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UK Best Available Techniques

Formal Draft:
UK BAT Conclusions for the Textiles Sector

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Preface

Status of the Document

This document is the formal draft of the UK Best Available Techniques (BAT) and BAT Associated Emission Levels (BAT-AELs) for the textiles sector.

It has been developed based on the outputs from the EU BREF process, which UK representatives participated in up to 31 January 2020, along with comments and evidence provided by the UK BAT Textiles TWG. It uses evidence available from current industry practice, sector activities and regulatory submissions within a UK context.

The formal draft documents have been agreed by consensus through the formal meetings of the TWG held on 07 to 09 Feb 2023 and 12 July 2023. No alternative positions have been presented.

UK BAT process

The UK BAT process was established in 2022 to organise an information exchange between UK Government, Devolved Administrations, Regulators, industry and interested third parties, e.g. environmental non-governmental organisations (NGOs) on BAT used to control industrial pollution. Technical Working Groups (TWGs) will be formed for each sector under review. They will work in a collaborative forum to discuss and develop BATC for the United Kingdom.

The BATC comprise a short description of each Best Available Technique identified, its applicability and, where applicable, an associated emission or consumption levels.

This formal draft UK BATC will be published for comment and public consultation. When the BATC is approved it will be published as a statutory instrument and used as a basis for environmental permit conditions.

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Scope of Review

Scope of the Review under UK Legislation

In **England and Wales** UK SI 2016 no.1154 The Environmental Permitting (England and Wales) Regulation 2016:

Schedule 1 Part 2 Chapter 6 Other Activities Section 6.4 Coating activities, printing and textile treatments, Part A(1) (a) "Pre-treating (by operations such as washing, bleaching or mercerization) or dyeing fibres or textiles in plant with a treatment capacity of more than 10 tonnes per day."

Schedule 1 Part 2, Chapter 5 Section 5.7 – Treatment of wastewater as amended by The Environmental Permitting (England and Wales) (Amendment) (EU Exit) Regulations 2019 (S.I. 2019/39), regs. 1, 2(7)(a)(ii); 2020 c. 1, Sch. 5 para. 1(1), Part A(1)(a) "Independently operated treatment of wastewater not covered by the Urban Wastewater Treatment (England and Wales) Regulations 1994 and discharged by an installation carrying out any other Part A(1) or A(2) activity", provided that the main pollutant load originates from the activities covered by these BAT conclusions.

In **Scotland** under SSI 2012 no.360 The Pollution Prevention and Control (Scotland) Regulations 2012:

Schedule 1, Chapter 6 Other activities Section 6.4 Coating activities, printing and textile treatments, PART A (a) "Pre-treating textile fibres or textiles by operations such as washing, bleaching, mercerisation or dyeing, where the treatment capacity is more than 10 tonnes per day." and (b) "Surface treating substances, objects or products using organic solvents, in particular for dressing, printing, coating, degreasing, waterproofing, sizing, painting, cleaning or impregnating, with a consumption capacity of more than 150 kilogrammes per hour or more than 200 tonnes per year (whichever is the lesser)."

Schedule 1, Part 1, Chapter 5, SECTION 5.7: Treatment of wastewater as amended by The Environment (EU Exit) (Scotland) (Amendment etc.) Regulations 2019 (S.S.I. 2019/26), regs. 1, 13(20); 2020 c. 1, Sch. 5 para. 1(1), PART A "Independently operated treatment of wastewater not covered by the Urban Wastewater Treatment (Scotland) Regulations 1994 and discharged by an installation carrying out any other Part A activity provided that the main pollutant load originates from the activities covered by these BAT conclusions."

In **Northern Ireland** under Statutory Rules 2013 No. 160 The Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013:

Schedule 1, Chapter 6 Other Activities Section 6.4 Coating activities, printing and textile treatments, PART A (a) "Pre-treating (by operations such as washing, bleaching or mercerisation) or dyeing fibres or textiles in plant with a treatment capacity of more than 10 tonnes per day." and "(b) "Surface treating substances, objects or products using organic solvents, in particular for dressing, printing, coating, degreasing, waterproofing, sizing, painting, cleaning or impregnating, in plant with a consumption capacity of more than 150 kg per hour or more than 200 tonnes per year."

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Schedule 1, Part 1, Chapter 6, SECTION 6.11 Wastewater treatment, Part A(a) Independently operated treatment of wastewater not covered by Directive 91/271/EEC and discharged by a Part A installation or Part A mobile plant, provided that the main pollutant load originates from the activities covered by these BAT conclusions.

Activities excluded from the UK BAT Textiles scope under UK legislation

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 relevant BATC

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

a. Surface Treatment Using Organic Solvents including Preservation of Wood and Wood Products with Chemicals (STS);
b. Waste Incineration (WI);
c. Waste Treatment (WT).

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

Links between UK Legislation and EU Directives

These BATC cover the above textiles activities as defined in UK legislation based on Annex I of the Industrial Emissions Directive (2010/75/EU) facilitated through the European Union (Withdrawal) Act 2018 (2018c.16).

As they are based on the outputs from a process in which the UK was included the references to Directives and associated sections of the final EU BATC in the EU BREF for the textiles sector have been retained. This is to ensure a clear line of sight to the technical background developed from UK evidence.

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Definitions

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

General terms

Table 1: Definition of general terms for the textiles BATC's.

Term Used	**Definition**
Air-to-Textile ratio	The ratio of the total exhaust gas volume flow (expressed in Nm^3/hr) 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).
BAT-AEL	BAT Associated Emission Levels, defined in Article 3(13) to the IED as 'emission levels associated with the best available techniques' means the range of emission levels obtained under normal operating conditions using a best available technique or a combination of best available techniques, as described in BAT conclusions, expressed as an average over a given period of time, under specified reference conditions.
BAT-AEPL	BAT Associated Environmental Performance Level, described in Commission Implementing Decision 2012/119/EU, Section 3.3. Environmental performance levels associated with BAT may include: • emission levels, • consumption levels, • other levels (e.g. abatement efficiency).
Bioeliminability	The removal of a substance, especially from aqueous solution, by biochemical activity.
Boiler efficiency	Ratio between the energy produced at the boiler output (e.g. steam, hot water) and the fuel energy input (as lower heating values).
Bottom ash treatment plant	Plant treating slags and/or bottom ashes from the incineration of waste in order to separate and recover the valuable fraction and to allow the beneficial use of the remaining fraction. This does not include the sole separation of coarse metals at the incineration plant.
Cellulosic materials	Cellulosic materials include cotton and viscose.
Continuous measurement	Measurement using an automated measuring system permanently installed on site.

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Term Used	Definition
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 wastewater treatment.
Dry cleaning	Cleaning of textile materials with an organic solvent.
Existing plant	A plant that is not 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.
Greenhouse gases	The seven direct greenhouse gases under the Kyoto Protocol. These are as follows: Carbon dioxide (CO_2); Methane (CH_4); Nitrous oxide (N_2O); Hydrofluorocarbons (HFCs); Perfluorocarbons (PFCs); Sulphur hexafluoride (SF_6); and Nitrogen trifluoride (NF_3).
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.
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.

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Term Used	**Definition**
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/1907/2006 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 as defined 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).

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Pollutants and parameters

Table 2: Pollutants and parameters for the textiles BATC’s

Term	**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.
Arsenic	The sum of arsenic and its compounds, expressed as As.
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.
Cadmium	The sum of cadmium and its compounds, expressed as Cd.
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 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.

Term	Definition
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.
POPs	Persistent Organic Pollutants are poisonous chemical substances that break down slowly and get into food chains as a result. Historically used in various products including pesticides and industrial chemicals and released during chemical and agricultural processes, the manufacture, sale and use of products containing POPs is now banned. Materials or products that contain POPs can only be used in specific exceptions outlined in the Persistent Organic Pollutant Regulations 2007.
SO_X	The sum of sulphur dioxide (SO_2), sulphur trioxide (SO_3), and sulphuric acid (H_2SO_4) 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.

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Acronyms

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

Table 3: Acronym definitions for the textiles BATCs

Term	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
POPs	Persistent Organic Pollutants

Descriptions of Techniques

Table 4: Technique to select process chemicals, prevent or reduce emissions to air definitions

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 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

Table 5: Techniques to reduce emissions to air definitions

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 absorbers 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 electric field. Electrostatic precipitators are capable of 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).

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Table 6: Techniques to reduce emissions to water definitions

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 collision 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.

Technique	Description
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 an 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 wastewater treatment plants. The first step is aerobic nitrification when 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 separator	The separation of oil and water including the subsequent oil removal by gravity separation of free oil, using separation equipment or emulsion breaking (using

Technique	Description
	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 precipitates. The solid precipitates formed are subsequently separated by sedimentation, air flotation or filtration.
Sedimentation	The separation of suspended particles by gravitational settling.

Table 7: Techniques to reduce the consumption of water, energy and chemicals definitions

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), 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.

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General Considerations

The techniques listed and described in these UK 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, these BAT Conclusions are generally applicable.

Emission Levels associated with the best available techniques (BAT-AELs) for Emissions to Air

It is important to ensure that any BAT-AEL is expressed in a manner that allows consistent measurement and comparisons. This is achieved by defining the reference conditions under which monitoring should be undertaken. Emission levels associated with the best available techniques (BAT-AELs) and indicative emission levels 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 definitions apply:

Table 8: Averaging periods of BAT-AELs for emissions to air.

Type of measurement	Averaging period	Definition
Periodic	Average over the sampling period	Average value of three consecutive 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 measurements is inappropriate, a more representative sampling/measurement procedure may be employed.

For the purpose of calculating the mass flows in relation to BAT 22 (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), BAT 51 (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), BAT 52 (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) and BAT 51 (BAT-associated emission levels (BAT-AELs) for channelled emissions of organic compounds and formaldehyde to air) and BAT 52 (BAT-associated emission level (BAT-AEL) for channelled dust emissions to air from singeing and thermal treatments, excluding thermofixation and heat-setting), 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 49 (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)). 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:

a. In the case of continuous discharge, daily average values, i.e. 24-hour flow-proportional composite samples.
b. 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 BAT 47) is based on the influent and effluent load of the wastewater treatment plant.

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

Other environmental performance levels associated with the best available techniques (BAT-AEPLs and indicative performance levels)

Indicative performance level for specific energy consumption (energy efficiency)

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, and;
activity rate:	total annual amount of textile materials treated in the thermal treatment, expressed in t/year.

Indicative performance level 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.

BAT-AEPLs for 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, and;
activity rate:	total annual amount of raw wool fibres pre-treated by scouring, expressed in t/year.

BAT-AEPLs for 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.

BAT Conclusions - General

This section captures overarching BATCs which are associated with best practice and good environmental leadership for industrial process, but which do not directly lead to the setting of BAT-AELs.

BAT 1: Environmental Management System

To improve and maintain overall environmental performance, BAT is to elaborate and implement an environmental management system (EMS) that incorporates <u>all</u> of the following features:

a. management commitment, leadership, and accountability, including senior management, for the implementation of an effective EMS;
b. an analysis that includes the organisation's context, the needs and expectations of interested parties, and the characteristics of the installation that are associated with possible risks for the environment including human health; as well as the applicable legal requirements relating to the environment;
c. development of an environmental policy that includes the continuous improvement of the environmental performance of the installation;
d. establishing objectives and performance indicators in relation to the significant environmental aspects, including safeguarding compliance with applicable legal requirements;
e. planning and implementing the necessary procedures and actions (including corrective and preventive actions where needed), to achieve the environmental objectives and avoid environmental risks;
f. determination of structures, roles and responsibilities in relation to the environmental aspects and objectives including the provision of the financial and human resources needed;
g. 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);
h. internal and external communication;
i. fostering employee involvement in good environmental management practices;
j. establishing and maintaining a management manual, written procedures to control activities with significant environmental impact, and records that demonstrate compliance and record non-compliances;
k. effective operational planning and process control;
l. implementation of appropriate maintenance programmes;
m. emergency preparedness and response protocols, including the prevention and/or mitigation of the adverse (environmental) impacts of emergency situations;
n. 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;
o. implementation of a monitoring and measurement programme;

p. application of sectoral benchmarking on a regular basis;
q. periodic internal auditing and 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;
r. 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;
s. periodic review, by senior management, of the EMS and its continuing suitability, adequacy and effectiveness;
t. following and taking into account the development of cleaner techniques.

Specifically for the textiles sector, BAT is to also incorporate the following features in the EMS:

u. Establish, maintain, and regularly review an inventory of inputs and outputs (see BAT 2)
v. Raw Material Inventory Wastewater Inventory (see BAT 10)
w. Chemicals Management System (see BAT 3)
x. OTNOC Management Plan (see BAT 6)
y. Energy Efficiency Plan (see BAT 40)
z. Water Management Plan (see BAT 37)
aa. Noise and Vibration Management Plan (see BAT 55)
bb. Waste Management Plan (see BAT 45)
cc. Odour Management Plan (see BAT 57)

Note: Certification to ISO14001 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: Establish, maintain, and regularly review an inventory of inputs and outputs

In order to improve the overall environmental performance, BAT is to establish, maintain and regularly review (including where 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:

a. Information about the production process(es), including:
   i. Simplified process flow sheets that show the origin of the emissions;

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

b. Information about the quantity and characteristics of materials used, including textile materials (see BAT 9 (a)) and process chemicals (see BAT 5);
c. Information about water consumption and usage;
d. Information about energy consumption and usage;
e. Information about the quantity and characteristics of the wastewater streams, such as:
   i. Average values and variability of flow, pH, temperature and conductivity;
   ii. 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;
   iii. 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));
f. Information about the characteristics of the waste gas stream, such as:
   i. Average values and variability of flow and temperature;
   ii. 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 Table 4);
   iii. Flammability, lower and higher explosive limits, reactivity, hazardous properties;
   iv. Presence of other substances that may affect the waste gas treatment system or installation safety (e.g. water vapour, dust);
g. 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: Chemicals Management System

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:

a. 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:

i. 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 Table 4));
ii. 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;
iii. the potential for recovery and reuse (see BAT 5 (f) and (g) as well as BAT 34);
iv. 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;
v. the anticipatory analysis of regulatory changes related to hazardous substances and substances of very high concern, and safeguarding compliance with applicable legal requirements.

Note: The inventory of process chemicals (see BAT 4) 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.

b. Goals and action plans to avoid or reduce the use of and risks associated with hazardous substances and substances of very high concern.
c. Development and implementation of procedures for the procurement, handling, storage and use of process chemicals (see BAT 54), disposal of waste containing process chemicals and return of unused process chemicals (see BAT 45 (d)), to prevent or reduce emissions to the environment.

BAT 4: Elaborate and Implement a Chemicals Inventory

In order to improve the overall environmental performance, BAT is to elaborate and implement a chemicals inventory as part of the CMS (see BAT 3).

Description

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

a. the identity of the process chemicals;

b. the quantities, location and perishability of the process chemicals procured, recovered (see BAT 5 (g)), stored, used and returned to suppliers;
c. 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 5: Reduce chemical consumption

In order to reduce the use of chemicals, BAT is to use all of the techniques outlined below:

Table 9: Techniques to reduce chemicals consumption.

Technique	**Description**	**Applicability**
a. Reduction of the need for process chemicals	· Regularly reviewing and optimising the formulation of process chemicals and liquors; · Production optimisation (see BAT 37 (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 17 (b)).	Not applicable to washing and rinsing
c. Treatment of textile materials with enzymes	Enzymes are selected (see BAT 3(a)(iv)) 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	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

Technique	Description	Applicability
	production machines (See BAT 7)	chemicals and process liquors
e. Optimisation of the quantity of process chemicals used	See BAT 37 (e)	Generally applicable
f. Reuse of process liquors	See BAT 37 (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 6: Other than Normal Operating Techniques (OTNOC)

To reduce the frequency and duration of the occurrence of OTNOC and to reduce emissions during OTNOC, BAT is to set up and implement a risk based OTNOC management plan (OTNOC-MP) as part of the EMS that includes all the following elements:

a. identification of potential OTNOC scenarios (i.e. 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 scenarios following the periodic assessment below;
b. reference to consideration of appropriate design of critical equipment (e.g. compartmentalisation of fabric filters – this is expected to be contained within the permit application);
c. set-up and implementation of an inspection and preventive maintenance plan for critical equipment;
d. quantification monitoring (i.e., estimating or, where possible, measuring) and recording of emissions during OTNOC and of associated circumstances;
e. periodic assessment of the emissions occurring during OTNOC (e.g. frequency of events, duration, amount of pollutants emitted and their likely impact) and implementation of corrective actions additional measures to reduce the likelihood, duration and severity of future occurrence if necessary.

Applicability

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

BAT 7: Advanced process and monitoring control

In order to improve the overall performance, BAT is to use advanced process and monitoring 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:

a. volume, pH and temperature of the process liquor;
b. amount of textile materials treated;
c. dosage of process chemicals;
d. drying parameters (see also BAT 42 (d)).

BAT 8: Minimise contaminants and processing needs

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

Table 10: Techniques to improve environmental performance by minimising contaminants and processing needs.

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	Generally applicable

Technique	Description	Applicability
	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 semiprocessed) 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.	
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.

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BAT Conclusions – Process

This section captures BATC's appropriate to the control of environmental impacts best controlled through good process control of the unit operations being used.

BAT 9: BAT is to monitor at least once per year

The annual consumption of water, energy and materials used, including:

a. Textile materials and process chemicals;
b. The annual amount of wastewater generated;
c. The annual amount of materials recovered or reused;
d. 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 10: Monitoring of wastewater streams identified by the inventory of inputs and outputs

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

Description

When bioeliminability/biodegradability and inhibitory effects are key parameters, monitoring is carried out before the biological treatment for:

a. bioeliminability/biodegradability using standards EN ISO 9888 or EN ISO 7827, and
b. 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 11: Monitor emissions to water

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.

Table 11: Monitoring of emissions to water.

Substance(s) / parameter	**Standard(s)**	**Activities / processes**	**Minimum monitoring frequency**
a. Adsorbable organically bound halogens (AOX) (1)	EN ISO 9652	All activities / processes	Once every month (2)
b. Biochemical Oxygen Demand (BOD_n) (3)	EN 1899-1, EN 1899-2)	All activities / processes	Once every month
c. Brominated Flame Retardants (1)	EN standard available for some polybrominated diphenyl ethers (i.e. EN 16694)	Finishing with flame retardants	Once every three months
d. Chemical Oxygen Demand (COD) (4)	ISO 6060, ISO 15705	All activities / processes	Once every day (5) (6)
e. Colour	EN ISO 7887	Dyeing	Once every month (2)
f. Antimony (Sb)	ISO 17378-1, ISO 11373-2	· Pre-treatment and/or dyeing of polyester textile materials · Finishing with flame retardants using antimony trioxide	Once every month (2)
g. Chromium (Cr)	EN 1233	Dyeing with chromium mordant or Chromium containing dyes (e.g. metal-complex dyes)	Once every month (2)

Substance(s) / parameter	Standard(s)	Activities / processes	Minimum monitoring frequency
h. Copper (Cu)	EN ISO 11885, EN ISO 17294-2, EN ISO 15586	· Dyeing · Printing with dyes	Once every month (2)
i. Nickel (Ni)	EN ISO 11885, EN ISO 17294-2, EN ISO 15586	· Dyeing · Printing with Dyes	Once every month (2)
j. Zinc (Zn) (1)	EN ISO 11885, EN ISO 17294-2, EN ISO 15586	All activities / processes	Once every month (2)
k. Hexavalent Chromium (Cr(VI))	ISO 11083, EN ISO 18412, EN ISO 23913	Dyeing with chromium mordant	Once every month
l. Pesticides (1)	EN 12918, EN 16693, EN ISO 27108	Pre-treatment of raw wool fibres by scouring	To be decided, after effluent characterisation (7)
m. Per- and polyfluoroalkyl substances (PFAS) (1)	ISO 21675	All activities / processes	Once every 3 months
n. Sulphide, easily released (S^{2-})	ISO 10530	Dyeing with Sulphur dyes	Once every week or once every month (2)
o. 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
p. Other surfactants	EN 903 for anionic Surfactants, EN ISO 2871-1 for cationic surfactants	All activities / processes	Once every 3 months (8)
q. Total Nitrogen (TN)	Various EN standards available (e.g. EN	All activities / processes	Once every day (5) (6)

Substance(s) / parameter	Standard(s)	Activities / processes	Minimum monitoring frequency
	12260, EN ISO 11905-1)		
r. Total Organic Carbon (TOC) (4)	EN 1484	All activities / processes	Once every day (5) (6)
s. Total Phosphorus (TP)	Various EN standards available (e.g. EN ISO 6878, EN ISO 15681-1, EN ISO 15681-2, EN ISO 11885)	All activities / processes	Once every day (5) (6)
t. Total Suspended Solids (TSS)	EN 872	All activities / processes	Once every day (5) (6)
u. Toxicity (9): Fish eggs (*Danio Rerio*)	EN ISO 15088	All activities / processes	To be decided based on a risk assessment, after effluent characterisation (7)
v. Toxicity (9): Daphnia (*Daphnia Magna Straus*)	EN ISO 6341	All activities / processes	To be decided based on a risk assessment, after effluent characterisation (7)
w. Toxicity (9): Luminescent bacteria (*Vibrio fischeri*)	Various EN standards available (e.g. EN ISO 11348-1, EN ISO 11348-2, EN ISO 11348-3)	All activities / processes	To be decided based on a risk assessment, after effluent characterisation (7)
x. Toxicity (9): Duckweed (*Lemna minor*)	Various EN standards available (e.g. EN ISO 20079, EN ISO 20227)	All activities / processes	To be decided based on a risk assessment, after effluent characterisation (7)
y. Toxicity (9): Algae	Various EN standards available (e.g. EN ISO 8692, EN	All activities / processes	To be decided based on a risk assessment, after effluent

Substance(s) / parameter	Standard(s)	Activities / processes	Minimum monitoring frequency
	ISO 10253, EN ISO 10710)		characterisation (7)

[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 wastewater 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 wastewater 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 wastewater 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] 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.

[8] In the case of an indirect discharge, the monitoring frequency may be reduced to once every 6 months if the downstream wastewater treatment plant is designed and equipped appropriately to abate the pollutants concerned.

[9] Either the most sensitive toxicity parameter or an appropriate combination of the toxicity parameters can be used.

BAT 12: Prevent or reduce emissions of poorly biodegradable substances to water

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

Table 12: Techniques to prevent or reduce emissions of poorly biodegradable substances to water.

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

BAT 13: Prevent or reduce the pollutant loads discharged to the wastewater treatment plant and the emissions to water

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

a. process-integrated techniques (see BAT 37 and *BAT conclusions in EU BREF Section 1.2 to 1.7*),
b. techniques to recover and reuse process liquors, (see BAT 37(j) and BAT 34), separate collection of wastewater streams and pastes (e.g. printing and coating) containing high loads of pollutants that cannot be adequately treated by biological treatment; these wastewater streams and pastes are either pretreated (see BAT 14) or handled as waste (see BAT 46),
c. (final) wastewater treatment techniques (see BAT 47).

Description

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

BAT 14: Pretreat (separately collected) wastewater streams and pastes (e.g. printing and coating)

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

Description

Such wastewater streams and pastes include:

a. spent dyeing, coating or finishing padding liquors from continuous and/or semi-continuous treatments;
b. desizing liquors;
c. spent printing and coating pastes.

The pre-treatment is carried out as part of an integrated strategy for wastewater management and treatment (see BAT 13) and is generally necessary to:

a. protect the (downstream) biological wastewater treatment against inhibitory or toxic compounds;
b. remove compounds that are insufficiently abated during biological wastewater treatment (e.g. toxic compounds, poorly biodegradable

organic compounds, organic compounds that are present in high loads or metals);

c. remove compounds that could otherwise be stripped to air from the collection system or during biological wastewater treatment (e.g. sulphide);
d. remove compounds that have other negative effects (e.g. corrosion of equipment; unwanted reaction with other substances; contamination of wastewater 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 wastewater 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 47).

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

a. 80% after 7 days (for adapted sludge), when determined according to standard EN ISO 9888, or
b. 70% after 28 days when determined according to standard EN ISO 7827.

The associated monitoring is given in BAT 10.

BAT 15: Reduce emissions to water from the use of sizing chemicals

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

Table 13: Techniques to reduce emissions to water from the use of sizing chemicals.

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 3) and used.	Generally applicable

Technique	Description	Applicability
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 16: Avoid the use of mineral oils

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 17: Prevent or reduce emissions to water of chlorine-containing compounds and complexing agents

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.

Table 14: Techniques to Prevent or reduce emissions to water of chlorine-containing compounds and complexing agents.

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	May not be applicable to the brightening of flax and other bast fibres.

Technique	Description	Applicability
	pre-treatment with enzymes (see BAT 5 (c)).	
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 18: Reduce emissions to water from the dyeing of wool

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.

Table 15: Techniques to reduce emissions to water from the dyeing of wool.

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 19: Reduce emissions to water from the dyeing of polyester with disperse dyes

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.

Table 16: Techniques to reduce emissions to water from the dyeing of polyester with disperse dyes.

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 ºC) 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.	Generally applicable.
c. Optimised desorption of unfixed dye in batch dying	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).

BAT 20: Optimise the cleaning of printing equipment

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

Description

This includes:

a. mechanical removal of the printing paste;
b. automatic start and stop of the cleaning water supply;
c. reuse and/or recycling of cleaning water (see BAT 37 (i)).

BAT 21: Improve the overall environmental performance, especially to prevent or reduce emissions to the environment and waste, of oil-, water- and soil-repellence finishing.

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:

a. the risks associated with them, in particular in terms of persistence and toxicity, including the potential for substitution (e.g. PFAS, see BAT 3(a)(iv));
b. the composition and form of the textile materials to be treated;
c. the product specifications (e.g. combined oil-, water-, soil-repellence and flame retardance).

BAT 22: Monitor channelled emissions to air

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.

Table 17: Monitoring of channelled emissions to air.

Substance or Parameter	Process	Standard(s)	Minimum monitoring frequency(1)	Monitoring associated with
a. CO	· Singeing; · Combustion; · Flame lamination.	EN 15058	Once every 3 years	-
b. Dust	· Combustion; · Thermal treatments associated with pre-treatment, dyeing, printing and finishing	EN 13284-1	Once every year (2)	BAT 52
c. CMR (other than	· Coating (4);	EN TS 13649	Once every year	-

Substance or Parameter	**Process**	**Standard(s)**	**Minimum monitoring frequency**[1]	**Monitoring associated with**
formaldehyde [3])	· Flame lamination [4]; · Finishing [4]; · Thermal treatments associated with coating, lamination and finishing. [4]			
d. Formaldehyde [3]		EN TS 17638	Once every year	BAT 51
e. NH_3 [3]	· Coating [4]; · Printing ([5]); · Finishing [4] · Thermal treatments associated with coating, printing and finishing [4].	EN ISO 21877	Once every year	BAT 53
f. NO_x	· Singeing; · Combustion	EN 14792	Once every 3 years	-
g. SO_2 [5]	· Combustion	EN14791	Once every 3 years	-
h. TVOC [3]	· Coating; · Dyeing; · Finishing, · Lamination; · Printing; · Singeing; · Thermofixation or heat setting; · Thermal treatments · Associated with coating, · dyeing, lamination, printing and finishing.	EN 12619	Once every year [6]	BAT 51

This draft document should not be used for reference until the final version is published (expected at the end of 2025).

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[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.

BAT 23: Reduce emissions of organic compounds to air from the pre-treatment of knitted synthetic textile materials

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 24: Prevent ammonia emissions to air and to prevent the generation of urea-containing wastewater from printing with reactive dyes on cellulosic materials

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

Table 18: Techniques to prevent ammonia emissions to air and to prevent the generation of urea-containing wastewater from printing with reactive dyes on cellulosic materials.

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 25: Reduce emissions of organic compounds (e.g. formaldehyde) and ammonia to air from printing with pigments

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:

a. thickeners with no or low contents of volatile organic compounds;
b. fixation agents with low potential for formaldehyde releases;
c. binders with low contents of ammonia and low potential for formaldehyde releases.

BAT 26: 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

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.

BAT 27: Improve the overall environmental performance, especially to prevent or reduce emissions to the environment and waste, of flame retardance finishing.

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).

Table 19: Techniques to improve the overall environmental performance, especially to prevent or reduce emissions to the environment and waste, of flame retardance finishing.

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 3(a)(iv)); · 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.

BAT 28: Reduce emissions to water from shrink-proof finishing of wool

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).

BAT 29: Reduce the consumption of mothproofing agents

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

Table 20: Techniques to reduce the consumption of mothproofing agents.

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 Table 7. In the case of spraying, the excess mothproofing solution is recovered from the textile materials by centrifugation and reused.	Generally applicable.

BAT 30: Reduce emissions of organic compounds to air from lamination

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.

BAT 31: Use resources efficiently and to reduce the amount of waste sent for disposal

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, wastewater treatment sludge).

Description

The organic residues are treated, for example by composting.

This draft document should not be used for reference until the final version is published (expected at the end of 2025).

BAT Conclusions – Efficiency

This section captures BATC which reflect the measures required to improve and maintain process efficiency. These may include resource use, energy efficiency and waste management.

BAT 32: Use resources efficiently as well as reduce water consumption and wastewater generation

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

Description

Wastewater 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.

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

Table 21: 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)
a. 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
b. Extra- and super-fine wool (i.e. wool fibre diameter typically lower than 20 μm)	kg of recovered grease per tonne of raw wool fibres pretreated by scouring	50 - 60

The associated monitoring is given in BAT 9.

BAT 33: Use resources efficiently as well as reduce water consumption and wastewater generation

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

Table 22: Techniques to use resources efficiently as well as reduce water consumption and wastewater generation.

Technique	Description	Applicability
a. Combined pre-treatment of cotton textiles	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 Table 7).	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 34: Use resources efficiently and to reduce the amount of alkali discharged to wastewater treatment

In order to use resources efficiently and to reduce the amount of alkali discharged to wastewater 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.

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Applicability

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

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

Table 23: BAT-AEPL for the recovery of caustic soda used for mercerisation.

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

BAT 35: Use resources efficiently and to reduce emissions to water from dyeing

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.

Table 24: Techniques to use resources efficiently and to reduce emissions to water from dyeing.

Technique	Description
a. Techniques for batch and continuous dyeing: Selection of dyes	Dyes with dispersing agents that are biodegradable (e.g. based on fatty acid esters) are selected.
b. Techniques for batch and continuous dyeing: 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.
c. Techniques for batch dyeing: 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. Techniques for batch dyeing: 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 5 (c)) and/or vinyl polymers. This reduces the number of rinsing steps needed.
e. Techniques for batch dyeing: Low-liquor-ratio systems	See Table 7
f. Techniques for continuous dyeing: Low-volume application systems	See Table 7

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BAT 36: Resource efficiency – printing

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

Table 25: Techniques for printing resource efficiency.

Technique	Description	Applicability
a. Selection of printing technology: digital jet printing	Computer controlled injection of dye onto textile materials.	Only applicable to new plants or major plant upgrades.
b. Selection of printing technology: 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.	Only applicable to new plants or major plant upgrades.
c. Design and operation technique: Optimised use of printing paste	This includes: · minimisation of the volume of 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 printing; · manual addition of printing paste for small-scale usage.	Generally applicable.
d. Recovery and reuse of printing paste: 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. Recovery and reuse of printing paste: 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 37: Reduce water consumption and wastewater generation

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

Table 26: Techniques to reduce water consumption and wastewater generation.

Technique	Description	Applicability
a. Management techniques: 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. Management techniques: 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	Generally applicable.

Technique	Description	Applicability
	shades in the same dyeing equipment.	
c. Design and operation techniques: 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 wastewater 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. Design and operation techniques: 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. Design and operation techniques: Optimisation of the amount of process liquor used	Batch processes are carried out with low-liquor-ratio systems (see Table 7). Continuous processes are carried out with low volume application systems, such as spraying (see Table 7).	Generally applicable.
f. Design and operation techniques: 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 20)); · 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. Design and operation techniques: Optimised batch processing, washing and	This includes:
	· Use of auxiliary tanks for temporary storage of:
	  · Spent washing or rinsing water;
	  · Fresh or spent process liquor.
		The use of auxiliary tanks in existing plants may be restricted by a lack of space.

Technique	Description	Applicability
rinsing of textile materials	· Multiple drain and fill steps for rinsing and washing with low amounts of water.	
h. Design and operation techniques: 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 42(a)) to reduce the carry-over of process chemicals.	Generally applicable.
i. Reuse and recycling techniques: Water reuse and recycling	Water streams may be segregated (see BAT 37 (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 wastewater treatment).	Generally applicable.
j. Reuse and recycling techniques: Reuse of process liquor	Process liquor, including the process liquor extracted from textile materials by mechanical dewatering (*see* BAT 42 (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.

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Indicative environmental performance level for specific water consumption.

Table 27: Indicative environmental performance levels for specific water consumption.

Specific process(es)	**Indicative levels (Yearly average)** (m^3/t)
a. Bleaching (batch)	10 – 32 [1]
b. Bleaching (continuous)	3 – 8
c. Scouring of cellulosic materials (batch)	5 – 15 [1]
d. Scouring of cellulosic materials (continuous)	5 – 12 [1]
e. Desizing of cellulosic materials	5 – 12 [1]
f. Combined bleaching, scouring and desizing of cellulosic materials	9 – 20 [1]
g. Mercerisation	2 – 13 [1]
h. Washing of synthetic material	5 – 20 [1]
i. Batch dyeing (fabric)	10 – 150 [1]
j. Batch dyeing (yarn)	3 – 140 [1] [2]
k. Batch dyeing (loose fibre)	13 – 60
l. 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.

BAT 38: Use resources efficiently and reduce emissions to water from the dyeing of cellulosic material

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 below.

Table 28: Techniques to support resources efficiently and reduce emissions to water from the dyeing of cellulosic material.

Technique	Description	Applicability
a. Technique for dyeing with sulphur and vat dyes: Minimised use if 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).
b. Technique for continuous dyeing with vat dyes: 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.
c. Technique for dyeing with dyeing with reactive dyes: 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. Technique for dyeing with dyeing with reactive dyes: Cold pad-batch dyeing	Dyeing is carried out with the cold pad-batch technique (see Table 7).	Generally applicable.
e. Technique for dyeing with dyeing with reactive dyes: 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 40 (i)).	Generally applicable.
f. Technique for dyeing with dyeing with reactive dyes:	In cold pad-batch dyeing (see Table 7), concentrated aqueous alkali solutions	May not be applicable to dyeing with dark shades.

Technique	Description	Applicability
Use of concentrated alkali	without sodium silicate are used for the fixation of dyes.	
g. Technique for dyeing with dyeing with reactive dyes: 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 39: Improve the overall environmental performance of softening

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

Table 29: Techniques to improve the overall environmental performance of softening.

Technique	Description
a. Low-volume application of softening agents	See Table 7. 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 5 (c) Enzymes are used for softening, possibly in combination with washing or dyeing.

BAT 40: Energy Efficiency

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.

Table 30: Techniques to improve energy efficiency.

Technique	Description	Applicability
a. Management techniques: Energy efficiency plan and audits	An energy efficiency plan and audits are part of the EMS (see BAT 1) and include:	The level of detail of the energy efficiency plan and audits will

Technique	Description	Applicability
	· 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.	generally be related to the nature, scale and complexity of the plant.
b. Management techniques: Production optimisation	Optimised scheduling of fabric batches to undergo thermal treatment in order to minimise the idling time of the equipment.	Generally applicable.
c. Process and equipment selection and optimisation: 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. Process and equipment selection and optimisation: 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;	Generally applicable.

Technique	Description	Applicability
	· Avoiding overheating of the process liquors.	
e. Process and equipment selection and optimisation: 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. Process and equipment selection and optimisation: 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.
g. Heat recovery techniques: Recycling of warm cooling water	See BAT 37 (i). This avoids the need for heating cold water.	Generally applicable.
h. Heat recovery techniques: Reuse of warm process liquor	See BAT 37 (j). This avoids the need for heating cold process liquor.	Generally applicable.
i. Heat recovery techniques: Heat recovery from wastewater	Heat from wastewater is recovered by heat exchangers, e.g. to warm up process liquor.	Generally applicable.
j. Heat recovery techniques: 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).	Generally applicable.
k. Heat recovery techniques: Heat recovery from steam use	Heat e.g. from condensate and boiler blowdown, is recovered.	Generally applicable.

BAT 41: Increase energy efficiency when using compressed air

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

Table 31: Techniques to increase energy efficiency when using compressed air.

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).	Generally applicable.
d. Reuse and/or recycling of warm cooling water or warn 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 40 (g).	Generally applicable.

BAT 42: Increase energy efficiency of thermal treatment

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

Table 32: Techniques to increase energy efficiency of thermal treatment.

Technique	Description	Applicability
a. Techniques for reducing the use of heating: 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.

Technique	Description	Applicability
b. Techniques for reducing the use of heating: Avoiding overdrying of textile materials	The textile materials are not dried below their natural moisture level.	Generally applicable.
c. Design and operation techniques: 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. Design and operation techniques: Advanced process monitoring and control of drying	The drying parameters are monitored and controlled (see BAT 7). 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. Design and operation techniques: 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.
f. Heat recovery techniques: Heat recovery	See BAT 40 (j).	Only applicable when the waste

Technique	Description	Applicability
from waste gases		gas flow is sufficient.

Indicative environmental performance level for specific energy consumption:

Table 33: 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 9.

BAT 43: Energy efficiency for the pre-treatment of raw wool fibres by scouring

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

Table 34: Techniques to increase energy efficiency for the pre-treatment of raw wool fibres by scouring.

Technique	Description	Applicability
a. Covered scouring bowls	Scouring bowls are fitted with covers to prevent heat losses by convection or evaporation (see BAT 40 (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 42 (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 44: Energy efficiency for the spinning of fibres (other than man-made fibres) and the production of fabric

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

Table 35: Techniques to increase energy efficiency for the spinning of fibres (other than man-made fibres) and the production of fabric.

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.

BAT 45: Prevent or reduce the generation of waste and reduce the quantity of waste sent for disposal

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.

Table 36: Techniques to prevent or reduce the generation of waste and reduce the quantity of waste sent for disposal.

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 54), the packaging is reused, returned to the supplier or sent for material recycling.	Generally applicable.
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 46: Improve the overall environmental performance of the handling of waste, especially to prevent or reduce emissions to the environment

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.

Table 37: Techniques to improve the overall environmental performance of the handling of waste, especially to prevent or reduce emissions to the environment.

Technique	**Description**
a. 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 13) 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 wastewater treatment.

BAT Conclusions – Emissions

This section captures those BATCs where there are BAT-AELs which are not captured in other sections. Where the descriptive flow requires other non-BAT-AEL BATC can also be included here. It includes emissions to air, land and water as well as noise and odour.

BAT 47: Reduce emissions to water

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

Table 38: Techniques to reduce emissions to water.

Technique (1)	**Typical pollutant targeted**	**Applicability**
a. Pre-treatment of individual waste streams, e.g. Adsorption	Adsorbable dissolved non-biodegradable or inhibitory pollutants (e.g. AOX in dyestuffs, organophosphorus flame retardants)	Generally applicable.
b. Pre-treatment of individual waste streams, e.g. Precipitation	Precipitable dissolved non-biodegradable or inhibitory pollutants (e.g. metals in dyestuffs)	Generally applicable.
c. Pre-treatment of individual waste streams, e.g. Coagulation and flocculation	Suspended solids and particulate-bound non-biodegradable or inhibitory pollutants (e.g. metals in dyestuffs)	Generally applicable.
d. Pre-treatment of individual waste streams, e.g. 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)	Generally applicable.
e. Pre-treatment of individual waste streams, e.g. Chemical reduction	Reducible dissolved non-biodegradable or inhibitory pollutants (e.g. hexavalent chromium (Cr(VI))	Generally applicable.
f. Pre-treatment of individual waste streams, e.g. Anaerobic pre-treatment	Biodegradable organic compounds (e.g. azo dyestuffs, printing pastes)	Generally applicable.
g. Pre-treatment of individual waste streams, e.g. Filtration (e.g. nanofiltration)	Suspended solids and particulate-bound non-biodegradable or inhibitory pollutants	Generally applicable.

Technique (1)	**Typical pollutant targeted**	**Applicability**
h. Pre-treatment of combined wastewater streams, e.g. 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. Pre-treatment of combined wastewater streams, e.g. Equalisation	All pollutants	Generally applicable.
j. Pre-treatment of combined wastewater streams, e.g. Neutralisation	Acids, alkalis	Generally applicable.
k. Primary treatment, e.g. Sedimentation	Suspended solids and particulate-bound metals or non-biodegradable or inhibitory pollutants	Generally applicable.
l. Primary treatment, e.g. Precipitation	Precipitable dissolved non-biodegradable or inhibitory pollutants (e.g. metals in dyestuffs)	Generally applicable.
m. Primary treatment, e.g. Coagulation and flocculation	Suspended solids and particulate-bound non biodegradable or inhibitory pollutants (e.g. metals in dyestuffs)	Generally applicable.
n. Secondary treatment, e.g. Activated sludge processes	Biodegradable organic compounds	Generally applicable.
o. Secondary treatment, e.g. Membrane bioreactor	Biodegradable organic compounds	Generally applicable.
p. Secondary treatment, e.g. 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

Technique [1]	Typical pollutant targeted	Applicability
		of the wastewater is low (e.g. below 12 °C)
q. Tertiary treatment, e.g. Coagulation and flocculation	Suspended solids and particulate-bound non biodegradable or inhibitory pollutants (e.g. metals in dyestuffs)	Generally applicable.
r. Tertiary treatment, e.g. Precipitation	Precipitable dissolved non-biodegradable or inhibitory pollutants (e.g. metals in dyestuffs)	Generally applicable.
s. Tertiary treatment, e.g. Adsorption	Adsorbable dissolved non-biodegradable or inhibitory pollutants (e.g. AOX in dyestuffs)	Generally applicable.
t. Tertiary treatment, e.g. Chemical oxidation (e.g. oxidation with ozone, hydrogen peroxide or UV light)	Oxidisable dissolved non-biodegradable or inhibitory pollutants (e.g. brighteners and azo dyestuffs, sulphide)	Generally applicable.
u. Tertiary treatment, e.g. Flotation	Suspended solids and particulate-bound non biodegradable or inhibitory pollutants	Generally applicable.
v. Tertiary treatment, e.g. Filtration (e.g. sand filtration)	Suspended solids and particulate-bound non biodegradable or inhibitory pollutants	Generally applicable.
w. Advanced treatment for recycling the wastewater, e.g. Filtration (e.g. sand filtration or membrane filtration) [2]	Suspended solids and particulate-bound non biodegradable or inhibitory pollutants	Generally applicable.
x. Advanced treatment for recycling the wastewater, e.g. Evaporation [2]	Soluble contaminants (e.g. salts)	Generally applicable.

[1] The descriptions of the techniques are given in Table 6.

[2] Minimal wastewater discharge (e.g. 'zero liquid discharge') may be achieved by using a combination of techniques including advanced treatment techniques for recycling the wastewater.

This draft document should not be used for reference until the final version is published (expected at the end of 2025).

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

Table 39: BAT-AELs for direct discharges.

Substance/Parameter	**Activities / processes**	**BAT-AEL** [(1)] (mg/l)
a. Adsorbable organically bound halogens (AOX) [(2)]	All activities / processes	0.1 – 0.4 [(3)]
b. Chemical Oxygen Demand (COD) [(4)]	All activities / processes	40 – 100 [(5)] [(6)]
c. Hydrocarbon oil index (HOI)[(2)]	All activities / processes	1 – 7
d. Antimony (Sb)	· Pre-treatment and/or dyeing of polyester textile materials; · Finishing with flame retardants using antimony trioxide.	0.1 – 0.2 [(7)]
e. Chromium (Cr)	Dyeing with chromium mordant or chromium-containing dyes (e.g. metal-complex dyes)	0.01 – 0.1 [(8)]
f. Copper (Cu)	· Dyeing; · Printing with dyes	0.03 – 0.4
g. Nickel (Ni)	· Dyeing; · Printing with dyes	0.01 – 0.1 [(9)]
h. Zinc (Zn) [(2)]	All activities / processes	0.04 – 0.5 [(10)]
i. Sulphide, easily released (S^{2-})	Dyeing with sulphur dyes	<1
j. Total Nitrogen (TN)	All activities / processes	5 – 15 [(11)]
k. Total organic carbon (TOC)[(4)]	All activities / processes	13 – 30 [(6)] [(12)]
l. Total Phosphorus (TP)	All activities / processes	0.4 – 2
m. Total Suspended Solids (TSS)	All activities / processes	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 wastewater 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 wastewater 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 BOD5 level in the effluent from a biological wastewater 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 wastewater 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 wastewater 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 11

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

Table 40: BAT-AELs for indirect discharges.

Substance/Parameter	**Activities / processes**	**BAT-AEL (1) (2)** (mg/l)
a. Adsorbable organically bound halogens (AOX) (3)	All processes	0.1 – 0.4 (4)
b. Hydrocarbon oil index (HOI) (3)	All processes	1 – 7

Substance/Parameter	Activities / processes	BAT-AEL [1] [2] (mg/l)
c. Antimony (Sb)	· Pre-treatment and/or dyeing of polyester textile materials; · Finishing with flame retardants using antimony trioxide.	0.1 – 0.2[5]
d. Chromium (Cr)	Dyeing with chromium mordant or chromium-containing dyes (e.g. metal-complex dyes)	0.01 – 0.1[6]
e. Copper (Cu)	· Dyeing; · Printing with dyes	0.03 – 0.4
f. Nickel (Ni)	· Dyeing; · Printing with dyes	0.01 – 0.1[7]
g. Zinc (Zn)[3]	All activities / processes	0.04 – 0.5[8]
h. 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 wastewater 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 wastewater 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 11.

BAT 48: Reduce diffuse emissions to air

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 49: Facilitate the recovery of energy and the reduction of channelled emissions to air

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 50: Prevent emissions of organic compounds to air from dry cleaning and from scouring with organic solvent

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 Table 5) and to fully recirculate it.

BAT 51: Prevent or reduce channelled emissions of organic compounds to air from singeing, thermal treatment, coating and lamination

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.

Table 41: Techniques to prevent or reduce channelled emissions of organic compounds to air from singeing, thermal treatment, coating and lamination.

Technique [(1)]	**Typical pollutant targeted**	**Description**
a. Prevention techniques. 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 3, BAT 12, BAT 21, BAT 27). As an example, emission factors may be used for selection (see Table 4)
b. Reduction techniques. Condensation	Organic compounds excluding formaldehyde	See Table 5
c. Reduction techniques. Thermal oxidation	Organic compounds	See Table 5
d. Reduction techniques. Wet scrubbing	Organic compounds	See Table 5
e. Reduction techniques. Adsorption	Organic compounds excluding formaldehyde	See Table 5

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

Table 42: BAT-AELs for channelled emissions of organic compounds and formaldehyde to air.

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

[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:

(a) 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 22.

BAT 52: Prevent or reduce channelled dust emissions to air from singeing and thermal treatments, excluding thermofixation and heat-setting.

In order to prevent or 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.

Table 43: Techniques to prevent or reduce channelled dust emissions to air from singeing and thermal treatments, excluding thermofixation and heat-setting.

Technique	**Description**
a. Cyclone	See Table 5 Cyclones are mainly used as pretreatment before further dust abatement (e.g. for coarse dust).
b. Electrostatic precipitator (ESP)	See Table 5
c. Wet scrubbing	See Table 5

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

Table 44: BAT-AELs 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 22.

This draft document should not be used for reference until the final version is published (expected at the end of 2025).

BAT 53: Prevent or reduce channelled ammonia emissions to air from coating, printing and finishing, including thermal treatments.

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.

Table 45: Techniques to Prevent or reduce channelled ammonia emissions to air from coating, printing and finishing, including thermal treatments.

Technique	**Description**
a. Prevention techniques: 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 3, BAT 12, BAT 21, BAT 24, BAT 25, BAT 27). As an example, emission factors may be used for selection (see Table 4)
b. Reduction techniques: Condensation	See Table 5

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

Table 46: BAT-AELs 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 27*).

The associated monitoring is given in BAT 22.

BAT 54: Prevent or reduce emissions to soil and groundwater and improve the overall performance of the handling and storage of process chemicals

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.

Table 47: Techniques to prevent or reduce emissions to soil and groundwater and improve the overall performance of the handling and storage of process chemicals.

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 7); · 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).	Generally applicable.
c. Optimised storage location of	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	The applicability to existing plants may be

Technique	Description	Applicability
process chemicals	transport distances on site are minimised).	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 4).	Generally applicable.
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.	Generally applicable.

BAT 55: Noise and Vibration

To prevent or, where that is not practicable, to minimise emissions of noise and vibration, BAT is to set up, implement and regularly review a noise and vibration management plan, as part of the EMS that includes all the following elements:

a. a protocol containing appropriate actions and timelines;

b. a protocol for conducting noise and vibration monitoring;

c. a protocol for response to identified noise and vibration events, e.g. equipment failure or complaints;

d. a noise and vibration minimisation programme designed to:

   i. emphasize the importance of a site plan annotated to identify sources and also sensitive receptors;

   ii. identify the source(s) and sensitive receptors, either potential or existing;

   iii. measure/estimate noise and vibration exposures;

   iv. to characterise the contributions of the sources;

   v. to rank order of the sources;

   vi. to implement prevention and/or minimisation measures.

This draft document should not be used for reference until the final version is published (expected at the end of 2025).

Applicability

The applicability is commonly restricted to cases where a noise or vibration impact at sensitive human receptors is expected and/or has been substantiated. However, if there is potential for an adverse noise impact on non-human receptors such as birds, bats, or other protected species or even farm animals, it may be necessary to minimise emissions of noise and vibration on those receptors.

BAT 56: Noise and Vibration Abatement

To prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to use one or a combination of the techniques given below.

Table 48: Techniques to reduce noise and vibration emissions.

Technique	Description	Applicability
a. Use of inherently quiet processes or low-noise equipment	This includes but not limited to techniques such as direct drive motors, low-noise compressors, pumps and fans, variable speed fans, and aerodynamic pipework layout. Opportunities to minimise noise at source should always be sought when equipment is reviewed/replaced.	Generally applicable
b. Appropriate site layout to maximise screening and distances	Noise levels can be minimised by orienting equipment and processes with the highest noise impact away from the sensitive receptors, relocating the exits or entrances of the buildings, using buildings as a noise screen, and increasing the distance between the emitter and the receiver. The appropriate site layout may minimise the need for reversing goods vehicles	For existing plants, the relocation of equipment and the exits or entrances of the buildings may be more difficult due to a lack of space and/or excessive costs
c. Phasing of development and operational measures	These include but not limited to techniques such as: · inspection and maintenance of equipment; · closing of doors and windows of enclosed areas, if possible; · equipment operation by experienced staff;	Generally applicable

Technique	Description	Applicability
	· using sympathetic timings, e.g. avoiding noisy activities at night-time; · provisions for noise control, e.g. during production and maintenance activities, transport and handling of feedstock and materials; · landfill filling sequence; · careful placing instead of dropping off materials.	
d. Noise and vibration control equipment	· This includes but not limited to techniques such as: · rev engine limiters; · acoustic and vibrational insulation of equipment; · enclosure of noisy equipment (e.g. scarfing and grinding machines, wire drawing machines, air jets); · building materials and elements with high sound insulation properties (e.g. for walls, roofs, windows, doors).	Applicability to existing plants may be more difficult due to a lack of space and/or excessive costs
e. Noise abatement and maintenance	· Inserting obstacles between emitters and receivers (e.g. protection walls, bunding, noise barriers, embankments and buildings). · Changing bearings before noise becomes excessive, maintaining relief valves to prevent chattering. · Carrying out monitoring and/or measurement as an operational tool to assist with abatement.	Noise abatement is applicable to existing plants, as the design of new plants should make this technique unnecessary. For existing plants, the insertion of obstacles may be more difficult due to a lack of space and/or excessive costs.

BAT 57: Odour Management

To prevent or, where that is not practicable, to reduce odour emissions, BAT is to set up, implement and regularly review an Odour Management Plan (OMP). The OMP should provide sufficient detail to allow operators and maintenance staff to clearly understand the operational procedures for both normal and abnormal conditions. The OMP should include all the following elements:

a. Implementation of procedures paying particular attention to:

   i. Structure and responsibility
   ii. Recruitment, training, awareness and competence
   iii. Communication and employee involvement
   iv. Documentation
   v. Effective process control
   vi. Maintenance programme
   vii. Emergency preparedness and response
   viii. Safeguarding compliance with environmental legislation

b. Checking performance and taking corrective action, paying particular attention to:
   i. Monitoring and measurements
   ii. Corrective and preventative action
   iii. Maintenance of records
   iv. Auditing to determine whether the OMP has been properly implemented and maintained

c. Commitment of the management, including directors and senior management, that includes;
   i. Continuous improvement of the environmental performance of the installation
   ii. Review, by senior management, of the OMP and its continuing suitability, adequacy, and effectiveness
   iii. The plan should address in a step-by-step basis how these abnormal operation events will be rectified in as short a period as possible.

BAT 58: Odour Monitoring

Odour emissions can be monitored using EN standards (e.g. dynamic olfactometry according to EN 13725 in order to determine the odour concentration or EN 16841-1 or -2 in order to determine the odour exposure).

When applying alternative methods for which no EN standards are available (e.g. estimation of odour impact), ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

The monitoring frequency is determined in the odour management plan.

Applicability

The applicability is restricted to cases where odour pollution is expected and/or has been substantiated.