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Sectoral Guidance for Chemicals Management in the Textile Industry

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EU STRATEGY FOR THE BALTIC SEA REGION FLAGSHIP

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List of Abbreviations

BAT	Best Available Techniques
BImSchG	Bundes-Immissionsschutzgesetz = German Federal Clean Air Act
BREF	Best Available Techniques Reference or Reference Document
CAS	Chemical Abstract System
CLP	Classification, Labelling and Packaging Regulation
CMS	Chemical Management System
ECHA	European Chemical Agency
ES	Exposure scenario
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
IED	Industrial Emissions Directive
IE plants	Industrial installations falling under the IED
IMPEL	European Union Network for the Implementation and Enforcement of Environmental Law
IPPC	Integrated Pollution Prevention and Control
KEMI	Swedish Chemical Agency
MSDS	Material safety data sheet
PBT	Persistent, bio-accumulative and toxic
POP	Persistent Organic Pollutants
PST	Partnership for Sustainable Textiles, Germany
REACH	Regulation concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals
SME	Small and medium-scale enterprise
SVHC	Substances of very high concern
TGW	Technical Working Group
TXT	Textile
UBA	Federal Environment Agency, Germany
vPvB	Very persistent and very bio-accumulative
WFD	Water Framework Directive
WWTP	Wastewater treatment plant

ZDHC	Zero Discharge of Hazardous Chemicals

Preface

The Sectoral guidance for the textile industry is a product of the HAZBREF project *"Hazardous industrial chemicals in the IED BREFs"*. As part of the overarching Work Package 4 "Best practices in chemicals management in the industry", it presents the results for the textile sector related part of Work Package 4.1 "Sectoral guidance for three IED sectors (textile, surface treatment of metals and plastics)". The guidance was prepared for HAZBREF by the German Federal Environment Agency (UBA) with support from adelphi. The team of WP 2 provided input on the strategies to identify relevant target substances.

HAZBREF is funded by the EU Interreg Baltic Sea Region Program and the implementation period is three years from October 2017 until September 2020.

The overall aim of HAZBREF is to increase the knowledge base of the industrial sources and the reduction measures of hazardous chemicals. HAZBREF will identify relevant chemicals used in industrial sectors, their use patterns, environmental characteristics and measures to prevent and reduce releases to environment.

On the EU level, the main instrument to control industrial releases is the Industrial Emissions Directive (IED), particularly through the publication of BAT Reference documents (BREFs) and their key chapter: the BAT conclusions. However, these BAT conclusions in most cases do not address hazardous substances in a systematic and comprehensive way. HAZBREF aims to develop a systematic approach that will help to exchange and utilize the existing information about hazardous substances between different regulatory frameworks (IED, REACH, Water Framework Directive, Marine Strategy Framework Directive, EU provisions on Circular Economy, Stockholm POP Convention & HELCOM) in the preparation of BREFs.

When the use and risks of chemicals are better addressed in BAT Reference documents, the capacity to manage industrial chemicals will be enhanced among both authorities and operators. The information gathered in BREFs is also useful for the Baltic Marine Environment Protection Commission HELCOM in the development of actions to reduce the inputs of hazardous substances to the Baltic Sea. HAZBREF also promotes the circular economy by finding ways to better include circular economy aspects in BREFs.

HAZBREF outputs target both the policy and the enforcement level. On policy level the outputs will strengthen the links between different regulatory frameworks and their key players. On enforcement level at industrial installations the project will identify and test model solutions for hazardous chemical management.

The activities are carried out in four Work Packages:

- **WP1** – Project management and administration (Lead Partner SYKE) including communication and dissemination of results;
- **WP2** – Identification of target substances (Lead by UBA) that include:
    - WP 2.1 - Identification and selection of target substances
    - WP 2.2 - Fate of substances during emission treatment
- **WP3** – Policy improvement (Lead by UBA) that include:
    - WP 3.1 - Strengthening links between regulatory frameworks on different levels
    - WP 3.2 - Developing a method to include substance information into BREFs, improve communication and data flow
- **WP4** – Best practices in chemicals management in industry (lead by IETU) that include:
    - WP 4.1 - Sectoral guidance for three IED sectors (chemicals, textile, surface treatment of metals and plastics)
    - WP 4.2 - Case studies in selected installations
    - WP 4.3 - BAT descriptions and model permits
    - WP 4.4 - Circular economy aspects

The HAZBREF partnership includes 5 organizations from the Baltic Sea region: Finnish Environment Institute (SYKE) (Lead partner), German Environment Agency (UBA), Swedish Environmental Protection Agency (SWEPA), Institute for Ecology of Industrial Areas (IETU) and Estonian Environmental Research Centre (KLAB).

In addition, 27 associated organizations and a wide range of other stakeholders are involved in HAZBREF, such as ministries and governmental environmental and chemical agencies from several EU countries, permitting and supervision authorities as well as industries and environmental NGOs.

More information about HAZBREF is provided on the **project website**[1].

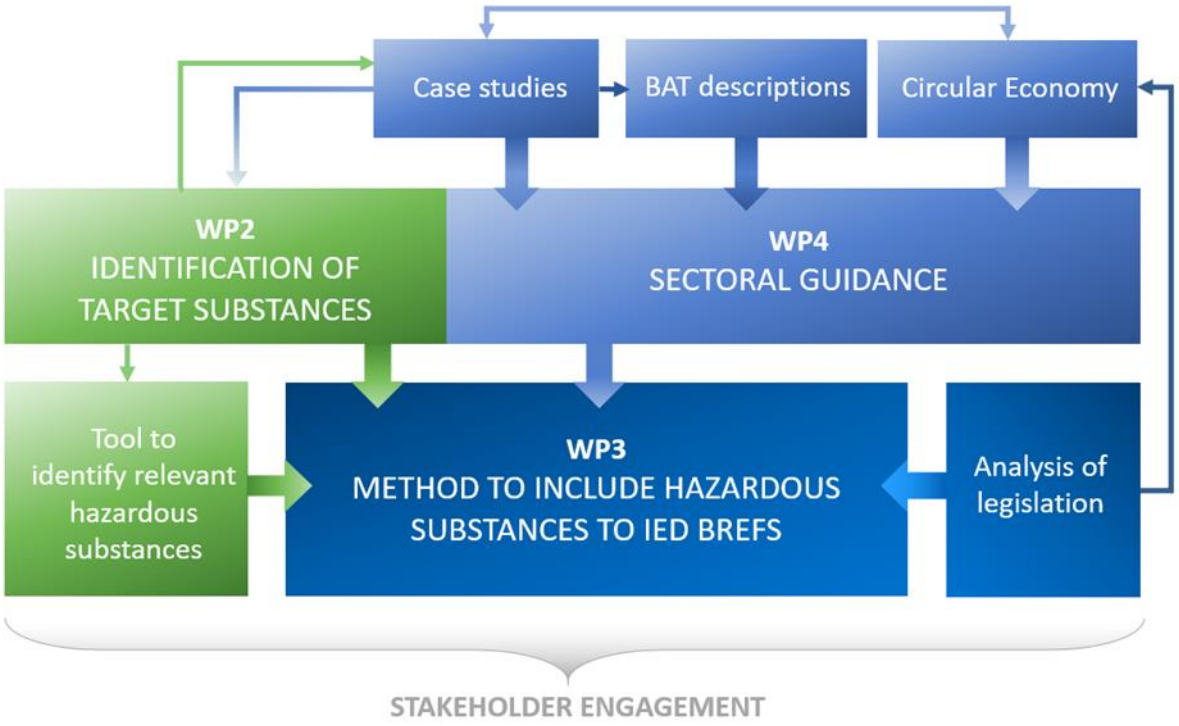


Figure 1: Overview of the design of the HAZBREF-project with its four work packages

[1] www.syke.fi/projects/HAZBREF

Executive Summary

This guidance report is the product of activity 4.1 under work package 4 “Best practices in chemicals management in the industry” of the HAZBREF-project.

Aims, areas of interest, methodology and structure

The textile sector-specific report provides guidance to key actors at national level (textile industry, competent authorities) on how to implement appropriate measures in the areas of chemicals management (such as substitution, emission prevention and authorisation). To this regard, it takes reference to relevant requirements such as per the Industrial Emission Directive (IED) and the sectoral Best Available Techniques Reference Documents (BREFs).

The document summarises key findings of interviews and discussions with HAZBREF experts, representatives from textile sector and relevant authorities as well as insights from four textile sector case studies conducted in three project countries (Germany, Poland and Sweden). The report focuses on prevalent practices and challenges related to the IED permitting process, with special reference to relevant target substances for the textile sector. The report also reflects findings of other Work packages under HAZBREF and refers to recommendations published under the European Union Network for the Implementation and Enforcement of Environmental Law (IMPEL).

The first section of the report provides an introduction to textile sector in Europe, focusing on current market changes, challenges and regulations with regard to chemicals management. The second section discusses strategies for the systematic identification and consideration of relevant target substances, aiming to provide guidance for representatives from EIPPCB and Technical Working Group (TWG) during the BREF review process. It further contains recommendations on the application of a systematic scheme for identifying target substances at operator level. The third section highlights the obligations for downstream users of chemicals (including textile operators) under REACH and the IED with regard to hazardous substances. It also provides guidance for operators and competent authorities on how to fulfil this obligation by describing essential elements of good chemicals management. Section 4 gives recommendations on both generic and process specific techniques to be considered by the TGW for the determination of Best Available Technologies (BAT). In order to place the regulatory guidelines, obligations and instruments discussed in the previous sections in the context of the IED, section 5 explains the different steps of the IED permitting procedure and provides guidance to both operators and permitting authorities on how to carry out the respective steps with particularly focusing on good chemicals management.

The findings of the guidance will feed into in the current revision of the Textile Industry BREF. They are further used for HELCOM recommendations on how to reduce the discharge of hazardous substances into the Baltic Sea.

Main findings and proposals

Efficient chemicals management, addressing environmental issues as well as occupational health and safety aspects, remains a major challenge for the textile finishing industry. The same applies to the authorities responsible for the IED permitting, which are often required to assess a wide range of chemical products (typically textile finishing industries use 100-300 different products per year) while guiding the textile industry towards zero emission of hazardous chemicals. Considering the aim of improving the management of chemicals in the European textile industry and taking into account the different provisions of the IED, the findings and proposals from the guidance can be summarised as follows:

Proposal for the development of well-managed chemical inventories and databases

The establishment and maintenance of chemical inventories was identified as an important prerequisite for effective and responsible chemicals management in the textile sector. Well managed chemical inventories can significantly simplify the application process under the IED both for the operators of textile installations and for the competent permitting authorities. When aiming to improve the chemicals

management it is recommended to consider the establishment of an appropriate chemical database in which all chemical products used are listed with their properties as described in section 3.2.3.

Proposal for improved awareness raising and good chemical housekeeping

In many cases, the implementation of good housekeeping practices can already lead to significant improvements in responsible chemicals management. Special focus should be placed on appropriate unloading, handling and storage of chemicals within textile installations. With regard to proper disposal, it is particularly important that concentrates containing hazardous chemicals or non-biodegradable/non-bioeliminable chemicals are separated and disposed of, using BATs. This should, however, only be the case if the hazardous chemicals concerned cannot be substituted.

In the context of awareness raising on chemicals management, it is also recommended to provide information in a more targeted and user-friendly fashion. This applies in particular to information on the biodegradability and bioeliminability of chemicals and formulations used, as both textile operator and competent authorities often lack knowledge in this area.

Proposal for a systematic assessment & improvement of MSDS and ES quality

To allow for adequate chemicals management, it has to be assured that all Material Safety Data Sheets (MSDS) comply with the quality level as required under REACH Annex II. This implies that the information contained must be sufficient with respect to chemical description, ecological information and information on proper storage and handling. Further, MSDS shall contain information on whether the respective chemical product contains chemicals listed in SVHC, WFD priority lists, the Stockholm Convention on Persistent Organic Chemicals, the ZDHC MRSL or in other relevant lists such as OEKOTEX, GOTS or bluesign®. To avoid unrecognized negative environmental impacts and identify information gaps in MSDS, further guidance on quality verification of information sources, as well as additional guidance for applicants on how to extract and consolidate the relevant information from the MSDS should be provided for both operators and competent authorities.

Proposal for the comprehensive compilation of relevant tools and references

Numerous references and tools are already available to support textile companies and competent authorities in implementing the IED with regard to good chemicals management. However, a strategic approach for the efficient use of these resources does not exist yet. It is therefore recommended to provide an overview of the tools and references in a clearly arranged and suitable place to facilitate their use by plant operators and competent authorities.

Proposal for a systematic Identification of new chemical related BATs and development of BAT conclusions

The responsible management of chemicals as well as the reduction of hazardous substances should be included as a mandatory aspect when identifying new BATs and compiling BAT conclusions for the textile sector. MSDS and ES as elaborated in this guidance document can be used as a basis to identify techniques that need to be taken into account when determining BATs, also including potential technical constrains or limitations of their applicability. Using information obtained from MSDS could further support the development of BAT conclusions and help to better regulate the safe use of the hazardous substances in industrial textile installations. To achieve better implementation in practice, it is recommended to strengthen the interfaces and regulatory coherence between REACH theIED and BAT conclusions.

1 Sector Overview

The European textile manufacturing industry is characterised by long and complex industrial value-added chains. Due to a combination of technological changes, the evolution of production costs, the emergence of important international competitors, and the elimination of imports quotas after 2004 the sector had been subject to a series of radical transformations over recent decades. The textile sector is fragmented and heterogeneous, composed of a wide number of sub-sectors, covering the entire production cycle from the production of raw materials (natural and man-made fibres) to semi-processed (yarn, woven and knitted fabrics with their finishing processes) and final products (carpets, home textiles, apparel and industrial use/technical textiles) as well as the use phase, disposal, recycling and re-use. The sector is dominated by small and medium-scale enterprises (SMEs), with a demand mainly driven by three end-uses: clothing, home furnishing and industrial use. Annex 7 provides an overview of the textile value-added chain including the main and the side chains, the input of chemicals and the environmental hot spots.

There are about 185,000 companies operating in the European textile sector. Combined they employ about 1.7 million people and generate a turnover of 166 billion euros per year[1]. Although the sector declined by 28% between 1998 and 2009 and lost half of its employees, it still accounted for 5% of employment and over 2% of value added in European manufacturing in 2015. European manufacturers are world leaders in the markets for technical-industrial textiles and non-wovens (industrial filters, hygiene products, products for the automotive and medical sectors, etc.) and high-quality clothing with a high design content. The market volume of technical textiles in Europe is estimated at 85 billion dollars (world volume 250 billion dollars), with the majority of production capacities (approx. 60%) located in Italy, Germany and France[2]. The role of technical and conventional textile production in the EU member countries varies between the individual member states. In Germany, for example, more than 50% of the textiles produced are technical textiles.

Table 1: Breakdown of the European textile sector (Source: Euratex, 2017)

Market	Share
Made-up textiles and carpets	28%
Technical textiles (including non-wovens, cordages, twine and netting	26%
Weaving and k&c fabrics	23%
Spinning	10%
Finishing	8%
Other	5%

The European textile industry continues to be a major source of hazardous substances into wastewater and air. This is mainly due to the fact that most chemicals applied along the textile value chain (e.g. detergents, dispersants, complexing agents, sizing agents) are later discharged together with wastewater or – gas, while only a small proportion of chemicals such as dyes, optical brighteners and finishing chemicals remain on the textile substrate. Processes that play a major role in the release of hazardous substances into the environment are the pre-treatment, dyeing and finishing of textiles. With regard to the management of hazardous chemicals, contract processing poses particular challenges. This is mostly due to the often small production range, the frequent changes in the substances used and the stockpiles of a wide variety of substances. The latter require special attention regarding tracking, assessment and risk management during production and at the end of use. In the European Union, contract processing is particularly widespread among SMEs in southern and south-eastern Europe.

[1] https://ec.europa.eu/growth/sectors/fashion/textiles-clothing/eu_de

[2] Roberta Adinolfi, Statistics and trends of the EU technical textile production and international trade, 2019

Due to their limited size, the majority of textile installations in the European Union are not covered under the IED. In total, there are therefore only about 200 IED textile plants in Europe, 8 of which are located in the Baltic Sea catchment area. This relatively small number illustrates the increasingly low importance of the Baltic Sea region as a production location for the textile manufacturing industry, which has been increasingly relocated to southern Europe and Asia since the end of the 20th century[1]. Strengthening the textile production industry in Europe with "advanced manufacturing technologies offers the opportunity to develop new production systems that are cleaner, less labour and resource intensive and more circular". These factors, together with the rising costs of production, the negative environmental and social implications and the partial very long delivery times often associated with production in Asia, can support a return of textile production to Europe[2].

Case Study Installations selected under WP 4.2

Under WP 4.2 of HAZBREF four representative textile factories in Germany, Poland and Sweden were selected for compiling voluntary case studies. For each of the selected plants, an analysis of the on-site situation was carried out with regard to chemicals management and chemical substances used. Prevalent environmental and health hazard associated with the identified chemicals are presented in Annex 1.

The four selected installations engage in the following lines of products:

1. Processing of woven fabric consisting mainly of pure cotton (around 96% share) and blends of cotton and polyester (around 4% share) for final products such as damask, interlinings for shirts, and menswear.
2. Production of fabrics for classic work wear, mainly for hospital and health care sector, as well as for personal protective equipment (PPE); fabrics for CI-compatible corporate clothing also form part of the product range; processing fabrics consisting of a cotton/polyester blends varying from 35/65 to 65/35.
3. Production of textile blinds and curtains.
4. Dyeing, bleaching, washing, finishing and digital printing of knitted and woven fabrics.

The case studies cover a wide range of processes, raw materials and products as covered by the TXT BREF. However, processing of wool, non-wovens and synthetic fibers other than polyester, carpet production and a wide range of technical textiles are not represented. This is also true for fiber production (e.g. spinning) and production of end products.

Three of the four installations are registered under the Industrial Emissions Directive (IED), as their production capacity exceeds 10 tonnes per day.

The European textile sector is subject to a range of environmental legislations that regulate its chemical use and emissions. These legislations include the Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (Industrial Emissions Directive, IED), the regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) and the EU Water Framework Directive (WFD)[3]. They are further complemented by a range of voluntary industry agreements with reference to hazardous substances.

This textile sector-specific guide is intended to help key actors at national level (textile industry, competent authorities) to implement appropriate measures in the areas of chemicals management, substitution, emission prevention, control and authorisation with particular reference to hazardous

[1] Nilsson, L., Persson, P.O., Ryden, L., Darozhka, S., Zaliauskiene, A. 2007. Cleaner Production. Technologies and Tools for Resource Efficient Production. The Baltic University Press. Uppsala.

[2] https://publications.jrc.ec.europa.eu/repository/bitstream/JRC106917/kjna28634enn.pdf

[3] https://ec.europa.eu/growth/sectors/fashion/textiles-clothing/legislation/other_de

substances. In lieu with the Best Available Techniques References document for the textile sector (BREF TXT), the scope of this document is confined to pre-treatment, dyeing and finishing processes. Although the guide is primarily aimed at IED facilities, the findings are, to some extent, also applicable to non-IED facilities. In this context, the guide also refers to practical data on chemicals management collected in four European textile companies and analysed in four case studies prepared in the framework of HAZBREF (see text box above).

2 How to Identify Chemical Substances Relevant to the Textile Sector

To minimise the release of hazardous chemical substances into the environment (and to protect workers from exposure), an improved, systematic consideration of relevant chemical substances has to be achieved in both the ongoing revision of the 2003 textile BREFs (TXT BREF) and the formulation of BAT conclusions for the textile sector. In this context, it is of particular importance to modify or redevelop BATs, paying special attention to chemical substances with an increased hazard potential in toxicological terms or a specific fate and behaviour in the environment. Ultimately, by complying with the revised TXT BREF and BAT conclusions, public authorities and operators have to be able to ensure that the use of relevant target substances is reduced or – in case that is not possible – at least reduce their release into the environment by applying minimisation and mitigation techniques consistent with BAT. To facilitate this process, the following sections provide an overview of available references on chemical substances (Section 2.1) as well guidance on how chemical substances of particular relevance to the textile sector can be identified both in the ongoing revision of the TXT BREF (2.3) and in the textile mills themselves (2.4).

2.1 Available references on chemical substances

Although the use and potential release of chemicals applied in the textile sector is to a certain extent already addressed under the IED framework and the Best Available Technique References (BREFs), the full extent of potentially hazardous substances applied in the sector has not yet been systematically and comprehensively compiled. To assess the chemicals applied for textile finishing it therefore lies within the duty of the operator to collect, compile and assess the chemicals applied. For this purpose, operators must not only take MSDS into account (see section 3.2.1) but also make use of both regulatory and non-regulatory chemical references. The same is true for the competent authorities when checking, evaluating and assessing the information submitted in the course of the IED permitting process (see section 5). In this context, both regulatory and non-regulatory references may also be used to draw conclusions on necessary requirements, stipulations and conditions in the permit. This is not only required when issuing or amending a permit (due to substantial changes of the installation) but also when identifying hazardous chemicals to prevent their use, reduce their consumption or minimise their emission by applying abatement techniques consistent with BAT. The most relevant regulatory and non-regulatory chemical references are touched upon in sections 2.1.1 and 2.1.2. These references may also be used for the revision of BREFs and the development of new BATs for good chemicals management.

2.1.1 Regulatory references

ECHA database of registered chemicals

The European Chemical Agency (ECHA) maintains one of the world's largest regulatory **databases** on chemicals. The database provides users access to information on over 22.600 chemical substances on the EU market through three layers: (i) infocard, (ii) brief profile and (iii) source data. The Infocard provides the ‘first tier’, the most basic and relevant information (about this substance, properties of concern, how to use it safely etc.). For more detailed information one can easily navigate to the ‘second tier’ – the Brief Profile – (substance identity, classification and labelling, hazardous effects, regulatory activities, Authorisation List, Restriction List, together with generalized information on uses of substance). From the Brief Profile, users can access the ‘third tier’, the source information compiled from the registration’s dossier of the substance (registrants/suppliers, phys./chem. properties, environmental fate and pathways, toxicological and ecotoxicological information) on which the summaries of the Infocard and Brief Profile are based. However, it needs to be mentioned that the level of detail and quality of data might vary considerably between the different chemical datasets.

Complementing the database of registered chemicals, ECHA further provides an inventory of classification and labelling information on notified and registered substances received from manufacturers and importers, covering nearly 152,000 chemicals. The majority of the substances have only undergone a so-called Self Classification process conducted by the companies. The respective rules for this process are provided within the Classification, Labelling and Packaging Regulation (CLP) Legislation. Experience shows that this process results in a wide range of different self classifications for the same substance.

REACH Candidate List of substances of very high concern (SVHC) for Authorisation

This list is updated twice per year by ECHA, with the first substances listed on 28th of October 2008. Companies may have immediate legal obligations following the inclusion of a substance in the Candidate List on the ECHA website including in particular Articles 7, 31 and 33 of the REACH Regulation. EU and EEA suppliers of substances on the Candidate List (supplied either on their own or as constituent in mixtures) have to provide their customers with a safety data sheet that includes safe use instructions that consider the specific hazardous behaviour of the substance. Section 15 of pre-existing safety data sheets should be updated to reflect the identification of the substance as an SVHC (Article 31(9)(a)).

Most of the chemicals mentioned in the REACH candidate list are not relevant for textile finishing. However, some textile-relevant applications have been identified (see section 2.3.3).

REACH Authorisation List

A list of substances subject to authorization under REACH. Substances on this list are selected from the REACH SVHC list and cannot be placed on the market or used after a given date ("sunset date"), unless an authorization is granted for their specific use, or the use is exempted from authorization.

As information on alternative chemical substances can be used from companies to substitute critical substances the information from BREF should also be considered in the authorisation process. The information on alternatives is further relevant for the decision process of the European Commission on applications for authorisation. In this context, Information on the BAT for risk management may also support the decision of the European Commission. A company applying for an authorization should at least be in line with BAT.

Substances Restricted under REACH

Annex XVII to REACH includes all the restrictions adopted in the framework of REACH and the previous legislation, Directive 76/769/EEC. Each entry shows a substance, a group of substances or a substance in a mixture, and the consequent restriction conditions. The list is not sector-specific, is regularly updated so that operators are obliged to keep themselves constantly informed.

Priority substances under the Water Framework Directive:

In 2018, Directive 2013/39 /EU listed 45 substances (or substance groups) to WFD Annex X (Annex of EU priority substances).

The European Commission reviews the list of priority substances every six years according to Art. 1 2013/39/EU. In practice, the list has been reviewed twice (in 2008 (2008/105/EC) and in 2013 (Directive 2013/39/EU)) since it was first compiled in 2001[1]. Art. 16 par. 2 of the directive introduces a scientifically based methodology for selecting priority substances based on their significant risk to or via the aquatic environment. Priority substances are required to be minimized, priority hazardous substances have to be phased out. So far, however, the priority list is of limited relevance for textile finishing as most sources for WFD priority substances have already been banned.

List of chemicals covered by the regulation 2019/1021 (EC) on persistent organic pollutants

The regulation 2019/1021 (EC) on persistent organic pollutants prohibits or restricts the production and use, as well as the import and export of intentionally produced POPs, listed in Annex I and II to the

[1] Decision No 2455/2001/EC of the European Parliament and of the Council of 20 November 2001 establishing the list of priority substances in the field of water policy and amending Directive 2000/60/EC (Text with EEA relevance), OJ L 331/1.

regulation (Article 3). Operators of textile plants are responsible for ensuring that they know the substances listed in the regulation and are not allowed to use them (in accordance with the requirements of the regulation). Competent authorities are required to monitor the implementation of the regulation. As the substances listed in the regulation are hardly used in the textile industry today, it is only of limited relevance to the sector. One notable exception may be Perfluorooctanoic acid (PFOA) and its precursors. Although recently added to the POP list, PFOA, PFOA derivatives and especially substances generating PFOA in the environment (whether 8:2 fluorotelomer derivatives themselves or as minor constituents in 6:2 FT derivatives) may still occur in the textile sector, as they for instance may be used as a process aid in the production of Polytetrafluorethylene (PTFE) for membranes. In addition, traces of PFOA may also be found as an unintentional by-product in textile finishing auxiliaries containing telomer-based perfluorinated compounds.

List of hazardous substances under Annex VI Part 3 of the Regulation (EC) No 1272/2008 on the classification, labelling and packaging of substances and mixtures (CLP Regulation)

Under the CLP Regulation manufacturers, importers or downstream users of chemical substances have to (self)classify and label hazardous substances and mixtures to ensure a high level of protection of human health and the environment. For hazards of highest concern (carcinogenicity, mutagenicity, reproductive toxicity (CMR) and respiratory sensitisers) and for other substances on a case-by-case basis, classification and labelling is harmonised throughout the EU to ensure an adequate risk management. This is done through harmonised classification and labelling (CLH). Hazardous substances for which **harmonised classification and labelling** has been established at EU level are listed in Part 3 of Annex VI to the CLP Regulation.

2.1.2 Non-regulatory references

Although not required by law, the below mentioned non-regulatory chemical lists are commonly referred to by both textile sector representatives and experts when identifying or evaluating chemicals applied in textile processing and manufacturing, as well in the course of IED permitting (see section 5). As the references are textile-specific, they may also be considered during the permitting procedure and when compiling an inventory of chemicals (see Section 3.2.3 and Annex 6).

The references below include both open access chemical lists and chemical certification schemes. As some chemical manufacturers declare conformity with these certification schemes or substances list, they may further serve as a decision supporting mechanism for the procurement of chemicals in the textile sector.

Zero Discharge of Hazardous Substances (ZDHC) - Manufacturing Restricted Substances List (MRSL)

The **ZDHC MRSL** offers brands and suppliers a single, harmonised list of chemical substances banned from intentional use during manufacturing and related processes in supply chains of the textile, apparel, and footwear (including leather and rubber) industries (the Industry). The list specifies the maximum concentration limit of each substance within commercial chemical formulations. The MRSL was developed by ZDHC brands for the apparel and footwear industry and is based on the 11 priority chemical hazard groups addressed under the Greenpeace detox campaign. The MRSL is regularly updated. Operators may use ZDHC MRSL for their purchasing policy as chemical suppliers provide information on “ZDHC-conformity” of chemicals. The ZDHC MRSL is primarily targeted at ordinary apparel and out-door articles.

Oekotex STeP MRSL

This list outlines chemical substances prohibited within the framework of the **STeP by OEKO-TEX® certification**. The objective of STeP certification is the permanent implementation of environmentally friendly production processes, optimal health and safety protection and socially responsible working conditions along the entire textile and leather production chain.

bluesign® – System Black Limits (BSBL)

The bluesign® **System Black Limits** sets threshold limits for chemical substances in finished chemical products such as textile auxiliaries and dyes. The threshold limits are to be seen as a minimum requirement. The composition of the substances in the BSBL is an excerpt from the bluesign® TOOL. All substances from the BSSL (bluesign® SYSTEM SUBSTANCES LIST) for which a usage ban is defined in articles are listed in the BSBL. The BSBL is revised at least once a year.

ChemSec – SIN List

The **SIN List** is a comprehensive database of hazardous chemicals that are used in a wide variety of articles, products and manufacturing processes around the globe. The Swedish procurement agency recommends the SIN List as part of official procurement criteria, and it is further included in procurement criteria for many municipalities and counties. The SIN List is publicly available and regularly updated. It is based on the criteria in REACH Art. 57, which serve as the basis for SVHC identification, and as such has proven to be an early warning system for substances likely to be included in the SVHC list, The filter options provided allow among other things to filter for chemicals with registered uses in the textile and clothing sector. This **particular search query** results in a list of 309 chemical substances. As the SIN List is of rather technical nature and focuses primarily on the chemicals – not the formulations in which the chemicals might be present – the results are mainly of interest for chemical producers or suppliers rather than the final consumers.

2.2 Definition of relevant target substances proposed by the HAZBREF project

To allow a targeted identification of substances relevant for improving chemicals management and reducing pollutant emissions from industrial plants in the Baltic SEA, HAZBREF experts have agreed on a categorisation of chemical substances. Although the IED considers emissions into all compartments, HAZBREF focusses on the water pathway for practical reasons. The categorisation of chemical substances considered is outlined in Table 2.

Table 2: Categories of chemical substances considered

Chemical substances considered under HAZBREF[1]
The term hazardous generally refers to ecotoxicological or human toxicological properties of a substance – something like "poisonous". Depending on the legal context, this term may address different (and additional) substances properties. In EU regulations relevant for the context of this study the term hazardous is not used in a consistent way. Depending on the legal context, this term may address different (and additional) substances properties. The IED uses the term hazardous only for those substances that are used, produced or released at the site of the installation and that have a potential to contaminate soil and groundwater contamination (Art. 22). Other relevant substances and substance properties to be considered for determining BAT under the IED are referred to as polluting substances and they include groups of substances, hazard classes and substances properties (Annex II IED). In EU regulations connected to the IED there are negative listings, such as the WFD list of priority substances; other EU regulations list hazardous classes (e.g. CLP Regulation (EC) No 1272/2008 on the classification, labelling and packaging of substances and mixtures); others do not refer at all at the term hazardous (e.g. REACH); finally, other regulations refer to a positive authorised list of active substances (e.g. Regulation (EU) No 528/2012 concerning biocidal products). **The HAZBREF project initially refers to "hazardous" substances as those which are "released from industrial installations through discharges to waters, emissions to air and wastes and which have a harmful effect on the environment"**. This definition addresses CMR and toxic substances, but according to the REACH Substances of Very High Concern (SVHC) definition, the release of PBT and vPvB substances from installations should be avoided, too. Hazardous in

[1] HAZBREF (2020). Analysis of the interfaces, possible synergies or gaps between Industrial Emission Directive, REACH Regulation, Water Framework Directive, Marine Strategy Framework Directive and the POP Regulation concerning hazardous substances.

HAZBREF, which focusses BAT for industrial installations (IED), considers two aspects: (a) the potential to be released, or conversely, the ability to be eliminated (in the WWTP) – which qualifies a substance as “target substance”, and (b), in addition, the intrinsic potential toxicity of the substance – which may qualify a substance as “relevant target substance”. Both aspects have several degrees of importance, and the term hazardous should be reserved for high potential to be released and/or significant toxicity. It is more appropriate to talk of concerns and degrees of concern. This is why for HAZBREF substances of concern are synonymous to target substances for consideration in BREFs. Adding "relevant" to the target substance for BREFs would then mean that there is a particularly high concern for either persistency, mobility or toxicity, for example.

2.3 Systematic identification of relevant target substances at sector-level in preparation of the BREF review process

The conclusions on best available techniques from BAT reference documents (BREFs) adopted by the Commission are the reference for setting the permit conditions under the IED (see section 3.1.2 & 5.1). They may also contain BATs related to hazardous substances or other target substances. The Commission should aim to update BAT reference documents 8 years after the publication of the previous version. The review of BREFs start with a preparatory phase during which a preliminary determination of key environmental issues (KEI) takes place. This was also the case in the ongoing review of the BREF for the textile industry. The EIPPCB made an initial proposal for the selection of KEIs to the Technical Working Group by assessing available documents and studies. HAZBREF intends to enrich the frontloading process of determining KEIs for BREF reviews by applying a more comprehensive, structured and systematic procedure in order to determine relevant target substances for BREF reviews. In order to systematically identify relevant target substances that may present a concern due to their properties and which may occur in industrial activities as defined in Annex I of the IED, experts under WP2 of HAZBREF have explored four strategies, which are presented in Figure 2. The strategies elaborated in the following sections aim to facilitate the identification of target substances at BREF level and are thus specifically addressed to representatives of the EIPPCB and TGW.

2.3.1 Search for all registered textile auxiliary agents used by screening ECHA chemicals data base with sector and product descriptors (Strategy A)

A first approach involved the identification of relevant target substances applied in the textile sector by scanning the chemicals database of the European Chemicals Agency (ECHA). Hereby, the WP2 team

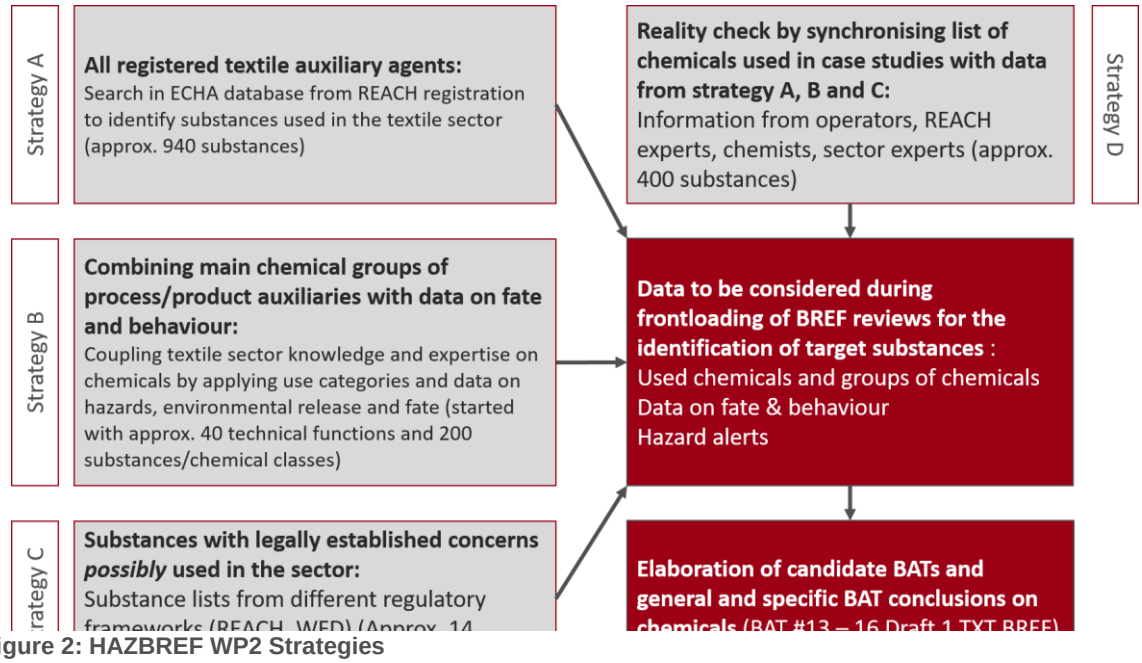


Figure 2: HAZBREF WP2 Strategies

referred to textile specific use categories and additional descriptors obtained from REACH-Registrations (such as descriptions containing the string 'textile*'). After applying various filtering methods with descriptors (e.g. “use by professional workers”), the scan resulted in a list of around 940 potential target substances. The list was used as a basis to be cross-checked with substances list retrieved from other approaches, e.g. with the information from the case studies on textiles as outlined below (See Strategy D).

2.3.2 Combining major chemical groups of process and product auxiliaries with data on their fate and behaviour (Strategy B)

Strategy B aims to identify chemicals, potentially used in the textile sector, by applying use categories or other descriptors, and characterise them according to hazard as well as to environmental release and fate criteria. In order to identify groups of chemicals with specific technical functions (e.g. surfactants, bleaching agents etc.) the approach considers available information from the textile sector and its respective processes. As a starting point for this work, a table of approximately 40 technical functions and about 200 substances/chemical classes used in the textile industry, compiled by the European IPPC Bureau as a contribution to the TXT BREF revision[1], was used. The identified individual compounds or chemical groups applied in the textile sector (use or technical function) were characterised with regard to hazard, environmental release potential and fate criteria. The results were further refined by comparing chemical groups and technical functions. A detailed description of the various search methods (generic name, systematic name fragment, SMILES code etc.) and the processing of the results will be presented in the final report of activity 2.1 of the HAZBREF-project “Identification of chemicals belonging to chemical classes used as textile auxiliaries” that is currently being prepared[2].

In a next step the identified substances within the various chemical groups were characterised by fate and behaviour in the environment (especially the industrial waste-water treatment). For this step physical-chemical data, information on the (eco)-toxicological potential as well as criteria for release into the environment and fate, were retrieved from the ECHA chemicals database. In case that environmental concerns at plant site (e.g. the Waste Water Treatment Plant (WWTP)) are identified, appropriate risk reduction measures can be derived for a group of chemicals.

As the identification of target substances under strategy B is still ongoing, the final results will be presented in a later report. However, the WP 2 team already concluded that to precisely identify target substances under HAZBREF further crosschecks with the outcomes of other strategies would be required.

2.3.3 Substances with legally established concern possibly used in the sector (Strategy C)

The hazard-based approach of Strategy C filtered the Candidate List of Substances of Very High Concern (SVHC, see section 2.1) with information on chemical substance uses in the EU. The latter were retrieved from both **ECHA** and the Substances in Preparation in Nordic Countries (**SPIN**) register. All substances that were registered as used for ‘manufacture of textiles’ in the section ‘uses at industrial sites’ of the ECHA infocard were deemed to be used at textile industry. The SVHC crosscheck under Strategy C was complemented by a similar approach for WFD priority substances. [3]The datasets were further complemented with information from Activity 2.2. of HAZBREF in which data on the specific fate of a subset of industrial target substances in typical waste water treatment was obtained. This approach may enable a targeted identification of substances that are likely to be released to surface water or air, triggering specific actions in industrial wastewater treatment plants (IWWTPs) or in the management of

[1] TXT Questionnaire, page 13, draft June 2018.

[2] Werschkun, B. (2020) Identification of chemicals belonging to chemical classes used as textile auxiliaries, First Draft, A study on behalf of the German Environment Agency in the context of HAZBREF; Dr. Barbara Werschkun Wissenschaftsbüro, Berlin.

[3] All listed chemicals are imported or manufactured in the EU in a total volume of between 10 and 1,000,000 tonnes per year. For all listed chemicals - with the exception of the banned dyes - an extended data sheet including exposure scenarios and appropriate safety measures should thus be available.

the substance in the installation (including e.g. substitution of chemicals). The results of Strategy C and Activity 2.2 are included in table 3, while detailed information on the approach of activity 2.2 is included in the **Technical Report of Activity 2.2 Fate of substances during emission treatment**.

A similar - albeit less systematic - approach to identifying key environmental issues as "frontloading" to the BREF revision was followed in the report on "Novel sustainable techniques in the textile sector identified by the Innovation Observatory" by Ricardo Energy & Environment. In a hazard-based approach, they considered CMR substances, SVHC, priority hazardous substances and POPs-list of substance subject to prohibition and subsequently checked whether these substance groups are relevant for the sector on the basis of a literature review.

Table 3: REACH substances of very high concern (SVHC) and WFD priority substances with registered uses in textile industry as per ECHA database[1]

Substance[2]	CAS	Classified as SVHC / WFD priority substance	Use in textile sector according to ECHA/SPIN database	"Fate" in wastewater treatment plant	Assessment regarding application in the textile sector / Occurrence in Case Studies
dichloromethane	75-09-2	WFD PS	ECHA: washing & cleaning products, manufacture of textile, leather or fur. amounts used not known EU Source screening (WFD 2010): textiles not mentioned SPIN: no info on textile use	4,9% to surface water 0,1% to sludge 65,8% biodegradation 29,2% volatilization	Solvent cleaning, can still contained in stain removers
Bis(pentabromophenyl) ether (decabromodiphenyl ether) (DecaBDE)	1163-19-5	SVHC	ECHA: inks and toners and washing & cleaning products and manufacture of textile, leather or fur. SPIN: no use after 2012.	Not evaluated in HAZBREF 2.2	use banned, should not be used anymore
Cobalt dichloride	7646-79-9	SVHC	ECHA: textile treatment products and dyes. SPIN: no textile related use	Not evaluated in HAZBREF 2.2	Cobalt can be contained as central atom in cobalt phthalo-cyanine dyestuffs but not as cobalt dichloride

[1] Use information (in which applications and amount of used) have been searched from ECHA database in 2018/2019

[2] Substance is highlighted in "red" are not addressed in the ongoing revision of the TXT BREF. For this assessment the study "*Preliminary determination of Key Environmental Issues for the Textiles Industry" (Ricardo Energy & Environment, 17 Jan 2018), the questionnaire developed for collecting data from reference plants for the revision of the TXT BREF(EIPPCB , February 2019) and Draft 1 of the TXT BREF (EIPPCB, December 2019) were considered.*

Potassium dichromate	7778-50-9	SVHC	ECHA: textile treatment products and dyes. SPIN: no textile related use	Not evaluated in HAZBREF 2.2	Wool dyeing in some Italian industries
N,N-dimethylformamide	68-12-2	SVHC	ECHA: manufacture of textiles, leather, fur. Updated information in ECHA website (searched 5.2.2020): no textile related uses. SPIN: no textile related uses after 2007.	Not evaluated in HAZBREF 2.2	DMF may be used in the formulation of surfactants, liquid dyes and fluorescent whitening agents (optical brighteners). It is also the solvent used during the manufacture of acrylic fibres and some plastics, as well as the main part of the solvent mixture or exclusively the solvent for polyurethane coatings. Present in 1 Case Study installation (Optical Brightener)
N,N-dimethylacetamide	127-19-5	SVHC	ECHA: manufacture of textile, leather or fur. Updated information in ECHA website (searched 5.2.2020): no textile related uses. SPIN: no textile uses	22,5% to surface water 0,1% to sludge 77,4% biodegradation 0% volatilization	DMAC is used as the main solvent for elastane fibres and sometimes in wet spinning of polyacrylonitrile fibres, and may be used as a solvent for adhesives or coatings
Decamethylcyclopentasiloxane (D5)	541-02-6	SVHC	ECHA: washing & cleaning products, textile treatment products and dyes, manufacture of textile, leather or fur. SPIN: no textile use after 2007	2,0% to surface water 74,9% to sludge 0% biodegradation 23,1% volatilization	May be used in formulations for certain final finishing agents Present in 1 Case Study installation (Softener)

Cobalt(II) sulphate	10124-43-3	SVHC	ECHA: textile treatment products and dyes. SPIN: no textile use	Not evaluated in HAZBREF 2.2	Cobalt can be contained as central atom in cobalt phthalo-cyanine dyestuffs but not as cobalt sulphate
Phenolphthalein	77-09-8	SVHC	ECHA: textile treatment products and dyes, washing & cleaning products, manufacture of textile, leather or fur. SPIN: no textile use	Not evaluated in HAZBREF 2.2	Not used for textile finishing
1-Methyl-2-pyrrolidone (NMP)	872-50-4	SVHC	ECHA: washing & cleaning products SPIN: manufacture of textiles, manufacture of furniture	8,0% to surface water 0% to sludge 92% biodegradation 0% volatilization	May be contained in some levelling agents for dyeing
Disodium 3,3'-[[1,1'-biphenyl]-4,4'-diylbis(azo)]bis(4-aminonaphthalene-1-sulphonate) (C.I. Direct Red 28)	573-58-0	SVHC	ECHA: dye, pigment, wool, cotton, Updated information in ECHA website (searched 5.2.2020): no information about the use of this substance. SPIN: no textile use	Not evaluated in HAZBREF 2.2	Restricted/ forbidden dyestuff
Disodium 4-amino-3-[[4'-[(2,4-diaminophenyl)azo][1,1'-biphenyl]-4-yl]azo] -5-hydroxy-6-(phenylazo)naphthalene	1937-37-7	SVHC	ECHA: dye for colouring cellulose, wool, silk, bast, print cellulose, wool and silk, leather, plastics, stain wool, silk, acetate, nylon and production of aqueous inks.	Not evaluated in HAZBREF 2.2	Restricted/ forbidden dyestuff

-2,7-disulphonate (C.I. Direct Black 38)[1]			Updated information in ECHA website (searched 5.2.2020): no information about the use of this substance. SPIN: no textile use		
Hexabromocyclododecane (HBCDD)	-	SVHC, WFD PHS Textile use banned	ECHA: textile treatment products and dyes, manufacture of furniture, textile, leather or fur. SPIN: no textile use after 2015 (1,2,5,6,9,10-hexabromocyclodecane CAS: 3194-55-6)	Not evaluated in HAZBREF 2.2	use banned, should not be used anymore

[1] The dyes included in table 3 are two examples of a wide number of banned dyes (which are listed in sector specific MRSL (manufacturing restricted substance lists), like ZDHC MRSL)

2.3.4 Reality check of textile auxiliary agents used with and without established concerns (Strategy D)

Under strategy D the HAZBREF experts conducted a crosscheck between the chemicals identified under Strategy A and approximately 400 chemical substances reported to be used in four European case studies. The crosscheck revealed that only about one third (between 18.2% and 32.6%) of the substances identified under Strategy A, are actually used by the respective case study installations (see Table 4). It is however noteworthy that some substances from the case studies (such as cyclic volatile methyl siloxane (cVMS)) were found to be listed as SVHC under REACH. The substances meet the criteria in Annex XIII to Regulation (EC) No 1907/2006 for the identification of a persistent, bioaccumulative and toxic ('PBT') substance and/or a vPvB substance (very persistent and vey bioaccumulative). Furthermore, some substances in the case studies are already covered by the Community's Rolling Action Plan (CoRAP), which will be evaluated under REACH over a period of three years (e.g. Disperse Violet 057, Titanium dioxide).

Table 4: Matching Rate compared to all textile chemicals registered in the ECHA database (Strategy D)

Form	Case study (1)		Case study (2)		Case study (4)		Case study (3)[1]	
	total	hits	total	hits	total	hits	total	hits
Pretreatment agents	8	2	-	-	10	3		
Textile auxiliaries for dyeing and printing	14	1	19	3	30	2		
Agents for final finishing	6	-	61	15	24	3		
Textile auxiliaries for multipurpose use in the textile industry	11	2	10	3	-	-		
Other "textile auxiliaries"	-	-	42	2	-	-		
Basic textile chemicals	9	3	2		10	1		
Dyestuffs and organic pigments	17	6	14	6	27	10		
No. of Substances	**65**	**14**	**148**	**27**	**101**	**19**	**144**	**47**
Percent	**100**	**21,5**	**100**	**18,2**	**100**	**18.8**	**100**	**32,6**

Reasons for the relatively low matching rate may be that the four case study installations obviously cannot cover all substances used in the textile sector and instead only represent a small section. This is underlined by that fact that of the 400 chemicals, identified within the case studies (based on the CAS numbers), there is only little overlap in the use of the substances between the different installations[2]. This proves the specific type of applications and processes in the textile processing plants and, on the other hand, explains the large number of substances/mixtures as listed in the initial draft of the TXT BREF Questionnaire (see Strategy B).

[1] Assignment was not possible because the case study uses other groupings for the substances

[2] Only 26 chemicals are used simultaneously in two or three textile processing plants and just four substances can be found in all case studies

In addition, several substances not identified in the scan may be registered for use in other industries, although they are also used in the textile sector. Similarly, substances may be assigned to the textile sector in the course of registration under REACH, although they are no longer used. There may also be differences in the definition of usage categories and technical use descriptors. Further research on substances used in the textile sector in combination with additional assessment and filtering of data is therefore required before data from the ECHA chemical database can be used for BREF review purposes.

Although on its own Strategy D cannot be considered suitable to identify relevant target substances for the revision of the Textile BREF, the substance lists compiled in the four case studies nevertheless allow for some conclusions to be drawn. The most interesting substances datasets are hereby those, which give indications of mixture concentrations, biodegradability and ecotoxicity. However, the data on mixture concentrations is mostly available as ranges. Information on biodegradability and ecotoxicity can be checked against the corresponding entries in the ECHA dissemination site. Furthermore, information on the biodegradation of substances that ultimately originate from the MSDS cannot always be confirmed when looking at the ECHA database entries (e.g. claims such as "easily biodegradable" are not supported by the available tests or their significance is questioned).

Lessons learnt:

- Strategy A results in a relatively long list of chemicals that suffers from imprecise overlaps with chemicals actually used in textile plants.
- Strategy B seems promising since it combines the sector-perspective and expert knowledge on relevant groups of textile auxiliary agents with data on their fate and behavior, thus allowing to identifying recommendations for both operators and authorities. However, it remains nonspecific as it only addresses groups of chemicals and no single substances with a distinct CAS-number.
- Strategy C provides a short list of potentially used chemicals with concerns. However, their actual use in the textile sector remains to be verified.
- Strategy D has the advantage that the use of chemicals is demonstrated by real case studies. Moreover, potential concerns can be established by synchronizing the list of used chemicals with information from relevant databases (Strategy B and A) as well as knowledge from environmental fate and behavior of known chemical groups. On the other hand, due to limited resources, reality checks can only cover a small segment of the entire universe of textile processes and used chemicals.

Since the use of textile auxiliary agents is environmentally relevant, HAZBREF recommends to carry out a systematic search and assessment of used chemicals in the sector[1]. There is no ideal solution or royal road for how to conduct this work. However, it seems that a combination of approaches may best fit the purpose as no single method that delivers all BREF-relevant substances with a simple search or analysis ready to apply can be recommended. The current ECHA chemicals database is a valuable source of information but descriptors currently available do not allow for sector-specific searches in a substance-specific data base.

2.4 Systematic identification of target substances at operator level

While both the regulation for chemical substances and the BATs are changing quickly, BREF documents are compiled for a longer period. Depending on a static list of relevant target substances is therefore

[1] This is best carried out during the frontloading phase of a BREF review in order to be assessed and considered by the European IPPC Bureau and the Technical Working Groups in charge of revising and redrafting the current BREF text. However, HAZBREF started its work too late to be in a position to feed its findings directly into the frontloading phase of the TXT BREF review.

often non-sufficient for textile operators, as chemicals substances defined in such list may become obsolete after a while, and new substances, potentially applied in future, might not be addressed at all.

In theory, every plant operator should therefore identify relevant target substances on the basis of his chemical inventory. This case-by-case decision process should follow a certain systematic scheme for decision making. In the eighties and nineties, several such schemes were developed for the ecotoxicological assessment and classification of textile chemicals (textile auxiliaries). These included the Dutch General Assessment Methodology in the Netherlands (RIZA-Concept), the SCORE-System in Denmark, the BEWAG-Concept in Switzerland and the TEGEWA scheme developed in Germany by industry in collaboration with authorities (Textile BREF, 2003). The practice-oriented TEGEWA scheme (see Figure 3) has been applied the longest and successfully contributed to substitute or to phase out more than 200 critical products.

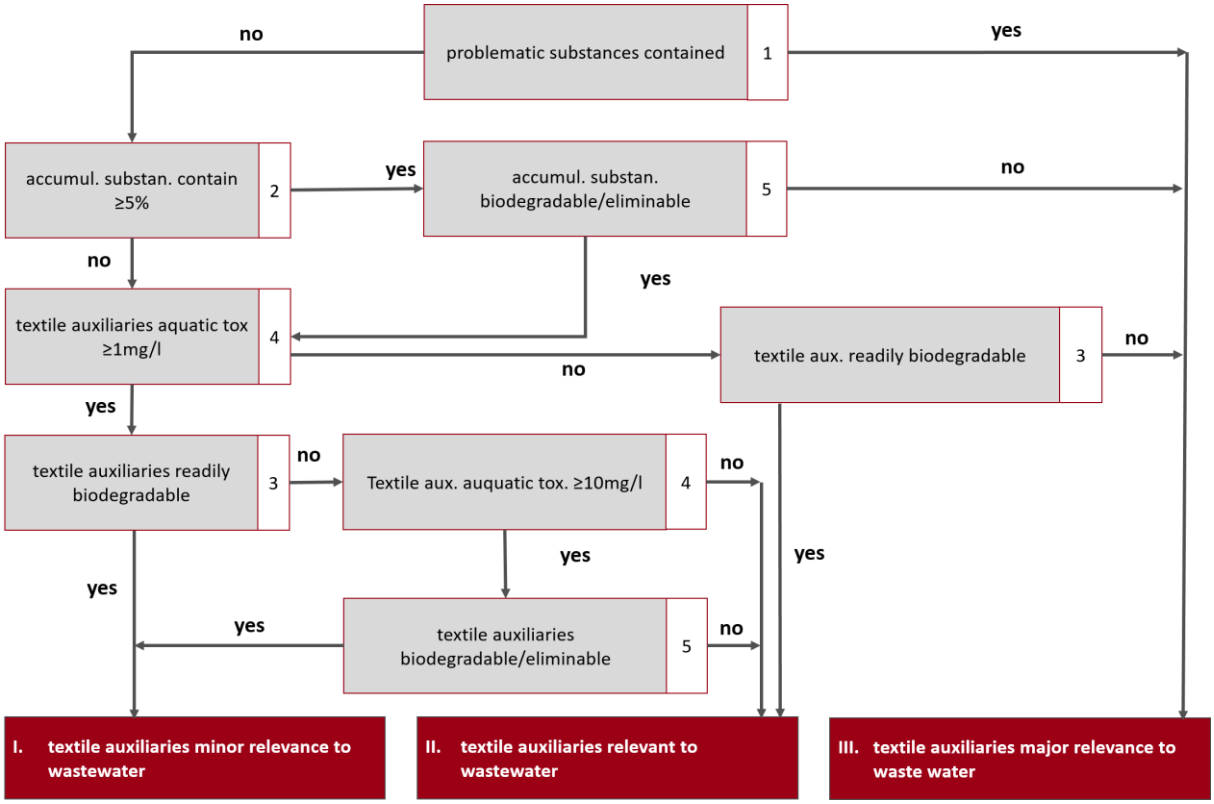


Figure 3: TEGEWA scheme for the classification textile chemical products according to their relevance to wastewater (Textile BREF, 2003)

The "TEGEWA scheme of classification of textile auxiliaries according to their relevance to wastewaters" provides for a classification of textile auxiliaries in 3 classes:

- Class I Minor relevance to wastewater
- Class II Relevant to wastewater
- Class III Major relevance to wastewater

The introduction of the classification concept rests primarily on the following pillars:

- Classification by producers on their own responsibility
- Screening of correct classification of textile auxiliaries in the three classes by an expert
- A monitoring report on the effectiveness of the voluntary commitment, which will be communicated to the authorities. For this purpose, the number and quantity of Class I, II and

III textile auxiliaries sold in Europe are collected from the manufacturers by a neutral consultant.

- The triggering of market mechanisms to develop more environmentally sound products.

It is not claimed that the classification concept allows a differentiated ecotoxicological assessment of textile auxiliaries. Rather, the classification concept is intended to enable users to select textile auxiliaries from an ecological point of view. Ecological competition is intended to trigger a trend towards the development of more environmentally compatible textile auxiliaries. The effectiveness of this approach has already been successfully demonstrated. However, in order to continue to be applied in the context of today's chemicals management in the textile sector, the scheme needs to be adapted to the changed legal framework. Special focus should be put on the criteria for problematic substances, the testing for accumulation and toxic substances as well as the threshold values for biodegradability and bioeliminability.

2.5 Challenges and recommendations with regard to the identification of chemical target substances

A particular challenge when identifying relevant target substances for the textile sector is that the suppliers or registrants of a chemical substance under REACH usually do not know the full extent of its use in the supply chain. Delays in communication within the supply chain, e.g. between downstream users and registrants, further aggravate this problem. As a result, many substances used in textile sector are not explicitly registered. This is especially true for process auxiliaries that do not have a direct function in textile processing (e.g. 1,2-Benzisothiazol-3(2H)-one, Permethrin, Pyrithionzinc). Attempts to identify individual chemicals from sales catalogue information are furthermore rendered ineffective in most cases as the textile processing industry hardly ever uses individual chemicals, but rather formulations and mixtures.

Further investigation by both the teams of WP 2 and WP 4 also revealed that the various information sources used by the installations did not provide the desired level of detail as required for identifying relevant target substances. As main information sources, the installations commonly use materials safety data sheets (MSDS) as provided by their chemical suppliers. However, a review of the MSDS revealed common shortcomings with regard to the information contained about the products' exact composition (see section 3.2).

Adapting an existing systematic scheme for the classification of textile chemicals to the context of today's chemicals management and the respective legal frameworks, could significantly support the identification of relevant target substances. In doing so, it is recommended to focus on criteria for problematic substances, testing for accumulating and toxic substances as well as the threshold values for biodegradability and bioeliminability.

3 Obligations and Essential Elements of Chemicals Management

The following section highlights the obligations for downstream users of chemicals (including textile operators) with regard to hazardous substances under REACH and the IED. It further provides guidance on how to fulfil this obligation by addressing essential elements of good chemicals management, which have been identified on the basis of expert workshops, interviews and case studies.

3.1 Chemicals management related obligations under REACH and the IED

3.1.1 Obligations under REACH

Downstream-users, i.e. manufacturers, importers, distributors or consumers[1] who use substance(s) or mixture(s) in the context of industrial or professional activities and do not supply these substances (individually or in mixtures) to customers further down the supply chain, have to comply with the obligations listed below[2]:

Obligations for downstream users under REACH:

- Apply appropriate risk management measures (RMMs) and operational conditions (OC) proposed in the core section of the (extended) safety data sheet (ext-SDS) or other information received from your supplier to adequately control the risks identified.
- Communicate to your suppliers any information that might call into question the appropriateness of the RMM and OC recommended.
- In case available: Check compliance with exposure scenarios (ES) attached to MSDS received from your supplier (see 0).
- Note that according to Article 37 (2) you have a right to inform the supplier about your use of the substance, in case it is not identified in MSDS.
- Decide on which actions to take if you use the substance or mixture outside the exposure scenario communicated by your supplier. In this respect, you may decide to conduct your own Chemical Safety Assessment for your specific use, document it in Chemical Safety Report (CSR) and to notify the specific use to ECHA according to requirements outlined in Article 38.
- If the substance – on its own, in a mixture or in an article – requires an authorisation before use, it should be stated in the MSDS or in other communication from your supplier. If an authorisation has been granted ensure that it covers your use(s), check if you comply with the authorisation conditions and report to ECHA the use of the substance under the authorisation of an actor up the supply chain.
- If you incorporate a substance of very high concern (SVHC) into an article to supply it further down the supply chain you have to provide information to your customers under Article 33 of the REACH Regulation (see Guidance on requirements for substances in articles, section 4.3) or you may respond to consumers upon request within 45 days when SVHC are contained in your article(s).
- Communicate to your suppliers any new or additional information on the hazards of substances when new information becomes available to you.

[1] Workshops, craftsmen and service providers have in principle the same obligations as other end users.

[2] ECHA Guidance on REACH and CLP implementation: https://echa.europa.eu/support/guidance-on-reach-and-clp-implementation/identify-your-obligations/navigator/-/navigator/obligation/26

The complete **Guidance for Downstream Users** provides detailed information on the various obligations and options downstream users have depending on the situation and the information they receive from their suppliers. Downstream users may also gain additional insights and relevant information by consulting the following sources:

- The "**Downstream users" web page** on the ECHA website
- Practical Guide 13 "**How downstream users can handle exposure scenarios**"
- **Questions and answers on Downstream User reports**
- The **Guidance on the compilation of safety data sheets**
- The **ECHA Navigator** tool which helps to identify industry's obligations

3.1.2 Obligations under the Industrial Emissions Directive

The Industrial Emissions Directive (IED) establishes a general framework for the integrated prevention and control of health & environmental risks arising from certain large industrial installations in the EU (listed in Annex I o the Directive), giving priority to intervention at source and ensuring prudent management of natural resources (Art. 3 para. 3 IED). As most of the health and environmental risks caused by industrial activities are based on the use, manufacturing and processing of chemical substances it is crucial for permit authorities that operators submit all relevant information with their permit applications. As summarized in the Impel Report on linking the IED and REACH the duties of enterprises and permitting authorities under the IED include[1]:

(1) Duty to integrate the information about substances in the process chain in the permit application:

According to Art. 12 (1) IED all member states have to ensure that all applications for IED permits include among other things a description of: 1) the raw and auxiliary materials and other substances, 2) in cases where the activity involves the use, production or release of hazardous substances a baseline report on soil and groundwater and 3) the nature and quantities of foreseeable emissions from the installations into each medium as well as identification of significant effects of the emissions on the environment.

→ Section 3.2.1: Using safety data sheets

→ Section 3.2.2: Using exposure scenarios

→ Section 3.2.3: Elaborate, implement and update chemical inventories

(2) Duty to inform about changes:

According to Art. 20 IED operators must inform the competent authority of any planned change in the nature, function or emissions of the installation, which may have consequences for the environment. Even if this does not explicitly refers to chemical substances, it implies that the responsible IED authority or authorities must be informed about the risks of use, purpose and environmental impact emanating from the respective plant after the granting of the permit. In this context, chemical substances and their properties play a central role.

→ Section 3.2.2: Using exposure scenarios

→ Section 3.2.3: Elaborate, implement and update chemical inventories

(3) Duty to substitute hazardous substances

According to Article 58 of the EID, substances or mixtures classified or labelled with the hazard statements H340, H350, H350i, H360D or H360F shall be substituted as soon as possible by less

[1] IMPEL (2015), Linking the Directive on Industrial Emissions (IED) and the REACH Regulation

harmful substances or mixtures due to their content of volatile organic compounds (which are classified as carcinogenic, mutagenic or toxic for reproduction according to the provisions of Regulation (EC) No 1272/2008).

→ Section 4.1.3: Systematic selection and use of chemicals

(4) Duty to reference BAT-conclusions in the permit conditions:

According to Article 14(3) of the IED, BAT conclusions shall be the reference for setting the permit conditions to installations covered by the Directive. As soon as the BAT conclusions for the textile sector are available, new IED installations will be required to reach the standard required in this document before they commence operations. For existing installations, it is the responsibility of the competent authority to ensure that all permit conditions for the installation are revised (and where appropriate updated) in accordance with the relevant BAT conclusions within four years of their publication (also see 5.1.5).

In the absence of BAT conclusions, textile operators should continue to ensure that they meet the highest standards of environmental control based on BATs and the related textile BAT reference documents (see Annex 2 & Annex 5).

→ Section 4: Proposals for techniques considered for the determination of BAT

→ Annex 5: Level of BAT application in the European Textile Sector

3.2 Essential Elements of good chemicals management

3.2.1 Using safety data sheets

Material Safety Data Sheets (MSDS) are a well-accepted and effective method for the provision of information on chemical substances and mixtures to their recipients in the EU. They further form an integral part of the system of Regulation (EC) No 1907/2006 (Annex II, Art. 31 lit. a)-c) REACH) and, according to expert interviews, are the most commonly used source of information for both textile operators and competent authorities under the IED. MSDS are designed to provide comprehensive safety information on substances and mixtures where[1]:

- a substance or a mixture meets the criteria for classification as hazardous according to CLP
- a substance is persistent, bio-accumulative and toxic (PBT) or very persistent and very bio-accumulative (vPvB), according to the criteria given in Annex XIII of REACH
- a substance is included in the candidate list for eventual authorisation according to Article 59 (1) of REACH for any other reason (See Article 31(1) of REACH).

Article 31 of the REACH Regulation describes the specific requirements for MSDS in conjunction with Annex II. According to this, all MSDS are divided in 16 sections, which must contain, among other things, information on potential hazards and the composition/information on components of mixtures (a commented blank MSDS can be found **here**[2]). The MSDS sections with the highest relevance for good chemical management are sections 1, 2, 3, 9, 11 and 12 (also see Annex 4). Chemical suppliers are obliged to provide end users with MSDS for all relevant chemical substances or chemical products (formulation of different chemicals on chemical products) in such a way that they meet the formal requirements according to the corresponding ECHA guidelines. This includes specifications on the

[1] Under certain conditions some chemical formulations which do not meet the criteria for classification as hazardous according to CLP also require an SDS to be prepared or be made available on request (See Article 31(3) of REACH and notes to tables 3.4.6, 3.6.2, 3.7.2, 3.8.3and 3.9.4of Annex I of CLP).

[2] BAUA (n.d.) Templates and Blank forms. [online] Available at: https://www.baua.de/EN/Topics/Work-design/Hazardous-substances/Safety-data-sheet/Templates.html

substance classes contained in the respective product. However, it does not require information on the exact formulation of a chemical product and thus protects the intellectual property of suppliers. Figure 4 summarises the typical workflow for forwarding a MSDS or other information on a formulation to downstream users and distributors. MSDS do not have to be provided for textile products (garments, apparel, etc.). Although the MSDS format may, for a few specific textile products, be used to convey safety information downstream the supply chain, it is not adapted to most articles.

Downstream users of chemical products in the textile sector (namely the textile finishing industry) are obliged to check whether the information contained in the respective MSDS complies with the requirements of REACH. In particular, it must be ensured that the respective MSDS provide at least the following information:

- Chemical composition (it should be clear which compounds or compound groups or components are contained)
- Complete set of physical-chemical information
- Complete information on handling and storage as well as on fire-fighting measures
- Set of toxicological and ecological information (the textile finishing industry can only check whether there is set of information and cannot assess its quality)

In case of non-conformity, supplementary information must be requested from the manufacturer. The competent authority for the textile finishing industry may support efforts to obtain additional information or may themselves take action to obtain it.

Material Safety Data Sheets

MSDS can enable operators in the textile sector to understand the hazards associated with the substance or mixture and provide them with guidance on:

- correct handling and storage
- measures for the protection of human health and safety at the workplace (occupational health)
- measures for the protection of the environment (measures for controlling emissions to the environment under the defined operational conditions)
- correct responses in case of substance related emergencies or accidental releases
- correct disposal of the respective substances

Additional information on the content and appropriate use of MSDS is provided in the ECHA "**Guide on Safety data sheets and Exposure scenarios**".

3.2.2 Using exposure scenarios

In the case that a hazardous substance (according to REACH) is registered in a quantity above 10 tonnes per year and registrant, an extended safety data sheet, with exposure scenarios (ES) attached, must be provided. ES are intended to provide information on the sources, use patterns and release pathways of chemicals used and to assist in the estimation of releases of chemicals to the environment. In contrast to MSDS, the format of the ES is not specified by REACH. On the one hand this gives the suppliers the flexibility to present the information in different ways, on the other hand the different formats can lead to difficulties in identifying information relevant to the recipients. To address this problem, ECHA and various stakeholders recommend a harmonised format comprising the following four sections:

- Title section
- Conditions of use affecting exposure
- Exposure estimation
- Guidance to downstream users to evaluate if their use is within the boundaries of the exposure scenario

Key points to be included in the format as well as additional information on the use of exposure scenarios are provided in the ECHA "**Guide on Safety data sheets and Exposure scenarios**". Specific annotated formats can be downloaded from the website section "**Formats and templates**".

In order to take into account, the different conditions for production, use etc. in each country and to avoid duplication of work between Member States and industry, ES are among others also developed by the OECD. For this purpose, a project application must be submitted to the OECD, indicating the sector categories and/or use categories from the member countries. After approval by the OECD Working Group on Exposure Assessment, the lead country prepares the document, which is then forwarded to Working Group for comments. The drafts will be amended and published by the OECD in the light of the comments received.

With regard to the textile sector, the OECD Working Group has so far developed two specific ES which are available in the **OECD series on emission scenario documents:**

- **Number 7** – **on Textile Finishing Industry**, 2004, and
- **Number 36** – **on the Use of Textile Dyes**, 2017.

According to the assessment of experts involved in the HAZBREF project there are – apart from the two ES mentioned above – currently no other textile-specific ES available or under development.

Obligations of downstream users with regard to Exposure Scenarios

When receiving ES as part of the extended safety data sheet, downstream users must fulfil certain obligations. As a first step they have to determine whether the particular use and/or conditions of use in the installation is covered in the ES. If the respective use is covered in the ES downstream users are only obliged to document how this conclusion was reached (this information shall be made available to enforcement authorities on request). In case the particular use and- or conditions of use are not covered in the ES, downstream users can – depending on their situation – choose between the following options:

- Ask the supplier to include the relevant conditions of use in the chemical safety report and to submit an appropriate exposure scenario. Sufficient information must be made available to the supplier to enable him to carry out such an assessment.
- Implement the operating conditions described in the exposure scenario you have received. This option may require changes in the processes and/or products.
- Eliminate or substitute the substance or the activity with a safer alternative.
- Find another supplier who can provide the substance with MSDS and exposure scenario covering your use
- Carry out a chemical safety assessment and prepare a downstream user chemical safety report (DU CSR) for their uses and conditions of use, unless exemptions apply. The ECHA Guide 176 "**How to prepare a downstream user chemical safety report**" provides further details about this approach.

Further practical guidance for the procedure described above is provided in the ECHA Practical Guide Nr. 13 "**How downstream users can handle exposure scenarios**".

3.2.3 Elaborate, implement and update chemical inventories

The textile finishing industry uses a considerable number of chemical products. To allow for an effective chemicals management, it is therefore necessary to clearly identify which chemicals are used, how they should be used, and how they can be substituted if risks are identified. This requires the establishment of chemical inventories, which are continuously updated and archived. Chemical Inventories allow among other things for a targeted compilation and assessment of chemical related information, which can serve the specific information requirements of different organizational units within the industrial installation. They can also serve as an important reference and information tool for stakeholders such as IED permitting authorities (e.g. to assess compliance with lists of restricted substances or other chemical related regulations), thus going beyond the mere purpose of fulfilling storage or stock-keeping requirements.

Information requirements for chemical inventories

According to the assessment of IED permitting authority representatives and experts from HAZBREF, it is recommended to include at least the following information on substances and mixtures in a chemical inventory:

- The commercial name of the products used
- Chemical characterisation of the products used, if possible with single chemical compounds
- Identifiers, CAS / EC number of chemical substances contained
- Characterisation / description of use (input material, class of active ingredients, solvent, product, intermediate, by-product)
- Details of use / details about the process
- Annual consumption of the chemical products/substances
- Total quantity of the chemical products or substances that may be presently stored within the total installation/operational area
- Physical / chemical / toxicological / eco-toxicological properties of the chemical products/substances
- Biodegradability/ / bioeliminability in [%], including information on the testing method
- The lower content (as % by weight) of components in chemical formulations
- The highest content (as % by weight) of the component in chemical formulations
- Heavy metal content
- Content of organohalogen compounds (AOX)
- Content of phosphorus
- Risk assessment
- Information about possible emissions or possible reactions (e.g. decomposition) of substances in case of an incident or accident during the production process

An example for a well-maintained chemical inventory is provided in Annex 6.

In order to ensure the availability and completeness of all information necessary for a responsible chemicals management that can be used for both internal and external requirements, the inventory should include all chemical substances and products (including by-products, intermediates, residual raw materials and solvents) present throughout the production cycle.

The main and commonly used sources of data with respect to the different chemical products are the MSDS[1] and - to a certain extent - the Technical Data Sheets (TDS)[2]. Although the information in the chemical inventory do not have to exceed information provided in the respective MSDS, a complete inventory requires well-prepared MSDS (see 3.2.1). Additional sources of relevant chemical information such as type, chemical (containing) waste, production processes involving chemicals, as well as quantities of inputs and non-product outputs include eco-maps and process flow diagrams. Further reference on how to establish and maintain a chemical inventory is provided in Annex 2 – BAT Recommendations 1 "Establishment and use of a central chemical database as fundament and tool for systematic chemicals management".

Availability and maintenance of chemicals inventories have also become a common requirement in international supply chain management. Buyers` code of conducts commonly refer to the need of maintaining and using an up-to-date inventory of all substances used (see: Sustainable Apparel Coalition-Higgs FEM, Zero-Discharge of Hazardous Chemicals - ZDHC). Companies may also be required by law to maintain a chemical inventory (see for example German Hazardous Substances Ordinance (GefStoffV), section 3, para 6, point 12, revised 29th March 2017[3])

3.2.4 Examples of good practices for chemicals management

There are already a number of tools and practices that can be used to improve and facilitate good chemical management in textile plants. Three of these tools are presented in more detail below.

bluesign® – Input stream management

Instead of merely testing textile products for unwanted or restricted chemical substances, bluesign® uses input stream management in textile supply chains, which specifically covers the use of chemicals already on the level of chemical suppliers. Further, all chemicals used in production processes are subject to risk assessments, enabling manufacturers to adhere to strict chemical safety standards from the onset. Bluesign® also employs its own list of substances that should not be used in production processes, which is designed to account for a set of common Restricted Substance Lists (RSL). This makes bluesign® compatible with a range of other approaches. Additionally, bluesign® enables sustainability improvements in chemicals management based on self-provided company details, which forms the basis for an agreement, followed by an assessment, on-site implementation including support from bluesign®, and the subsequent certification and labelling procedure.

ZDHC Gateway – Chemical Module

The **ZDHC Gateway - Chemical Module** is an online platform that helps with registering and finding chemicals that conform to the ZDHC MRSL. It provides useful tools and facilitates the exchange of information between brands, retailers, suppliers and chemical companies. Brands and/ or retailers can engage their supply chain and communicate their requirements for safer chemistry. Suppliers see their customers' requirements, where brands and/ or retailers have defined them. The Chemical Gateway further works in harmony with numerous third-party certifications and testing labs, including OKEO-TEX, GOTS, Tox Services as well as testing laboratories such as Bureau Veritas, SGS, TÜV, Intertek or Geo chem.

[1] The short-comings of SDS in terms of their comprehensiveness and quality of information need to be taken into account and may require further inquiries with the chemical supplier, particularly as far as the complete disclosure of chemical product compositions is concerned.

[2] Technical data sheets contain information on the application of the product and instructions for its use. This may include the correct dilution range, the correct temperature as well as other information of use for the process engineer.

[3] **BAUA**: "…. the employer must keep a list of the hazardous substances used in the company in which reference is made to the corresponding safety data sheets. The list must contain at least the following information: 1. the name of the dangerous substance, 2. classification of the hazardous substance or information on its hazardous properties, 3. information on the tonnage ranges used in the establishment, 4. designation of the working areas in which employees are exposed to the hazardous substance…"

Included in the Gateway Chemical Module is the **ZDHC's InCheck Report**: a standardized, easy-to-read chemical inventory report that summarizes and assesses the installation's input stream chemicals and provides the following information:

- An evaluation of the supplier's chemical inventory against the ZDHC MRSL
- An understandable performance summary
- Recommendations for chemical inventory improvements

Partnership for Sustainable Textiles – Inventory Collection Template

Under the coordination of ZDHC and other members, the Partnership of Sustainable Textiles created a template for the collection and compilation of a good chemical inventory. The template is aligned with ZDHC and helps textile companies to submit key information on their chemical inventories in a standardized way. The template can be accessed via **this link**[1].

3.3 Challenges & recommendations with regard to good chemicals management

As the central source of chemical information for operators and competent IED authorities MSDS represent both a major opportunity and challenges for good chemicals management in the textile sector. While the availability of MSDS in the textile sector is generally warranted, spot checks of MSDS show lapses as well as inconsistencies of the information contained. A particular challenge in this context is that chemical suppliers are often hesitant to include information regarding the chemical composition of marketed substance-mixture. Furthermore, impurities such as solvents and by-products from previous synthesis or isolation operations, which are contained in chemicals of technical grade, are usually not listed in MSDS.

Information gaps can also occur when chemical suppliers do not update MSDS on a regular basis. A sample review of the MSDS used in the four selected case studies for textile finishing industries showed that the majority of MSDS were older than three (3) years (59%), and one third older than 5 years (31%). The sporadic frequency of the updates may be due to the fact that there is no time-bound obligation to revise the MSDS. In the case that end-users identify information gaps in MSDS, they are theoretically entitled to demand the missing information on chemical substances and particularly formulations from their chemical suppliers. However, as the majority of chemicals nowadays are supplied from outside the EU, end-users often face practical challenges during this process. Further complications with respect to the collection and evaluation of material safety data sheets arise from the large number of chemical formulations used by textile companies (often more than 250 at a single site)[2]. Given the various difficulties connected to the evaluation and verification of information in MSDS a precise assessment of chemical properties and compliance with IED regulations often poses a major challenge for both companies and competent authorities.

The development and use of systematic approaches and tools for MSDS evaluation can help operators and competent IED authorities to better use the information provided in the MSDS. However, only a few such tools are available on the European market. According to the IMPEL report "Linking the IED and REACH Regulation" the region Marche in Italy is one of the first that uses an electronic database for the assessment of MSDS. Other tools that specifically support the proper preparation and quality assessment of MSDS include a **checklist** that is specifically designed for recipients of MSDS and that was developed by ECHA in cooperation with the Enforcement Forum for both the suppliers and recipients of MSDS and the online tool **SDS-Check**. In order to address the challenge of large

[1] http://www.textilbuendnis.com/wp-content/uploads/2018/08/Partnership-for-sustainable-textiles-Chemical-Inventory_1.1.xlsx

[2] IMPEL, Linking the Directive on Industrial Emissions (IED) and the REACH Regulation, 2015.

substances varieties used at certain sites, IMPEL furthermore recommends the development of a procedure for prioritisation.

Closing information gaps in MSDS, requires a specification of the minimum information requirements laid for the MSDS in Annex II of the REACH Regulation. To this regard, especially aspects such as data on bio-degradability and mixture composition should be considered. Despite the lack of a time-bound obligation to revise the MSDS, it is further highly recommended to check for MSDS updates on a regular base. In this context the ZDHC Chemical Management System (CMS) Guideline[1] and several other supplier codes by international brands refer to a proof of review at least every three years. In accordance with Article 31 (9) of the REACH Regulation MSDS generally remain up to date until new information is available. Suppliers shall update the safety data sheet immediately as soon as (1) new information which may have an impact on risk management measures or new information on hazards becomes available, (2) an authorisation has been granted or refused or (3) a restriction has been imposed. The new, dated version of the information shall be marked "Revised on (date)" and made available free of charge on paper or electronically to all previous customers to whom suppliers have sold the substance or mixture in the previous 12 months. Annex 4 provides a selection of commented Best and Worst Practices for MSDS, also containing references to the relevance of respective MSDS information in the context of permit requirements.

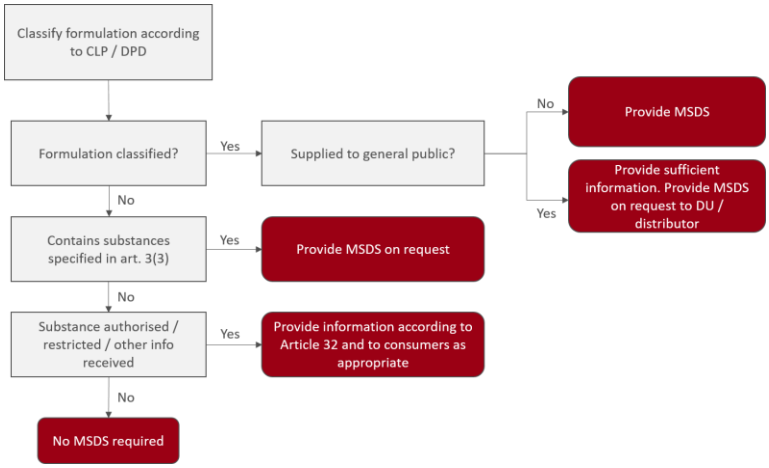


Figure 4: Obligation related to Safety data sheets for mixtures[2]

The major challenge with regard to ES, is their very low rate of application among operators, licensing authorities and competent authorities in the textile sector. One of the main reasons for the low rate of application - particularly by the competent authorities – is the lack of regulatory incentives. In addition, the HAZBREF experts noted that both industry and competent authorities often lack sufficient chemical expertise on biodegradability and environmental fate and behaviour together with occurrence of substance in the different environmental media to apply ES selectively in their processes or considerations.

The lack of sufficient chemical expertise is another factor that hinders textile installations in using MSDS and ES for collecting and assessing relevant, chemical related data for the compilation of chemical inventories or the IED permitting process. Hence, it is recommended that - in addition to further developing and improving ES for chemicals and mixtures relevant to the textile sector – awareness and the necessary chemical expertise at both the level of textile operators and competent authorities is facilitated as well.

[1] https://uploads-ssl.webflow.com/5c4065f2d6b53e08a1b03de7/5db6f0404b859058c4c26b1a_CMS_EN.pdf

[2] ECHA, Guidance in a Nutshell - Downstream users, 2013.

4 Proposals for techniques considered for the determination of BAT

Based on the analysis of findings in the four installations surveyed under WP4 of HAZBREF as well as expert interviews, five BAT proposals were developed and forwarded to the TGW for the revision of the Textile BREF for consideration. The proposed BAT can, among other things, serve to fulfil the obligations under IED and REACH (section 3.1) and to meet the challenges of good chemicals management (section 3.3). They address both general chemical management practices (proposal 1 and 2) and specific techniques for the abatement of emissions (proposal 2 – 5). The BAT proposals are described in detail under Annex 2. As part of the case study initiative, the HAZBREF team also analysed and compared prevalent BATs as applied by the respective installations. The identified BATs are outlined below.

4.1 Generic BATs

4.1.1 Management of chemicals

For the storage of chemicals, the installations refer to the instructions outlined in the MSDS as well as to the recommendations provided by the chemical suppliers (e.g. storage conditions, storage climate control, placement by storage classes according to compatibility). Furthermore, provisions are made to avoid spillage of chemicals, such as by using work instructions, secondary containments and catchment facilities. In addition, provisions for spillage control (spill kits with suitable absorption material) are in place to react to and clean up spillages and leakage. The companies surveyed record their respective inputs and outputs by documenting and recording recipes. It was found that, depending on the company, the process was carried out either fully electronically or manually.

Regarding chemical related data management, the installations collect and refer to the MSDS as well as technical data sheets as provided by their suppliers. According to HAZBREF case studies, the MSDS constitute the key source of information and reference, from which relevant data is being extracted as and when required. Technical data sheets were mentioned as an additional source of information. Use of extended safety data sheets and/or exposure scenarios were not indicated by any of the case study installations.

The selected installations are maintaining different types of chemical inventory systems. The establishment and use of an enhanced chemical inventory system, which could serve as a structured CM knowledge information system (in line with the format recommended in the ZDHC CMS guidance or the German Partnership for Sustainable Textiles) as well as BAT recommendation (See Annex 2 - BAT 1 “Chemicals Inventorying”) were not commonly found. The provision of such information in a more structured format would allow a better involvement of the different internal parties in an integrated process of chemicals management. This could be easily done in form of an in-house electronic database, with corresponding search filters (e.g. from waste water, compliance, safety & health or purchasing perspectives).

4.1.2 Dosing and dispensing of chemicals

The installations use either semi- or fully-automatic dosing and dispensing systems which meter the exact amounts of chemicals and auxiliaries, delivering these directly to the various machines through pipework without human intervention. This approach also reduces the potential risk of accidental spillage and release into the environment, as this is often caused by inappropriate manual handling.

4.1.3 Systematic selection and use of chemicals

The operator of one installation reported the use of specific procedures referring to the consideration of hazard levels (including to environment as well as to safety & health aspects) for the selection of less hazardous chemicals as part of enhanced "responsible purchasing practices". For this purpose, Classification, Labelling and Packaging (CLP) ratings of chemicals and formulations are systematically taken into consideration. The installations in Poland and Sweden also indicated that for this purpose they are frequently seeking support by external service providers or online tools such as those provided by ECHA. However, according to the contact persons of the installations concerned, no textile-specific tools are used. The Swedish installation uses the PRIO chemical database, which has been developed by the Swedish Chemical Agency (KEMI). PRIO contains examples of substances with environmental and health hazard properties which should be prioritised in efforts to reduce chemical related risks. Against a similar background, the UBA has published a **Guide to Sustainable Chemicals**, which serves as a decision-making tool for substance manufacturers, formulators and end-users of chemicals, helping them to select more sustainable chemicals. The guide focuses on sustainability aspects in areas like hazardous properties for human health and for the environment; mobility of a substance, greenhouse gas emissions and resource consumption as well as responsibility in the supply chains. Additional tools such as UBA`s **Rigoletto**, are designed to support both the operators and authorities in classifying substances and mixtures for their water-hazardous properties. The classification is carried out on the basis of the Ordinance on Facilities for Handling Substances that are Hazardous to Water (*Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen* (AwSV)) of 18th of April 2017 (BGBl 2017, Part I, No. 22, Page 905). The German *Trade association for raw materials and chemical industry (BG RCI)* and *Trade association for wood and metal (BGHM)* offer a range of tools, such as the Chemical Hazard Information Systems (**GisChem**), which includes a "mixture calculator" for the correct classification and labelling for substance mixtures in the Globally Harmonised System (GHS) system.

REACH lists were indicated as being of high relevance to the installations. None of the installations indicated that they explicitly refer or conform to any Manufacturer Restricted Substances Lists MRSL (as described under 2.1.2). However, it was indicated that they referred to OEKO-TEX, Global Organic Textile Standards (GOTS), Fair Trade and/ or Nordic Swan requirements.

4.1.4 Reducing chemical consumption through systematic water management

One operator emphasized that during the modernization of the installed process machines, special attention was paid to the installation of machines for batch processes with low, extremely low and very low liquor ratios (in line with BREF TXT sections 4.6.19 to 4.6.21). According to the operator, this measure has led to a significant reduction of substrate-specific chemicals consumption. The implementation of enhanced maintenance practices with regard to pipework, valves and pumps can further contribute to a reduction of water demand and chemical wastage. This in turn also reduces the wastewater quantity generated and treatment costs incurred.

4.1.5 Management of wastewater streams and recovery of chemicals

The results of the case studies show that the separate collection and treatment of wastewater streams for the systematic recycling and reuse of water and chemicals is not yet widespread and, when applied, is mainly used in the context of water recovery and reuse. One installation indicated that they are taking steps towards recovery of brine from high-loaded wastewater. Furthermore, installations with mercerizing processes usually recover caustic soda (ref. "BREF TXT 4.5.7 Recovery of alkali from mercerising"). Such recovery processes are also increasingly being adopted by manufacturers in other parts of the world (e.g. Bangladesh, India, Pakistan and China).

4.2 Process-specific BATs in use in installations

Annex 5 of this report provides a list of the chemical related BATs that are applied in the European textile sector. At the time of the preparation of this document, other relevant studies on BATs (some of which also address chemical management), such as the report on “Novel sustainable techniques in the textiles sector identified by the Innovation Observatory” by Ricardo Energy & Environment; have been prepared and provided to the TXT BREF TGW in connection with the TXT BREF revision.

4.3 Recommendations for identifying future BAT

When identifying new BATs and developing the BAT conclusions for the textile sector it is crucial to include the responsible management of chemicals as well as the reduction of substances of concern should as a mandatory aspect. MSDS and ES, as elaborated in in section 3.2, may be used as a first step to identify techniques that need to be taken into account when determining BATs as well as potential technical constrains or limitations for their applicability. Using information obtained from MSDS could also support the development of BAT conclusions and help to facilitate the safe use of the substance of concern in industrial textile installations. Furthermore, strengthening the interfaces between REACH, IED and BAT conclusions can help to achieve better implementation in practice.

5 Permitting Process and Management

Based on a command-and-control approach, the IED stipulates that no IED installation may be operated without a valid permit that meets the IED requirements. Such a permit must contain emission limit values (for emissions to air, water and soil), which are based on BAT listed in the sector-specific BREF. Furthermore, the permit must contain all relevant conditions and stipulations (also based on BAT) on: (1) integrated pollution prevention measures (such as the prevention of applying certain chemicals, not to carry out certain processes, establishment of wastewater, waste and chemicals inventories); (2) self-monitoring, storage and handling of chemicals; (3) health and safety aspects, especially concerning the application of hazardous toxic chemicals; (4) the right of the competent authorities to carry out inspections any time, to take wastewater samples any time and (5) measurements of emissions to air by certified third-party institutions at a certain frequency etc.

The case studies and interviews with representatives from permitting authorities in four countries[1] indicate significant differences between the respective permitting procedures regarding details as well as frequency of information on substances to be submitted. Furthermore, while some countries apply BREFs and BAT conclusions directly (e.g. Sweden), others transpose it into national law (e.g. Germany).

Differences in the permitting requirements are also visible within countries. For example, while in one German federal state IED installations are required to submit a list of chemicals products (textile auxiliaries, basic chemicals and dyestuffs/pigments) used on an annual basis, in other federal states no such requirements are in place.

5.1 IED permitting and inspection cycle

In the following, the steps of the IED permitting and inspection cycle will be addressed with special consideration of available tools and references as well as common challenges for permit writers, competent permitting authorities and operators. Figure 5 provides an overview of the steps, inputs, links between the steps and how they work together.

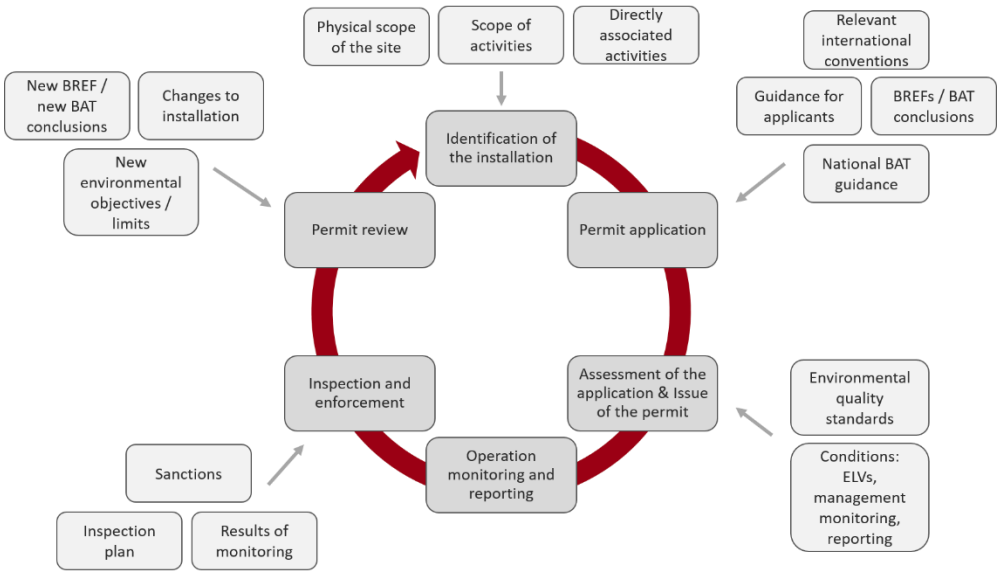


Figure 5: IED permitting and inspection cycle[2]

[1] Germany, Poland, Sweden, Finland

[2] Based on: IMPEL, Linking the Directive on Industrial Emissions (IED) and the REACH Regulation, 2013

5.1.1 Identification of the installation

According to the IED, “installations” are technical units in which one or more industrial activities listed in Annex I or in part 1 of Annex VII of the IED are carried out. This also includes directly associated activities on the same site, which have a technical connection with the activities in those Annexes and which could have an effect on emissions and pollution. Activities listed under 6.2. Annex I: Pre-treatment (operations such as desizing, scouring, bleaching, mercerisation and related washing operations) or dyeing of textile fibres/ textiles where the treatment capacity exceeds 10 tonnes per day are also covered. For the purpose of determining the installation, the operator has to describe the boundaries of the planned installation including the physical scope, scope of activities and all directly associated activities.

5.1.2 Permit Application

Before starting to prepare a permit application, it is recommended that operators contact the competent authority and get an overview of the available templates and guidance materials. A list of available reference documents and tools is provided in Annex 3. According to Article 12 of the IED, the licence application must contain descriptions of certain aspects, which in the following have been adapted to the specific situation of the textile finishing industry:

- the installation and its activities, i.e. the description of the production (layout of the whole production site with integrated indication of all machines and water supply lines and wastewater sewers, job work or finishing own materials, type of products, type of make-ups processed, end-use of finished textiles, type of customers etc.);
- the raw and auxiliary materials, other substances and the energy used in or generated by the installation, i.e. the annual mass stream overview (Annex 8) and environmental performance indicators calculated from it (specific water consumption, specific consumption of textile organic auxiliaries, dyestuffs and basic chemicals, specific consumption of primary energy, electricity and steam) as well as a water balance (annual water consumption for the main processes such as boiler feed water, water consumption for textile pre-treatment, dyeing, printing and final finishing whereby major machines/processes are listed separately);
- the sources of emissions from the installation, i.e. the main process sequence(s) with indication of water and chemicals input as well as waste gas and wastewater emissions at each process stage; ideally, annual mass stream overviews are provided for all main processes, e.g. for continuous pre-treatment lines, for continuous or semi-continuous dyeing operations, for each stenter etc. a chemical inventory of all chemical products used is required (see Annex 6);
- the conditions of the site of the installation, i.e. age of the installation and the main machines, maintenance plans for all relevant equipment, indication of segregated individual wastewater streams or the options to segregate them;
- the nature and quantities of foreseeable emissions from the installation into each medium, as well as the identification of significant effects of the emissions on the environment, i.e. emission factors ‘in g/kg textile’ for wastewater emissions (COD, BOD_5, heavy metals, AOX, Total nitrogen, ammonium, total phosphorus, substances listed in ZDHC MRSL or REACh SVHC etc.), for waste gas (from boiler house, singeing, distinct final finishing operations such as thermosol processes, finishing processes carried out in stenters etc.) by means of the emission factor concept as well as for solid wastes (residual padding liquors from sizing, dyeing, or final finishing, residual printing pastes, residual coating pastes or liquors etc.);
- the proposed technology and other techniques for preventing, or where this is not possible, reducing emissions from the installation; i.e. measures to prevent, to minimise and to reduce

emissions to water and air by process- or production-integrated measures or abatement techniques;

- measures for the prevention, preparation for re-use, recycling and recovery of waste generated, i.e. for residual sizing liquors, residual padding liquors from dyeing and final finishing, residual printing pastes and residual pastes from coating;
- further measures to comply with the general principles of the basic obligations of the operator as provided in IED Article 11; i.e. dose of low liquor exhaust dyeing, machines, use of padders with minimised volume, automated preparation and dosage of prepared formulations ready for application in the process concerned, use of rotary printing machines with minimised system volumes, use of digital printing as much as possible, automatic preparation of dyeing and finishing solutions as well as of printing pastes;
- measures planned to monitor emissions into the environment; i.e. the online monitoring of total wastewater flow as well as of conductivity, pH, temperature, and (in case of direct discharge) colour, use of automated samplers to take flow-proportional 24-h composite wastewater samples to be daily analysed for COD, colour, conductivity and pH, weekly for heavy metals, total nitrogen, total phosphorous, AOX and hazardous compounds of hazardous compounds according to ZDHC MRSL if the compounds can be expected in wastewater;
- the main alternatives to the proposed technology, techniques and measures studied by the applicant in outline (for installations regulated under the EIA Directive).

Apart from the reference materials listed in Annex 3, operators can use information that is supplied or produced in response to other legislation. To date, the main source of information are the MSDS; however, they often do not contain sufficient information. In this the operator has look for additional information sources, such as for information published by ECHA, information provided by other databases (see section 2.1) as well as information that the operator has generated in order to comply with REACH obligations (see section 3). It is further the competent authority's duty to ensure that the operator submits the chemical inventory (see Annex 6 and BAT 1 in Annex 2) as complete as possible. In the event that the inventory of the first version of the application is insufficient, the competent authority must clearly inform the operator that it requires a complete inventory containing all the information required under the headings. Using the data provided in the chemical inventory the competent authority, can:

- identify chemical products containing hazardous and heavily or non-biodegradable substances
- develop permit conditions such as emission limit values for certain compounds
- develop stipulations to substitute certain chemical products containing hazardous or heavily or non-biodegradable substances or at least to substantially reduce their consumption and requirements concerning abatement of emissions to water or to air.

The same is true for requirements for handling and storage as well as processing of chemicals in the installations. Chemical products, for instance, which can spontaneously decompose resulting in explosions (e.g. hydrogen peroxide) or fires (e.g. sodium dithionite) have to be stored separately with adequate security measures (see also BAT 2 in Annex 2). Stipulations and requirements also concern the separation and specific disposal of concentrates containing hazardous or heavily or non-biodegradable chemical substances (see BAT 3). It is stressed that these measures concern emissions to water whereas emissions to air can be managed best by applying the emission factor concept[1]

Although the IED does not address compliance with REACH duties as such, several European member states, which were questioned in the course of the IMPEL Report on "Linking the Directive on Industrial

[1] The "emission factor concept (emissions to air)" as briefly described in chapter 4.3.2 of the Best Available Techniques Reference Document for the Textiles Industry (2003) (https://eippcb.jrc.ec.europa.eu/sites/default/files/2019-11/txt_bref_0703.pdf))

Emissions (IED) and the REACH Regulation", stated that IED and REACH are already linked directly or indirectly in their legislation (e.g. through reference on REACH in legislation and guidance documents or supporting tools). In the electronic IED application software (ELiA) used by 8 of the 16 German federal states, REACH duties are for instance especially checked in the Template "Chemical Safety". In other countries, REACH duties are not systematically checked in the course of IED permitting. This is mainly due to high efforts associated with a well-founded audit. However Competent authorities may insist that the operator submits information on chemical products used, not only in case of the erection of an installation or its substantial change but also for routine operation, e.g. on an annual base by submission of up-dated chemical inventories (see Annex 6).

Good Practice: Electronic tool for submission of applications (ELiA)

ELiA is an IT solution designed for the application and approval of installations under the IED resp. the German Clean Air Act (BImSchG). With this tool, companies or the engineering offices commissioned, can electronically prepare IED permit applications and send them to the competent permitting authority in encrypted form. The aim is to ensure that even extensive permitting procedures for the erection and operation of installations (or for their substantial change) are carried out more uniformly, effectively, efficiently and in accordance with the BImSchG. ELiA is currently used by 8 of the 16 German federal states and can be downloaded free of charge from the websites of the respective state governments.

5.1.3 Assessment of the application documents and permit decision

As described above, the competent authority must assess the environmental performance of the installation. Chemical-related data are evaluated on the basis of the chemical inventory (see section 3.2.3 and BAT 1 in Annex 2). In case, the inventory is incomplete or does not contain sufficiently detailed data, the competent authorities either have to demand a new, more complete version from the operator, or explore further information sources such as the ECHA or US databases, regulatory and non-regulatory lists (see Section 2.1.1, Section 2.1.2 and Annex 3). This way, compliance with other sector-specific regulations (e.g. WFD and occupational safety regulations)[1] may also be achieved. Only a properly-filled chemical inventory allows to effectively compare the listed chemical products with the existing reference list of hazardous chemicals (regulatory and non-regulatory). In the event that certain environmental quality standards impose stricter requirements than those that can be achieved through the application of BATs, additional measures may be required in the permit to comply with given standards. In case the assessment of the competent authority concludes that all permit requirements are met by the installation, the permit may be issued.

A major challenge for an efficient assessment of chemical-related information in the context of the IED permitting is the lack of systematic evaluation approaches and the lack of comprehensive and accessible information sources. As a result, the competent permitting authorities rely on those information sources that are known and accessible to them. The most important sources of information regarding relevant substances in this respect are the MSDS (see 3.2.1). Other sources include chemical databases such as those made available by ECHA or national organisations (see section 2.1), as well as various checklists or reference tools. In case they are available, ES can serve as an additional valuable source of information on substances relevant for the textile sector (see 0). To improve the application assessment process with regard to chemicals management for both textile operators and competent authorities, it is recommended to provide a comprehensive overview of available tools and references

[1] If, for example, a priority substance regulated under the WFD (e.g. mercury) is present in the waste water of an installation (in a relevant quantity), the operator is required to take measures in order to reduce emissions and to phase out the emissions, discharges and losses of the substance.

in a clearly arranged and easily accessible way, suitable to facilitate their use by plant operators and competent authorities. An exemplary compilation of tools and references relevant for the respective IED permitting steps is presented in Annex 3.

Good Practice: Norway

The Norwegian Environmental Agency has developed a flow chart, which is mainly used as a working tool by permit writers. The flowchart gives an overview of the different chemical regulations that apply when working with IED approvals and further contains a link to the **Norwegian Chemicals Database**. Searching by substance name, CAS or EC, this database provides results which include the respective provisions of the National Priority List, the REACH Candidate List, the REACH Authorisation List, the REACH Restriction List, CLP and possible other provisions (e.g. related to biocides).

Good Practice: Germany (Schleswig-Holstein)

In Schleswig-Holstein, an interdepartmental team of experts was formed to pool expertise on IED applications and chemicals legislation and to make the relevant information more easily accessible. Consisting of experts in chemical law enforcement and environmental inspectors, the experts can advise both applicants and competent authorities on questions relating to chemical law aspects in the field of IED permitting and plant monitoring. Their work includes the evaluation of chemical inventories, the reference to obligations under chemicals law (in particular REACH obligations), the formulation of ancillary provisions for permitting, as well as the monitoring of chemicals legislation (general, implementation of actions, participation in monitoring of BImSchG/IE plants with regard to issues of chemicals law).

5.1.4 Monitoring, reporting and inspections

To ensure compliance with the emission limit values (ELVs) established for the pollutants listed under Annex II IED and specified on the base of the chemical inventory assessment conducted by the competent authority (see Section 5.1.3 above), textile installations should be subject to regular monitoring. The monitoring should take into account the nature of the pollutants as well as the risk of the pollution shifting from one medium to another (in case of scrubbers using water). According to the frequency defined in the permit (at least annually), the operator has to submit the up-dated chemical inventory, including:

- the major changes in the past year (new chemical products applied, recently identified hazardous chemicals)
- measures taken or foreseen to prevent and abate emissions of hazardous chemicals
- a compilation of all monitoring results of emissions to water and to air
- the type and quantity of hazardous waste listed together with the disposal route.

The permit may also allow the monitoring to be carried out by a certified third party who subsequently transmits the results to the competent authority. Once BAT conclusions for the textile sector are available, they shall be the reference point for setting the monitoring framework (e.g. parameters to be monitored, test method to be applied, required frequency of reporting). In German federal states and in Sweden the operators are further obliged to establish and maintain a chemical inventory as part of the self-monitoring. Based on an individual inspection plan, the competent authority should regularly draw up programmes for routine environmental inspections. The determination of the period between two site visits shall be based on a systematic assessment of the environmental risks of the installation concerned (between 1 and 3 years). The characteristics of the chemicals processed or produced in the installation concerned play an important role in the risk assessment. However, as presented above, the chemicals management is also subject of the annual reporting. Should the inspection reveal non-compliance with

the permit conditions, an additional on-site visit must be carried out within 6 months after the first inspection. Non-routine inspections may be carried out in order to investigate serious environmental damage, serious chemical and environmental accidents or incidents of non-compliance. The inspections should be carried out as soon as possible and, where appropriate, before the permit is granted, reviewed or updated.

5.1.5 Review of the permit

Competent authorities should regularly check whether substances manufactured or used in the relevant installation are included in the SVHC or ZDHC candidate list or whether they are subject to authorisation or restrictions. Changes should be taken into account when evaluating new measures and reviewing the permit, as appropriate. Furthermore, Art. 21 (1) requires the competent authorities to ensure that, no later than four years after publication of the BAT conclusions, all permit conditions have been reviewed and, if necessary, updated to ensure compliance with the relevant provisions and that the operators of the installation have taken appropriate measures.

To improve the review process, it is recommended to include a stipulation in the permit that requires textile installations to submit a chemical inventory (as described under 3.2.3 and Annex 4) on an annual basis. This would allow for a regular screening of the applied chemicals/ chemical products and thus minimise the risk of hazardous chemicals being used.

In Sweden IED and BAT conclusions are implemented as general binding rules. Therefore, instead of reviewing the permit after the publication of new BAT conclusions, operators are required to prepare an annual environmental report including a summary of all measures taken to ensure compliance with the general rules of consideration, the permit conditions and the BAT conclusions. A review of the permit is only required in case the installation is upgraded in response to the new regulations.

5.2 Challenges & Recommendations with regard to IED permitting

A common challenge for both the operators of IED installations and competent permitting authorities is the access to and evaluation of information on hazardous substances (e.g. standard hazardous substance reference lists). Textile operator frequently do not provide sufficient information on chemical products used. Thus, the required competent assessment of the chemical products used (i.e. chemical product by chemical product) cannot be carried out. Although it is the duty of the operator to submit sufficient data, the competent authority is responsible to inform the operator about the extent and format of required chemical information. Most operators simply compile chemical information from the MSDS and send a simple list together with the MSDS for all chemical products used. The evaluation of this rarely processed chemical data is often too time consuming for the competent authority. Although there are first approaches to standardise the IED application requirements with regard to information on chemicals used (e.g. ELiA Germany), most IED requirements regarding the provision of information on used (hazardous) substances are by no means standardised at both international and national levels. Therefore, Section 3.2.3 and BAT 1 in Annex 2 of this Report provide an overview of chemical information requirements that should be available during IED-permitting.

Other challenges with regard to the evaluation of the data provided in the IED application on the chemicals used in operations include the lack of systematic procedures and compilations / database of available references. This is particularly relevant as spot checks of MSDS often show significant lapses and inconsistencies of the information contained. A verification of the contained information thus requires well-founded expert knowledge. In case a chemical supplier fails to provide MSDS with sufficient quality, it is the duty of both the operator and the competent authority to demand the missing information. To highlight and explain the different qualities of MSDS Annex 4 provides a Best and a Worst Practice example.

Availability of staff and technical capacities pose a particular challenge for competent authorities. Short-staffed authorities are not able to dedicate enough time to each IED installation, hampering their ability to carry out sufficiently extensive and in-depth evaluations of chemical inventories or look for more detailed information, which may be available but cannot be identified and assessed due to time constraints and limited human resources. The same is true for analysing measurement results in the context of the respective processes and mass flows (input materials, behaviour of substances in treatment plants, production and products). Ideally, the staff composition of relevant authorities would bring together expertise in the areas of chemical and environmental engineering, legal requirements and sectoral process technology. With respect to proper chemicals management, the staff of competent authorities should include chemists, chemical engineers or environmental engineers with a chemical background. Competent authorities might also benefit from establishing chemical expert units that can support their colleagues with respect to chemicals management (see 5.1.3). With regard to chemical references it would be of significant assistance to the work of the competent authorities if a national or international body were to check all available regulatory references to textile-specific chemicals and make the results available to both operators and the competent authorities. It is further recommended to develop standard provisions and specifications for chemicals management, complemented by appropriate training for the staff of the competent authority.

Certainly, the format for a chemical inventory should be standardised. An appropriate approach is given in Annex 4. It is the duty of the operator to provide information in a way that it can be quickly assessed and that conclusions in the form of permit requirements, stipulations and conditions can be drawn more easily.

6 Annexes

Annex 1 – Prevalent environmental and health hazards

Hazard Statement	Meaning	Process area where prevalent	Substance categories
Environmental hazards			
H400	Very toxic to aquatic life	Dyeing	Dispersing agents and protective colloids; e.g. Dye pigments, Disperse dyestuffs; Anti-micro biotics; coating agents; anti-mosquito finishing agent
H410	Very toxic to aquatic life with long-lasting effects	Dyeing Finishing	Dyestuff and Pigments, Basic textile chemicals e.g. Disperse dyestuffs, softener, anti-mosquito finishing agent, stabiliser
H411	Toxic to aquatic life with long-lasting effects	Dyeing Finishing	Dyestuff and Pigments; Basic textile chemicals; Textile auxiliaries for dyeing and printing e.g. Acid dyestuffs; Anti-micro biotics, softener, defoaming agent, stabiliser
H412	Harmful to aquatic life with long-lasting effects	Pre-treatment Dyeing Finishing	Reactive dyestuffs, Vat dyestuffs, Repellents; Conditioning agents; Handle-imparting agents; Levelling agents, Detergents, dispersing and emulsifying agents, coating agents , wetting agents, anti-flammable finishing agent, stabiliser
H413:	May cause long-lasting harmful effects to aquatic life	Pre-treatment Dyeing Finishing	Disperse dyestuffs, softener;
Health hazards			
H300	Fatal if swallowed	Dyeing	Dyestuffs
H350/H350i	May cause cancer	Finishing	Agents for the improvement of crease and shrink resistance; Coating agents
H360	May damage fertility or the unborn child	Dyeing and printing Finishing	Reducing agents; coating agents; levelling agent
H351	Suspected of causing cancer	Finishing	Anti-flammable finishing agent, cleaning agent (solvent based)
H341	Suspected of causing genetic defects	Finishing	Coating agents
H370	Causes damage to organs	Finishing	Agents for the improvement of crease and shrink resistance

Hazard Statement	Meaning	Process area where prevalent	Substance categories

Note:

The below categorisation of hazards is based on

- IFA Column model **www.dguv.de/medien/ifa/en/pra/ghs_spaltenmodell/spaltenmodell_2017_en.pdf**, developed by the Institute for Occupational Safety and Health of the German Social Accident Insurance (IFA) and
- UBA Guideline on Sustainable Chemistry **www.umweltbundesamt.de/sites/default/files/medien/479/publikationen/161221_uba_fb_chemikalien_engl_bf.pdf**

Very high priority in terms of environmental hazards:

(1) Substances/mixtures acutely hazardous to the aquatic environment, Cat. 1 (H400)
(2) Substances/mixtures chronically hazardous to the aquatic environment, Cat. 1 (H410)
(3) Substances/mixtures of German Water Hazard Class WGK 3
(4) PBT substances
(5) vPvB substances

High priority in terms of environmental hazards

- Substances/mixtures chronically hazardous to the aquatic environment, Cat. 2 (H411)
- Substances hazardous to the ozone layer (H420)

Medium priority in terms of environmental hazards

(1) Substances/mixtures chronically hazardous to the aquatic environment, Cat. 3 (H412)
(2) Substances/mixtures of German Water Hazard Class WGK 2

Very high priority in terms of health hazards

(1) Acutely toxic substances/mixtures, Cat. 1 or 2 (H300, H310, H330)
(2) Carcinogenic substances/mixtures, Cat. 1A or 1B (H350, H350i)
(3) Carcinogenic activities or processes according to TRGS 906
(4) Substances/mixtures mutagenic to germ cells, Cat. 1A or 1B (H340)

High priority in terms of health hazards

(1) Acutely toxic substances/mixtures, Cat. 3 (H301, H311, H331)
(2) Substances/mixtures toxic in contact with eyes (EUH070)
(3) Substances/mixtures that in contact with water or acids liberate toxic gases (EUH029, EUH031)
(4) Substances/mixtures with specific target organ toxicity (single exposure), Cat. 1: Organ damage (H370)
(5) Skin sensitising substances/mixtures (H317, Sh)
(6) Substances/mixtures that sensitise the respiratory organs (H334, Sa)
(7) Substances/mixtures corrosive to the skin, Cat. 1A (H314)
(8) Substances/mixtures toxic to reproduction, Cat. 1A or 1B (H360, H360F, H360D, H360FD, H360Fd, H360Df)
(9) Carcinogenic substances/mixtures, Cat. 2 (H351)
(10) Substances/mixtures mutagenic to germ cells, Cat. 2 (H341)
(11) Substances/mixtures with specific target organ toxicity (repeated exposure), Cat. 1: Organ damage (H372)

Medium priority in terms of health hazards

(1) Acutely toxic substances/mixtures, Cat. 4 (H302, H312, H332)
(2) Substances/mixtures with specific target organ toxicity (single exposure), Cat. 2: Possible organ damage (H371)
(3) Substances/mixtures corrosive to the skin, Cat. 1B, 1C (H314, pH ≥ 11,5, pH ≤ 2)
(4) Eye-damaging substances/mixtures (H318)
(5) Substances/mixtures with corrosive effect on respiratory organs (EUH071)
(6) Nontoxic gases that can cause suffocation by displacing air (e.g. nitrogen)
(7) Substances/mixtures toxic to reproduction, Cat. 2 (H361, H361f, H361d, H361fd)
(8) Substances/mixtures with specific target organ toxicity (repeated exposure), Cat. 2: Possible organ damage (H373)
(9) Substances/mixtures that can harm babies via their mothers' milk (H362)

Annex 2 – BAT Recommendations

BAT 1

Establishment and use of a central chemical database as fundament and tool for systematic chemicals management

Description:

Textile finishing industries use a considerable number of chemical products[1] (100 – 300) for the different finishing processes (pre-treatment, dyeing, printing and final finishing). The chemical products have to be selected not only with respect to their finishing effects (desired product qualities) but also regarding their environmental properties (e.g. acute/chronic human and aquatic toxicity, biodegradability/eliminability).

Technical description:

In order to ensure the availability and completeness of information necessary for a responsible chemical management, the relevant data for the chemical auxiliaries and process chemicals used are entered, collected and managed in one dedicated database by the respective installation. From the collected data a tailored compilation and assessment of information can be generated which can serve the specific information requirements of different organizational units within the installation. The main and commonly used sources of data used for the different chemical products are the material safety data sheets (MSDS)[2] and to some extent the Technical Instruction Sheets. In order to allow just-in-time evaluations it is further important to link this data base with a comprehensive modern production planning and control system.

The data base serves as the starting point for making compilations and conducting evaluations relevant for the different chemicals management needs such as:

- Compilation of all products in forms showing the information for the products grouped as follows (see example in Annex 6), for example in form of a chemical inventory
- Identification of chemical products with acute aquatic toxicity
- Identification of chemical products which are readily, inherently or non-biodegradable in industrial wastewater treatment
- Identification of all combustible/flammable products and those which can decompose (thermally or by reaction with other chemicals)
- Compilation of relevant data required for planning and implementing adequate storage and handling
- Assessing compatibility of substances and preparing according storage layout plan
- Compilation of data relevant for communication, reporting and/or certification purposes such as for authorities or customers (e.g. Oekotex STeP[3], GOTS[4])

[1] Chemical products are those which are provided from chemical suppliers. These products are usually formulations containing different chemical substances. For textile finishing, according to specific recipes, different chemical products may be mixed prior to their application.

[2] The short-comings of MSDS in terms of their comprehensiveness and quality of information need to be taken into account and may require further inquiries with the chemical supplier, particularly as far as the complete disclosure of chemical product compositions is concerned.

[3] Oekotex Sustainable Textile Production (STeP)

[4] Global Organic Textile Standard (GOTS)

- Cross-referencing with manufacturing restricted and/or positive substances lists (e.g. ZDHC Manufacturer restricted substances list, bluesign® system substances list), specific customer restricted substances lists or other lists (e.g. ECHA-SVHC list)

Concerning emissions to air from stenters, special reference is made to the product-specific emissions factors for chemical products used for final finishing on these machines (also see Textile BREF, 2003)[1]. From the emission factors for the various products, the emission factors for applied recipes (formulation of different chemical products) can be calculated and compared to specific emission limit values.

Achieved environmental benefits:

The chemical inventory derived from the data base, combined with different filtering and evaluation options allows for a systematic identification of substances with undesirable environmental and toxicological (adverse) properties. This is turn facilitates the systematic planning and monitoring of an improvement in the selection of chemical products in terms of avoidance of hazardous substances. Among others, this also helps streamlining the coordination with chemical suppliers asking for products with improved environmental properties.

Environmental performance and operational data

The data from the 16 sections of the respective MSDS (as per European CLP/GHS) is systematically inserted into the data base, enabling different options of evaluation:

- Section 1: Identification of the substance/mixture and of the company/undertaking
- Section 2: Hazards identification
- Section 3: Composition/information on classified ingredients[2]
- Section 4: First aid measures
- Section 5: Firefighting measures
- Section 6: Accidental release measure
- Section 7: Handling and storage
- Section 8: Exposure controls/personal protection
- Section 9: Physical and chemical properties
- Section 10: Stability and reactivity
- Section 11: Toxicological information
- Section 12: Ecological information
- Section 13: Disposal considerations
- Section 14: Transport information
- Section 15: Regulatory information
- Section 16: Other information

With regard to environmental protection, information on chemical composition of the respective chemical products, information on handling and storage as well as the ecological information are most relevant in practice.

Annex 6 shows an exemplary outline of a chemical inventory containing all relevant environmental data of chemical products used for dyeing which can be used for compilation of information or evaluation against certain criteria.

[1] For every chemical product which is used to create a formulation (mixture of different chemical products) which is applied on a stenter, the emission factor is determined by means of a laboratory stenter. Then, the emission factor for the formulation is calculated by using the factors of the different components. This factor is compared with the emission limit. Every three years, the calculated emission factors of the formulations with the highest factors are verified by onsite measurements by a certified third party measurement firm.

[2] If possible, the complete composition of the product

Concerning emissions to air from final finishing processes on stenters, the required emission factors for the various products are not contained in the MSDS but have to be provided separately by the suppliers. Thus, updating information on emissions factors for the products concerned requires regular contact to chemical suppliers. To date, only one German company has established a laboratory stenter to determine the emission factors for the chemical products. However, any concerned company can also establish such a facility.

Cross-media effects:

No cross-media effects expected.

Technical consideration relevant to applicability:

This measure is applicable to any textile finishing industry. It is then part of Good Housekeeping and responsible chemicals management. The necessary software application for the establishment and implementation of such a data base and respective evaluation tools can be either obtained by a range of providers available on the market (as part of an integrated business or stand-alone application) or developed in-house for smaller inventories.

Economics:

The investment and operating costs for a chemical data base depend on the level of sophistication intended. Preliminary estimates put the investment costs into the range of 20,000 to 50,000 €. Savings usually arise from streamlined stocks, improved management of surplus chemicals, simplification or automation of procedures/processes (e.g. by using chemical inventory software) as well as indirectly from reduced environmental management costs based of the gradual substitution of hazardous chemicals and emissions to the environment.

Driving force for implementation:

Substitution of hazardous substances

Availability and maintenance of chemicals management have become a common requirement in international supply chain management. Buyers` Code of Conducts commonly refer to the need of maintaining and using an up-to-date inventory of all substances used (see for example: Sustainable Apparel Coalition-Higgs FEM, Zero-Discharge of Hazardous Chemicals - ZDHC).

Companies may be required by law to maintain a chemical inventory (see for example German Hazardous Substances Ordinance (GefStoffV), section 3, para 6, point 12, revised 29th March 2017, see translation of relevant point in subnote[1])

A chemical product database allows continuous improvement in the selection of chemical products according to the environmental performance of their ingredients. It further helps to optimize production performance by improving and simplifying production planning and control systems (Performance data is included) and the operation of industrial wastewater treatment plants.

With respect to emission to air from stenters, a successful realization of a chemical database also allows the implementation of the emission factor concept (see section 4.3.2, Textile BREF, 2003). This in turn enables the calculation of emissions to air of different recipes, thus simplifying compliance with emission limit values and prescribed documentation duties.

[1] **www.baua.de** – "…. the employer must keep a list of the hazardous substances used in the company in which reference is made to the corresponding safety data sheets. The list must contain at least the following information: 1. the name of the dangerous substance, 2. classification of the hazardous substance or information on its hazardous properties, 3. information on the tonnage ranges used in the establishment, 4. designation of the working areas in which employees are exposed to the hazardous substance…"

Example plants:

Many textile industries in and outside Europe have established and use such a chemical as an integral part of their production planning and control system.

Reference literature:

- Chemical Management System Guidance Manual, Zero Discharge of Hazardous Chemicals (ZDHC), 2015, Section 2.1.4 Creating a Comprehensive Chemical List **www.roadmaptozero.com/fileadmin/layout/media/downloads/en/CMS_EN.pdf**
- GIZ Practical Chemical Management Toolkit, 2017.
- German TRSG 400, section 5.8 Hazardous Substances Lists.
- Chemical Inventory Collection Template, Partnership for Sustainable Textiles, **www.textilbuendnis.com/wp-content/uploads/2018/03/Partnership-for-sustainable-textiles-Chemical-Inventory-Collection-Template_bsv.xlsx**
- Supplier Handbook Chemical Management – Section: Documentation (Inventory/MSDS) **www.tchibo.com/servlet/cb/1199382/data/-/TrainingshandbuchChemikalienmanagement.pdf**

BAT 2

Proper unloading, storage and handling of chemicals

Description

Textile finishing industries use various chemical products in significant quantities. Their labelling and handling according to their risk potential for water and solid contamination is a pre-requisite for preventive measures. In Germany, the Water Hazard Classification (WGK) scheme has been introduced more than 20 years ago and proven to be successful in grouping chemicals accordingly. In order to avoid hazards and accidents, including accidental release of chemicals into the environment threshold values have been developed which concern the quantities stored and specify respective protective measures to be taken[1]. Chemical products, exceeding these quantitative threshold values are required to be received and unloaded in secured areas, stored properly and handled safely as part of general good chemical management practices.

Technical description

In order to prevent any unintended release (accidental release) of chemicals certain precautionary measures are to be taken. Liquid-bulk chemicals require dedicated areas for their unloading and shall be stored in double-walled tanks with overfill protection and leakage detection. Intermediate bulk containers and drums are to be stored at collection points where the minimum volume of the catchment facility determines the volume of the largest container or drum. Examples for proper unloading, storage and handling of chemicals are provided under “Environmental performance and operational data”.

When storing chemicals, it is of particular importance to check for their respective storage compatibilities as certain chemicals cannot be stored together. In order to identify potential storage incompatibilities of chemicals, chemical segregation charts are available. Examples for chemicals with special storage requirements are hydrogen peroxide which shall be stored separately in a dedicated catchment facility and sodium dithionite which shall be even stored in a separate dry room. Chemical segregation charts (see figure 1 for an example from the German Technical Rule for Hazardous Substances TRGS 510 (2013) in section “Environmental performance and operational data”) should be used together with information gathered from the corresponding Material Safety Data Sheets (MSDS).

In addition to the measures described above, the following general measures should also be implemented:

- Any production and storage facility should be tight, bearing, robust and thermally and chemically resistant
- Any leakage should be detectable fast and reliably
- Catchment facilities should not have a drain
- Storage facilities should be equipped with sufficient lighting and ventilation
- All chemical products should be labelled clearly and unambiguously
- The entire staff should regularly receive competent training
- Emergency exits and escape routes shall be provided

[1] For hazardous substances, dedicated storage is required for highly toxic substances (H Statements 300, 301, 310, 311, 330, 331, 370, 371) at quantities of more than 50 kg, for CMR substances (H Statements 340, 350) at quantities of more than 50 kg, for easily or highly inflammable substances (H Statements 224, 225, 226) at quantities of more than 20 – 100 kg, for substances which decompose at contact with water (H Statements 260, 261) at quantities of more than 200 kg, oxidizing substances (H Statements 271, 271) at quantities higher than 50 kg (Technical Rules for Hazardous Substances TRGS 510).

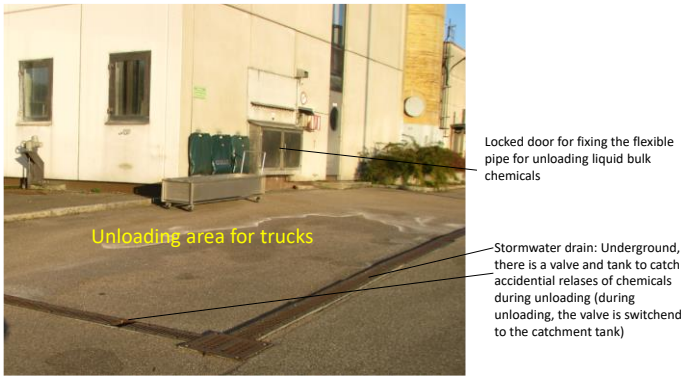
Concerning water hazard classification (German Regulation concerning installations handling substances hazardous to water - AwSV), the different categories for volumes stored are 0.22 – 1, 1 – 10, 10 – 100, 100 – 1000, and > 1000 m^3 or t m^3 or t, and the measures to be taken also depend on the category; there are three categories: 0, 1, 2, and 3. The higher the figure the more hazardous is the substance or chemical product.

Achieved environmental benefits

Proper unloading, storage and handling of chemicals, combined with a general staff awareness of hazards and a high level of precaution, can significantly reduce the likelihood of accidental release of chemical products used for textile finishing.

Environmental performance and operational data

The following table outlines exemplary measures (common good chemicals management practices) for the proper discharge, storage and handling of chemical products:

Dedicated unloading area with precautionary measures in case of spillages for liquid bulk chemicals; typically acetic acid, NaOH, KOH, H_2O_2, urea, main surfactants; stormwater drain needs to be connected to the treatment plant. (Photo: Dr. Harald Schönberger)	
Double-walled tanks with overfilling prevention and leakage detection for bulk chemicals (NaOH, KOH, H_2O_2, detergents, urea); explosion prevention is required for H2O2 (also a safety relief valve and an over-roof pipe). (Photo: Dr. Harald Schönberger)	
Single-walled tank are placed in a catchment facility where its volume shall be determined by the volume of the tank, or, where several tanks are placed in one catchment facility, the volume of the largest tank. (Photo: Dr. Harald Schönberger)	

All IBCs, small tanks and drums are placed on catchment facilities (secondary containments) (secondary containment units should be able contain 10% of the total volume of all containers or 100% of the largest container; holding capacity ideally 110% of the maximum capacity of the largest tank or drum). (Photo: Dr. Harald Schönberger)	

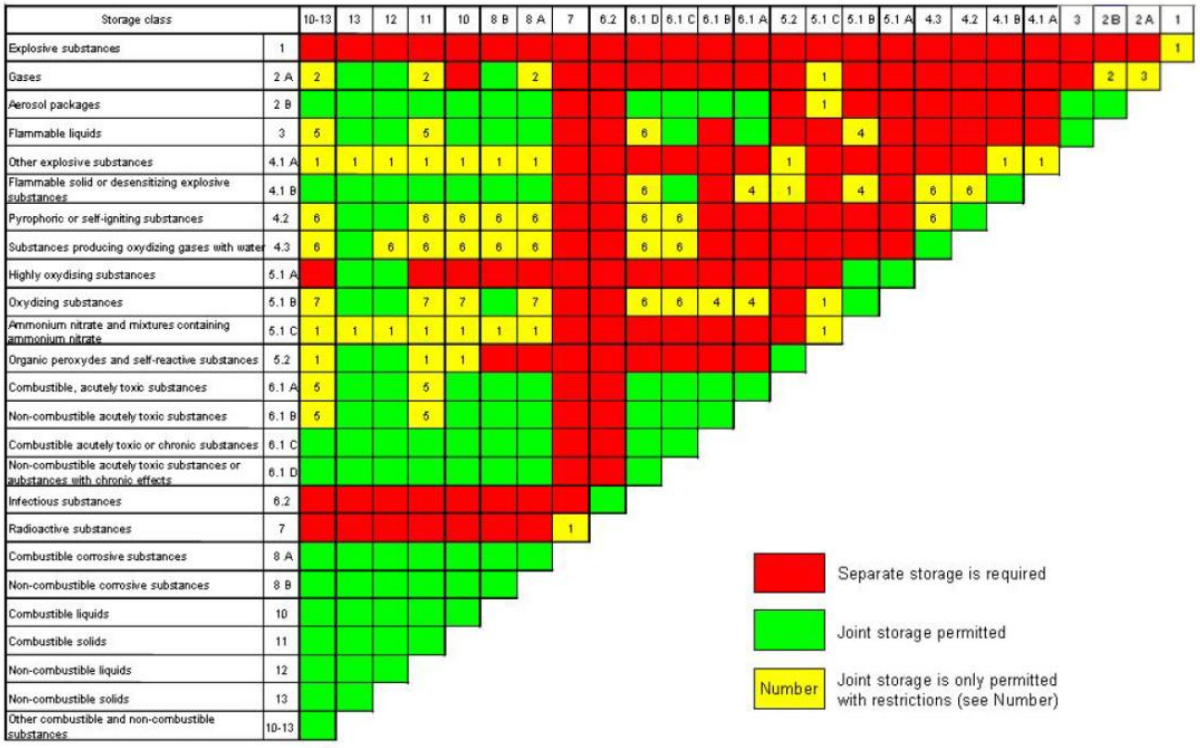


Figure 6: Storage class compatibility check used in Germany

Note: The figures in the first row as well as in the second column correspond to the designated “storage groups/classes” which may be given for the chemical product in the MSDS (ref. section 7). Alternatively, storage classes can be assigned using the procedure as outlined in annex 4, of BG RCI Code of practice M 062e, Hazardous Substances - Storage of Hazardous Substances, BG RCI (November 2013). This not only forms the basis for the development of a chemical storage (layout) plan but also serves as an instrument for reducing the risk of adverse effects emanating from accidental mixing of incompatible chemicals during further handling and disposal.

Technical consideration relevant to applicability

There are no technical restrictions known for the applicability of the measures described.

Economics

There are no precise figures available yet for the different measures described. Potential savings arise from reduced risks of uncontrolled reactions and connected costs (losses, damages, insurance costs).

Driving force for implementation

Proper unloading, storage and handling of chemicals is a common compliance requirement for many companies adhering to environmental management systems. In addition, the measures described above facilitate the receipt of insurance benefits and help to meet the necessary requirements of the competent authorities.

Example plants

Many textile finishing industries in Europe apply measures described above, at least part of them.

Reference literature

- TRGS 510: Storage of hazardous substances in non-stationary containers, Technical Rule for Hazardous Substances, Version: January 2013, GMBl 2013 p. 446–475 of 15 May 2013 [No. 22], amended and supplemented: GMBl 2014 p. 1346 of 19.11.2014 [No. 66-67].
- Chemical warehousing - The storage of packaged dangerous substances, HSG71, HSE, UK, **www.hse.gov.uk/pubns/priced/hsg71.pdf**
- Hazardous Substances - Storage of Hazardous Substances, Code of practice M 062e, BG RCI, November 2013.
- Guidance on the compilation of safety data sheets, ECHA, Version 3.1, November 2015.

BAT 3

Separation and specific disposal of concentrates containing recalcitrant chemicals

Description

In wet textile processing various highly concentrated liquors or pastes are used. The required quantity of these residual padding liquors and printing pastes can be minimized by separating residues and disposing of concentrate in a targeted manner.

Technical Description

During textile wet processing, the following highly concentrated liquors or pastes are applied:

- Padding dyeing liquors for semi-continuous (cold pad batch) and continuous dyeing which may contain direct, reactive, vat, sulphur or disperse dyestuffs
- Printing pastes which may contain organic pigments, reactive, vat or disperse dyestuffs
- Padding liquors for final finishing; the chemicals used are very divers and depend on the targeted effect. They include amongst others softeners, optical brighteners, ethylene urea derivatives, flame retardants, oil and water repellents (organofluorine compounds are used), biocides (e.g. cypermethrine, zinc pyrithione etc.).

The required amount of residual padding liquors and printing pastes can be minimized by a number of techniques such as:

- Minimization of excess liquor/paste by automated liquor and printing paste preparation systems
- Minimization of the system volume for the application of the aforementioned concentrates (small-volume pipes, squeegees, screens and pumps in case of rotary printing)
- Minimized padder volume in case of semi-continuous and continuous dyeing and final finishing
- Just-in-time preparation of liquors.

All of the above techniques are comprehensively described in the Best Available Techniques Reference Document for the Textiles Industry from 2003 [Textile BREF, 2003].

The three aforementioned residues of liquors/ pastes have to be separated. While in the case of residual printing pastes this is easy to achieve, separating residual padding liquors from dyeing and final finishing requires additional efforts as the residual padding liquor has to be pumped from the padder to an intermediate bulk container (IBC) or another type of appropriate container. This can either be done automatically by adequate programming and the installation of valves or by using a manually operated pump to empty the padder and the residue in the padder liquor preparation tank.

Once separated the waste concentrates require further treatment. The various treatment options are indicated in Table 1.

Table 1: Technical options to treat/dispose residual padding liquors and printing pastes

Type of residue	Treatment option
Residual dyeing padding liquor	
Option 1	The residual dyeing padding liquor is oxidized (at least to fragments which arte biodegradable) by means of a wet oxidation process as described in the [Textile BREF, 2003]. This is possible for all relevant groups of dyestuffs such as reactive, direct, vat, sulphur and disperse dyestuffs
Option 2	In case of reactive dyestuffs, the dyestuffs can be precipitated/flocculated by means of an organic cationic flocculant. The sludge formed is separated by dewatering (e.g. in a chamber filter press) and disposed of in a BAT incineration plant.
Option 3	In case of vat and sulphur dyestuffs in their oxidized form as well as in case of vat dyestuffs, the dyestuffs can be separated by precipitation/flocculation by means of a combination of inorganic precipitating agents (iron or aluminum salts) and a polyelectrolyte. The sludge is separated by dewatering (e.g. in a chamber filter press) and disposed of in a BAT incineration plant.
Residual printing paste	
Option 1	In case of pigment printing paste, inorganic precipitating agents can be used. The sludge formed is separated by dewatering (e.g. in a chamber filter press) and disposed of in an incineration plant. It is also appropriate to directly incinerate the residual pigment printing paste.
Option 2	Residual paste containing reactive dyestuffs can be fed to an anaerobic digester as most (not all) reactive dyestuffs are azo dyestuffs and under anaerobic conditions, the azo groups are cleaved. However, the resulting aromatic amines are non-biodegradable and reach the aerobic part of a treatment plant with the digester´s overflow and the filtrate and can thus reach the natural water.
Residual final finishing padding liquor	
	There are many different chemical compounds used and each has its individual chemical properties. In general, it is best to directly incinerate the residual final finishing padding liquors unless the compounds exclusively consist of readily biodegradable compounds such as fatty acids esters applied as softeners.

Achieved environmental benefits

The segregation and specific disposal of the aforementioned concentrates can considerably reduce the load of non-biodegradable compounds and thus water pollution.

Environmental performance and operational data

Possibilities to segregate the residual padding liquors are shown in Figure 7 to Figure 9.

Figure 7: On the left, the photo shows the padder of a stenter and on the right an intermediate bulk container (IBC) equipped with a pump and pipes to manually empty the padder (Photos: Dr. Harald Schönberger)

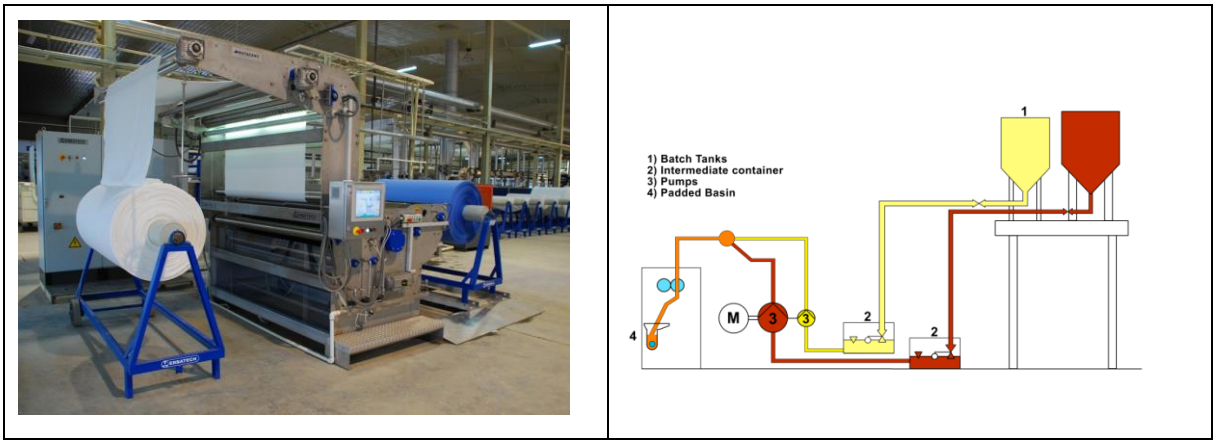


Figure 8: On the left, there is a cold pad batch dyeing facility with the padder and on the right a scheme showing the preparation and application of the dyeing padder liquor (preparation tank and padder) (Photo: Dr. Harald Schönberger)

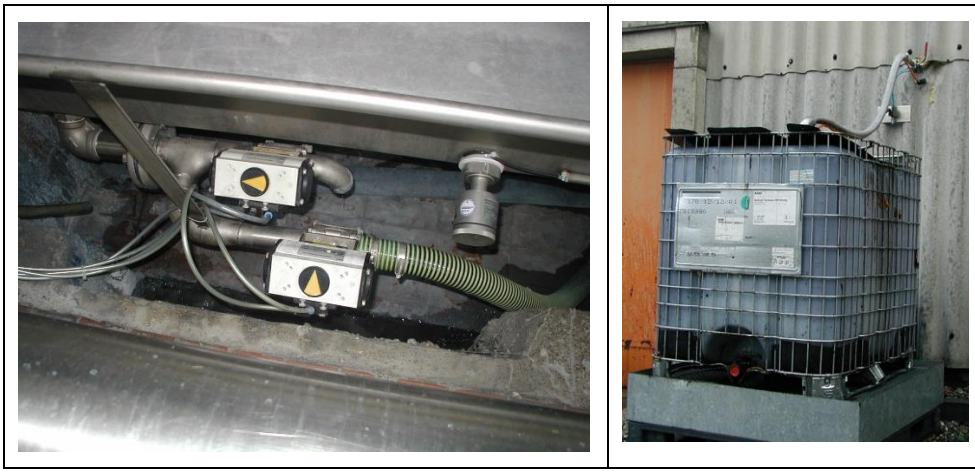


Figure 9: On the left, there is an automated system to segregate the residual dyeing padding liquor and on the right the IBC to collect it (Photos: Dr. Harald Schönberger)

Cross-media effects

As the residual padding liquors and printing pastes are incinerated (possible subsequent to precipitation/flocculation), additional emissions to air have to be considered. However, in waste

incineration plants which apply best available techniques, emission to air usually are very low so that the additional emission load caused by the incineration of concentrates is insignificant. In general the benefits of proper incineration easily outweigh the relatively low cross-media effects.

It is nevertheless important that the quantity of residues is minimized prior to disposal.

Technical consideration relevant to applicability

The technique is applicable for both existing and new installations. There are no technical restrictions with respect to the application of the technique.

Economics

For a padder, the investment costs for an automated system for the segregation of residual padding liquors (valves, tank below the padder from where the residual padding liquor is pumped to an IBC) are in the range of 20,000 – 30,000 €. Investment costs for the manually operated separation system (flexible pipes and a flexible pump) are around 5,000 €. Operating costs are negligible. The costs for the treatment of residual printing pastes and residual padding liquors depend on the techniques applied and may be in the range of a few €/t (in case of anaerobic treatment) to 300 – 500 €/t in case of direct incineration.

Driving force for implementation

The reduction of COD and colour load discharged as well as compliance with existing regulations are the main driving forces.

Example plants

AG Cilander AG, CH-Herisau (direct incineration of residual padding liquors), Textilveredlung an der Wiese and Lauffenmühle, both located in Loerrach/Germany (anaerobic co-fermentation of residual dyeing padding liquors in the municipal anaerobic digester).

Reference literature

Not available

BAT 4

Treatment of waste gas from stenters with special consideration of methanol

Description

In textile finishing, emissions of organic chemicals to air usually emanate from stenters and continuous dyeing of polyester. The release of methanol poses a particular problem which has to be addressed by adequate abatement measures such as the combination of various end-of-pipe techniques.

Technical description

Possible sources for emissions of organic compounds to air from stenters may include:

- Organic compounds present in the textile substrate from up-stream processes (fibre production, spinning, knitting) such as primary and secondary preparations, spinning and knitting oils
- Organic compounds from dyeing, printing or coating which then can be volatilized during stenter operation, such as carriers, levelling agents, after-treatment agents, wetting agents, hydrocarbons from printing pastes, acetic acid, tetrachloro ethene (if dry-cleaning is carried out) (Textile BREF, 2003)
- Organic compounds which are applied on the stenter and which may enter waste gas during thermal treatment in the stenter such as finishing agents (stiffening cross-linking agents), de-aeration agents, antistatic agents, softeners, optical brighteners, flame retardants, coating agents (e.g. polyvinyl acetate or polyurethane), easy-care finishing, finishing with oil or water repellents etc. (Textile BREF, 2003)
- The release of methanol poses a particular problem. For certain products, especially for men's shirts, moist cross-linking agents are applied at low pH value. Formerly, this process was connected to the release of significant amounts of formaldehyde. Today, however, chemical products are used that release methanol instead. In Germany, the emission limit value of methanol is 20 mg/Nm^3 which corresponds with an emission factor of 0.4 g methanol/kg textile processed. There are, however, cases where the untreated waste gas contains about 15 times higher concentrations and emission factors respectively
- Other possible sources, which will not be covered in the following, include emissions from coating facilities.

Measures to prevent the emission of organic compounds at the source have top priority. They include among other things the application of thermos-stable or more thermos-stable (compared to conventional products) preparations, the substitution of mineral oil in spinning or knitting oils and the use of easy-care finishing products which release no or very low quantities of formaldehyde or methanol. However, in many cases, the residual contamination is still high, making additional end-of-pipe techniques necessary. Here, a number of techniques, often combined with each other, are applied (e.g. scrubbers after heat exchanger followed by an electrostatic precipitator).

Achieved environmental benefits

The emission minimisation of organic compounds - determined in the form of the sum parameter volatile organic carbon (VOC), or detected as individual substances, such as formaldehyde or methanol (two compounds which are considered to be toxic) - as well as particulates and compounds causing odour nuisances is achieved.

Environmental performance and operational data

The design of an end-of-pipe treatment system depends on the type and concentration of pollutants. In the case of oily compounds and particles as well as some easily water-soluble compounds, a combination of a two stage heat exchanger, followed by a fine-mist scrubber and an electrostatic precipitator could for instance reduce the aforementioned components by 90 %. The scrubber can often further reduce the waste gas temperature which also improves the efficiency of the electrostatic precipitator. The combination of techniques described above is shown in Figure 1.

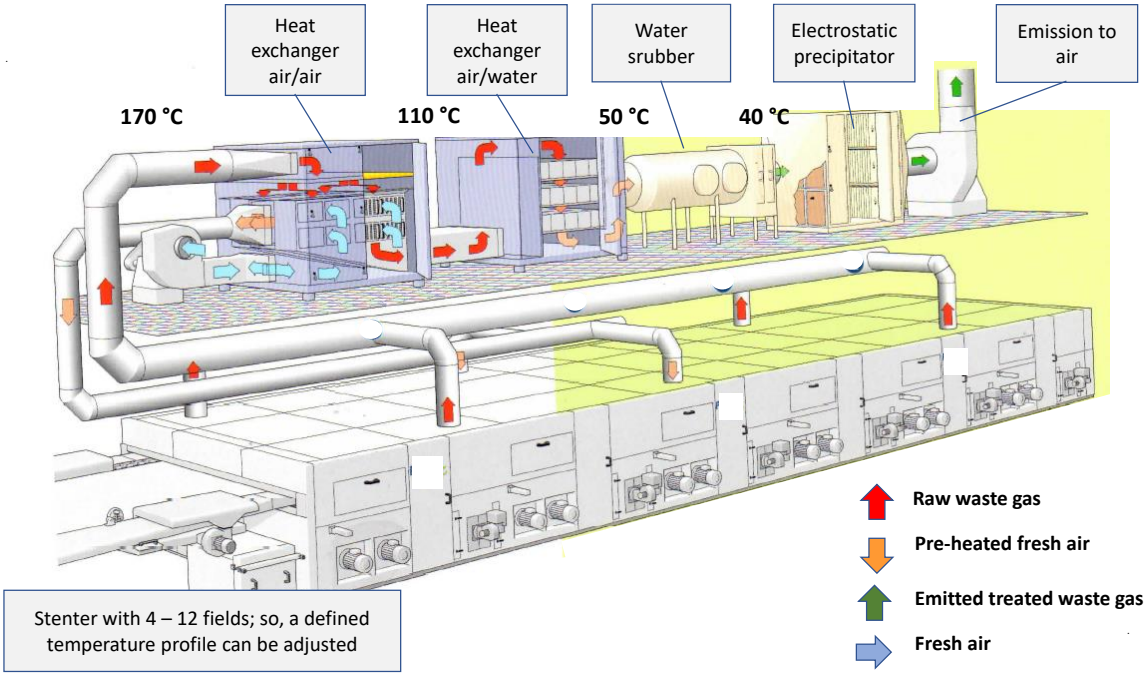


Figure 10: Combination of heat exchanger, fine-mist scrubber and electrostatic precipitator for the removal of oily and water-soluble waste gas components (Figure based on Brückner leaflet "ECO TECHNOLOGIES", 2019)

In case of formaldehyde, the scrubber can be operated with addition of hydrogen peroxide at alkaline pH value. The scrubbing liquor is usually circulated and thus warms up quickly.

In case of methanol, the removal efficiency depends on the concentration in the untreated waste gas, the quantity of water used for scrubbing and the temperature of the circulating scrubber liquor. A possible scrubber setup is shown in Figure 12.

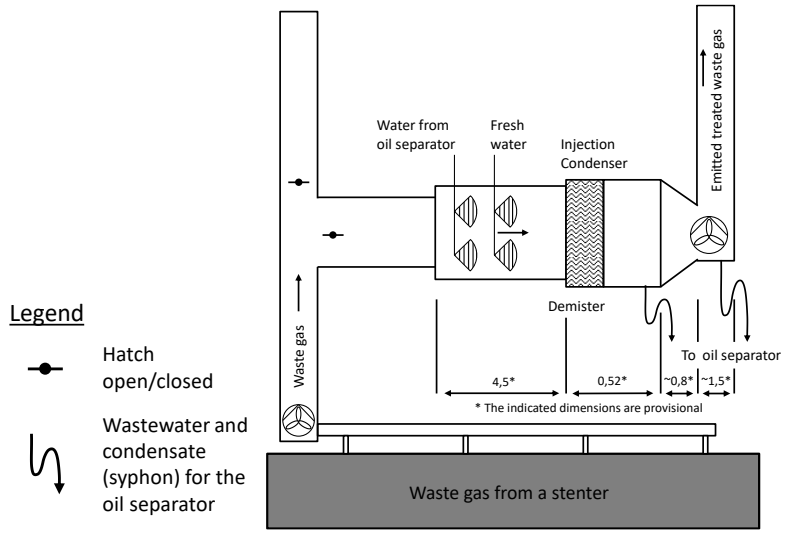


Figure 11: Scheme of a scrubber for the removal of water-soluble, partly also of water-insoluble, components; the scrubber water is sprayed as fine mist into the waste gas

Provided that the waste gas temperature is not higher than 50 °C after heat exchange, the specific water consumption is in the order of 0.2 – 0.4 l/Nm^3 for a methanol removal efficiency of 50 – 60 % and can be as high as 2 l/Nm^3 for a removal efficiency of about 90 %. However, by cooling the circulating scrubbing liquor, the specific water consumption for high removal efficiencies can be significantly reduced.

It is important to regularly clean the heat exchanger and the electrostatic precipitator. The required frequency depends on the type of compounds and their concentration in the untreated waste gas. For example, in case of raw fixation of synthetic knitwear, heat exchangers and electrostatic precipitators have to be cleaned very often, i.e. weekly.

Usually, a thermal treatment of waste gas from stenters (as coating is not covered here) is not considered as proportionate due to the low VOC content of the untreated waste gas (less than 500 mg/Nm^3) and the high energy consumption required for thermal oxidation.

Cross-media effects

In wet scrubbers, the pollutants are shifted from waste gas to waste water. However, they can easily be removed and broken down respectively by conventional wastewater treatment, such as separation of oily components in oil/water separators and biological treatment of biodegradable compounds, such as formaldehyde (the concentrations are low and thus it does not have an inhibiting effect) or methanol. The treatment can also be carried out in municipal or industrial wastewater treatment plants.

Technical consideration relevant to applicability

The technique can be applied both for existing and new installations. The combination of different components depends on the composition of organic compounds and has to be adapted accordingly.

Economics

The investment costs for heat exchange, fine mist scrubber and electrostatic precipitator for a stenter (based on a waste gas flow in the range of 7,000 – 10,000 Nm^3/h) is in the order of 200,000 €.

The operating costs relate to electricity and water consumption, costs for staff to carry out cleaning and other maintenance operations and the disposal of separated oil from the electrostatic precipitator.

Further costs can arise for chemicals dosed into the scrubber liquor. Exact cost calculations are not yet available.

Driving force for implementation

Regulatory requirements by competent authorities, requirements posed by customers and neighbourhood conflicts as well as the operator's intrinsic motivation to minimise emission to air are the main driving forces.

Example plants

A number of textile finishing industries in Europe apply techniques as described above.

Reference literature

Not available yet

BAT 5

Biological pre-treatment of PVA-containing segregated streams

Description

Polyvinyl alcohol (PVA) is the most important synthetic sizing agent in the textile sector and is increasingly used for high-speed weaving looms. During desizing (part of textile pre-treatment), PVA is virtually removed from the fabric. In principle, PVA is biodegradable, but only under certain conditions that must be adjusted and maintained in order to achieve high removal efficiencies.

Technical description

PVA is only biodegradable when certain system conditions are met. These include a wastewater temperature of more than 15 °C, a food-to-microorganism ratio of less than 0.15 kg BOD_5/kg MLSS x d and adaptation of the biomass (Schönberger et al. 1997). If in an industrial or municipal biological wastewater treatment plant these conditions cannot be maintained over the entire year (e.g. due to very low wastewater temperature in winter), additional biological pre-treatment is required. Possible measures include

- the precipitation with boron salts (not preferable as a sludge is generated very difficult to dispose of)
- the wet oxidation of the desizing liquor, preferably by a continuous Fenton's oxidation process (Textile BREF, 2003)
- biological pre-treatment in a membrane biological reactor (MBR)

It is recommended to use a MBR which is equipped with an ultrafiltration membrane, preventing residual PVA from leaving the reactor (as the size of this polymer is too large to pass the membrane). As a result the PVA is retained in the activated sludge system. The membrane can either be separately installed or directly submerged in the activated sludge tank.

Achieved environmental benefits

The emission of PVA to water bodies is drastically minimized over the entire year, including winter time with low wastewater temperature.

Environmental performance and operational data

Figure 13 shows an exemplary waste water treatment plant with PVA containing streams originating from two machines where desizing is carried out. The wastewater streams are then segregated by automated valves and directed to an equalization tank from where the streams are fed to the tube flocculator and subsequently to the membrane bio reactor (MBR). The food-to-microorganism ratio is about 0.2 kg BOD_5/kg MLSS x d. PVA is degraded between 95% and 98%, even at temperatures of 40 °C when it is usually not biodegradable anymore (Sträßner, 1994; Chamoun, 2018). To still enable biodegradation the PVA-degrading microorganisms have been adapted to elevated temperature levels.

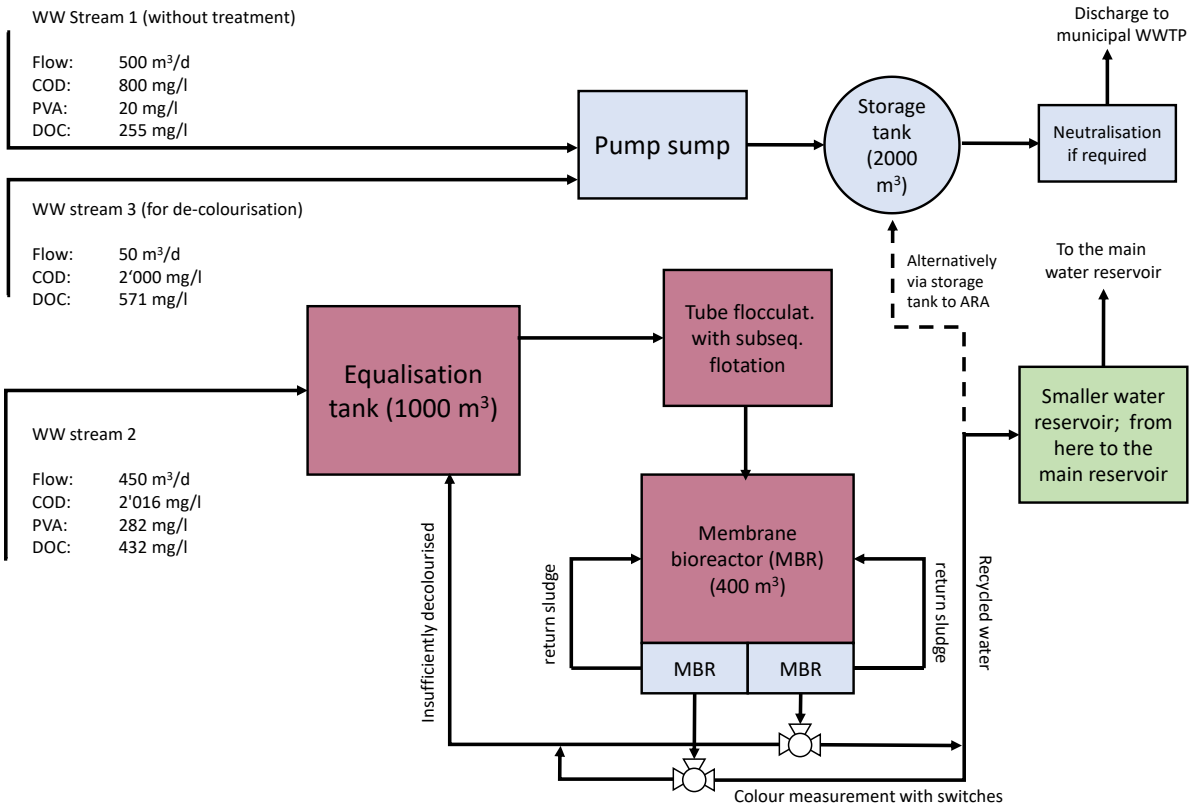


Figure 12: Figure 1 - Scheme of the wastewater pre-treatment plant with a membrane bioreactor (MBR) for the biological PVA degradation (based on: Wastewater disposal scheme of Cilander AG in CH-Herisau)

Cross-media effects

Compared to the treatment in a conventional activated sludge system or in a municipal wastewater treatment plant, biological treatment in a MBR requires additional energy as the energy consumption of a MBR plant is higher than that of conventional activated sludge systems.

Technical consideration relevant to applicability

The technique is applicable to both new and existing plants. However, in existing plants, sufficient space for equalization tanks and the MBR plant is a pre-requisite. Furthermore, in existing plants additional wastewater pipes have to be retrofitted to enable proper segregation of the different wastewater streams. It can be expected that low wastewater temperatures (where PVA degradation is low) usually only occur in municipal wastewater treatment plants in colder parts of Europe (e.g. Central and Northern Europe).

Economics

The investment costs for the plant shown in Figure 1 are about 1.5 million €. The treatment costs are about 1 – 1.5 €/m³.

Driving force for implementation

Strict requirements, emission limit values and the reduction of wastewater fees (in case of indirect discharge) are the most important driving forces for this technique.

Example plants

Cilander AG, Herisau/Switzerland

Reference literature

Chamoun, C.C. (2018), Study of the biodegradation of polyvinyl alcohol as a function of temperature, Master thesis at the Institut für Siedlungswasserbau, Wassergüte- und Abfallwirtschaft (ISWA) at the University of Stuttgart.

European Commission (2003). Best Available Techniques Reference Document for the Textiles Industry.

Schönberger H., Baumann A., Keller W. (1997). Study of Microbial Degradation of Polyvinyl Alcohol (PVA) In Wastewater Treatment Plants. American Dyestuff Reporter, 86(8), 9-18.

Sträßner, P. J. (1995). Optimierung des mikrobiellen Abbaus von Polyvinylalkohol. Hamburg-Harburg, Techn. Univ., Inst. Biotechnologie 2. Diss: 1995.

Annex 3 – Overview of selected references and tools

The following list provides an overview of available, sector specific tools for good chemical management of substances and mixtures (general and textile). The list does not claim to be an exhaustive list of references and tools which could be applied in the sector. Other tools may exist, or may be developed, which could also be considered for good chemicals management.

Name of source	Address/location	Description	Languages	Sector specific scope	Relevant Permitting Steps[1]
BAM dangerous goods database	**http://www.dgg.bam.de/de/index.htm**	The DANGEROUS GOODS database is part of a dangerous goods information system of the Federal Republic of Germany and provides processed and compressed information from the relevant dangerous goods regulations required for the safe transport of dangerous goods.	German		AA; R
BHive®	**https://www.thebhive.net/**	The tool developed by the Hongkong based organisation GoBlu aims at supporting users in quickly developing accurate chemical inventories and showcase chemical compliance. Using OCR technology software application allows the compilation of chemical inventory, cross-referencing and verifying the same against chemical database (including 45000 chemical products) and sustainability requirements of many brands/retailers. Based on the findings the users can decide which chemicals to keep and which to phase out.	EN, Chinese	Yes, prior registration required	PA

[1] I (Identification of the installation); PA (Permit Application); AA (Assessment of the application documents); PI (Involvement of the Public); PD (Permit Decision) M (Monitoring, reporting and inspections), R (Review of the Permit)

Name of source	Address/location	Description	Languages	Sector specific scope	Relevant Permitting Steps[1]
Chemical Management Guide for Textiles	**http://textileguide.chemsec.org/**	Based on a three step process, this tool by ChemSec (Sweden) helps users to find chemicals, evaluate them and act to replace the hazardous ones. The database can be searched by CAS number or chemical names, with further filters such as hazard groups (H-statements), functional groups as well as various substances lists including EU candidate and restrictive substances lists.		Yes	PA; AA; R

Name of source	Address/location	Description	Languages	Sector specific scope	Relevant Permitting Steps[1]
CHEmical Safety Assessment and Reporting tool (CHESAR)	**https://chesar.echa.europa.eu/home**	Chesar is an application developed by the European Chemicals Agency (ECHA) to help companies to carry out their chemical safety assessments (CSAs) and to prepare their chemical safety reports (CSRs) and exposure scenarios (ESs) for communication in the supply chain. Chesar enables registrants to carry out their safety assessments in a structured, harmonised, transparent and efficient way. This includes the importing of substance-related data directly from IUCLID, describing the uses of the substance, carrying out exposure assessment including identifying conditions of safe use, related exposure estimates and demonstrating control of risks. Based on this, Chesar automatically generates the CSR and exposure scenarios for communication as a text document, and export information on use and exposure to IUCLID. Chesar also facilitates the re-use (or update) of assessment elements generated in a single Chesar instance or imported from external sources.		general	PA, M

Name of source	Address/location	Description	Languages	Sector specific scope	Relevant Permitting Steps[1]
Database of the C+L directory at ECHA	**http://echa.europa.eu/de/information-on-chemicals/cl-inventory-database**	This database contains information on classification and labelling (C&L) of notified and registered substances submitted to ECHA during substance registration under REACH or notification under CLP, including harmonised classifications (Table 3.1 in Annex VI of CLP). ECHA maintains the list but does not check the validity of this information.	All European languages		PA, AA, R, M
Database on REACH-registered substances at ECHA	**https://echa.europa.eu/information-on-chemicals/registered-substances**	The data contained here are taken from the registration dossiers submitted to ECHA. In addition to the classification, this database also contains other information on the substances, such as physical data or study summaries.	All European languages	Yes, see findings of HAZBREF, WP2	PA, AA, R
ECETOC's Targeted Risk Assessment (TRA) tool	**http://www.ecetoc.org/tools/targeted-risk-assessment-tra/**	ECETOC TRA ("Targeted Risk Assessment") is a tool for exposure assessment, developed by the ECETOC research group. The instrument will be used as preferred level 1 model for workplace exposure estimation.	English		AA
eChemPortal by OECD	**http://www.echemportal.org**	The eChemPortal enables the search for reports and data sets of chemicals by substance name, CAS number and the like. It contains links to hazard and risk analyses and national and regional classifications. Information on exposure and use of the substances is also available.	English		PA, AA

Name of source	Address/location	Description	Languages	Sector specific scope	Relevant Permitting Steps[1]
ES Modifier	Not available	This tool, jointly developed by TNO (Netherlands), Confederation of Danish Industry was meant to support end users in checking and modifying suppliers exposure scenarios (ES) to fit their own conditions, formulators in preparing ES for preparations as well as support preparation of Downstream user Chemical Safety Reports (CSR).		Current status unknown	
European Union System for the Evaluation of Substances (EUSES)	**https://ec.europa.eu/jrc/en/scientific-tool/european-union-system-evaluation-substances**	EUSES was developed to enable government authorities, research institutes and chemical companies to carry out rapid and efficient assessments of the general risks posed by chemical substances	Various		AA
GESTIS Substance Database	**www.dguv.de/ifa/stoffdatenbank**	The GESTIS substance database contains information on more than 8700 substances with regard to identification, physical, toxicological and eco-toxicological properties, occupational medicine, first aid and safe handling as well as relevant regulations. Information on classification and labelling is partly taken from MSDS from manufacturers or distributors.	German, English		PA, AA, R

Name of source	Address/location	Description	Languages	Sector specific scope	Relevant Permitting Steps[1]
GisChem Hazardous Substance Information System of the German Employers' Liability Insurance Association for Raw Materials and Chemical Industries (BG RCI) and the German Employers' Liability Insurance Association for Wood and Metal (BGHM)	**http://www.gischem.de/suche/index.htm**	The database contains data sheets and draft operating instructions. The search for hazardous substances can be carried out by name, CAS no., branches of industry or procedure. In addition, selection is also possible via a complete list. Under the GisChem Interactive the site also offers free-of-charge assessment tools such the “mixture calculator” which provide assistance in finding the correct classification and labelling for any substance mixtures whatsoever in the GHS system	German, with sections in English		PA, AA, R
GSBL - Common Substance Data Pool Federation/States	**http://www.gsbl.de/**	In the data pool of the BMU and the environment ministries of the German states, up-to-date, comprehensive information on environmentally relevant properties of chemical substances and mixtures is available for all areas of environmental protection and hazard prevention. Access to the complete GSBL database is reserved for representatives of the authorities.	German		PA, AA, R

Name of source	Address/location	Description	Languages	Sector specific scope	Relevant Permitting Steps[1]
Hazardous substance database of the Federal states in Germany (GDL):	**https://www.gefahrstoff-info.de/**	The common hazardous substance database of the authorities of all federal states responsible for the state monitoring of hazardous substance legislation in the field of occupational health and safety (GDL) contains information on hazards and protective measures as well as legal regulations/limit values of individual substances and substance groups. Important aspects from relevant national and EU legislation are integrated into the database on a substance or substance group basis.	German		AA, M, R
IGS - Information system for hazardous substances:	**http://igsvtu.lanuv.nrw.de**	IGS is provided by the State Office for Nature, Environment and Consumer Protection of North Rhine-Westphalia. In IGS-Public, the publicly accessible part of the substance data information system, the focus is on the substance-related mapping of legal sources.	German, English		PA, AA, R

Name of source	Address/location	Description	Languages	Sector specific scope	Relevant Permitting Steps[1]
Information about Chemicals	**https://echa.europa.eu/information-on-chemicals**	Important and comprehensive source of information on chemicals produced in or imported into Europe. It covers hazardous properties, classification, labelling and information on their safe use. Since 20 January 2016, information on some 120,000 chemicals has been available in complex form. It is divided into three levels: an information map, a short profile and detailed source data. Statistical evaluations of the different classifications from the C&L inventory are also available for many substances.	All European languages		PA, AA
KemiDigi	**https://www.kemidigi.fi/**	KemiDigi is a national chemical information resource and service which pulls together national chemical data. KemiDigi aims to create a streamlined electronic service for companies managing their reporting obligations related to chemicals. The core elements of KemiDigi comprises (i) a chemical register of the dangerous chemicals on the market; (ii) a substance register of substances and the groups comprising the substances; and (iii) lists of chemicals by companies, which utilise information from the chemical and substance registers.	Finnish, Swedish, English		PA, AA

Name of source	Address/location	Description	Languages	Sector specific scope	Relevant Permitting Steps[1]
Norwegian Chemical database	**http://miljodirektoratet.no/kjemikaliesok/**	This database is a search tool for substances, by name or CAS- and EC-numbers. The search results in which chemical regulations a substance is covered by the national priority list, REACH candidate list, REACH authorisation list, REACH restricted substance list, CLP and possible other regulations like for biocides.	Norwegian		PA, AA, R
OECD Substitution and Alternatives Assessment Tool Selector	**http://www.oecdsaatoolbox.org/Home/Tools**	This websites allows the user to identify and link to various tools designed for providing information on online resources and software that can be used in conducting chemical substitutions or alternatives assessments. The Tool Selector is divided into two categories: (i) Tools, which provide users with the ability to evaluate a chemical, material, process, product and/or technology for attribute analysis with an alternatives assessment, and (ii) data sources, which contain a repository of organized information but no mechanism for data manipulation for outside users.			PA, AA, R, M

Name of source	Address/location	Description	Languages	Sector specific scope	Relevant Permitting Steps[1]
Other tools					
PRIO (Sweden)	**https://www.kemi.se/en/prio-start**	PRIO was developed by the Swedish Chemical Inspectorate (KEMI) to help eliminate high hazard chemicals from products to meet the Swedish government's goal of a "non-toxic environment" by 2020. PRIO contains a database of chemicals of high concern to human health and the environment, which are divided into "phase-out" or "priority risk reduction" chemicals. “Phase-out” chemicals should be avoided or substituted, and the tool provides a seven step process for identifying safer alternatives. For “priority risk reduction” chemicals, further assessments are recommended to ensure risk minimization. Users search databases based on authoritative lists by specific substance, hazard properties, chemical category, or specific database. If a specific substance is not in the database, users can research substance properties and compare against PRIO criteria.	Swedish		AA, M, R
REACH Arbeitshilfe Abwasser des Verbandes TEGEWA				Discontinued	

Name of source	Address/location	Description	Languages	Sector specific scope	Relevant Permitting Steps[1]
Rigoletto (UBA)	**https://webrigoletto.uba.de/rigoletto/public/language.do;jsessionid=A3C82B85A5DC7C9949C6472AAFE1ECDD?language=english**	This web-based information tool has been established by the Umweltbundesamt, Germany to support users in determining the water hazard classes (WGK) of substances and mixtures (e.g. 1: slightly hazardous to water, 2: obviously hazardous to water, 3: highly hazardous to water.) on the basis of the Ordinance on Facilities for Handling Substances that are Hazardous to Water (Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen (AwSV)) of 18 April 2017	German/ English		PA, AA, R
SPIN - Substances in Preparations in Nordic Countries	**http://spin2000.net/**	SPIN is a database on the use of Substances in Products in the Nordic Countries. It is a public accessible database, which can be used free of charge. The user can find information on the chemicals that are used in the Nordic countries. The information includes quantities, industries in which it is used (NACE and national) and the function it is used for (USE Category).	English		AA
Stoffenmanager	**https://gestis.stoffenmanager.com**	Developed by TNO (Netherlands, Arbo Unie and BECO (EY) in 2003, this online instrument helps users identify the chemical hazards, control the exposure at workplaces and communicate in an understandable, transparent manner to managers, employees and external stakeholders, thus helping them to comply with the regulatory and broader ethical and sustainability requirements.	German, English	General comment: Paid and free version	PA

Name of source	Address/location	Description	Languages	Sector specific scope	Relevant Permitting Steps[1]
SubSelect (UBA)	**https://www.umweltbundesamt.de/en/document/subselect-guide-for-the-selection-of-sustainable**	This guide helps you to select more sustainable chemicals. The selection of sustainable chemicals has beneficial effects for occupational safety, consumer and environmental protection. In the medium run, sustainability leads to more innovative uses of chemicals, and is therefore also economically attractive. More sustainable products mean: fewer pollutants, greater acceptance, less adverse impacts on the environment and to society, with simultaneous success in the market. SubSelect help you as a manufacturer, formulators or end users of substances to put a greater emphasis on sustainability aspects: in the selection of substances and use of chemicals in the company.	German, English, Baltic languages		R
UBA - Checklist based on best available techniques in the textile industry	**https://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/4294.pdf** **https://www.umweltbundesamt.de/en/document/checklists-on-best-available-techniques-for-the**	This checklist-based tool supports the identification of improvement potential regarding the environmental impact in the textiles industry. It is based on a comprehensive technical analysis of the European textile industry and refers to currently available technologies.	German, English	Yes, in line with BREF TXT, 2003	R, AA

Name of source	Address/location	Description	Languages	Sector specific scope	Relevant Permitting Steps[1]
ZDHC Gateway – Chemical Module*	**https://www.roadmaptozero.com/gateway/**	Under the umbrella of the Zero Discharge of Hazardous Substances (ZDHC) initiative, the ZDHC an online search tool that enables textile, apparel, leather and footwear suppliers to evaluate the ZDHC Manufacturer Restricted Substances List (MRSL) conformance level of chemical formulations used in production processes.	EN	Yes, prior registration required	R, AA
EUSES	**https://ec.europa.eu/jrc/sites/jrcsh/files/EUSES_2.1.2_installation_and_docs.zip**	Estimate Predicted Environmental Concentrations (PEC) - The European Union System for the Evaluation of Substances (EUSES) is a free tool developed by the European Commission to assist authorities, research institutes and companies to estimate environmental exposure levels of industrial chemicals and biocides. EUSES is easy to use. Only a few data on substance properties are needed to calculate PECs for tier 1 assessment. If the use of default exposure estimates and tier 1 assessment do not lead to PEC/PNEC<1, a refined assessment is possible in EUSES by including more specific information on releases.			

Annex 4 – Material Safety Data Sheets Examples

Best Practices Example MSDS

The following table include an example and description of good practice for selected sections of a good MSDS. The selection of the sections covered is based on a technical assessment of their relevance for good chemical management. Where appropriate, the sections also include a brief explanation of the contents and recommendations for operators and competent IED authorities on how to use the information contained. Further guidance on the assessment and correct use of MSDS is provided in the ECHA "**Guide on Safety data sheets and Exposure scenarios**".

It is outstanding that the following MSDS provides information on a number of chemical substances contained such as toxicological and ecotoxicological data and information on biodegradability/bioeliminability for individual substances rather than information for the chemical product as a whole which is a mixture of many chemical substances. The bad example contrasts sharply to the good example. The Worst Practice MSDS on the other hand does not even follow the MSDS standard structure as indicated in the aforementioned ECHA "Guide on Safety data sheets and Exposure scenarios and BAT 1 in Annex 2.

MSDS Section	Explanation and Recommendations for Use
Section 1 – Identification	
1.1 Product Identifier Trade Name: […] Product No: […]	The product identifier shall be provided in accordance with Article 18(2) of Regulation (EC) No 1272/2008 in the case of a substance and in accordance with Article 18 (3) (a) of Regulation /(EC) No 1272/2008 in the case of a mixture, and as provided on the label in the official language(s) of the Member State(s) where the substance or mixture is placed on the market, unless the Member States(s) concerned provide(s) otherwise. For substances subject to registration, the product identifier shall be consistent with that provided in the registration and the registration number assigned under Article 30(3) of this Regulation shall also be indicated.

1.2 Relevant identified uses of the substance or mixture and uses advised against Use of the substance/mixture: • textile auxiliaries • Detergents and cleaning agents	At least the identified uses relevant for the recipient(s) of the substance or mixture shall be indicated. This shall be a brief description of what the substance or mixture is intended to do. Where applicable the uses which the supplier advises against and the reasons why shall be stated (Example: Do not use for injecting and spraying). In many cases, information in the registration dossiers about uses of substances is limited because downstream users do not have an incentive to provide sufficient information about their uses to the upstream provider of chemicals.
1.3 Details of the supplier providing the safety data sheet Manufacturer / Supplier: Name / Address / Information Contact / Email (competent person) Name / Address / Information Contact / Email (competent person) Importer: - Information-providing department:	Contact details of manufacturer need to be available and shall match with the information provided on the respective chemical containers. In case of non-EU supplier of chemicals, the contact details of the local importer or distributor need to be indicator. In view of the fact that the majority of chemicals used in the textile sector are manufactured outside the EU, special attention should be paid to the availability of information regarding importers and distributors.
1.4 Emergency contact: • +49 7071 154 0 (Germany, 24h) • +41 71 763 88 11 (Switzerland, 24h)	A 24 hour emergency contact number of the manufacturer, importer and/or distributor needs to be indicated in the MSDS (as well as on the chemical container). Most EU Member States, with exception of Germany, Poland, Italy, and France, have appointed an official emergency response center, whose contact information must be listed in Section 1.4 of the MSDS. In Germany, manufacturers and importers may optionally notify one of several poison centers

	in the country, or they may provide their own number, given certain conditions. France now lists the National Research and Safety Institute for the Prevention of Occupational Accidents and Diseases (INRS) as its official emergency contact to be listed in Section 1.4 of the SDS. For further information about the contact points, refer to the downloadable list of emergency telephone numbers available from the ECHA website **https://echa.europa.eu/support/helpdesks**
Section 2 – Possible Hazards	
2.1 Classification of the substance or mixture: Classification (REGULATION (EC) No 1272/2008): Irritant effect on the skin, category 2 • H315: Causes skin irritation. Severe eye damage, Category 1 • H318: Causes severe eye damage. Long-term (chronic) water hazard, category 3 • H412: Harmful to aquatic organisms, having long term effects.	The classification of the substance or the mixture which results from the application of the classification criteria in Regulation (EC) No 1272/2008 shall be given in the MSDS. The classification provided here should be consistent with the information provided in the MSDS Sections 9 to 12, covering the most important adverse physical, human health and environmental health and environmental effect. The information needs to be presented in a way that allows non-experts to identify the hazards of the substance or mixture.
2.2 Labelling elements Labelling (Regulation (EC) No 1272/2008): Hazard pictograms	This section of the MSDS should show how the substance or mixture should be labelled. For both substances and mixtures the label elements are to be indicated according to the CLP Regulation. If a substance on its own or in a mixture is subject to REACH authorisation, the authorisation number (see the ECHA-term (**https://echa-term.echa.europa.eu/**) for a definition) must be included here. In such case, more information regarding authorization should be available in MSDS Section 15.

 Signal word • Danger Hazard Statements • H315 Causes skin irritation • H318 Causes severe eye damage • H412 Harmful to aquatic organisms, with long-term effects Safety instructions - Prevention: • P264 Wash skin thoroughly after use. • P273 Avoid release into the environment. • P280 Wear protective gloves/ eye/ face protection. Safety instructions – Reaction: • P305 + P351 + P338 + P310 IN EYE CONTACT: Rinse gently with water for several minutes. Remove contact lenses if possible. Continue rinsing. Call the POISON CENTER/physician immediately. • P332 + P313 In case of skin irritation: seek medical advice. Safety instructions - Disposal: • P501 Contents/ container to be disposed of in an approved waste disposal facility Hazard-determining component(s) for labelling:	The label elements indicated here need to correspond to those on the product (container, packaging).

• Isotridecanolethoxylate • Alcohols, C12-15 branched and linear, ethoxylated propoxylated • 2-[2-(2-Butoxyethoxy)ethoxy]ethanol • Acrylic acid polyethylene-polypropylene glycol monoallyl ether copolymer	
2.3 Other hazards This substance/mixture does not contain components at concentrations of 0,1 % or higher that are either persistent, bioaccumulative and toxic (PBT) or very persistent and very bioaccumulative (vPvB).	In case the substance is a PBT or vPVB, this needs to be indicated in form of a statement here.
Section 3 - Composition/Information on Components	
3.2 Mixtures Chemical characterization: • Mixture of fatty alcohol alkoxylates Hazardous components	Section 3 provides information on the composition of the chemical product. If it is a substance, the information is provided in Section 3.1. If the chemical is a mixture, the information is in Section 3.2, usually in form of a table. This table should include (i) the name and/or trade name, and (ii) other identifiers (such as CAS number, registration number, etc.) of the substances, ingredients or impurities, which ○ contribute to the overall hazard classification; or ○ are present at concentrations above certain levels of concern; or ○ have occupational exposure limits. Usually an ingredient must be disclosed, if it meets GHS classification criteria as a hazardous substance and its content exceeds relevant cut-off value (usually 0.1% or 1% depending on hazards). For example, a carcinogen must be disclosed in SDSs, if its concentration is above or equal to 0.1%.

Substance name	CAS-No. EG-No. Registration number	Classification	Concentration (% w/w)
Isotridecanolethoxylat	69011-36-5 Polymer	Eye Dam. 1; H318 Aquatic Chronic 3; H412	>= 20 - < 25
Alkohole, C12-15-verzweigt und linear, ethoxyliert propoxyliert	120313-48-6 Polymer	Skin Irrit. 2; H315 Eye Dam. 1; H318 Aquatic Acute 1; H400 Aquatic Chronic 3; H412	>= 10 - < 20

2-[2-(2-Butoxyethoxy)ethoxy]ethanol	143-22-6 205-592-6 01-2119475107-38	Eye Dam. 1; H318	>= 3 - < 10
Isotridecanolethoxylat	69011-36-5 Polymer	Eye Irrit. 2; H319 Aquatic Chronic 3; H412	>= 2,5 - < 10
Acrylsäure-Polyethylen-Polypropylenglykolmonoal-lylether Copolymer	205327-92-0 Polymer	Skin Corr. 1B; H314	>= 3 - < 5
Alkohole, C16-18, ethoxyliert	68439-49-6 Polymer	Eye Irrit. 2; H319	>= 1 - < 10
3,6,9,12 Tetraoxahexadecan-1-ol	1559-34-8 216-322-1	Eye Irrit. 2; H319	>= 1 - < 10
2-(2-Butoxyethoxy)ethanol	112-34-5 203-961-6 01-2119475104-44	Eye Irrit. 2; H319	>= 1 - < 10

In the EU, disclosure of non-hazardous substances is required, if there are union workplace exposure limits for them or if they belong to PBT and vPvB substances.

Chemical suppliers may like to withhold exact substance name and exact concentration or concentration ranges in this section 3 claiming these confidential business information. In the EU, this requires with prior approval according to CLP, article 4.

Section 9 - Physical and chemical properties

9.1 Information on the basic physical and chemical properties:

Appearance: fluid
Colour: Colourless, light, yellowish
Odour: Characteristic
pH: 3,5 - 4,1 (20 °C)
Concentration: 100 g/l
Melting point/Melting range: No data available
Boiling point/Boiling range: No data available
Ignition point: 100 °C
Evaporation speed: Not applicable

This section contains information about the basic physical and chemical properties of the chemical substance or mixture (such as appearance, odour, pH, boiling point etc.) which are relevant to the classification and the hazards.

Information of this MSDS section is relates to further characteristics as described in MSDS section 10 (stability and reactivity). The latter section informs about the stability of the substance or mixture, hazardous reactions that could occur under certain conditions of use or if released into the environment, conditions to avoid, incompatible materials, hazardous decomposition products.

No sections should be kept blank. If data is not available, it should be clearly indicated in form of a corresponding statement (“no data available”).

Upper explosive limit: Not applicable Lower explosion limit: Not applicable Vapour pressure: No data available Relative vapour density: Not applicable Density: - 1.03 g/cm3 (20 °C) **Solubility(s)** Water solubility: miscible Distribution coefficient: n-octane/water - Not applicable **Viscosity** Viscosity, dynamic • 90 - 150 mPa.s (20 °C) • Brookfield LVT • 50 rpm • Spindle 2 Oxidizing properties: Not applicable	
9.2 Other disclosures Conductivity: not determined Spontaneous ignition: not self-igniting	

Section 11 - Toxicological information

11.1 Information on toxicological effects

Acute toxicity
Product:
Acute oral toxicity:

- LD50 (rat): > 2 000 mg/kg
- conclusion by analogy

Acute inhalative toxicity:

- On the basis of the available data, the classification criteria are not met.

Acute dermal toxicity:

- On the basis of the available data, the classification criteria are not met.

Ingredients:
Isotridecanolethoxylate:
Acute oral toxicity:

- LD50 (rat): > 5 000 mg/kg
- literature value

Acute dermal toxicity:

- LD50 (rat): > 2 000 mg/kg
- Method: OECD test guideline 402
- literature value

Alcohols, C12-15 branched and linear, ethoxylated propoxylated:
Acute oral toxicity:

- LD50 (rat): > 2 000 mg/kg

Section 11 of a GHS-SDS contains detailed information about the adverse health effects that result from exposure to the product, as well as data about how these effects are influenced by dosage and route of exposure.

While all SDS sections are important for user health & safety, the information contained in this section is vital should an employee or other user ever experience uncontrolled, accidental exposure to a product. It is of utmost importance to medical professionals and toxicologists, and is used primarily in emergency situations during medical treatment. The information will help medical professionals and emergency responders evaluate long-term and short-term health risks.

Accordingly, this MSDS section should provide following information for the substance and/or components as identified in SMDS section 3.2:

- Relevant health hazards and corresponding toxicological data
- Likely routes of exposure
- Potential adverse health effects that may occur upon exposure
- Delayed and immediate effects, due to both short-term and long-term exposure
- Numerical measures of toxicity
- Relevant interactions with other substances
- Information about other adverse health effects that do not fall into GHS classification

With regard to the health hazard references should cover at least

- Acute toxicity
- Skin corrosion/irritation
- Serious eye damage/irritation
- Respiratory and skin sensitization
- Germ cell mutagenicity
- Carcinogenicity

• conclusion by analogy 2-[2-(2-Butoxyethoxy)ethoxy]ethanol: Acute oral toxicity: • LD50 (rat): 5 170 mg/kg Acute dermal toxicity: • LD50 (rabbit): 3 480 mg/kg • Isotridecanolethoxylate: Acute oral toxicity: • LD50 (rat): > 5 000 mg/kg • Method: OECD test guideline 401 • literature value Acute dermal toxicity: • LD50 (rat): > 5 000 mg/kg • literature value 2-(2-Butoxyethoxy)ethanol: Acute oral toxicity: • LD50 (rat): > 2 000 mg/kg • Method: OECD test guideline 401 Acute dermal toxicity: • LD50 (rabbit): > 2 000 mg/kg • Method: OECD test guideline 402 **Etching/irritant effect on the skin** • […] **Eye damage/irritation**	○ Reproductive toxicity ○ Single target organ toxicity/single exposure ○ Single target organ toxicity/repeated exposure ○ Aspiration hazards It may not always be able to obtain information on the hazards of a substance or mixture. In cases where data on the specific substance or mixture are not available, data on similar substances or mixture, if appropriate, may be used, provided the relevant similar substance or mixture is identified. In case data is not available, this shall be clearly indicated rather than leaving blanks. It is important to make sure that results as well as testing guidelines applied are clearly indicated.

• […] **Sensitization of the respiratory tract/skin** • […] **Germ cell mutagenicity** • […] **Carcinogenicity** • […] **Reproductive toxicity** • […] **Specific target organ toxicity at single exposure** • […] **Specific target organ toxicity for repeated exposure** • […] **Aspiration toxicity** • […]	

Section 12 - Environmental disclosures	
12.1 Toxicity **Product**:	Section 12 contains ecological and eco-toxicological data for both terrestrial and aquatic environments. The information shall describe on the effects of the

Toxicity to fish: • No data available for the product itself. Toxicity to daphnia and other aquatic invertebrates: • EC50 (Daphnia magna (large water flea)): 5,8 mg/l • exposure time: 48 h • Method: OECD test guideline 202 Toxicity to algae: • No data available for the product itself. Toxicity to microorganisms: • EC50 (activated sludge): > 1 000 mg/l • exposure time: 3 h • Method: OECD test guideline 209 **Ingredients**: **Isotridecanolethoxylate**: Toxicity to fish: • LC50 (Oncorhynchus mykiss (rainbow trout)): > 1 - 10 mg/l • exposure time: 96 h • (Classified according to CESIO recommendations) Toxicity to daphnia and other aquatic invertebrates: • EC50 (Daphnia magna (Great Water Flea)): > 1 - 10 mg/l • exposure time: 48 h • (Classified according to CESIO recommendations) Toxicity to algae: • EC50 (algae): > 1 - 10 mg/l • Exposure time: 72 h • Method: OECD test guideline 201	chemical on the environment if released as well as its environmental fate (What happens to the chemical after its release into the environment?). This section is designed to assist environmental stewardship, prevent harmful effects to the health of local ecosystems, as well as help businesses evaluate one product against another. This information forms the basis for deciding on waste and wastewater treatment practices, how to handle spills and control of releases. The content of this section provides the basis for the classification and risk management measures given in the safety data sheet. The information in Sections 2, 3, 4, 6, 7, 8, 9, 13, 14, and 15 should be consistent with the ecological information provided here. This MSDS section, with its subsections on (i) eco-toxicity, (ii) persistence and degradability, (iii) bioaccumulation potential, (iv) mobility in ground, and (v) results of the PBT and vPvB assessment, should also outline how the chemical was tested for toxicity, persistence and degradability, bioaccumulative potential, and mobility in soil, together with the test results. It should also contain the results of a PBT and vPvB assessment, if one has been carried out as part of a chemical safety assessment. The eco-toxicological test data for aquatic organisms used to determine GHS classifications should be provided, such as ○ Fish: 96 hours, Lethal concentration (LC) 50, chronic No Observed Effect Level (NOEC) or Effective Concentration (ECx) ○ Crustaceans: 48 hours, Lethal concentration (LC) 50, chronic No Observed Effect Level (NOEC) or Effective Concentration (ECx) ○ Algae & aquatic plants: 72 or 96 hours, effectice reduction of growth rate concentration (ErC50), chronic No Observed Effect Level (NOEC) or Effective Concentration (ECx) Important details to include throughout this section include species, media, test duration and test conditions.

• (Classified according to CESIO recommendations) • EC10 (algae): > 1 - 10 mg/l • Exposure time: 72 h • Method: OECD test guideline 201 • (Classified according to CESIO recommendations) Toxicity to microorganisms: • EC50 (activated sludge): > 1 000 mg/l • exposure time: 16 h • Method: DIN 38412, part 8 • conclusion by analogy Toxicity to daphnia and other aquatic invertebrates (chronic toxicity): • NOEC: 1 mg/l • Species: Daphnia magna (Great Water Flea) • literature value Assessment of ecotoxicity Long-term (chronic) water endangering: • Harmful to aquatic organisms with long-term effects (classified according to CESIO recommendations). **Alcohols, C12-15 branched and linear, ethoxylated propoxylated:** • […] **2-[2-(2-Butoxyethoxy)ethoxy]ethanol:** • […] **Isotridecanolethoxylate**: • […] **<u>2-(2-Butoxyethoxy)ethanol:</u>**	The information in this section 12 should be consistent with the other sections of the SDS. The eco-toxicological (EC50, NOEC) endpoints should be consistent with the aquatic toxicity categories, respectively. Since some components in a mixture may behave very differently from the mixture as a whole when released to the environment, eco-toxicological information should be given for all relevant ingredients. Any information that indicates possible impact on wastewater treatment plants, like degradability and inhibitory effects on microorganisms, should be mentioned.

• […]	
12.2 Persistence and degradability **Product**: Biodegradability: • Type of test: DOC-CO2 measurement • Biological degradation: 68%. • Method: OECD 302 B with CO2 (mineralisation) • Type of test: DOC measurement • Biological degradation: 95%. • Method: OECD 302 B with CO2 (elimination) • The product is inherently bio-degradable according to OECD criteria. • Type of test: O2 measurement • Biological degradation: 76%. • Method: OECD 301 F (mineralisation) • The product is readily biodegradable according to OECD criteria. The surfactant contained in this mixture fulfils the conditions of biodegradability as laid down in Regulation (EC) No. 648/2004 on detergents. Documents confirming this will be kept available for the competent authorities of the Member States and will only be made available to them at their direct request or at the request of a detergent manufacturer. Biochemical oxygen demand (BOD): • 180 mg/g • Incubation time: 5 d	Biodegradation is the process by which organic substances are broken down by living organisms such as bacteria and fungi. Biodegradation can happen in surface water, sediment and soil. With regard to expressing the biodegradability of a substance, it is important the type of test, methods, circumstances and results are specifically outlined to allow for a proper interpretation of the information. For example, common methods for determining the biodegradability include OECD 301 A-F (Ready biodegradability), OECD 302 A-C (inherent biodegradability). The pass levels for ready biodegradability are 70% removal of Dissolved organic carbon (DOC) and 60% of theoretical oxygen demand (ThOD) or theoretical carbon dioxide (ThCO2) production for respirometric methods (OECD 301).

• Method: DIN EN 1899-1 (H 55) Chemical oxygen demand (COD): • 1 240 mg/g • Method: DIN 38409-H-41 **<u>Compounds</u>**: **Isotridecanolethoxylate:** Biodegradability: • Type of test: CO2 measurement • Result: Easily biodegradable. • Biological degradation: > 60%. • exposure time: 28 d • Method: OECD 301 B (mineralisation) • (Classified according to CESIO recommendations) • Type of test: DOC measurement • Result: Easily biodegradable. • Biological degradation: > 90%. • exposure time: 28 d • Method: OECD 301 E (elimination) **Alcohols, C12-15 branched and linear, ethoxylated propoxylated:** Biodegradability: • Type of test: CO2 measurement • Result: Easily biodegradable. • Biological degradation: > 60%. • exposure time: 28 d • Method: OECD 301 B (mineralisation)	

• conclusion by analogy **2-[2-(2-Butoxyethoxy)ethoxy]ethanol:** • […] **Isotridecanolethoxylate:** • […] **2-(2-Butoxyethoxy)ethanol:** • […]	
12.3 Bioaccumulation potential **Product**: Bioaccumulation: • There is no data available for the product itself. Distribution coefficient: n-octanol/water: • Not applicable **Ingredients:** **2-(2-Butoxyethoxy)ethanol:** • Coefficient of partition: n-octane/water: • log Pow: 1 (20 °C) • pH value: 7 • Method: OECD 117	Information on bioaccumulation is vital for understanding the environmental behaviour of a substance. The information on bioaccumulation is used in 1) PBT assessment, 2) hazard classification, and 3) chemical safety assessment. The information on bioaccumulation is also a factor in deciding whether long-term ecotoxicity testing might be necessary. Bioconcentration Factor (BCF) is an indicator of a chemical substance's tendency to accumulate in the living organism. It can be obtained by calculation method based on logKow/logPowor bio-accumulation test. Calculated BCF values are unitless and generally range from one to a million. If an aquatic bioconcentration test (usually on fish) is conducted, BCF will be the concentration of test substance in/on the fish or specified tissues thereof (as mg/kg) divided by the concentration of the chemical substance in the surrounding medium (BCF = Concentration of the substance in fish (mg/kg)/Concentration of the substance in water (in mg/L)). n-octanol/water partition coefficient (Kow) is used as a screening test for bio-accumulation test. The assumption behind this is that the uptake of an organic substance is driven by its hydrophobicity. A chemical substance with high BCF will generally have low water solubility, a large Kow (octanol/water partition coefficient), and a large Koc (soil adsorption coefficient). As per EU REACH, a substance with a BCF>2000 will be regarded

	as bio-accumulative (B). A substance with a BCF>5000 will be regarded as very bio-accumulative (vB). For organic substances with a logKow value below 4.5 it is assumed that the affinity for the lipids of an organism is insufficient to exceed the bio-accumulation criterion i.e. a BCF value of 2000. Substances with very high logKow values (i.e, >4.5) are of greater concern because they may have the potential to bio-concentrate in living organisms. It is important that the specific testing guidelines for measuring Bioaccumulation in Fish (i.e. OECD 305) and for Kow/logKowis or log POW (e.g. OECD 117) are mentioned in the MSDS.
12.4 Mobility in the ground or soil **Product**: Mobility: • No data available	This subsection should indicate the soil Adsorption Coefficient (Kd/Koc) of a substance, measuring the mobility of a substance in soil. Koc is a very important input parameter for estimating environmental distribution and environmental exposure level of a chemical substance. A very high value (e.g. Koc > 100,000 or log Koc >5) indicate that the substance is strongly adsorbed onto soil and organic matter and does not move throughout the soil. In such case, additional terrestrial toxicology tests may be conducted to confirm the toxicity of a substance to soil organisms. A very low value (Koc >10 or log KOC <1) means it is highly mobile in soil. It is important that the testing guideline (e.g. OECD 106 or OECD 121) is indicate as well.
12.5 Results of the PBT and vPvB assessment **Product**: Rating: • This substance/mixture does not contain components at concentrations of 0,1 % or higher classified as either per-sistent,	

bioaccumulative and toxic (PBT) or very persistent and very bioaccumulative (vPvB).	
12.6 Other adverse effects **Product**: Adsorb. org. bound halogen (AOX): • Due to the fact that it does not contain organically bound halogens, this product cannot contribute to the AOX contamination of waste water. Other ecological information: • According to our current state of knowledge, the product does not contain any heavy metals or compounds of the EC Directive 2000/60/EC.	

Worst Practices Example MSDS

The following MSDS is a bad example of a chemical product with has been marketed at least in Germany until 2019. The product is a sizing agent, mainly consisting of polyvinyl alcohol (PVA). As the add-on of sizing agents is considerable (3 – 20 weight-% related to woven fabric) and as the sizing agents are completely removed during textile pre-treatment (desizing), the load and concentration in wastewater are considerably high. The MSDS is not structured according to the 16 standard sections but has only 3 pages as follows. The information is insufficient to adequately assess the product. For instance, it is told that biodegradability is more than 90 % (Zahn-Wellens-Test according to OECD 302 B). However such a high removal efficiency is only possible under certain system conditions of a wastewater treatment plant (temperature in the biological system > 15 °C, full adaptation of the biomass to PVA, food-to-microorganism ratio < 0.15 kg BOD_5/kg MLSS x d). But this not told in the MSDS below. It is known that for PVA the specific BOD_5 value or the result of another OECD 301 test is very low (e.g. the specific BOD_5 value is 50 mg/g – the specific BOD_5 value is not present in the MSDS but should be) whereas the specific COD value is high (e.g. 1700 mg/g, in the example below, a value of 1470 mg/g is mentioned). This means that PVA is not easily biodegradable. But the question is whether it is biodegradable under system conditions which are more favourable for biodegradation compared to BOD_5/OECD 301 and whether such conditions are present in real wastewater treatment plants. The answer is yes. Under the system conditions already mentioned above (temperature in the biological system > 15 °C, full adaptation of the biomass to PVA, food-to-microorganism ratio < 0.15 kg BOD_5/kg MLSS x d), the biodegradation of PVA is more than 90 %. In contrast, it can be less than 20 % at low temperature or if the food-to-microorganism ratio is high (> 0.5 kg BOD_5/kg MLSS x d); if there is not adaptation, the biodegradation rate is almost zero. These explanations indicate that expert knowledge is required to fully understand and to properly evaluate information on biodegradability/bioeliminability and also to assess whether provided information on biodegradability/bioeliminability is sufficient or not.

Application

Sizing agent for warp yarns composed of cellulosic fibres, polyester/cellulosic fibre blends, wool and polyester/wool blends

The high adhesive power of Size C1-66 leads to an excellent sizing effect and weaving performance.

Warps that have been correctly sized with Size CF-66 give high weaving efficiency on all types of weaving machines normally employed for staple fibres.

Size C1-66 can be used alone or in conjunction with other size products. Recycling Size C1-66 is suitable for size recovery with subsequently reuse. Size C1-66 disposed of the necessary easy washing-out properties, it can be used again after increasing the concentration by Ultrafiltration to usual practical concentrations.

Desizing

Size CF1-66 itself can be washed out from the fabric at a temperature >70 °C with an addition of Vecochem ᵞCW Conc. The rate of dissolution can be increased still further by raising the temperature of the wash liquor, by intensive movement of the liquor or fabric during the desizing process and by adding small amounts of soda ash.

When Size C1-66 is applied in combinations with starch, the desizing conditions depend on the nature of the starch products employed.
Size C1-66 containing PVA. The usual desizing process for desizing PVA should be observed.

Safety

When using this product, the information and advice given in our Safety Data Sheet should be observed. Due attention should also be given to the precautions necessary for handling chemicals.

Size	C1-66
Chemical nature	Synthetic copolymer, containing PVA
Physical form	White to yellowish granules
Storage	Size CF-66 can be stored for at least 12 month in the original closed containers at between -30 °C and 70 °C.. Containers should always be closed tightly again after product has been taken out.

Properties	
Active content	Approx. 95 %
Concentration (%)	= Refractometer value (in °Brix) x 0.9
pH value	Approx. 4.8 (10 % aqueous solution)
Bulk density	Approx. 680 kg/m3
Viscosity	10 % aqueous solution at 85 °C: approx. 80 – 300 mPa s (Brookfield RVT, sp. 5 / 100 min-1)
Solubility	Size C1-66 is soluble by stirring it into warm water and forms a slightly yellowish, opaque to turbid solution. In order to get a complete dissolved size solution, it is recommended to boil the liquor until a homogeneous size solution is obtained. In vessels fitted with only slow-running stirrers, it is advisable to strew the Size C1-66 slowly into the water.
COD	Approx. 1470 mg O2/g product

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Ecology	Size C1-66 is > 90 % biologically eliminable (Tegewa test, analogous to OECD 302 B), and suitable for recycling. The values given characterize the range of physical properties. The tolerance limits can be seen from the product specification.
Compatibility	Size C1-66 can be mixed with the usual starch products, carboxymethyl starches and CMC sizes.

Note

The information submitted in this publication is based on our current knowledge and experience. In view of the many factors that may affect process- ing and application, these data do not relieve processors of the responsibi- lity of carrying out their own tests and experiments; neither do they imply any legally binding assurance of certain properties or of suitability for a specific purpose. It is the responsibility of those to whom we supply our products to ensure that any proprietary rights and existing laws and legislation are observed.

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Annex 5 – Level of BAT application in the European Textile Sector

The numbers in the first column refer to the specific reference number in the BREF TXT (2003) document. The last column indicates how many of the four case installations (at least) have specifically indicated the use of the respective BAT. BATs marked with an asterisk under “Level of application” (e.g. applied*) have not been indicated as being applied in the four selected installations, however are known to be applied in the sector according to expert assessments.

BAT Ref.	Description	Level of application	No. of case installations reporting BAT application
General good management practices			
4.1.1	Management and good housekeeping	Applied	3
4.1.2	Input/Output streams evaluation/inventory	Applied	1
4.1.3	Automated preparation and dispensing of chemicals	Applied	3
Quality management of incoming fibre			
4.2.1	Man-made fibre preparation agents with improved environmental performance	Applied*	
4.2.2	Mineral oils substitution in wool spinning lubricants	Applied*	
4.2.3	Mineral oils substitution in knitted fabric manufacturing	Applied*	
4.2.4	Selection of sizing agents with improved environmental performance	Applied*	1
4.2.5	Minimising sizing agent add-on by pre-wetting the warp yarns	Not applied or reported	
4.2.6	Use of techniques that allow reduced load of sizing agents on the fibre (compact spinning)	Not applied or reported	
4.2.7	Minimising residues of organochlorine ectoparasiticides in the raw material by substitution	Not applied or reported	
4.2.8	Minimising residues of organophosphate and synthetic pyrethroid ectoparasiticides in the raw material by substitution	Not applied or reported	
Substitution of chemicals used			

BAT Ref.	Description	Level of application	No. of case installations reporting BAT application
4.3.1	Selection of textile dyes and auxiliaries according to their waste water relevance	Applied	2
4.3.2	Emission factor concept (emissions to air)	Applied	2, also widely applied (in Germany)
4.3.3	Substitution for alkylphenol ethoxylates (APEO) (and other hazardous surfactants)	Applied	2
4.3.4	Selection of biodegradable/bio-eliminable complexing agents in pre-treatment and dyeing processes	Applied	2
4.3.5	Selection of antifoaming agents with improved environmental performance	Applied	2
Wool scouring			
4.4.1	Use of integrated dirt removal/grease recovery loops	Applied*	
4.4.2	Use of integrated dirt removal/grease recovery loops combined with evaporation of the effluent and incineration of the sludge	Not applied or reported	
4.4.3	Minimising energy consumption in wool scouring installations	Not applied or reported	
4.4.4	Wool scouring with organic solvent	Not applied or reported	
Pre-treatment			
4.5.1	Recovery of sizing agents by ultrafiltration	Has been formerly applied	1
4.5.2	Application of the oxidative route for efficient, universal size removal	Applied	2
4.5.3	One-step desizing, scouring and bleaching of cotton fabric	Applied	1
4.5.4	Enzymatic scouring	Applied*	
4.5.5	Substitution for sodium hypochlorite and chlorine-containing compounds in bleaching operations	Applied	4

BAT Ref.	Description	Level of application	No. of case installations reporting BAT application
4.5.6	Minimising consumption of complexing agents in hydrogen peroxide bleaching	Applied	2
4.5.7	Recovery of alkali from mercerising	Applied	2
4.5.8	Optimisation of cotton warp yarn pre-treatment	Not applied or reported	
Dyeing			
4.6.1	Exhaust dyeing of polyester and polyester blends with carrier-free dyeing techniques or with use of environmentally optimised carriers	Applied	1
4.6.2	Use of non-carrier dyeable PES fibres	Applied	2
4.6.3	Dispersing agents with higher bio eliminability in dye formulations	Applied*	
4.6.4	One-step continuous vat dyeing in pastel to pale shades	Applied*	
4.6.5	After treatment in PES dyeing	Applied	2
4.6.6	Dyeing with sulphur dyes	Applied*	
4.6.7	Minimisation of dye liquor losses in pad dyeing techniques	Applied	2
4.6.8	Enzymatic after-soaping in reactive dyeing	Applied*	
4.6.9	Silicate-free fixation method for cold pad batch dyeing	Applied	1
4.6.10	Exhaust dyeing of cellulosic fibres with high-fixation poly-functional reactive dyestuffs	Applied*	
4.6.11	Exhaust dyeing with low-salt reactive dyes	Not applied or reported	
4.6.12	Omitting the use of detergents in after washing of cotton dyed with reactive dyes	Applied (probably)	
4.6.13	Alternative process for continuous (and semi continuous) dyeing of cellulosic fabric with reactive dyes	Applied	2
4.6.14	pH-controlled dyeing techniques	Applied	2

BAT Ref.	Description	Level of application	No. of case installations reporting BAT application
4.6.15	Low-chrome and ultra-low-chrome after chroming methods for wool	Applied*	
4.6.16	Chromium-free dyeing of wool	Applied*	
4.6.17	Emission reduction in dyeing wool with metal-complex dyestuffs	Applied*	
4.6.18	Use of liposomes as auxiliaries in wool dyeing	Not applied or reported	
4.6.19	Equipment optimisation in batch dyeing	Applied	1
4.6.20	Equipment optimisation applied to winch beck dyeing machines	Not applied or reported	
4.6.21	Equipment optimisation applied to jet dyeing machines	Applied*	
4.6.22	Water re-use/recycling in batch dyeing processes	Applied*	
Printing			
4.7.1	Urea substitution and/or reduction in reactive printing	Applied*	
4.7.2	Reactive two-step printing	Not applied or reported	
4.7.3	Pigment printing pastes with optimised environmental performance	Applied*	
4.7.4	Volume minimisation of printing paste supply systems in rotary screen printing machines	Applied	1
4.7.5	Recovery of printing paste from supply system in rotary screen printing machines	Applied*	
4.7.6	Recycling of residual printing pastes	Applied	1
4.7.7	Reduction of water consumption in cleaning operations	Applied*	
4.7.8	Digital jet printing of carpet and bulky fabric	Applied*	
4.7.9	Ink-jet digital printing for flat fabric	Applied*	

BAT Ref.	Description	Level of application	No. of case installations reporting BAT application
Finishing			
4.8.1	Minimisation of energy consumption of stenter frames	Applied	2
4.8.2	Formaldehyde-free or formaldehyde-poor easy-care finishing agents	Applied	3
4.8.3	Avoiding batch softening	Applied*	
4.8.4	Minimisation of emissions in the application of mothproofing agents	Applied*	
Washing			
4.9.1	Water and energy conservation in batch washing and rinsing	Applied	2
4.9.2	Water and energy conservation in continuous washing and rinsing	Applied	1
4.9.3	Use of fully closed-loop installations for fabric washing (scouring) with organic solvent	Applied	1
Final effluent/emission abatement techniques			
4.10.1	Treatment of textile waste water in activated sludge system with low food-to-microorganisms ratio (F/M)	Applied	2
4.10.2	Treatment of mixed waste water with about 90% water recycling	Applied in specific cases	
4.10.3	Combined biological, physical and chemical treatment of mixed waste water effluent	Applied*	
4.10.4	Recycling of textile waste water by treatment of selected streams with membrane techniques	Applied in few cases*	
4.10.5	Treatment and recovery of waste water containing pigment paste	Applied in few cases*	
4.10.6	Anaerobic removal of residual dyestuff from padding liquors and printing paste residues	Applied	2

BAT Ref.	Description	Level of application	No. of case installations reporting BAT application
4.10.7	Treatment of selected and segregated, non-biodegradable waste water stream by chemical oxidation	Was applied in very few cases	
4.10.8	Waste water treatment by flocculation/precipitation and incineration of the resulting sludge	Applied*	
4.10.9	Air emission abatement techniques	Applied	2

Annex 6 – Example for a good chemical inventory

The format below gives an example for a systematic inventory of all chemical products used in one year to be submitted in case of the erection and substantial change of an installation (textile finishing industry). The inventory may be grouped into forms for the following chemical products: pre-treatment agents, textile auxiliaries for dyeing and printing, agents for final finishing, basic chemicals, dyestuffs and organic pigments and "other textile auxiliaries (see also Table 4). Because of the size of the excel table, in the interest of readability, it is divided into two parts.

Form for textile auxiliaries for dyeing and printing

List of used chemical products
sorted according to annual consumption quantity

Name of the textile finishing industry

Year:

3. Textile auxiliaries for dyeing and printing

3.1 Dyestuff solubilizing and hydrophobic agents
3.2 Dispersing agents and protective colloids
3.3 Dyeing wetting agents, deaeration agents
3.4 Levelling agents
3.5 Carriers
3.6 Crease-preventing agents
3.7 Dyestuff protecting agents, boildown protecting agents
3.8 Padding auxiliaries
3.9 Fixing accelerators for continuous dyeing and printing
3.10 Aftertreatment agents for fastness improvement

No.	Commercial name	Producer	Chemical characterisation General and individual substances if available (see CAS no.)	Known CAS no.	Process, application	Annual consumption [kg/yr]	MSDS date	GHS Hazard	Cont. haz. substances according to SVHC, ZDHC, PBT and vPvB in [weight-%] for indiv. subst.	Ionogenic character	Biolog. degradation/elimination product and invidual substances in [%] and test duration [d] and testing method
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

spec. COD-value [mg O_2/g]	spec. BOD_5-value [mg O_2/g]	Heavy metal content [mg/g]	Org. halogen content [mg/g]	Total nitrogen [mg N/g]	Total phosphorus [mg P/g]	Classification wastewater relevance	Toxixity bacteria EC50 [mg/l]	Toxicity algae EC50 [mg/l]	Toxicity daphnia EC50 [mg/l]	Toxicity fish LC50 [mg/l]	Max. quantity stored [t]	Classification conc. storage

Annex 7 – The textile value-added chain

The following figure depicts the textile value-added chain including the main chain as well as the side chains. The input of chemicals is indicated with red arrows. Environmental hot spots are marked with red ellipses.

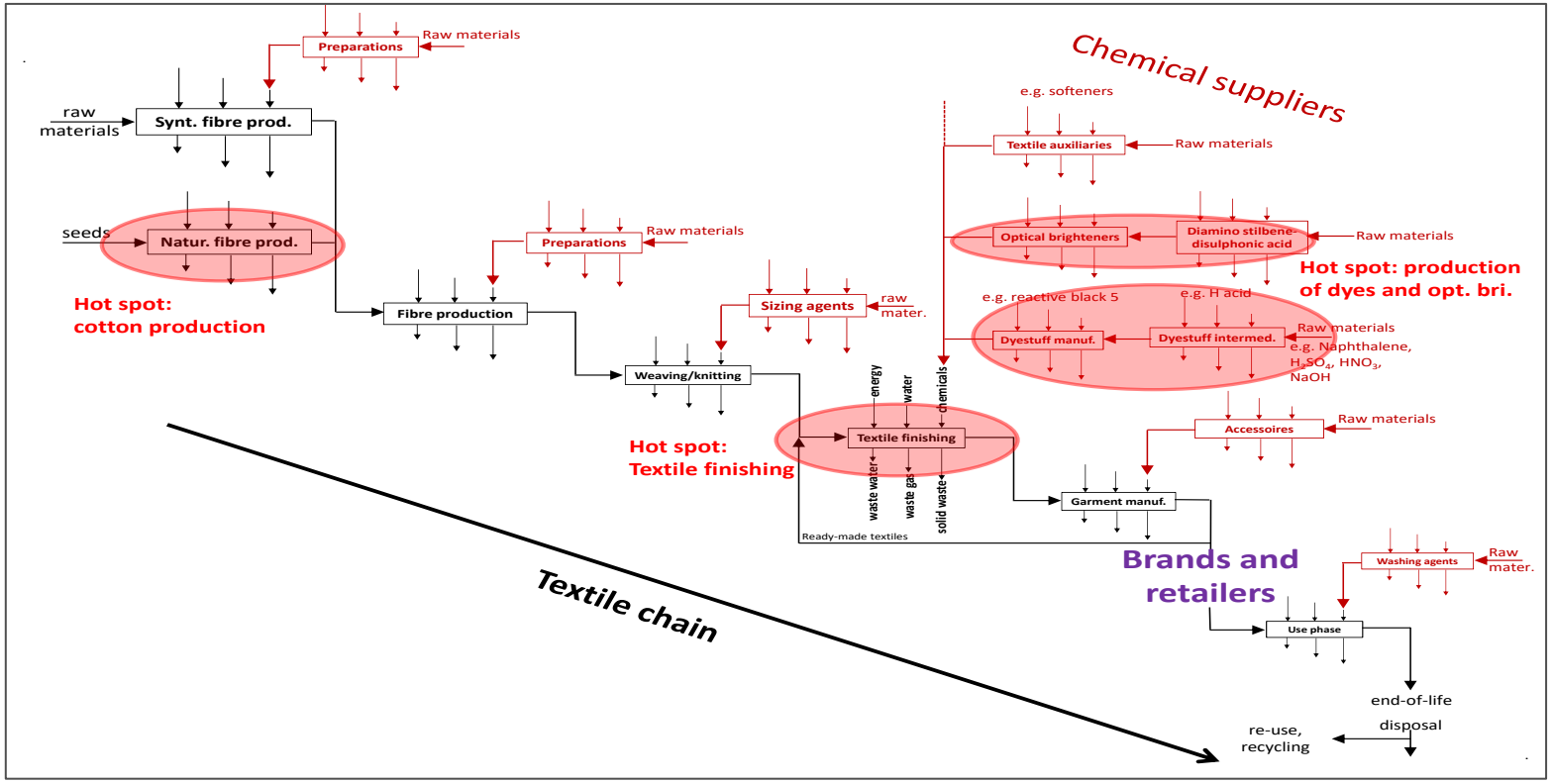

Figure 13: The textile value-added chain (Source: Schönberger, H., Umweltfreundlichere Herstellung von Farbstoffen und optischen Aufhellern. Chemikalienmanagement und Umweltschutz in der Textilen Kette. Kolloquium zur nachhaltigen Textilproduktion, Schriftenreihe "Stuttgarter Berichte zur Siedlungswasserwirtschaft", Band 237 (2017) 61-86)

Annex 8 – Annual mass stream overview of a textile finishing industry (operator)

The following figure shows the input and output of a textile finishing industry on an annual base. Using an annual mass stream overview, important environmental performance indicators such as the specific consumption of water, primary energy, electricity, dyestuffs and organic pigment, organic textile auxiliaries and basic chemicals as well as specific emission factors for wastewater, emissions to air and solid waste fractions can be determined. The description of the process sequence (box in the centre) and the information on raw materials and products further enable benchmarking as well as the grouping of the industry concerned.

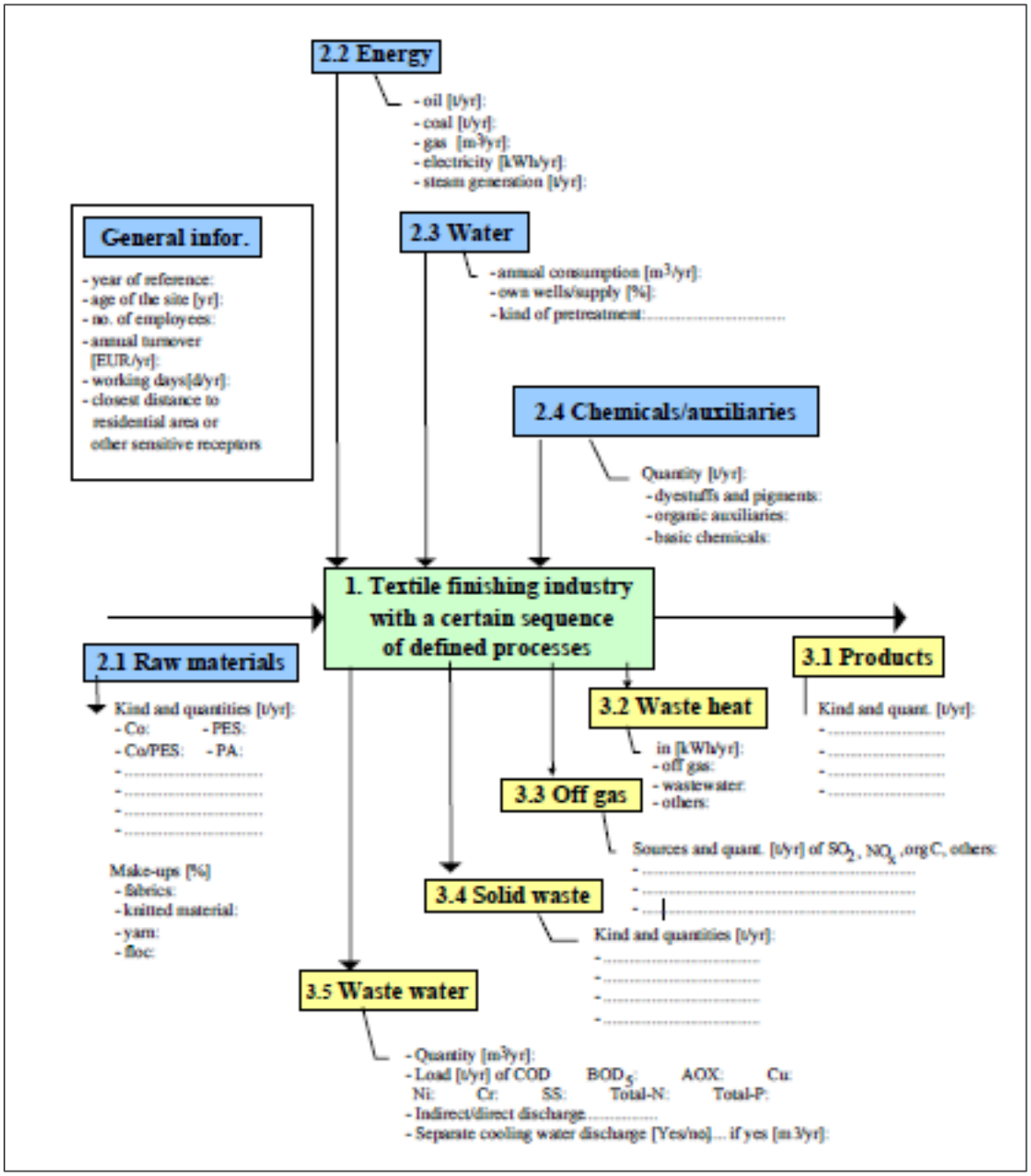

Figure 15: Annual mass stream overview of a textile finishing industry (source: Best Available Techniques Reference Document for the Textiles Industry, 2003, https://eippcb.jrc.ec.europa.eu/sites/default/files/2019-11/txt_bref_0703.pdf)