concentrations of a dissolved substance in a two-phase system consisting of the largely immiscible solvents n-octanol and water.

Major plant upgrade	A major change in the design or technology of a plant with major adjustments or replacements of the process and/or abatement technique(s) and associated equipment.
Mass flow	The mass of a given substance or parameter which is emitted over a defined period of time.
New plant	A plant first permitted at the site of the installation following the publication of these BAT conclusions or a complete replacement of a plant following the publication of these BAT conclusions.
Organic solvent	Organic solvent as defined in Article 3(46) of Directive 2010/75/EU.
Periodic measurement	Measurement at specified time intervals using manual or automated methods.
Pick-up	For a continuous process, weight ratio between the liquid taken up by the textile materials and the dry textile materials.
Process chemicals	Substances and/or mixtures as defined in Article 3 of Regulation (EC) No 1907/2006 [2] that are used in the process(es), including sizing chemicals, bleaching chemicals, dyes, printing pastes and finishing chemicals. Process chemicals may contain hazardous substances and/or substances of very high concern.
Process liquor	Solution and/or suspension containing process chemicals.
Residual pick-up	The remaining capacity of wet textile materials to take up additional liquid (after the initial pick-up).
Scouring	Pre-treatment of textile materials which consists of washing the incoming textile material.
Singeing	Removal of the fibres at the surface of the fabric by passing the fabric through a flame or heated plates.
Sizing	Impregnation of yarn with process chemicals aiming to protect the yarn and provide lubrication during weaving.
Substances of very high concern	Substances meeting the criteria mentioned in Article 57 and included in the Candidate List of Substances of Very High Concern, according to the REACH Regulation ((EC) No 1907/2006).
Synthetic materials	Synthetic materials include polyester, polyamide and acrylic.
Textile materials	Textile fibres and/or textiles.
Thermal treatment	Thermal treatment of textile materials includes thermofixation, heat-setting or a process step (e.g. drying, curing) of the activities covered by these BAT conclusions (e.g. coating, dyeing, pre-treatment, finishing, printing, lamination).

[1] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L 312, 22.11.2008, p. 3).

[2] Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC (OJ L 396, 30.12.2006, p. 1).

Pollutants and parameters	
Term used	Definition
Antimony	Antimony, expressed as Sb, includes all inorganic and organic antimony compounds, dissolved or bound to particles.
AOX	Adsorbable organically bound halogens, expressed as Cl, include adsorbable organically bound chlorine, bromine and iodine.
BOD_n	Biochemical oxygen demand. Amount of oxygen needed for the biochemical oxidation of the organic matter to carbon dioxide in *n* days (*n* is typically 5 or 7). BOD_n is an indicator for the mass concentration of biodegradable organic compounds.
Chromium	Chromium, expressed as Cr, includes all inorganic and organic chromium compounds, dissolved or bound to particles.
CO	Carbon monoxide.
COD	Chemical oxygen demand. Amount of oxygen needed for the total chemical oxidation of the organic matter to carbon dioxide using dichromate. COD is an indicator for the mass concentration of organic compounds.
Copper	Copper, expressed as Cu, includes all inorganic and organic copper compounds, dissolved or bound to particles.
CMR	Carcinogenic, mutagenic or toxic for reproduction. This includes CMR substances of categories 1A, 1B and 2, as defined in Regulation (EC) No 1272/2008 of the European Parliament and of the Council ([1]) and amended, i.e. with hazard statement codes: H340, H341, H350, H351, H360 and H361.
Dust	Total particulate matter (in air).
HOI	Hydrocarbon oil index. The sum of compounds extractable with a hydrocarbon solvent (including long-chain or branched aliphatic, alicyclic, aromatic or alkyl-substituted aromatic hydrocarbons).
NH_3	Ammonia.
Nickel	Nickel, expressed as Ni, includes all inorganic and organic nickel compounds, dissolved or bound to particles.
NO_X	The sum of nitrogen monoxide (NO) and nitrogen dioxide (NO_2), expressed as NO_2.
SO_X	The sum of sulphur dioxide (SO_2), sulphur trioxide (SO_3), and sulphuric acid aerosols, expressed as SO_2.
Sulphide, easily released	The sum of dissolved sulphides and of those undissolved sulphides that are easily released upon acidification, expressed as S^{2-}.
TOC	Total organic carbon, expressed as C (in water), includes all organic compounds.
TN	Total nitrogen, expressed as N, includes free ammonia and ammonium nitrogen (NH_4-N), nitrite nitrogen (NO_2-N), nitrate nitrogen (NO_3-N) and organically bound nitrogen.

TP	Total phosphorus, expressed as P, includes all inorganic and organic phosphorus compounds, dissolved or bound to particles.
TSS	Total suspended solids. Mass concentration of all suspended solids (in water), measured via filtration through glass fibre filters and gravimetry.
TVOC	Total volatile organic carbon, expressed as C (in air).
VOC	Volatile organic compound as defined in Article 3(45) of Directive 2010/75/EU.
Zinc	Zinc, expressed as Zn, includes all inorganic and organic zinc compounds, dissolved or bound to particles.

(1) Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006 (OJ L 353, 31.12.2008, p. 1).

ACRONYMS

For the purposes of these BAT conclusions, the following acronyms apply:

Acronym	Definition
CMS	Chemicals management system
DTPA	Diethylenetriaminepentaacetic acid
EDTA	Ethylenediaminetetraacetic acid
EMS	Environmental management system
ESP	Electrostatic precipitator
IED	Industrial Emissions Directive (2010/75/EU)
OTNOC	Other than normal operating conditions
PFAS	Per- and polyfluoroalkyl substances

GENERAL CONSIDERATIONS

Best Available Techniques

The techniques listed and described in these BAT conclusions are neither prescriptive nor exhaustive. Other techniques may be used that ensure at least an equivalent level of environmental protection.

Unless otherwise stated, the BAT conclusions are generally applicable.

Emission levels associated with the best available techniques (BAT-AELs) for emissions to air

The BAT-AELs for emissions to air given in these BAT conclusions refer to concentrations (mass of emitted substances per volume of waste gas) under the following standard conditions: dry gas at a temperature of 273,15 K and a pressure of 101,3 kPa, without correction for oxygen content, and expressed in mg/Nm^3.

For averaging periods of BAT-AELs for emissions to air, the following **definition** applies.

Type of measurement	Averaging period	Definition
Periodic	Average over the sampling period	Average value of three consecutive samplings/measurements of at least 30 minutes each. (1)

(1) For any parameter where, due to sampling or analytical limitations and/or due to operational conditions, a 30-minute sampling/measurement and/or an average of three consecutive samplings/measurements is inappropriate, a more representative sampling/measurement procedure may be employed.

For the purpose of calculating the mass flows in relation to BAT 9, BAT 26, BAT 27 and Table 1.5 and Table 1.6, where waste gases from one type of source (e.g. stenter) discharged through two or more separate emission points could, in the judgement of the competent authority, be discharged through a common emission point, these emission points shall be considered as a single emission point (see also BAT 23). Mass flows at the plant/installation level can be used as an alternative.

Emission levels associated with the best available techniques (BAT-AELs) for emissions to water

The BAT-AELs for emissions to water given in these BAT conclusions refer to concentrations (mass of emitted substances per volume of water), expressed in mg/l.

Averaging periods associated with the BAT-AELs refer to either of the following two cases:

— In the case of continuous discharge, daily average values, i.e. 24-hour flow-proportional composite samples.

— In the case of batch discharge, average values over the release duration taken as flow-proportional composite samples, or, provided that the effluent is appropriately mixed and homogeneous, a spot sample taken before discharge.

Time-proportional composite samples can be used provided that sufficient flow stability is demonstrated. Alternatively, spot samples may be taken, provided that the effluent is appropriately mixed and homogeneous.

In the case of total organic carbon (TOC) and chemical oxygen demand (COD), the calculation of the average abatement efficiency referred to in these BAT conclusions (see Table 1.3) is based on the influent and effluent load of the waste water treatment plant.

The BAT-AELs apply at the point where the emission leaves the installation.

Other environmental performance levels

Indicative levels for specific energy consumption

The indicative environmental performance levels related to specific energy consumption refer to yearly averages calculated using the following equation:

$$\text{specific energy consumption} = \frac{\text{energy consumption rate}}{\text{activity rate}}$$

where:

energy consumption rate:	total annual amount of heat and electricity consumed by the thermal treatment, minus the heat recovered from the thermal treatment, expressed in MWh/year;
activity rate:	total annual amount of textile materials treated in the thermal treatment, expressed in t/year.

Indicative levels for specific water consumption

The indicative environmental performance levels related to specific water consumption refer to yearly averages calculated using the following equation:

$$\text{specific water consumption} = \frac{\text{water consumption rate}}{\text{activity rate}}$$

where:

water consumption rate:	total annual amount of water consumed by a given process (e.g. bleaching) including water used for washing and rinsing the textile materials and for cleaning the equipment, minus the water reused and/or recycled to the process, expressed in m^3/year;
activity rate:	total annual amount of textile materials treated in a given process (e.g. bleaching), expressed in t/year.

Specific wool grease recovery level associated with the best available techniques

The environmental performance level related to specific wool grease recovery refers to a yearly average calculated using the following equation:

$$\text{specific wool grease recovery} = \frac{\text{rate of wool grease recovered}}{\text{activity rate}}$$

where:

rate of wool grease recovered:	total annual amount of wool grease recovered from the pre-treatment of raw wool fibres by scouring, expressed in kg/year;
activity rate:	total annual amount of raw wool fibres pre-treated by scouring, expressed in t/year.

Caustic soda recovery level associated with the best available techniques

The environmental performance level related to caustic soda recovery refers to a yearly average calculated using the following equation:

$$\text{caustic soda recovery} = \frac{\text{rate of caustic soda recovered}}{\text{rate of caustic soda before recovery}}$$

where:

rate of caustic soda recovered:	total annual amount of caustic soda recovered from spent mercerisation rinsing water, expressed in kg/year;
rate of caustic soda before recovery:	total annual amount of caustic soda in the spent mercerisation rinsing water, expressed in kg/year.

1.1. *General BAT conclusions*

1.1.1. Overall environmental performance

BAT 1. In order to improve the overall environmental performance, BAT is to elaborate and implement an environmental management system (EMS) that incorporates all of the following features:

i. commitment, leadership, and accountability of the management, including senior management, for the implementation of an effective EMS;

ii. an analysis that includes the determination of the organisation's context, the identification of the needs and expectations of interested parties, the identification of characteristics of the installation that are associated with possible risks for the environment (or human health) as well as of the applicable legal requirements relating to the environment;

iii. development of an environmental policy that includes the continuous improvement of the environmental performance of the installation;

iv. establishing objectives and performance indicators in relation to significant environmental aspects, including safeguarding compliance with applicable legal requirements;

v. planning and implementing the necessary procedures and actions (including corrective and preventive actions where needed), to achieve the environmental objectives and avoid environmental risks;

vi. determination of structures, roles and responsibilities in relation to environmental aspects and objectives and provision of the financial and human resources needed;

vii. ensuring the necessary competence and awareness of staff whose work may affect the environmental performance of the installation (e.g. by providing information and training);

viii. internal and external communication;

ix. fostering employee involvement in good environmental management practices;

x. establishing and maintaining a management manual and written procedures to control activities with significant environmental impact as well as relevant records;

xi. effective operational planning and process control;

xii. implementation of appropriate maintenance programmes;

xiii. emergency preparedness and response protocols, including the prevention and/or mitigation of the adverse (environmental) impacts of emergency situations;

xiv. when (re)designing a (new) installation or a part thereof, consideration of its environmental impacts throughout its life, which includes construction, maintenance, operation and decommissioning;

xv. implementation of a monitoring and measurement programme; if necessary, information can be found in the Reference Report on Monitoring of Emissions to Air and Water from IED Installations;

xvi. application of sectoral benchmarking on a regular basis;

xvii. periodic independent (as far as practicable) internal auditing and periodic independent external auditing in order to assess the environmental performance and to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained;

xviii. evaluation of causes of nonconformities, implementation of corrective actions in response to nonconformities, review of the effectiveness of corrective actions, and determination of whether similar nonconformities exist or could potentially occur;

xix. periodic review, by senior management, of the EMS and its continuing suitability, adequacy and effectiveness;

xx. following and taking into account the development of cleaner techniques.

Specifically for the textile industry, BAT is also to incorporate the following features in the EMS:

xxi. an inventory of inputs and outputs (see BAT 2);

xxii. an OTNOC management plan (see BAT 3);

xxiii. a water management plan and water audits (see BAT 10);

xxiv. an energy efficiency plan and energy audits (see BAT 11);

xxv. a chemicals management system (see BAT 14);

xxvi. a waste management plan (see BAT 29).

Note

Regulation (EC) No 1221/2009 establishes the European Union eco-management and audit scheme (EMAS), which is an example of an EMS consistent with this BAT.

Applicability

The level of detail and the degree of formalisation of the EMS will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have.

BAT 2. In order to improve the overall environmental performance, BAT is to establish, maintain and regularly review (including when a significant change occurs) an inventory of inputs and outputs, as part of the environmental management system (see BAT 1), that incorporates all of the following features:

I. information about the production process(es), including:

   a. simplified process flow sheets that show the origin of the emissions;

   b. descriptions of process-integrated techniques and waste water/waste gas treatment techniques to prevent or reduce emissions, including their performance (e.g. abatement efficiency);

II. information about the quantity and characteristics of materials used, including textile materials (see BAT 5 (a)) and process chemicals (see BAT 15);

III. information about water consumption and usage (e.g. flow diagrams and water mass balances);

IV. information about energy consumption and usage;

V. information about the quantity and characteristics of the waste water streams, such as:

   a. average values and variability of flow, pH, temperature and conductivity;

   b. average concentration and mass flow values of relevant substances/parameters (e.g. COD/TOC, nitrogen species, phosphorus, metals, priority substances, microplastics) as well as their variability;

   c. data on toxicity, bioeliminability and biodegradability (e.g. BOD_n, BOD_n to COD ratio, results of Zahn-Wellens test, biological inhibition potential (e.g. inhibition of activated sludge));

VI. information about the characteristics of the waste gas streams, such as:

   a. average values and variability of flow and temperature;

   b. average concentration and mass flow values of relevant substances/parameters (e.g. dust, organic compounds) as well as their variability; emission factors may be used to assess the variability of emissions to air (see Section 1.9.1);

c. flammability, lower and higher explosive limits, reactivity, hazardous properties;

d. presence of other substances that may affect the waste gas treatment system or installation safety (e.g. water vapour, dust);

VII. information about the quantity and characteristics of waste generated.

Applicability

The scope (e.g. level of detail) and nature of the inventory will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have.

BAT 3. In order to reduce the frequency of the occurrence of OTNOC and to reduce emissions during OTNOC, BAT is to set up and implement a risk-based OTNOC management plan as part of the EMS (see BAT 1) that includes all of the following elements:

i. identification of potential OTNOC (e.g. failure of equipment critical to the protection of the environment ('critical equipment')), of their root causes and of their potential consequences, and regular review and update of the list of identified OTNOC following the periodic assessment below;

ii. appropriate design of critical equipment (e.g. waste water treatment, waste gas abatement techniques);

iii. set-up and implementation of an inspection and preventive maintenance plan for critical equipment (see BAT 1 xii);

iv. monitoring (i.e. estimating or, where possible, measuring) and recording of emissions during OTNOC and of associated circumstances;

v. periodic assessment of the emissions occurring during OTNOC (e.g. frequency of events, duration, amount of pollutants emitted) and implementation of corrective actions if necessary;

vi. regular review and update of the list of identified OTNOC under point i. following the periodic assessment of point v.;

vii. regular testing of back-up systems.

Applicability

The level of detail and degree of formalisation of the OTNOC management plan will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have.

BAT 4. In order to improve the overall environmental performance, BAT is to use advanced process monitoring and control systems.

Description

The monitoring and control of processes is carried out with on-line automated systems equipped with sensors and controllers using feedback connections to rapidly analyse and adapt key process parameters to reach optimal process conditions (e.g. optimal uptake of process chemicals).

Key process parameters include:

— volume, pH and temperature of the process liquor;

— amount of textile materials treated;

— dosage of process chemicals;

— drying parameters (see also BAT 13 (d)).

BAT 5. In order to improve the overall environmental performance, BAT is to use both of the techniques given below.

Technique		Description	Applicability
a.	Use of textile materials containing a minimised content of contaminants	Criteria for the selection of incoming textile materials (including recycled textile materials) are defined to minimise the content of contaminants including hazardous substances, poorly biodegradable substances and substances of very high concern. These criteria may be based on certification schemes or standards. Regular controls are carried out to verify that incoming textile materials fulfil the predefined criteria. These controls may consist of measurements and/or verification of information provided by suppliers and/or producers of textile materials. These controls may address the content of: — ectoparasiticides (veterinary drugs) and biocides in the incoming raw (or semi-processed) wool fibres; — biocides in the incoming cotton fibres; — manufacturing residues in the incoming synthetic fibres (e.g. monomers, side products of polymer synthesis, catalysts, solvents); — mineral oils (e.g. used for coning, spooling, spinning or knitting) in the incoming textile materials; — sizing chemicals in the incoming textile materials.	Generally applicable.
b.	Use of textile materials with reduced processing needs	Use of textile materials with inherent characteristics that reduce the need for processing. These materials include: — spin-dyed man-made fibres; — fibres with inherent flame retardance properties; — elastane fibres or blends of elastane fibres with other polymer fibres that contain reduced amounts of silicone oils and residual solvents; — blends of synthetic fibres with thermoplastic elastomers; — polyester fibres dyeable without carriers.	The applicability may be restricted by product specifications.

1.1.2. **Monitoring**

BAT 6. BAT is to monitor at least once every year:

— the annual consumption of water, energy and materials used, including textile materials and process chemicals;

— the annual amount of waste water generated;

— the annual amount of materials recovered or reused;

— the annual amount of each type of waste generated and sent for disposal.

Description

Monitoring preferentially includes direct measurements. Calculations or recording, e.g. using suitable meters or invoices, can also be used. The monitoring is broken down, as much as possible, to process level and considers any significant changes in the processes.

BAT 7. For waste water streams identified by the inventory of inputs and outputs (see BAT 2), BAT is to monitor key parameters (e.g. continuous monitoring of waste water flow, pH and temperature) at key locations (e.g. at the inlet and/or outlet of the waste water pre-treatment, at the inlet to the final waste water treatment, at the point where the emission leaves the installation).

Description

When bioeliminability/biodegradability and inhibitory effects are key parameters (e.g. see BAT 19), monitoring is carried out before the biological treatment for:

— bioeliminability/biodegradability using standards EN ISO 9888 or EN ISO 7827, and

— inhibitory effects on biological treatment using standards EN ISO 9509 or EN ISO 8192,

with a minimum monitoring frequency to be decided after effluent characterisation.

The effluent characterisation is carried out before starting operation of the plant or before a permit for the plant is updated for the first time after the publication of these BAT conclusions, and after each change (e.g. change of 'recipe') in the plant that may increase the pollutant load.

BAT 8. BAT is to monitor emissions to water with at least the frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

Substance(s)/parameter	Standard(s)	Activities/ processes	Minimum monitoring frequency	Monitoring associated with
Adsorbable organically bound halogens (AOX) (1)	EN ISO 9562	All activities/ processes	Once every month (2)	BAT 20
Biochemical oxygen demand (BOD_n) (3)	Various EN standards available (e.g. EN 1899-1, EN ISO 5815-1)		Once every month	
Brominated flame retardants (1)	EN standard available for some polybrominated diphenyl ethers (i.e. EN 16694)	Finishing with flame retardants	Once every 3 months	
Chemical oxygen demand (COD) (4)	No EN standard available	All activities/ processes	Once every day (5) (6)	
Colour	EN ISO 7887	Dyeing	Once every month (2)	

Hydrocarbon oil index (HOI) [1]		EN ISO 9377-2	All activities/ processes	Once every 3 months [7]
Metals/ metalloids	Antimony (Sb)	Various EN standards available (e.g. EN ISO 11885, EN ISO 17294-2, EN ISO 15586)	Pre-treatment and/or dyeing of polyester textile materials	Once every month [2]
			Finishing with flame retardants using antimony trioxide	
	Chromium (Cr)		Dyeing with chromium mordant or chromium-containing dyes (e.g. metal-complex dyes)	
	Copper (Cu)		Dyeing Printing with dyes	
	Nickel (Ni)			
	Zinc (Zn) [1]		All activities/ processes	
	Hexavalent chromium (Cr(VI))	Various EN standards available (e.g. EN ISO 10304-3, EN ISO 23913)	Dyeing with chromium mordant	Once every month
Pesticides [1]		EN standards available for some pesticides (e.g. EN 12918, EN 16693, EN ISO 27108)	Pre-treatment of raw wool fibres by scouring	To be decided, after effluent characterisation [8]
Per- and polyfluoroalkyl substances (PFAS) [1]		No EN standard available	All activities/ processes	Once every 3 months
Sulphide, easily released (S^{2-})		No EN standard available	Dyeing with sulphur dyes	Once every week or once every month [2]

Surfactants	Alkylphenols and alkylphenol ethoxylates [1]	EN standards available for some non-ionic surfactants, e.g. alkylphenols and alkylphenol ethoxylates (i.e. EN ISO 18857-1 and EN ISO 18857-2)	All activities/processes	Once every 3 months	
	Other surfactants	EN 903 for anionic surfactants		Once every 3 months [7]	
		No EN standard available for cationic surfactants			
Total nitrogen (TN)		Various EN standards available (e.g. EN 12260, EN ISO 11905-1)		Once every day [5] [6]	
Total organic carbon (TOC) [4]		EN 1484		Once every day [5] [6]	
Total phosphorus (TP)		Various EN standards available (e.g. EN ISO 6878, EN ISO 15681-1, EN ISO 15681-2, EN ISO 11885)		Once every day [5] [6]	
Total suspended solids (TSS)		EN 872		Once every day [5] [6]	
Toxicity [9]	Fish eggs (*Danio rerio*)	EN ISO 15088		To be decided based on a risk assessment, after effluent characterisation [8]	
	Daphnia (*Daphnia magna Straus*)	EN ISO 6341			
	Luminescent bacteria (*Vibrio fischeri*)	Various EN standards available (e.g. EN ISO 11348-1, EN ISO 11348-2, EN ISO 11348-3)			
	Duckweed (*Lemna minor*)	Various EN standards available (e.g. EN ISO 20079, EN ISO 20227)			
	Algae	Various EN standards available (e.g. EN ISO 8692, EN ISO 10253, EN ISO 10710)			

(1) The monitoring only applies when the substance(s)/parameter(s) (including groups of substances or individual substances in a group of substances) concerned is identified as relevant in the waste water stream based on the inventory of inputs and outputs mentioned in BAT 2.
(2) In the case of an indirect discharge, the monitoring frequency may be reduced to once every 3 months if the downstream waste water treatment plant is designed and equipped appropriately to abate the pollutants concerned.
(3) The monitoring only applies in the case of a direct discharge.
(4) TOC monitoring and COD monitoring are alternatives. TOC monitoring is the preferred option because it does not rely on the use of very toxic compounds.
(5) In the case of an indirect discharge, the monitoring frequency may be reduced to once every month if the downstream waste water treatment plant is designed and equipped appropriately to abate the pollutants concerned.
(6) If the emission levels are proven to be sufficiently stable, a lower monitoring frequency of once every month can be adopted.
(7) In the case of an indirect discharge, the monitoring frequency may be reduced to once every 6 months if the downstream waste water treatment plant is designed and equipped appropriately to abate the pollutants concerned.
(8) The effluent characterisation is carried out before starting operation of the plant or before a permit for the plant is updated for the first time after the publication of these BAT conclusions, and after each change (e.g. change of 'recipe') in the plant that may increase the pollutant load.
(9) Either the most sensitive toxicity parameter or an appropriate combination of the toxicity parameters can be used.

BAT 9. BAT is to monitor channelled emissions to air with at least the frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

Substance/ parameter	Standard(s)	Activities/processes	Minimum monitoring frequency (1)	Monitoring associated with
CO	EN 15058	Singeing	Once every 3 years	—
		Combustion		
		Flame lamination		
Dust	EN 13284-1	Singeing	Once every year (2)	BAT 27
		Combustion		
		Thermal treatments associated with pre-treatment, dyeing, printing and finishing		
CMR (other than formaldehyde) (3)	No EN standards available	Coating (4)	Once every year	—
		Flame lamination (4)		
		Finishing (4)		
		Thermal treatments associated with coating, lamination and finishing (4)		

Formaldehyde (3)	EN standard under development	Coating (4)	Once every year	BAT 26
		Flame lamination		
		Printing (4)		
		Singeing		
		Finishing (4)		
		Thermal treatment (4)		
NH_3 (3)	EN ISO 21877	Coating (4)	Once every year	BAT 28
		Printing (5)		
		Finishing (4)		
		Thermal treatments associated with coating, printing and finishing (4)		
NO_X	EN 14792	Singeing	Once every 3 years	—
		Combustion		
SO_2 (5)	EN 14791	Combustion	Once every 3 years	—
TVOC (3)	EN 12619	Coating	Once every year (6)	BAT 26
		Dyeing		
		Finishing		
		Lamination		
		Printing		
		Singeing		
		Thermofixation or heat-setting		
		Thermal treatments associated with coating, dyeing, lamination, printing and finishing		

(1) To the extent possible, the measurements are carried out at the highest expected emission state under normal operating conditions.
(2) In the case of a dust mass flow of less than 50 g/h, the minimum monitoring frequency may be reduced to once every 3 years.
(3) Monitoring results are reported together with the corresponding air-to-textile ratio.
(4) The monitoring only applies when the substance concerned is identified as relevant in the waste gas stream based on the inventory of inputs and outputs mentioned in BAT 2.
(5) The monitoring does not apply if natural gas only, or liquefied petroleum gas only, is used as fuel.
(6) In the case of a TVOC mass flow of less than 200 g/h, the minimum monitoring frequency may be reduced to once every 3 years.

1.1.3. **Water consumption and waste water generation**

BAT 10. In order to reduce water consumption and waste water generation, BAT is to use techniques (a), (b) and (c), and an appropriate combination of the techniques (d) to (j) given below.

	Technique	Description	Applicability
Management techniques			
a.	Water management plan and water audits	A water management plan and water audits are part of the EMS (see BAT 1) and include: — flow diagrams and water mass balances of the plant and processes as part of the inventory of inputs and outputs mentioned in BAT 2; — establishment of water efficiency objectives; — implementation of water optimisation techniques (e.g. control of water usage, reuse/recycling, detection and repair of leaks). Water audits are carried out at least once every year to ensure that the objectives of the water management plan are met and the water audits recommendations are followed-up and implemented. The water management plan and the water audits may be integrated in the overall water management plan of a larger industrial site.	The level of detail of the water management plan and water audits will generally be related to the nature, scale and complexity of the plant.
b.	Production optimisation	This includes: — optimised combination of processes (e.g. pre-treatment processes are combined, bleaching of textile materials is avoided before dyeing in dark shades); — optimised scheduling of batch processes (e.g. dyeing of the textile materials in dark shades is carried out after dyeing in light shades in the same dyeing equipment).	Generally applicable.
Design and operation techniques			
c.	Segregation of polluted and unpolluted water streams	Water streams are collected separately, based on the pollutant content and on the required treatment techniques. Polluted water streams (e.g. spent process liquors) and unpolluted water streams (e.g. cooling waters) that can be reused without treatment are segregated from waste water streams that require treatment.	Applicability to existing plants may be restricted by the layout of the water collection system and the lack of space for temporary storage tanks.
d.	Processes using little or no water	Processes include plasma or laser treatment, and processes using low amounts of water such as ozone treatment.	The applicability may be restricted by the characteristics of the textile materials and/or product specifications.

e.	Optimisation of the amount of process liquor used	Batch processes are carried out with low-liquor-ratio systems (see Section 1.9.4). Continuous processes are carried out with low-volume application systems, such as spraying (see Section 1.9.4).	Generally applicable.
f.	Optimised cleaning of the equipment	This includes: — water-free cleaning (e.g. by wiping or brushing the tanks' inner surfaces, mechanical pre-cleaning of squeegees, rotary screens and drums containing printing pastes (see BAT 44)); — multiple cleaning steps with low amounts of water; the water of the last cleaning step may be reused to clean another part of the equipment.	The applicability of water-free cleaning in existing plants may be restricted by accessibility to the equipment (e.g. closed and semi-closed systems).

g.	Optimised batch processing, washing and rinsing of textile materials	This includes:
		— use of auxiliary tanks for temporary storage of:
		  — spent washing or rinsing water;
		  — fresh or spent process liquor.
		— multiple drain and fill steps for rinsing and washing with low amounts of water.
			The use of auxiliary tanks in existing plants may be restricted by a lack of space.

h.	Optimised continuous processing, washing and rinsing of textile materials	This includes: — timely process liquor preparation based on online pick-up measurements; — automatic closure of the washing water inflow when the washing machine stops; — countercurrent rinsing and washing; — intermediary mechanical dewatering of textile materials (see BAT 13 (a)) to reduce the carry-over of process chemicals.	Generally applicable.

Reuse and recycling techniques

i.	Water reuse and/or recycling	Water streams may be segregated (see BAT 10 (c)) and/or pre-treated (e.g. membrane filtration, evaporation) before reuse and/or recycling, e.g. for cleaning, rinsing, cooling or in the processing of textile materials. The degree of water reuse/recycling is limited by the content of impurities in the water streams. Reuse and/or recycling of water originating from several plants operating on the same site may be integrated in the overall site water management of a larger industrial site (e.g. using common waste water treatment).	Generally applicable.
j.	Reuse of process liquor	Process liquor, including the process liquor extracted from textile materials by mechanical dewatering (see BAT 13 (a)), is reused after analysis and make-up if needed. The degree of reuse of the process liquor is limited by the modification of its chemical composition, or by its content of impurities and perishability.	Generally applicable.

Table 1.1

Indicative environmental performance levels for specific water consumption

Specific process(es)		Indicative levels (Yearly average) (m^3/t)
Bleaching	Batch	10–32 ([1])
	Continuous	3–8
Scouring of cellulosic materials	Batch	5–15 ([1])
	Continuous	5–12 ([1])
Desizing of cellulosic materials		5–12 ([1])
Combined bleaching, scouring and desizing of cellulosic materials		9–20 ([1])
Mercerisation		2–13 ([1])
Washing of synthetic material		5–20 ([1])
Batch dyeing	Fabric	10–150 ([1])
	Yarn	3–140 ([1]) ([2])
	Loose fibre	13–60
Continuous dyeing		2–16 ([1]) ([3])

([1]) The lower end of the range may be achieved with a high level of water recycling (e.g. sites with integrated water management for several plants).
([2]) The range also applies to combined yarn and loose fibre batch dyeing.
([3]) The higher end of the range may be higher and up to 100 m^3/t for plants using a combination of continuous and batch processes.

The associated monitoring is given in BAT 6.

1.1.4. Energy efficiency

BAT 11. In order to use energy efficiently, BAT is to use techniques (a), (b), (c) and (d), and an appropriate combination of the techniques (e) to (k) given below.

	Technique	Description	Applicability
Management techniques			
a.	Energy efficiency plan and audits	An energy efficiency plan and audits are part of the EMS (see BAT 1) and include: — energy flow diagrams of the plants and processes as part of the inventory of inputs and outputs (see BAT 2); — setting objectives in terms of energy efficiency (e.g. MWh/t of textile materials processed); — implementing actions to achieve these objectives. Audits are carried out at least once every year to ensure that the objectives of the energy efficiency plan are met and the energy audits recommendations are followed-up and implemented.	The level of detail of the energy efficiency plan and audits will generally be related to the nature, scale and complexity of the plant.

b.	Production optimisation	Optimised scheduling of fabric batches to undergo thermal treatment in order to minimise the idling time of the equipment.	Generally applicable.

Process and equipment selection and optimisation

c.	Use of general energy-saving techniques	This includes: — burner maintenance and control; — energy-efficient motors; — energy-efficient lighting; — optimising steam distribution systems, e.g. by using point-of-use boilers; — regular inspection and maintenance of the steam distribution systems to prevent or reduce steam leaks; — process control systems; — variable speed drives; — optimising air conditioning and building heating.	Generally applicable.
d.	Optimisation of heating demand	This includes: — reducing heat losses by insulating equipment components and by covering tanks or bowls containing warm process liquor; — optimising the temperature of the rinsing water; — avoiding overheating of the process liquors.	Generally applicable.
e.	Wet-on-wet dyeing or finishing of fabric	Dyeing or finishing liquors are applied directly to the wet fabric, thus avoiding an intermediate drying step. Appropriate scheduling of production steps and dosing of chemicals need to be considered.	May not be applicable when chemicals cannot be taken up by the fabric due to insufficient residual pick-up.
f.	Cogeneration	Cogeneration of heat and electricity where the heat (mainly from the steam that leaves the turbine) is used for producing hot water/steam to be used in industrial processes/activities or in a district heating/cooling network.	Applicability in existing plants may be restricted by the plant layout and/or lack of space.

Heat recovery techniques

g.	Recycling of warm cooling water	See BAT 10 (i). This avoids the need for heating cold water.	Generally applicable.
h.	Reuse of warm process liquor	See BAT 10 (j). This avoids the need for heating cold process liquor.	
i.	Heat recovery from waste water	Heat from waste water is recovered by heat exchangers, e.g. to warm up process liquor.	
j.	Heat recovery from waste gases	Heat from waste gases (e.g. from thermal treatment of textile materials, steam boilers) is recovered by heat exchangers and used (e.g. to warm up process water or to preheat combustion air).	
k.	Heat recovery from steam use	Heat, e.g. from hot condensate and boiler blowdown, is recovered.	

BAT 12. In order to increase energy efficiency when using compressed air, BAT is to use a combination of the techniques given below.

	Technique	Description	Applicability
a.	Optimal design of the compressed air system	Several compressed air units supply air with different pressure levels. This avoids the unnecessary production of high-pressure air.	Only applicable to new plants or major plant upgrades.
b.	Optimal use of the compressed air system	Compressed air production is stopped during long shutdown or idling times of equipment, and single areas can be isolated (e.g. by valves) from the rest of the system, in particular if they are associated with infrequent use.	Generally applicable.
c.	Control of leakages in the compressed air system	The most common sources of air leakages are regularly inspected and maintained (e.g. couplings, hoses, tubes, fittings, pressure regulators).	
d.	Reuse and/or recycling of warm cooling water or warm cooling air from air compressors	Warm cooling air (e.g. from air-cooled air compressors) is reused and/or recycled (e.g. for drying of coils and hanks if needed). For reuse and/or recycling of warm cooling water, see BAT 11 (g).	

BAT 13. In order to increase the energy efficiency of thermal treatment, BAT is to use all of the techniques given below.

	Technique	Description	Applicability
Techniques for reducing the use of heating			
a.	Mechanical dewatering of textile materials	The water content of textile materials is reduced by mechanical techniques (e.g. centrifugal extraction, squeezing and/or vacuum extraction).	Generally applicable.
b.	Avoiding overdrying of textile materials	The textile materials are not dried below their natural moisture level.	
Design and operation techniques			
c.	Optimising air circulation in stenters	This includes: — adapting the number of air injection nozzles to the width of the fabric; — ensuring the distance between the nozzles and the fabric is as short as possible; — ensuring the pressure drop caused by the stenters' internal components is as small as possible.	Only applicable to new plants or major plant upgrades.

d.	Advanced process monitoring and control of drying	The drying parameters are monitored and controlled (see BAT 4). These parameters include: — humidity content and temperature of the inlet air; — temperature of textile materials and air within the dryer; — humidity content and temperature of the exhaust air; drying efficiency is optimised by an appropriate humidity content (e.g. above 0,1 kg water/kg dry air); — residual moisture content of the fabric. The exhaust airflow is adjusted to optimise drying efficiency and is reduced during idle periods of drying equipment.	Generally applicable.
e.	Microwave or radio-frequency dryers	Drying of textile materials with high-efficiency microwave or radio frequency dryers.	Not applicable to textile materials containing metallic parts or fibres. Only applicable to new plants or major plant upgrades.
Heat recovery techniques			
f.	Heat recovery from waste gases	See BAT 11 (j).	Only applicable when the waste gas flow is sufficient.

Table 1.2

Indicative environmental performance levels for specific energy consumption

Process	Indicative level (Yearly average) (MWh/t)
Thermal treatment	0,5–4,4

The associated monitoring is given in BAT 6.

1.1.5. Chemicals management, consumption and substitution

BAT 14. In order to improve the overall environmental performance, BAT is to elaborate and implement a chemicals management system (CMS), as part of the EMS (see BAT 1), that incorporates all of the following features:

I. A policy to reduce the consumption and risks associated with process chemicals, including a procurement policy to select less harmful process chemicals and their suppliers with the aim of minimising the use and risks associated with hazardous substances and substances of very high concern as well as avoiding the procurement of an excess amount of process chemicals. The selection of process chemicals is based on:

a) the comparative analysis of their bioeliminability/biodegradability, ecotoxicity and potential to be released into the environment (which in the case of emissions to air can be determined by using emission factors for example (see Section 1.9.1));

b) the characterisation of the risks associated with the process chemicals, based on the chemicals' hazard classification, pathways through the plant, potential release and level of exposure;

c) the potential for recovery and reuse (see BAT 16 (f) and (g) as well as BAT 39);

d) the regular (e.g. annual) analysis of the potential for substitution with the aim to identify potentially new available and safer alternatives to the use of (groups of) hazardous substances and substances of very high concern, such as PFAS, phthalates, brominated flame retardants, chromium-(VI)-containing substances; this may be achieved by changing process(es) or using other process chemicals with no or lower environmental impacts;

e) the anticipatory analysis of regulatory changes related to hazardous substances and substances of very high concern, and safeguarding compliance with applicable legal requirements.

The inventory of process chemicals (see BAT 15) may be used to provide and keep the information needed for the selection of process chemicals.

The criteria for selecting process chemicals and their suppliers may be based on certification schemes or standards. In that case, the compliance of the process chemicals and their suppliers with these schemes or standards is regularly verified.

II. Goals and action plans to avoid or reduce the use of and risks associated with hazardous substances and substances of very high concern.

III. Development and implementation of procedures for the procurement, handling, storage and use of process chemicals (see BAT 21), disposal of waste containing process chemicals and return of unused process chemicals (see BAT 29 (d)), to prevent or reduce emissions to the environment.

Applicability

The level of detail of the CMS will generally be related to the nature, scale and complexity of the plant.

BAT 15. In order to improve the overall environmental performance, BAT is to elaborate and implement a chemicals inventory as part of the CMS (see BAT 14).

Description

The chemicals inventory is computer-based and contains information about:

— the identity of the process chemicals;

— the quantities, location and perishability of the process chemicals procured, recovered (see BAT 16 (g)), stored, used and returned to suppliers;

— the composition and physico-chemical properties of process chemicals (e.g. solubility, vapour pressure, n-octanol/water partition coefficient), including properties with adverse effects on the environment and/or human health (e.g. ecotoxicity, bioeliminability/biodegradability).

Such information may be retrieved from Safety Data Sheets, Technical Data Sheets or other sources.

BAT 16. In order to reduce the consumption of chemicals, BAT is to use all of the techniques given below.

	Technique	Description	Applicability
a.	Reduction of the need for process chemicals	This includes: — regularly reviewing and optimising the formulation of process chemicals and liquors; — production optimisation (see BAT 10 (b)).	Generally applicable.
b.	Reduction of the use of complexing agents	The use of soft/softened water reduces the amount of complexing agents used in the process liquors, e.g. for dyeing or bleaching (see BAT 38 (b)).	Not applicable to washing and rinsing.
c.	Treatment of textile materials with enzymes	Enzymes are selected (see BAT 14 I. (d)) and used to catalyse the reactions with textile materials to lower the consumption of process chemicals (e.g. in desizing, bleaching and/or washing).	The applicability may be restricted by the availability of suitable enzymes.
d.	Automatic systems for preparation and dosing of process chemicals and process liquors	Automatic systems for weighing, dosing, dissolving, measuring and dispensing which ensure precise delivery of process chemicals and process liquors to the production machines. See BAT 4.	The applicability to existing plants may be restricted by a lack of space, the distance between the preparation and the production machines or by frequent changes of process chemicals and process liquors.
e.	Optimisation of the quantity of process chemicals used	See BAT 10 (e).	Generally applicable.
f.	Reuse of process liquors	See BAT 10 (j).	Generally applicable.
g.	Recovery and use of leftover process chemicals	Residual process chemicals are recovered (e.g. by thoroughly purging pipes or completely emptying packaging) and used in the process. The degree of use may be limited by the content of impurities and the perishability of the process chemicals.	Generally applicable.

BAT 17. In order to prevent or reduce emissions to water of poorly biodegradable substances, BAT is to use all of the techniques given below.

	Technique	Description	Applicability
a.	Substitution of alkylphenols and alkylphenol ethoxylates	Alkylphenols and alkylphenol ethoxylates are substituted by biodegradable surfactants, e.g. alcohol ethoxylates.	Generally applicable.

b.	Substitution of poorly biodegradable phosphorus- or nitrogen-containing complexing agents	Complexing agents containing phosphorus (e.g. triphosphates) or nitrogen (e.g. amino polycarboxylic acids such as EDTA or DTPA) are substituted by biodegradable/bioeliminable substances, e.g.: — polycarboxylates (e.g. polyacrylates); — salts of hydroxy carboxylic acids (e.g. gluconates, citrates); — sugar-based acrylic acid copolymers; — methylglycinediacetic acid (MGDA), L-glutamic acid N,N-diacetic acid (GLDA) and iminodisuccinic acid (IDS); — phosphonates (e.g. aminotris methylene phosphonic acid (ATMP), diethylenetriamine pentamethylene phosphonic acid (DTPMP) and 1-hydroxyl ethylidene-1,1-diphosphonic acid (HEDP)).	Generally applicable.
c.	Substitution of mineral-oil-based antifoaming agents	Mineral-oil-based antifoaming agents are substituted by biodegradable substances, e.g. antifoaming agents based on synthetic ester oil.	Generally applicable.

1.1.6. **Emissions to water**

BAT 18. In order to reduce the waste water volume, to prevent or reduce the pollutant loads discharged to the waste water treatment plant and the emissions to water, BAT is to use an integrated strategy for waste water management and treatment that includes an appropriate combination of the techniques given below with the following order of priority:

— process-integrated techniques (see BAT 10 and BAT conclusions in Sections 1.2 to 1.7);

— techniques to recover and reuse process liquors (see BAT 10 (j) and BAT 39), separate collection of waste water streams and pastes (e.g. printing and coating) containing high loads of pollutants that cannot be adequately treated by biological treatment; these waste water streams and pastes are either pretreated (see BAT 19) or handled as waste (see BAT 30);

— (final) waste water treatment techniques (see BAT 20).

Description

The integrated strategy for waste water management and treatment is based on the information provided by the inventory of inputs and outputs (see BAT 2).

BAT 19. In order to reduce emissions to water, BAT is to pretreat (separately collected) waste water streams and pastes (e.g. printing and coating) containing high loads of pollutants that cannot be treated adequately by biological treatment.

Description

Such waste water streams and pastes include:

— spent dyeing, coating or finishing padding liquors from continuous and/or semi-continuous treatments;

— desizing liquors;

— spent printing and coating pastes.

The pre-treatment is carried out as part of an integrated strategy for waste water management and treatment (see BAT 18) and is generally necessary to:

— protect the (downstream) biological waste water treatment against inhibitory or toxic compounds;

— remove compounds that are insufficiently abated during biological waste water treatment (e.g. toxic compounds, poorly biodegradable organic compounds, organic compounds that are present in high loads or metals);

— remove compounds that could otherwise be stripped to air from the collection system or during biological waste water treatment (e.g. sulphide);

— remove compounds that have other negative effects (e.g. corrosion of equipment, unwanted reaction with other substances; contamination of waste water sludge).

The above-mentioned compounds to be removed include organophosphorus and brominated flame retardants, PFAS, phthalates and chromium-(VI)-containing compounds.

The pre-treatment of these waste water streams is generally carried out as close as possible to the source in order to avoid dilution. The pre-treatment techniques used depend on the pollutants targeted and may include adsorption, filtration, precipitation, chemical oxidation or chemical reduction (see BAT 20).

The bioeliminability/biodegradability of the waste water streams and pastes before they are sent to the downstream biological treatment is at least:

— 80 % after 7 days (for adapted sludge), when determined according to standard EN ISO 9888, or

— 70 % after 28 days when determined according to standard EN ISO 7827.

The associated monitoring is given in BAT 7.

BAT 20. In order to reduce emissions to water, BAT is to use an appropriate combination of the techniques given below.

Technique ([1])		Typical pollutants targeted	Applicability
Pre-treatment of individual waste water streams, e.g.			
a.	Adsorption	Adsorbable dissolved non-biodegradable or inhibitory pollutants (e.g. AOX in dyestuffs, organophosphorus flame retardants)	Generally applicable.
b.	Precipitation	Precipitable dissolved non-biodegradable or inhibitory pollutants (e.g. metals in dyestuffs)	
c.	Coagulation and flocculation	Suspended solids and particulate-bound non-biodegradable or inhibitory pollutants (e.g. metals in dyestuffs)	
d.	Chemical oxidation (e.g. oxidation with ozone, hydrogen peroxide or UV light)	Oxidisable dissolved non-biodegradable or inhibitory pollutants (e.g. optical brighteners and azo dyestuffs, sulphide)	
e.	Chemical reduction	Reducible dissolved non-biodegradable or inhibitory pollutants (e.g. hexavalent chromium (Cr(VI))	
f.	Anaerobic pre-treatment	Biodegradable organic compounds (e.g. azo dyestuffs, printing pastes)	

g.	Filtration (e.g. nanofiltration)	Suspended solids and particulate-bound non-biodegradable or inhibitory pollutants	

Pre-treatment of combined waste water streams, e.g.

h.	Physical separation (e.g. screens, sieves, grit separators, grease separators, oil-water separation, or primary settlement tanks)	Gross solids, suspended solids, oil/grease	Generally applicable.
i.	Equalisation	All pollutants	
j.	Neutralisation	Acids, alkalis	

Primary treatment, e.g.

k.	Sedimentation	Suspended solids and particulate-bound metals or non-biodegradable or inhibitory pollutants	Generally applicable.
l.	Precipitation	Precipitable dissolved non-biodegradable or inhibitory pollutants (e.g. metals in dyestuffs)	
m.	Coagulation and flocculation	Suspended solids and particulate-bound non-biodegradable or inhibitory pollutants (e.g. metals in dyestuffs)	Generally applicable.

Secondary treatment (biological treatment), e.g.

n.	Activated sludge process	Biodegradable organic compounds	Generally applicable.
o.	Membrane bioreactor		
p.	Nitrification/denitrification (when the treatment includes a biological treatment)	Total nitrogen, ammonium/ammonia	Nitrification may not be applicable in the case of high chloride concentrations (e.g. above 10 g/l). Nitrification may not be applicable when the temperature of the waste water is low (e.g. below 12 °C).

Tertiary treatment, e.g.

q.	Coagulation and flocculation	Suspended solids and particulate-bound non-biodegradable or inhibitory pollutants (e.g. metals in dyestuffs)	Generally applicable.
r.	Precipitation	Precipitable dissolved non-biodegradable or inhibitory pollutants (e.g. metals in dyestuffs)	
s.	Adsorption	Adsorbable dissolved non-biodegradable or inhibitory pollutants (e.g. AOX in dyestuffs)	

t.	Chemical oxidation (e.g. oxidation with ozone, hydrogen peroxide or UV light)	Oxidisable dissolved non-biodegradable or inhibitory pollutants (e.g. optical brighteners and azo dyestuffs, sulphide)	
u.	Flotation	Suspended solids and particulate-bound non-biodegradable or inhibitory pollutants	
v.	Filtration (e.g. sand filtration)		
Advanced treatment for recycling the waste water, e.g. (2)			
w.	Filtration (e.g. sand filtration, or membrane filtration)	Suspended solids and particulate-bound non-biodegradable or inhibitory pollutants	Generally applicable.
x.	Evaporation	Soluble contaminants (e.g. salts)	

(1) The descriptions of the techniques are given in Section 1.9.3.
(2) Minimal waste water discharge (e.g. 'zero liquid discharge') may be achieved using a combination of techniques including advanced treatment techniques for recycling the waste water.

Table 1.3

BAT-associated emission levels (BAT-AELs) for direct discharges

Substance/Parameter		Activities/processes	BAT-AEL (1) (mg/l)
Adsorbable organically bound halogens (AOX) (2)		All activities/processes	0,1–0,4 (3)
Chemical oxygen demand (COD) (4)			40–100 (5) (6)
Hydrocarbon oil index (HOI) (2)			1–7
Metals/metalloids	Antimony (Sb)	Pre-treatment and/or dyeing of polyester textile materials	0,1–0,2 (7)
		Finishing with flame retardants using antimony trioxide	
	Chromium (Cr)	Dyeing with chromium mordant or chromium-containing dyes (e.g. metal-complex dyes)	0,01–0,1 (8)
	Copper (Cu)	Dyeing Printing with dyes	0,03–0,4
	Nickel (Ni)		0,01–0,1 (9)
	Zinc (Zn) (2)	All activities/processes	0,04–0,5 (10)
Sulphide, easily released (S^{2-})		Dyeing with sulphur dyes	< 1
Total nitrogen (TN)		All activities/processes	5–15 (11)
Total organic carbon (TOC) (4)			13–30 (6) (12)
Total phosphorus (TP)			0,4–2
Total suspended solids (TSS)			5–30

(1) The averaging periods are defined in the general considerations.
(2) The BAT-AELs only apply when the substance/parameter concerned is identified as relevant in the waste water stream based on the inventory of inputs and outputs mentioned in BAT 2.
(3) The higher end of the BAT-AEL range may be higher and up to 0,8 mg/l when dyeing polyester and/or modacrylic fibres.
(4) Either the BAT-AEL for COD or the BAT-AEL for TOC applies. The BAT-AEL for TOC is the preferred option because TOC monitoring does not rely on the use of very toxic compounds.
(5) The higher end of the BAT-AEL range may be up to 150 mg/l:

— when the specific amount of waste water discharged is less than 25 m³/t of treated textile materials as a rolling yearly average; or
— when the abatement efficiency is ≥ 95 % as a rolling yearly average.

(6) No BAT-AEL applies for biochemical oxygen demand (BOD). As an indication, the yearly average BOD_5 level in the effluent from a biological waste water treatment plant will generally be ≤ 10 mg/l.
(7) The higher end of the BAT-AEL range may be higher and up to 1,2 mg/l when dyeing polyester and/or modacrylic fibres.
(8) The higher end of the BAT-AEL range may be higher and up to 0,3 mg/l when polyamide, wool or silk fibres are dyed using metal-complex dyes.
(9) The higher end of the BAT-AEL range may be higher and up to 0,2 mg/l when dyeing or printing with nickel-containing reactive dyes or pigments.
(10) The higher end of the BAT-AEL range may be higher and up to 0,8 mg/l when treating viscose fibres or when dyeing using zinc-containing cationic dyes.
(11) The BAT-AEL may not apply when the temperature of the waste water is low (e.g. below 12 °C) for prolonged periods.
(12) The higher end of the BAT-AEL range may be up to 50 mg/l:

— when the specific amount of waste water discharged is less than 25 m³/t of treated textile materials as a rolling yearly average; or
— when the abatement efficiency is ≥ 95 % as a rolling yearly average.

The associated monitoring is given in BAT 8.

Table 1.4

BAT-associated emission levels (BAT-AELs) for indirect discharges

Substance/Parameter		Activities/processes	BAT-AEL (1) (2) (mg/l)
Adsorbable organically bound halogens (AOX) (3)		All processes	0,1–0,4 (4)
Hydrocarbon oil index (HOI) (3)		All processes	1–7
Metals/metalloids	Antimony (Sb)	Pre-treatment and/or dyeing of polyester textile materials	0,1–0,2 (5)
		Finishing with flame retardants using antimony trioxide	
	Chromium (Cr)	Dyeing with chromium mordant or chromium-containing dyes (e.g. metal-complex dyes)	0,01–0,1 (6)
	Copper (Cu)	Dyeing Printing with dyes	0,03–0,4
	Nickel (Ni)	Dyeing Printing with dyes	0,01–0,1 (7)
	Zinc (Zn) (3)	All processes	0,04–0,5 (8)
Sulphide, easily released (S^{2-})		Dyeing with sulphur dyes	< 1

(1) The averaging periods are defined in the general considerations.
(2) The BAT-AELs may not apply if the downstream waste water treatment plant is designed and equipped appropriately to abate the pollutants concerned, provided this does not lead to a higher level of pollution in the environment.
(3) The BAT-AELs only apply when the substance/parameter concerned is identified as relevant in the waste water stream based on the inventory of inputs and outputs mentioned in BAT 2.
(4) The higher end of the BAT-AEL range may be higher and up to 0,8 mg/l when dyeing polyester and/or modacrylic fibres.
(5) The higher end of the BAT-AEL range may be higher and up to 1,2 mg/l when dyeing polyester and/or modacrylic fibres.
(6) The higher end of the BAT-AEL range may be higher and up to 0,3 mg/l when polyamide, wool or silk fibres are dyed using metal-complex dyes.
(7) The higher end of the BAT-AEL range may be higher and up to 0,2 mg/l when dyeing or printing with nickel-containing reactive dyes or pigments.
(8) The higher end of the BAT-AEL range may be higher and up to 0,8 mg/l when treating viscose fibres or when dyeing using zinc-containing cationic dyes.

The associated monitoring is given in BAT 8.

1.1.7. **Emissions to soil and groundwater**

BAT 21. In order to prevent or reduce emissions to soil and groundwater and to improve the overall performance of the handling and storage of process chemicals, BAT is to use all of the techniques given below.

	Technique	Description	Applicability
a.	Techniques to reduce the likelihood and environmental impact of overflows and failures of process and storage tanks	This includes: — slow immersion into and withdrawal of textile materials from the process liquor to avoid spillages; — automatic level adjustment of process liquor (see BAT 4); — avoiding direct injection of water to heat or cool the process liquor; — overflow detectors; — channelling overflows to another tank; — locating tanks for liquids (process chemicals or liquid waste) in a suitable secondary containment; their volume is sized to accommodate at least the complete loss of the liquid of the largest tank that is within the secondary containment; — isolation of tanks and secondary containment (e.g. by closing valves); — ensuring that the surfaces of the process and storage areas are impermeable to the liquids concerned.	Generally applicable.
b.	Regular inspection and maintenance of plant and equipment	The plant and the equipment are regularly inspected and maintained to ensure proper functioning; this includes in particular checking the integrity and/or leak-free status of valves, pumps, pipes, tanks and containments/bunds as well as the proper functioning of warning systems (e.g. overflow detectors).	

c.	Optimised storage location of process chemicals	The storage areas are located in such a way as to eliminate or minimise the unnecessary transport of process chemicals within the plant (e.g. the transport distances on site are minimised).	The applicability to existing plants may be restricted by a lack of space.
d.	Dedicated area for unloading process chemicals containing hazardous substances	Process chemicals containing hazardous substances are unloaded in a bunded area. Occasional spillages are collected and sent for treatment.	Generally applicable.
e.	Segregated storage of process chemicals	Incompatible process chemicals are kept separated. This segregation relies on physical separation and on the chemicals inventory (see BAT 15).	
f.	Handling and storage of packaging containing process chemicals	Packaging containing liquid process chemicals is completely emptied by gravity or by mechanical means (e.g. brushing, wiping) without the use of water. Packaging containing process chemicals in powder is emptied by gravity for small packaging and using suction for large packaging. Empty packaging is stored in a dedicated area.	

1.1.8. **Emissions to air**

BAT 22. In order to reduce diffuse emissions to air (e.g. VOCs from the use of organic solvents), BAT is to collect diffuse emissions and send the waste gases to treatment.

Applicability

In the case of existing plants, the applicability may be restricted by operational constraints or by the high volume of air to be extracted.

BAT 23. In order to facilitate the recovery of energy and the reduction of channelled emissions to air, BAT is to limit the number of emission points.

Description

The combined treatment of waste gases with similar characteristics ensures more effective and efficient treatment compared to the separate treatment of individual waste gas streams. The extent to which the number of emission points can be limited depends on technical (e.g. compatibility of the individual waste gas streams) and economic factors (e.g. distance between different emission points). Care is taken that limiting the number of emission points does not lead to the dilution of emissions.

BAT 24. In order to prevent emissions of organic compounds to air from dry cleaning and from scouring with organic solvent, BAT is to extract the air from these processes, to treat it using adsorption with activated carbon (see Section 1.9.2) and to fully recirculate it.

BAT 25. In order to reduce emissions of organic compounds to air from the pre-treatment of knitted synthetic textile materials, BAT is to wash them prior to thermofixation or heat-setting.

Applicability

Applicability may be limited by the fabric construction.

BAT 26. In order to prevent or reduce channelled emissions of organic compounds to air from singeing, thermal treatment, coating and lamination, BAT is to use one or a combination of the techniques given below.

Technique		Typical pollutants target	Description
Prevention techniques			
a.	Selection and use of mixtures of chemicals ('recipes') leading to low emissions of organic compounds	Organic compounds	Mixtures with low emissions of organic compounds are selected and used taking into consideration product specifications (see BAT 14. BAT 17, BAT 50, BAT 51). As an example, emission factors may be used for selection (see Section 1.9.1).
Reduction techniques			
b.	Condensation	Organic compounds excluding formaldehyde	See Section 1.9.2.
c.	Thermal oxidation	Organic compounds	
d.	Wet scrubbing	Organic compounds	
e.	Adsorption	Organic compounds excluding formaldehyde	

Table 1.5

BAT-associated emission levels (BAT-AELs) for channelled emissions of organic compounds and formaldehyde to air

Substance/Parameter	Activities/Processes (including associated thermal treatments)	BAT-AEL (Average over the sampling period) (mg/Nm^3)
Formaldehyde	Coating (1)	1–5 (2) (3)
	Flame lamination	
	Printing (1)	
	Singeing	
	Finishing (1)	
TVOC	Coating	3–40 (2) (4) (5)
	Dyeing	
	Finishing	
	Lamination	
	Printing	
	Singeing	
	Thermofixation or heat-setting	

(1) The BAT-AEL only applies when formaldehyde is identified as relevant in the waste gas stream based on the inventory of inputs and outputs mentioned in BAT 2.
(2) For activities listed under points 3 and 9, Part 1 of Annex VII to the IED, the BAT-AEL ranges only apply to the extent that they lead to lower emission levels than the emission limit values in Parts 2 and 4 of Annex VII to the IED.
(3) For finishing processes with easy-care agents, water-/oil-/soil-repellents and/or flame retardants, the higher end of the BAT-AEL range may be higher and up to 10 mg/Nm^3.
(4) The lower end of the BAT-AEL range is typically achieved when using thermal oxidation.
(5) The BAT-AEL does not apply when the TVOC mass flow is below 200 g/h for emission point(s) where:

— abatement techniques are not used, and
— no CMR substances are identified as relevant in the waste gas stream based on the inventory of inputs and outputs mentioned in BAT 2.

The associated monitoring is given in BAT 9.

BAT 27. In order to reduce channelled dust emissions to air from singeing and thermal treatments, excluding thermofixation and heat-setting, BAT is to use one or a combination of the techniques given below.

	Technique	Description
a.	Cyclone	See Section 1.9.2 Cyclones are mainly used as pretreatment before further dust abatement (e.g. for coarse dust).
b.	Electrostatic precipitator (ESP)	See Section 1.9.2.
c.	Wet scrubbing	

Table 1.6

BAT-associated emission level (BAT-AEL) for channelled dust emissions to air from singeing and thermal treatments, excluding thermofixation and heat-setting

Substance/Parameter	BAT-AEL (Average over the sampling period) (mg/Nm^3)
Dust	< 2–10 (1)

(1) The BAT-AEL does not apply when the dust mass flow is below 50 g/h for emission point(s) where:

— abatement techniques are not used, and
— no CMR substances are identified as relevant in the waste gas stream based on the inventory of inputs and outputs mentioned in BAT 2.

The associated monitoring is given in BAT 9.

BAT 28. In order to prevent or reduce channelled ammonia emissions to air from coating, printing and finishing, including thermal treatments associated with these processes, BAT is to use one or a combination of the techniques given below.

	Technique	Description
Prevention techniques		
a.	Selection and use of mixtures of chemicals ('recipes') leading to low emissions of ammonia	Mixtures with low emissions of ammonia are selected and used taking into consideration product specifications (see BAT 14, BAT 17, BAT 46, BAT 47, BAT 50, BAT 51). As an example, emission factors may be used for selection (see Section 1.9.1).

Reduction techniques		
b.	Wet scrubbing	See Section 1.9.2.

Table 1.7

BAT-associated emission level (BAT-AEL) for channelled ammonia emissions to air from coating, printing and finishing, including thermal treatments associated with these processes

Substance/Parameter	BAT-AEL (1) (Average over the sampling period) (mg/Nm^3)
NH_3	3–10 (2)

(1) The BAT-AEL only applies when NH_3 is identified as relevant in the waste gas stream based on the inventory of inputs and outputs mentioned in BAT 2.

(2) The higher end of the BAT-AEL range may be higher and up to 20 mg/Nm^3 when ammonium sulphamate is used as a flame retardant or ammonia is used for curing (see BAT 50).

The associated monitoring is given in BAT 9.

1.1.9. **Waste**

BAT 29. In order to prevent or reduce the generation of waste and to reduce the quantity of waste sent for disposal, BAT is to use all of the techniques given below.

Technique		Description	Applicability
a.	Waste management plan	A waste management plan is part of the EMS (see BAT 1) and is a set of features aiming to: — minimise the generation of waste, — optimise the reuse, regeneration, recycling and/or recovery of waste, and — ensure the proper disposal of waste.	The level of detail of the waste management plan will generally be related to the nature, scale and complexity of the plant.
b.	Timely use of process chemicals	Criteria are clearly established associated for example with maximum storage time of process chemicals, and relevant parameters are monitored to avoid process chemicals perishing.	Generally applicable.
c.	Reuse/recycling of packaging	Process chemicals packaging is selected to facilitate its complete emptying (e.g. considering the size of the packaging aperture or the nature of the packaging material). After emptying (see BAT 21), the packaging is reused, returned to the supplier or sent for material recycling.	
d.	Return of unused process chemicals	Unused process chemicals (i.e. which remain in their original containers) are returned to their suppliers.	Generally applicable.

BAT 30. In order to improve the overall environmental performance of the handling of waste, especially to prevent or reduce emissions to the environment, BAT is to use the technique given below before waste is sent for disposal.

Technique	Description
Separate collection and storage of wastes contaminated with hazardous substances and/or substances of very high concern	Wastes contaminated with hazardous substances and/or substances of very high concern (e.g. finishing chemicals such as flame retardants, oil-, water- and soil-repellents) are collected and stored separately. These wastes may contain high loads of pollutants such as organophosphorus and brominated flame retardants, PFAS, phthalates and chromium-(VI)-containing compounds (see BAT 18) and include in particular: — liquid waste (e.g. first rinsing water in flame retardance finishing), coating and printing pastes; — waste paper, cloths, absorbent material; — laboratory waste; — sludge from waste water treatment.

1.2. ***BAT conclusions for the pre-treatment of raw wool fibres by scouring***

The BAT conclusions in this section apply to the pre-treatment of raw wool fibres by scouring and apply in addition to the general BAT conclusions in Section 1.1.

BAT 31. In order to use resources efficiently as well as to reduce water consumption and waste water generation, BAT is to recover wool grease and recycle waste water.

Description

Waste water from wool scouring is treated (e.g. by a combination of centrifugation and sedimentation) to separate grease, dirt and water. Grease is recovered, water is partially recycled to scouring and dirt is sent for further treatment.

Table 1.8

BAT-associated environmental performance levels (BAT-AEPLs) for the recovery of wool grease from the pre-treatment of raw wool fibres by scouring

Type of wool	Unit	BAT-AEPL (Yearly average)
Coarse wool (i.e. wool fibre diameter typically higher than 35 µm)	kg of recovered grease per tonne of raw wool fibres pretreated by scouring	10–15
Extra- and super-fine wool (i.e. wool fibre diameter typically lower than 20 µm)		50–60

The associated monitoring is given in BAT 6.

BAT 32. In order to use energy efficiently, BAT is to use all of the techniques given below.

Technique		Description	Applicability
a.	Covered scouring bowls	Scouring bowls are fitted with covers to prevent heat losses by convection or evaporation (see BAT 11 (c)).	Only applicable to new plants or major plant upgrades.
b.	Optimised temperature of the last scouring bowl	The temperature of the last scouring bowl is optimised to increase the efficiency of the subsequent mechanical wool dewatering (see BAT 13 (a)) and drying.	Generally applicable.
c.	Direct heating	Scouring bowls and dryers are directly heated in order to avoid the heat losses which occur in the generation and distribution of steam.	Only applicable to new plants or major plant upgrades.

BAT 33. In order to use resources efficiently and to reduce the amount of waste sent for disposal, BAT is to biologically treat organic residues from the pre-treatment of raw wool fibres by scouring (e.g. dirt, waste water treatment sludge).

Description

The organic residues are treated, for example by composting.

1.3. *BAT conclusions for the spinning of fibres (other than man-made fibres) and the production of fabric*

The BAT conclusions presented in this section apply to the spinning of fibres (other than man-made fibres) and the production of fabric and apply in addition to the general BAT conclusions in Section 1.1.

BAT 34. In order to reduce emissions to water from the use of sizing chemicals, BAT is to use all of the techniques given below.

Technique		Description	Applicability
a.	Selection of sizing chemicals	Sizing chemicals with improved environmental performance in terms of quantity needed, washability, recoverability and/or bioeliminability/biodegradability (e.g. modified starches, certain galactomannans and carboxymethyl cellulose) are selected (see BAT 14) and used.	Generally applicable.
b.	Pre-wetting of the cotton yarns	The cotton yarns are dipped into hot water prior to sizing. This allows a reduction of the amounts of sizing chemicals used.	The applicability may be restricted by product specifications (e.g. when high tension is required on the fibre during weaving).
c.	Compact spinning	The fibre strands are compressed by suction or by mechanical or magnetic compacting. This allows a reduction of the amounts of sizing chemicals used.	The applicability may be restricted by product specifications (e.g. level of hairiness or technical properties of the yarn).

BAT 35. In order to improve the overall environmental performance of spinning and knitting, BAT is to avoid the use of mineral oils.

Description

Mineral oils are substituted by synthetic oils and/or ester oils, with improved environmental performance in terms of washability and bioeliminability/biodegradability.

BAT 36. In order to use energy efficiently, BAT is to use technique (a) and one or both of techniques (b) and (c) given below.

	Technique	Description	Applicability
a.	Use of general energy-saving techniques for spinning and weaving	This includes: — reducing, as much as possible, the volume of the production area (e.g. by installing a suspended ceiling) to reduce the amount of energy needed for humidifying the ambient air; — using advanced sensors that detect thread breaks to stop the spinning or weaving machines.	Generally applicable.
b.	Use of energy-saving techniques for spinning	This includes: — using lighter spindles and bobbins in ring frames; — using spindle oil with optimal viscosity; — maintaining an optimal oiling level of the yarn; — optimising the ring diameter with respect to the yarn diameter in ring frames; — gradual start-up of the ring spinning machines; — using vortex spinning; — optimising the movement of empty bobbin conveyors in cone winding machines.	Generally applicable.
c.	Use of energy-saving techniques for weaving	This includes: — avoiding excessive air pressure for air-jet weaving; — using a double-width loom for large-volume batches.	A double-width loom may only be applicable to new plants or major plant upgrades.

1.4. *BAT conclusions for the pre-treatment of textile materials other than raw wool fibres*

The BAT conclusions in this section apply to the pre-treatment of textile materials other than raw wool fibres and apply in addition to the general BAT conclusions in Section 1.1.

BAT 37. In order to use resources and energy efficiently as well as to reduce water consumption and waste water generation, BAT is to use both techniques (a) and (b), in combination with technique (c) or in combination with technique (d) given below.

Technique		Description	Applicability
a.	Combined pre-treatment of cotton textile	Various pre-treatment operations of cotton textiles (e.g. washing, desizing, scouring and bleaching) are carried out simultaneously.	Generally applicable.
b.	Cold pad-batch treatment of cotton textiles	Desizing and/or bleaching are carried out with the cold pad-batch technique (see Section 1.9.4).	Generally applicable.
c.	Single or limited number of desizing liquors	The number of desizing liquors for removing different types of sizing chemicals is limited. In some cases, e.g. for various cellulosic materials, a single oxidative desizing liquor may be used.	Generally applicable.
d.	Recovery and reuse of water-soluble sizing chemicals	When desizing is carried out by washing with hot water, water-soluble sizing chemicals (e.g. polyvinyl alcohol and carboxymethyl cellulose) are recovered from the washing water by ultrafiltration. The concentrate is reused for sizing, whereas the permeate is reused for washing.	Only applicable where sizing and desizing are carried out at the same plant. May not be applicable for synthetic sizing chemicals (e.g. containing polyester polyols, polyacrylates or polyvinyl acetate).

BAT 38. In order to prevent or reduce emissions to water of chlorine-containing compounds and complexing agents, BAT is to use one or both of the techniques given below.

Technique		Description	Applicability
a.	Chlorine-free bleaching	Bleaching is carried out with chlorine-free bleaching chemicals (e.g. hydrogen peroxide, peracetic acid or ozone), often combined with pre-treatment with enzymes (see BAT 16 (c)).	May not be applicable to the brightening of flax and other bast fibres.
b.	Optimised hydrogen peroxide bleaching	The use of complexing agents can be completely avoided or minimised by reducing the concentration of hydroxyl radicals during bleaching. This is achieved by: — using soft/softened water; — prior removal of metal impurities from textile materials (e.g. by magnetic separation, chemical treatment or pre-washing); — controlling the pH and the hydrogen peroxide concentration during bleaching.	Generally applicable.

BAT 39. In order to use resources efficiently and to reduce the amount of alkali discharged to waste water treatment, BAT is to recover caustic soda used for mercerisation.

Description

Caustic soda is recovered from the rinsing water by evaporation and further purified, if needed. Before evaporation, the impurities in the rinsing water are removed by using, for example, screens and/or microfiltration.

Applicability

Applicability may be restricted by a lack of suitable recovered heat and/or by a low amount of caustic soda.

Table 1.9

BAT-associated environmental performance level (BAT-AEPL) for the recovery of caustic soda used for mercerisation

Unit	BAT-AEPL (Yearly average)
% of caustic soda recovered	75–95

The associated monitoring is given in BAT 6.

1.5. *BAT conclusions for dyeing*

The BAT conclusions in this section apply to dyeing and apply in addition to the general BAT conclusions in Section 1.1.

BAT 40. In order to use resources efficiently and to reduce emissions to water from dyeing, BAT is to use one or a combination of the techniques given below.

Technique		Description
Techniques for batch and continuous dyeing		
a.	Selection of dyes	Dyes with dispersing agents that are biodegradable (e.g. based on fatty acid esters) are selected.
b.	Dyeing with levelling agents made from recycled vegetable oil	Levelling agents made from recycled vegetable oil are used in high-temperature dyeing of polyester and in dyeing of protein and polyamide fibres.
Techniques for batch dyeing		
c.	pH-controlled dyeing	For textile materials with zwitterionic characteristics, dyeing is carried out at constant temperature and controlled by gradually lowering the pH of the dyeing liquor below the isoelectric point of the textile materials.
d.	Optimised removal of unfixed dyestuff in reactive dyeing	Unfixed dyestuff is removed from the textile materials by using enzymes (e.g. laccase, lipase) (see BAT 16 (c)) and/or vinyl polymers. This reduces the number of rinsing steps needed.
Techniques for batch dyeing		
e.	Low-liquor-ratio systems	See Section 1.9.4.
Techniques for continuous dyeing		
f.	Low-volume application systems	See Section 1.9.4.

BAT 41. In order to use resources efficiently and to reduce emissions to water from the dyeing of cellulosic materials, BAT is to use one or a combination of the techniques given below.

	Technique	Description	Applicability
Technique for dyeing with sulphur and vat dyes			
a.	Minimised use of sulphur-based reducing agents	Dyeing is carried out without sodium sulphide or hydrosulphite as reducing agents. Where this is not possible, partially chemically pre-reduced dyes (e.g. indigo dyes) are used so that less sodium sulphide or hydrosulphite is added for dyeing.	The applicability may be restricted by product specifications (e.g. shade).
Technique for continuous dyeing with vat dyes			
b.	Selection of vat dyes	Vat dyes that are not prone to emissions during the use phase of the textile are selected. Auxiliaries (e.g. polyglycols) are used to enable dyeing with less or without subsequent steaming, oxidising and washing and to ensure appropriate colour fastness.	May not be applicable to dyeing with dark shades.
Techniques for dyeing with reactive dyes			
c.	Use of poly-functional reactive dyes	Poly-functional reactive dyes with more than one reactive functional group are used to provide a high level of fixation in exhaust dyeing.	Generally applicable.
d.	Cold pad-batch dyeing	Dyeing is carried out with the cold pad-batch technique (see Section 1.9.4).	Generally applicable.
e.	Optimised rinsing	Rinsing after dyeing with reactive dyes is carried out at a high temperature (e.g. up to 95 °C) and without using detergents. The heat of the rinsing water is recovered (see BAT 11 (i)).	Generally applicable.
Techniques for continuous dyeing with reactive dyes			
f.	Use of concentrated alkali solution	In cold pad-batch dyeing (see Section 1.9.4), concentrated aqueous alkali solutions without sodium silicate are used for the fixation of dyes.	May not be applicable to dyeing with dark shades.
g.	Steam fixation of reactive dyes	The reactive dyes are fixed with steam, which avoids the use of chemicals for fixation.	The applicability may be restricted by the characteristics of the textile materials and by product specifications (e.g. high-quality dyeing of polyester/cotton blends).

BAT 42. In order to reduce emissions to water from the dyeing of wool, BAT is to use one of the techniques given below in the following order of priority.

	Technique	Description	Applicability
a.	Optimised reactive dyeing	Wool dyeing is carried out with reactive dyes without chromium mordant.	Generally applicable.
b.	Optimised metal-complex dyeing	Dyeing is carried out with metal-complex dyes under optimised conditions in terms of pH, auxiliaries and acid used, in order to increase the exhaustion of the dyeing liquor and the fixation of the dyes.	May not be applicable to dyeing with dark shades.
c.	Minimised use of chromates	When the use of sodium or potassium dichromate as mordant is authorised, dichromates are dosed as a function of the amount of dye taken up by the wool. Dyeing parameters (e.g. pH and temperature of the dyeing liquor) are optimised to ensure that the dyeing liquor is exhausted as much as possible.	Generally applicable.

BAT 43. In order to reduce emissions to water from the dyeing of polyester with disperse dyes, BAT is to use one or a combination of the techniques given below.

	Technique	Description	Applicability
a.	Batch dyeing without dyestuff carriers	Batch dyeing of polyester and wool-free polyester blends is carried out at high temperature (e.g. 130 °C) without the use of dyestuff carriers.	Generally applicable.
b.	Use of environmentally friendly dyestuff carriers in batch dyeing	Batch dyeing of polyester-wool blends is carried out with chlorine-free and biodegradable dyestuff carriers.	
c.	Optimised desorption of unfixed dye in batch dyeing	This includes: — using a desorption accelerator based on carboxylic acid derivatives; — using a reducing agent that can be used in the acidic conditions of the spent dyeing liquor; — using disperse dyes that can be desorbed in alkaline conditions by hydrolysis instead of reduction.	The use of a reducing agent that can be used in acidic conditions may not be applicable to polyester-elastane blends. The use of dyes that are desorbable in alkaline conditions may be restricted by product specifications (e.g. colour fastness and shade).

1.6. ***BAT conclusions for printing***

The BAT conclusions in this section apply to printing and apply in addition to the general BAT conclusions in Section 1.1.

BAT 44. In order to reduce water consumption and waste water generation, BAT is to optimise the cleaning of the printing equipment.

Description

This includes:

— mechanical removal of the printing paste;

— automatic start and stop of the cleaning water supply;

— reuse and/or recycling of cleaning water (see BAT 10 (i)).

BAT 45. In order to use resources efficiently, BAT is to use a combination of the techniques given below.

	Technique	Description	Applicability
Selection of printing technology			
a.	Digital jet printing	Computer-controlled injection of dye onto textile materials.	Only applicable to new plants or major plant upgrades.
b.	Transfer printing on synthetic textile materials	The design is first printed on an intermediate substrate (e.g. paper) using selected disperse dyes and is subsequently transferred to the fabric by applying high temperature and pressure.	
Design and operation technique			
c.	Optimised use of printing paste	This includes: — minimisation of the volume of the printing paste supply system (e.g. minimising pipe lengths and diameters); — ensuring a uniform paste distribution over the whole width of the printing machine; — stopping the supply of printing paste shortly before the end of the printing; — manual addition of printing paste for small-scale usage.	Generally applicable.
Recovery and reuse of printing paste			
d.	Recovery of residual printing paste in rotary screen printing	Residual printing paste in the supply system is pushed back to its original container.	Applicability in existing plants may be restricted by the equipment.
e.	Reuse of residual printing paste	The residual printing paste is collected, sorted by type, stored and reused. The degree of reuse of printing paste is limited by its perishability.	Generally applicable.

BAT 46. In order to prevent ammonia emissions to air and to prevent the generation of urea-containing waste water from printing with reactive dyes on cellulosic materials, BAT is to use one of the techniques given below.

Technique		Description
a.	Reduction of urea content in printing pastes	Printing is carried out with a reduced amount of urea in printing pastes and by controlling the moisture content of textile materials.
b.	Two-step printing	Printing is carried out without urea by two padding steps with intermediate drying and addition of fixation agents (e.g. sodium silicate).

BAT 47. In order to reduce emissions of organic compounds (e.g. formaldehyde) and ammonia to air from printing with pigments, BAT is to use printing chemicals with improved environmental performance.

Description

This includes:

— thickeners with no or low contents of volatile organic compounds;

— fixation agents with low potential for formaldehyde releases;

— binders with low contents of ammonia and low potential for formaldehyde releases.

1.7. *BAT conclusions for finishing*

The BAT conclusions in this section apply to finishing and apply in addition to the general BAT conclusions in Section 1.1.

1.7.1. Easy-care finishing

BAT 48. In order to reduce emissions of formaldehyde to air from easy-care finishing of textile materials made of cellulosic fibres and/or blends of cellulosic and synthetic fibres, BAT is to use cross-linking agents with no or low potential for formaldehyde releases.

1.7.2. Softening

BAT 49. In order to improve the overall environmental performance of softening, BAT is to use one of the techniques given below.

Technique		Description
a.	Low-volume application of softening agents	See Section 1.9.4. Softening agents are not added to the dyeing liquor but applied in a separate process step by padding, spraying or foaming.
b.	Softening of cotton textile materials with enzymes	See BAT 16 (c). Enzymes are used for softening, possibly in combination with washing or dyeing.

1.7.3. **Flame retardance finishing**

BAT 50. In order to improve the overall environmental performance, especially to prevent or reduce emissions to the environment and waste, of flame retardance finishing, BAT is to use one or both of the techniques given below, giving priority to technique (a).

Technique		Description	Applicability
a.	Use of textile materials with inherent flame retardance properties	Textiles that do not require finishing with flame retardants are used.	The applicability may be restricted by product specifications (e.g. flame retardance).
b.	Selection of flame retardants	Flame retardants are selected considering: — the risks associated with them, in particular in terms of persistence and toxicity, including the potential for substitution (e.g. brominated flame retardants, see BAT 14 point I.(d)); — the composition and form of the textile materials to be treated; — the product specifications (e.g. combined flame retardance and oil-/water-/soil-repellence, wash durability).	Generally applicable.

1.7.4. **Oil-, water- and soil-repellence finishing**

BAT 51. In order to improve the overall environmental performance, especially to prevent or reduce emissions to the environment and waste, of oil-, water- and soil-repellence finishing, BAT is to use oil-, water- and soil-repellents with improved environmental performance.

Description

Oil-, water- and soil-repellents are selected considering:

— the risks associated with them, in particular in terms of persistence and toxicity, including the potential for substitution (e.g. PFAS, see BAT 14 point I.(d));

— the composition and form of the textile materials to be treated;

— the product specifications (e.g. combined oil-, water-, soil-repellence and flame retardance).

1.7.5. **Shrink-proof finishing of wool**

BAT 52. In order to reduce emissions to water from shrink-proof finishing of wool, BAT is to use chlorine-free antifelting chemicals.

Description

Inorganic salts of peroxymonosulphuric acid are used for shrink-proof finishing of wool.

Applicability

The applicability may be restricted by product specifications (e.g. shrinkage).

1.7.6. Mothproofing

BAT 53. In order to reduce the consumption of mothproofing agents, BAT is to use one or a combination of the techniques given below.

Technique		Description	Applicability
a.	Selection of dyeing auxiliaries	When mothproofing agents are added directly in the dyeing liquor, dyeing auxiliaries (e.g. levelling agents) that do not hinder the uptake of mothproofing agents are selected.	Generally applicable.
b.	Low-volume application of mothproofing agents	see Section 1.9.4. In the case of spraying, the excess mothproofing solution is recovered from the textile materials by centrifugation and reused.	Generally applicable.

1.8. *BAT conclusions for lamination*

The BAT conclusion presented in this section applies to lamination and applies in addition to the general BAT conclusions in Section 1.1.

BAT 54. In order to reduce emissions of organic compounds to air from lamination, BAT is to use hot-melt lamination instead of flame lamination.

Description

Molten polymers are applied to textiles without the use of a flame.

Applicability

May not be applicable to thin textiles and may be restricted by the strength of the bond between the laminate and textile materials.

1.9. *Description of techniques*

1.9.1. Technique to select process chemicals, prevent or reduce emissions to air

Technique	Description
Emission factors	Emission factors are representative values that attempt to relate the quantity of a substance emitted to a process associated with the emission of that substance. Emission factors are derived from emission measurements according to a predefined protocol considering the textile materials and the reference processing conditions (e.g. curing time and temperature). They are expressed as the mass of a substance emitted divided by the mass of textile materials treated at the reference processing conditions (e.g. grams of organic carbon emitted per kg of textile materials treated at a waste gas flow of 20 m^3/h). The quantity, hazardous properties and composition of the mixture of the process chemicals and their pick-up by the textile material are considered.

1.9.2. **Techniques to reduce emissions to air**

Technique	Description
Adsorption	The removal of pollutants from a waste gas stream by retention on a solid surface (activated carbon is typically used as an adsorbent). Adsorption may be regenerative or non-regenerative. In non-regenerative adsorption, the spent adsorbent is not regenerated but disposed of. In regenerative adsorption, the adsorbate is subsequently desorbed, e.g. with steam (often on site), for reuse or disposal and the adsorbent is reused. For continuous operation, typically more than two adsorbers are operated in parallel, one of them in desorption mode.
Condensation	Condensation is a technique that eliminates vapours of organic and inorganic compounds from a waste gas stream by reducing its temperature below its dew point.
Cyclone	Equipment for the removal of dust from a waste gas stream based on imparting centrifugal forces, usually within a conical chamber.
Electrostatic precipitator (ESP)	Electrostatic precipitators (ESPs) operate such that particles are charged and separated under the influence of an electrical field. Electrostatic precipitators are capable of operating under a wide range of conditions. Abatement efficiency may depend on the number of fields, residence time (size), and upstream particle removal devices. They generally include between two and five fields. Electrostatic precipitators can be of the dry or of the wet type depending on the technique used to collect the dust from the electrodes.
Thermal oxidation	The oxidation of combustible gases and odorants in a waste gas stream by heating the mixture of contaminants with air or oxygen to above its auto-ignition point in a combustion chamber and maintaining it at a high temperature long enough to complete its combustion to carbon dioxide and water.
Wet scrubbing	The removal of gaseous or particulate pollutants from a waste gas stream via mass transfer to water or an aqueous solution. It may involve a chemical reaction (e.g. in an acid or alkaline scrubber).

1.9.3. **Techniques to reduce emissions to water**

Technique	Description
Activated sludge process	The biological oxidation of dissolved organic pollutants with oxygen using the metabolism of microorganisms. In the presence of dissolved oxygen (injected as air or pure oxygen), the organic components are transformed into carbon dioxide, water or other metabolites and biomass (i.e. the activated sludge). The microorganisms are maintained in suspension in the waste water and the whole mixture is mechanically aerated. The activated sludge mixture is sent to a separation facility from where the sludge is recycled to the aeration tank.

Adsorption	Separation method in which compounds in a fluid (e.g. waste water) are retained on a solid surface (typically activated carbon).
Anaerobic treatment	The biological transformation of dissolved organic and inorganic pollutants in the absence of oxygen using the metabolism of microorganisms. Transformation products include methane, carbon dioxide, and sulphide. The process is carried out in an airtight stirred reactor. The most commonly used reactor types are: — anaerobic contact reactor; — upflow anaerobic sludge blanket; — fixed-bed reactor; — expanded-bed reactor.
Chemical oxidation	Organic compounds are oxidised to less harmful and more easily biodegradable compounds. Techniques include wet oxidation or oxidation with ozone or hydrogen peroxide, optionally supported by catalysts or UV radiation. Chemical oxidation is also used to degrade organic compounds causing odour, taste and colour nuisances and for disinfection purposes.
Chemical reduction	Chemical reduction is the conversion of pollutants by chemical reducing agents into less harmful compounds.
Coagulation and flocculation	Coagulation and flocculation are used to separate suspended solids from waste water and are often carried out in successive steps. Coagulation is carried out by adding coagulants with charges opposite to those of the suspended solids. Flocculation is carried out by adding polymers, so that collisions of microfloc particles cause them to bond to produce larger flocs. The flocs formed are subsequently separated by sedimentation, air flotation or filtration.
Equalisation	Balancing of flows and pollutant loads by using tanks or other management techniques.
Evaporation	The use of distillation to concentrate aqueous solutions of high-boiling substances for further use, processing or disposal (e.g. waste water incineration) by transferring water to the vapour phase. It is typically carried out in multistage units with increasing vacuums, to reduce the energy demand. The water vapours are condensed, to be reused or discharged as waste water.
Filtration	The separation of solids from waste water by passing them through a porous medium, e.g. sand or membrane filtration (see Membrane filtration below).
Flotation	The separation of solid or liquid particles from waste water by attaching them to fine gas bubbles, usually air. The buoyant particles accumulate at the water surface and are collected with skimmers.
Membrane bioreactor	A combination of activated sludge treatment and membrane filtration. Two variants are used: a) an external recirculation loop between the activated sludge tank and the membrane module; and b) immersion of the membrane module in the aerated activated sludge tank, where the effluent is filtered through a hollow fibre membrane, the biomass remaining in the tank.

Membrane filtration	Microfiltration, ultrafiltration, nanofiltration and reverse osmosis are membrane filtration processes that retain and concentrate, on one side of the membrane, pollutants such as suspended particles and colloidal particles contained in waste waters. They differ in terms of membrane pore sizes and hydrostatic pressure.
Neutralisation	The adjustment of the pH of waste water to a neutral level (approximately 7) by the addition of chemicals. Sodium hydroxide (NaOH) or calcium hydroxide ($Ca(OH)_2$) may be used to increase the pH, whereas sulphuric acid (H_2SO_4), hydrochloric acid (HCl) or carbon dioxide (CO_2) may be used to decrease the pH. Some pollutants may precipitate as insoluble compounds during neutralisation.
Nitrification/denitrification	A two-step process that is typically incorporated into biological waste water treatment plants. The first step is aerobic nitrification where microorganisms oxidise ammonium (NH_4^+) to the intermediate nitrite (NO_2^-), which is then further oxidised to nitrate (NO_3^-). In the subsequent anoxic denitrification step, microorganisms chemically reduce nitrate to nitrogen gas.
Oil-water separation	The separation of oil and water including the subsequent oil removal by gravity separation of free oil, using separation equipment or emulsion breaking (using emulsion-breaking chemicals such as metal salts, mineral acids, adsorbents and organic polymers).
Screening and grit separation	The separation of water and insoluble contaminants such as sand, fibre, fluff or other coarse materials from the textile effluent by filtering through screens or gravitational settling in grit chambers.
Precipitation	The conversion of dissolved pollutants into insoluble compounds by adding precipitants. The solid precipitates formed are subsequently separated by sedimentation, air flotation or filtration.
Sedimentation	The separation of suspended particles by gravitational settling.

1.9.4. **Techniques to reduce the consumption of water, energy and chemicals**

Technique	Description
Cold pad-batch treatment	In cold pad-batch treatment, the process liquor is applied by padding (e.g. with a foulard) and the impregnated fabric is slowly rotated at room temperature for a prolonged period. This technique allows a reduced consumption of chemicals and does not require subsequent steps such as thermal fixation and thereby reduces energy consumption.
Low-liquor-ratio systems (for batch processes)	A low liquor ratio can be achieved by improving the contact between the textile materials and the process liquor (e.g. by creating turbulence in the process liquor), by advanced process monitoring, by improved dosage and application of process liquor (e.g. by jets or spraying) and by avoiding the mixing of process liquor with washing or rinsing water.
Low-volume application systems (for continuous processes)	The fabric is impregnated with process liquor by spraying, vacuum suction through the fabric, foaming, padding, and dipping in nips (process liquor contained in the gap between two rollers) or in reduced-volume tanks, etc.