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Background report on the revision of the Blue Angel award criteria for textiles (DE-UZ 154, January 2023 edition)

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Kurzbeschreibung: Blue Angel eco-label for textiles

Die bestehenden Vergabekriterien des Umweltzeichens „Blauer Engel für Textilien“ (DE-UZ 154) sind im Rahmen einer Revision überprüft und neben einer Ausweitung und Konkretisierung des Geltungsbereiches gezielt in einzelnen Anforderungsbereichen weiterentwickelt worden. Die Überarbeitung erfolgte innerhalb der Bearbeitung des Forschungsvorhabens „Kriterienentwicklung und -überarbeitung für den Blauen Engel für Textilien“ (FKZ 3720 37 302 0). Die neuen Vergabekriterien wurden im Januar 2023 als DE-UZ 154, Ausgabe Januar 2023, veröffentlicht.

Abstract: Development and revision of the Blue Angel reward criteria for textiles

The existing award criteria for the Blue Angel eco-label for textiles (DE-UZ 154) have been reviewed as part of a revision and, in addition to expanding and further specifying the scope, have been specifically further developed in individual requirement areas. The revision was carried out as part of the research project "Development and revision of the Blue Angel reward criteria for textiles" (FKZ 3720 37 302 0). The new award criteria were published in January 2023 as DE-UZ 154, January 2023 edition.

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List of abbreviations

APE(O)	Alkylphenols/alkylphenol ethoxylates
AbTF	Aid by Trade Foundation
AFIRM	Apparel & Footwear International RSL Management Working Group
APEO	Alkylphenol ethoxylates
ASI	Accreditation Services International
B2B	Business-to-Business
B2C	Business-to-Consumer
BAT	Best Available Technique
BCI	Better Cotton Initiative
BE	Blue Angel
BfR	Federal Institute for Risk Assessment
BMJV	Federal Ministry of Justice and Consumer Protection
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BMUV	Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
BMZ	Federal Ministry for Economic Cooperation and Development
BOD	Biochemical oxygen demand
e.g.	for example
BREF	Best Available Techniques Reference Document
Bvse	Federal Association for Secondary Raw Materials and Waste Disposal e.V.
approx.	approximately
C2C	Cradle to Cradle
c.f.	circular.fashion UG
CmiA	Cotton made in Africa
CO_2	Carbon dioxide
CO_{2e}	Carbon dioxide equivalents
COD	Chemical oxygen demand
DAC	Development Assistance Committee
DE-ZU	German Ecolabel
DiätV	Dietary Regulation
DIN	German Institute for Standardisation
ECHA	European Chemicals Agency
EFRA	European Flame Retardants Association
EPA	Environmental Protection Agency
EPC	Electronic Product Code
EN	European Standard
EU	European Union
EU Commission	European Commission
FAO	Food and Agriculture Organization of the United Nations
CFC	Chlorofluorocarbons

FSC	Forest Stewardship Council
GDB	Genossenschaft Deutscher Brunnen e.G., Bonn
GfK	GfK SE, Nuremberg
GIZ	German Society for International Cooperation
GLP	Good laboratory practice
GMO	Genetically modified organisms (GMOs)
GOTS	Global Organic Textile Standard
GPP	sustainable public procurement
GRS	Global Recycling Standard
GMO	Genetically modified organisms
ID	Identification
i.e.	that is
iLUC	Indirect land use change, i.e. indirect changes in land use.
IÖW	Institute for Ecological Economy Research GmbH, non-profit
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IRP	International Resource Panel
ISCC	International Sustainability & Carbon Certification
ISO	International Organization for Standardization (IOS)
IUCN	International Union for Conservation of Nature
IVC	Industrievereinigung Chemiefaser e.V.
organic	Controlled organic cultivation
kbT	Controlled organic animal husbandry
KrWG	Act on the Promotion of the Circular Economy and Ensuring the Environmentally Sound Management of Waste
m.	Million
MMCF	Man-Made Cellulosic Fibre
MPs	Microplastics
Bn.	Billion
MRSL	Manufacturing Restricted Substance List
NGOs	Non-governmental organisation
NOP	National Organic Programme
PCR	Post Consumer Recycling
PEFC	Programme for the Endorsement of Forest Certification Schemes
PET	Polyethylene terephthalate
PFC	Perfluorocarbons
PPC	Paper, paperboard and cardboard
PUR	Polyurethane
QR code	Quick response code
RAL	Reich Committee for Delivery Conditions
RCS	Recycled Claim Standard
RDS	Responsible Down Standard
RFID	Radio-frequency identification (t: Identification via electromagnetic waves)

RL	Directive
RSB	Roundtable for Sustainable Biomaterials
RSL	Restricted Substance List
RSPO	Roundtable on Sustainable Palm Oil
RTRS	Roundtable Responsible Soy
SCCP	Short Chained Chlorinated Paraffins (engl. short-chain chlorinated paraffins)
TDS	Traceable Down Standard
THM	Textile auxiliaries
TSS	Total settleable solids
et al.	and others
UBA	Federal Environment Agency
etc.	and so on
IP	Eco-label
VDFI	Association of the German Down and Feather Industry
VerpackG	Packaging Act
WRAP	Waste and Resources Action Programme
ZDHC	Zero Discharge of Hazardous Chemicals
ZLD	Zero Liquid Discharge

Summary

Target

"In terms of the EU, the production of clothing, footwear and household textiles consumed in the EU caused total emissions of about 334 million tonnes of CO_2 e in 2017. This corresponds to 654 kg CO_2 e per European citizen. This puts this product group in fifth place when ranking the different consumption sectors in terms of their importance for climate change." (European Environmental Agency 2019), quoted from Teufel et al. im Erscheinen)).[1]

However, the importance of the textile sector should not be underestimated in terms of other environmental impacts, such as the use of global water reserves or the threat to water bodies through the use of aqua- and human-toxic chemicals, as well as its social impacts. The prevailing global value chains, production in countries with lower environmental and social standards, and the issue of "fast fashion" play a major role here. The short useful life, the high level of consumption and the declining quality of textiles, which prevents the recycling of end-of-life textiles, contribute significantly to the environmental impact of the textile sector.

Against this background, it is important to have technically sound, demanding criteria for awarding the Blue Angel for textiles for this product group, which promote and distinguish sustainable production in this important consumer sector.

Between 2009 and 2010, award criteria were developed for the first time, which were confirmed by the Environmental Label Jury and published in 2011 as the award basis RAL-UZ 154. The award criteria have been and will continue to be reviewed and developed on a regular basis.

As part of this periodic revision, the award criteria for the July 2017 version 8 were reviewed within the scope of the project carried out and adapted to accord with newer findings and developments.

Procedure

Extensive literature and desk top research were carried out as a basis for revising the requirements for textile fibres. In addition to the fibres already included in the 2017 award criteria, the research also included explicitly recycled fibres, as well as new and innovative fibres (based on previously unused raw materials such as stinging nettle, pineapple, waste products from the food industry, etc., or technical innovations such as "man-made protein fibres") and in addition "rediscovered" fibres such as nettle. The results of this research will be presented in a separate report. This report only covers those aspects that were specifically included in the revision of the requirements for the 2017 award criteria.

For reviewing the criteria for the existing DE-UZ 154 from 2017, various relevant and current textile standards such as bluesign® (bluesign® CRITERIA for bluesign® PRODUCT Version 3.0 | 2020-03 and bluesign® system substances list (BSSL) Consumer safety limits Version 10.0 | July 1, 2019), Cradle to Cradle (C2C), EU Ecolabel for textile products (2014/350/EU), Fairtrade Textile (Version: 22.03.2016_v1.2), GOTS (Version 6.0; 1 March 2020), Nordic Swan version 5.2, Oeko-Tex® 100, Oeko-Tex® Made in Green (2022) or the respective background reports on criteria development were consulted and compared.[2] In addition, various special sustainability

[1] As part of this research project "Development and revision of award criteria for the German Ecolabel 'Blue Angel' for textiles" (FKZ 3720 37 302 0) two partial reports were created: 1. "Ökologische Bewertung textiler Fasern - von "klassischen" Fasern über Recycling fibern bis zu innovativen und wiederentdeckten Fasern" (with English summary) and 2. Background report for the revision of the award criteria DE-UZ 154. Some parts of this partial report are taken from the partial report "Ökologische Bewertung textiler Fasern - von "klassischen" Fasern über Recyclingfasern bis zu innovativen und wiederentdeckten Fasern" (Teufel et al. 2023).

[2] In the following text, the standards are usually listed without their version.

standards were examined, such as various down standards, standards for the ecological or sustainable production of, for example, alpaca, cashmere, wood and other biogenic resources, as well as the Recycled Claim Standard 2.0 (2017) issued by Textile Exchange. The revision also incorporated the criteria discussed in the Green Button 2.0 meta-label, as well as the limits of the Zero Discharge of Hazardous Chemicals Manufacturing Restricted Substance List (ZDHC MRSL). The EU Ecolabel for textile products was also used, although it has not been updated since 2014. Furthermore, a "background document[3] " on the revision of the Nordic Swan was available, in which much of the background to the proposed criteria (Nordic Ecolabelling 2023a) was described and discussed. The updated final criteria for Nordic Swan version 5.2 were published in March 2022. [4]

In June 2021, the draft BREF document was released (REVISED DRAFT BEST AVAILABLE TECHNIQUES (BAT) CONCLUSIONS FOR THE TEXTILES INDUSTRY), with the final draft published in March 2022 (Roth et al. 2023). Both documents have been incorporated into the revision of the Blue Angel requirements for textiles. The REACh Regulation, especially entry 72 in Annex XVII, as well as limit values from the POP Regulation were also included. Furthermore, in the run-up to the revision, discussions were held with manufacturers, associations, testing institutes and non-governmental organisations (NGOs) in order to critically question, update and, if necessary, supplement the 2017 Blue Angel criteria for textiles.

The contents of the revised award criteria were then discussed with various stakeholders in three expert meetings. After reviewing and incorporating the information and comments from the three expert meetings, a draft version of the revised award criteria was presented and discussed in two expert hearings, moderated by RAL. In these expert hearings, it was finally determined in consultation with the expert group as to which requirements were to be revised and how.

The final award criteria were discussed and approved by the Environmental Label Jury on 7 December 2022. The criteria will be published in January 2023 and will be valid until 31 December 2027. This results in a transition period of one year for the old award criteria from 2017.

Results

Significant changes compared with the 2017 award criteria relate to the following points:

- Under 1.5[5] Definitions, the terms workwear, functional clothing, identity preserved (supply chain management), mass balance (supply chain management), contract textiles, recycled content, segregation (supply chain management), secondary packaging, dust, textile fabrics, transportation packaging, outer packaging, sales packaging and shipping packaging have been added. Changes have been made to synthetic fibres (instead of chemical fibres), natural fibres, recycled fibres and regenerated cellulosic fibres. Technical or functional textiles have been deleted as a term, as technical textiles were removed from the scope at the request of the participants in the expert hearings. However, technical textiles have not been explicitly

[3] This background document was initially used in its draft version. The final document was published in April 2023 (Nordic Ecolabelling 2023a).

[4] The current version of the Nordic Swan (Nordic Ecolabelling for Textiles, hides/skins, and leather, Version 5.1) is valid until May 2026 and can be downloaded from the following link: https://www.nordic-ecolabel.org/product-groups/group/?productGroupCode=039; last downloaded on 23.03.2023

[5] All figures listed refer to the respective sections of the Blue Angel award criteria for textiles and not to sections in this background report.

excluded from the award, as there may be products such as non-wovens used in horticulture that meet the award criteria.

- Extension of the scope to hand(bags), bicycle bags, backpacks and school satchels, which in future no longer have to consist of 90% by weight of textile fibres, but of at least 70% by weight of textile fibres.
- Extension of the scope to include "textile products with food contact".
- Technical textiles have been removed from the scope and the scope has been clarified with regard to functional clothing.
- In terms of exclusions, textile end products with electronic components have been defined more precisely, as have aspects concerned with "materials from animal, plant and wood species".
- The requirements for the origin of natural fibres, cellulose and other plant raw materials (section 3.2.1) have been divided into three sub-sections. In the requirements for natural fibres (3.2.1.1), the materials jute, nettle fibres, alpaca and cashmere have been added, and silk has been specified as silk from silk farms. The requirements and the verification of the origin of cellulose and other plant-based raw materials (3.2.1.2) have been specified much more precisely. For example, bamboo has been explicitly included. The requirements for pulp from recycled material and pulp from residues from the agricultural and food industries have been supplemented. In addition, criteria have been added including verification of the use of renewable raw materials for producing biobased polyester or polyamide fibres.
- In terms of process requirements for manufacturing fibres, the former point 3.2.2.1 Requirements for recycled fibres has been moved to point 3.2.2.10. Compliance verification procedures or certificates for verifying recycled fibres have also been added here. In addition, for each type of fibre it is now explicitly stated whether these requirements also apply to the recycled fibre, thus providing clarity for the applicant.
- For wool and other keratin fibres (3.2.2.2), a third sub-item has been added: exclusion of detergents containing alkylphenol ethoxylates (APEO).
- Extensive changes have been made to regenerated fibres (viscose and lyocell fibres) (3.2.2.3) by inserting four new criteria. Specifically, four additional requirements including compliance verification have been developed: regarding emissions to waste water and air, energy consumption in pulp production, and a requirement for the bleaching process.
- The requirements for recycled fibres have been defined more precisely for polyester fibres (3.2.2.4). The fibres must be produced with a minimum content of PET recycled from production and/or consumer waste. Beverage packaging made of PET may not be used. However, the use of PET beverage packaging for producing recycled fibres is still permitted for a transitional period of two years once the award criteria become applicable.
- In section 3.4 (requirements for down and feathers from waterfowl (geese and ducks)), several wastewater limit values have been removed as they are no longer relevant (3.4.1), and certificates (Downfresh and Daunasan) have been added (3.4.3). In addition, the exclusion of detergents containing APEO has also been added here (3.4.2).
- Requirements have also been adapted for filling materials. For latex foam, a limit value for nitrosamines has been tightened (see 3.5.1 Latex, b) VOC emissions after 72 hours). In the

case of polyurethane (PUR) (section 3.5.2), two sub-criteria relating to production have been included. The first criterion concerns a limit value for diisocyanates; the second relates to the exclusion of CFCs in foaming PUR. In addition, the list of restricted substances and mixtures in PUR has been extended to include plasticisers as a substance group with their corresponding limit values. Adjustments have also been made to the compliance verification procedure.

- In section 3.6.1 General exclusion of substances with certain properties, an additional H-phrase - H 373 – has been included. At the same time, the list of "Deviations for substances" has been extended. For example, H-phrase 373 has been included for the substance group "Auxiliary substances, including carriers, fastness improvers, levelling agents, dispersants, surfactants, thickeners, binders"; H-phrases 400 and 411 have been added to the substance group "Enzymatic desizing agents and enzymatic surface modification". Both H-phrases are also considered as excluded for the newly included "Proteases" substance group. Exemptions have also been added for "Fatty alcohol ethoxylates as substitutes for alkylphenol ethoxylates (APEO)", "Hydroxymethanesulfinic acid sodium salt as reducing agent for direct printing with vat dyes and etchants for white and colour etching" and "Ammonia for use in pigment printing and coating provided that low-emission formulations are used". In addition, the reference to the European Guidelines "Industry Guidelines on the Safe Handling of Enzymes in the Textile Finishing/Garment Finishing Industry" has also been included.

- In the section on special substance requirements in the finishing processes (3.6.2), adjustments have been made for quaternary ammonium compounds (3.6.2.1.1), enyzmatic desizing agents and enzymatic surface modification (3.6.2.2.2), biocidal and biostatic products (3.6.2.4.1) and flame retardant materials (3.6.2.4.2).

- The sections on metal complex dyes with copper, chromium and nickel (previously 3.6.2.3.2) and cerium compounds (previously 3.6.2.4.4) have been deleted, as these are no longer used in current finishing processes. It has been added that mineral oil-based anti foaming agents (3.6.2.1.3) must not be used.

- In the requirements for waste water from the textile finishing process, several limit values have been tightened (COD and total nitrogen (3.6.4.1)) and limit values added for copper, nickel, chromium and antimony (3.6.4.2). With regard to the requirements for emissions to air, firstly, the existing criterion has been made more specific (3.6.5.1) and the building block concept is now described in the Annex; secondly, a requirement for emissions to air, i.e. CO, SOx, NOx and dust from combustion plants, has been added for textile finishing. The emission values depend on the size of the plant (3.6.5.2).

- Additional requirements have been added to the individual substance requirements and end product tests (3.6.6). For example, a requirement for natural rubber (3.6.6.3) has been included as well as the following new tests on the end product:
  1.) Free aniline in jeans products (3.6.6.9); 2.) Alkylphenols and alkylphenol ethoxylates (3.6.6.13); 3.) Per- and polyfluorinated chemicals (PFCs) in hydrophobic textiles (3.6.6.14); 4.) Chinoline/Quinoline (3.6.6.15) and 5.) Pesticides in textiles with recycled cotton/wool (3.6.6.16).

- Changes to section 3.6.6 concern the testing of accessories (3.6.6.4), which has evolved from the former Nickel and its compounds section (previously 3.6.6.3). In addition to nickel, there are now requirements for metallic accessories made of lead, cadmium and chromium. Accessories made of plastics must not contain phthalates. Further organotin compounds have been included (3.6.6.7).

- New requirements within textile manufacturing concern textile products with food contact (3.7) that are already covered in the scope. There are also requirements for the average energy and water consumption (3.8), energy sources (3.9), waste (3.10) and energy-efficient techniques for washing, rinsing and drying (3.11). Both the energy and water consumption and energy sources only need to be listed. For waste, on-site waste incineration or uncontrolled landfilling with waste is not permitted and a waste register must be kept. A minimum number of general energy efficiency techniques, energy efficiency techniques for washing and rinsing, and energy efficiency techniques for drying and finishing on stenter frames shall be selected from a corresponding list.
- Various clarifications were made to the Fitness for use section (3.12). In addition, two further requirements have also been added: firstly, a criterion on abrasion resistance (3.12.9) and, secondly, on the resilience of zip and hook-and-loop fasteners (3.12.10).
- A clear specification has been added for packaging (3.13). In addition to various definitions of terms (see section 1.4), the requirements have now been divided according to the packaging material into specific requirements for packaging made of paper, paperboard and cardboard (3.12.2) and plastic packaging (3.13.3). This has also led to the insertion of a specific percentage of recycled plastics - comparable to the recycling percentage for packaging made of paper, paperboard and cardboard.
- Section 3.14 on consumer information has been adapted to cover electronic components and reparability.
- Section 3.15 on working conditions has been substantially revised.
- Both the objectives of the eco-label and the explanatory field have been adapted to the revised award criteria.
- Extensive research has also been carried out on the emission of microplastics from textiles (see section 2.3.4 of this document). It was found that this is a highly relevant environmental issue and that textiles are a major contributor to microplastic emissions. However, due to the current lack of standardised analytical methods, it was decided not to introduce a criterion.
- Finally, points were listed in the Outlook (e.g. microplastic emissions) for which no final assessment is possible at present, but which will be taken into account in the next revision.

1 Background

1.1 Brief overview of the environmental impact of textile production[6]

Compared with a television, refrigerator, printer or car, the environmental footprint of a textile garment or set of bed linen may seem rather insignificant at first glance. However, the importance of the textile sector in terms of its environmental and social impacts cannot be underestimated. The prevailing global value chains, production in countries with lower environmental and social standards, and the issue of "fast fashion" play a major role here. The short useful life, the high level of consumption and the deteriorating quality of textiles, which prevents the recycling of end-of-life textiles, contribute significantly to the environmental impact of the textile sector. Moreover, these impacts do not usually take place where most textiles are consumed. The vast majority of the environmental impact of textile consumption in Europe takes place in emerging and developing countries, i.e. where the production or sub-processes of textile production (including the cultivation or extraction of biogenic resources) take place (Köhler et al. 2021; Jungmichel et al. 2019).

If we consider only the actual production of textiles excluding the life cycle phases for their distribution, use and disposal, the cultivation and production of raw fibres and textile finishing are particularly harmful to the environment. The use of chemicals, some of which are toxic, carcinogenic, mutagenic, bioaccumulative, persistent or endocrine disruptors, for producing yarns and fabrics or in textile finishing, but also for cultivating natural fibres, is accompanied by emissions of pollutants into surface waters, groundwater and air, and can impair water quality and ecosystems. When polluted waste water enters local waters, people and the environment are harmed. In addition, resource and energy consumption also play a major role in the production of textiles; the considerable amount of water required by the textile industry is a major environmental concern, especially at production sites in regions suffering from water scarcity (Jungmichel et al. 2019; JRC 2019).

The following facts illustrate the importance of the textile sector's textile footprint.

Facts about the greenhouse gas potential of the textile industry

In terms of the environmental impact category greenhouse gas potential, data from Berg et al. (2020) show that the greenhouse gases emitted by the clothing industry (excluding home textiles or technical textiles) amounted to 2.1 billion tonnes of CO_2 e in 2018. According to the authors, this is equivalent to the total greenhouse gases emitted by France, Germany and the United Kingdom or 4% of global greenhouse gas emissions (Berg et al. 2020). Jungmichel et al. (2019) modelled a much lower share from the apparel sector amounting to no more than 1% of global GHG emissions based on EXIOBASE 3.4 using 2015 data. Quantis (2018), using 2016 data and additionally including home textiles and footwear, calculated a significantly higher share of around 8% of global GHG emissions.

In terms of the complete life cycle of textile products, Berg et al. (2020) estimate that around 70% of greenhouse gas emissions from the clothing industry come from upstream process stages, such as the production and finishing of raw materials.

For the EU, the production of clothing, footwear and household textiles consumed in the EU caused total emissions of around 334 million tonnes of CO_{2e} in 2017. This corresponds to 654 kg of CO_{2e} per European citizen. This therefore puts this product group in fifth place when ranking

[6] This overview is taken from the following partial report, which was written by the same main author at the same time as an in-depth background report in the same research project. (Teufel et al. 2023).

the various consumption sectors in terms of their significance for climate change (European Environmental Agency 2019).

(Berg et al. 2020) state that if current development trends continue, the clothing industry will miss the 1.5-degree target by 50%.

However, the sector must be aware of the fact that it is directly affected by the consequences of climate change. First and foremost are the issues of water scarcity and the availability of water resources for cultivating natural fibres (especially cotton), but also for various processes in the textile industry. In addition, climate change increases the physical and economic risks due to infrastructure damage caused by floods or storms. The availability of cotton or other raw materials may be jeopardised due to the consequences of climate change or may result in strong price fluctuations, to name just a few other risks (UNFCCC 2020).

Facts about the use of chemicals and fertilisers for producing textile precursors and manufacturing textiles

Jungmichel et al. (2019) come to the conclusion, based on ecologically extended input-output modelling (basis EXIOBASE 3.4), that 5% of the chemicals produced worldwide are consumed by the clothing industry.

According to the European Environmental Agency (2019), around 3,500 different chemical substances are used in textile production. 750 of the identified substances are classified as hazardous to health, 440 as hazardous to the environment, 240 of these substances are considered to be potentially very dangerous to human health and 120 are considered to be potentially very dangerous to the environment (European Environmental Agency 2019).

It is estimated that between 1.5 and 6.9 kg of chemicals are used to produce 1 kg of finished clothing (Nordic Ecolabelling 2023b).

The cultivation of textile fibres, especially cotton, requires 4% of the total amount of nitrogen fertiliser applied annually (Heffer 2017). Almost 6% of the pesticides sold worldwide each year are used in cotton cultivation. If we consider only insecticides among the pesticides, as much as 16% of the quantities sold worldwide are used in cotton cultivation (Ferrigno et al. 2017).

Facts about the use of water by the textile industry

Based on the results of ecologically extended input-output modelling (basis EXIOBASE 3.4), artificial irrigation used in cotton cultivation and the water consumed when dyeing fabrics for producing clothing account for 1.1% of global water withdrawals from water bodies and ground water (Jungmichel et al. 2019).

A study by the Ellen McArthur Foundation (2017) found that the textile industry (including water use in cotton production) consumes around 93 billion cubic metres of water annually, equivalent to 4% of global freshwater withdrawals. Clothing accounts for more than two-thirds of this water use. The authors therefore estimate that the water used by the clothing industry is higher than in the study by Jungmichel et al. (2019). 20% of global industrial water use is due to the dyeing and treatment of textiles (Ellen McArthur Foundation 2017).

It is also environmentally problematic that many of the major cotton-producing countries, including China, India, various regions of the USA, Pakistan and Turkey, are currently suffering from severe water scarcity (Ellen McArthur Foundation 2017).

According to the European Environmental Agency (2019), the global average water footprint of 1 kg of cotton is just over 10,000 litres. It is estimated that 53,000 million cubic metres (m^3) of

water are needed to produce the textiles purchased by EU households, of which over 90% is estimated to be consumed outside Europe.

Facts about resource use and consumption in the textile industry

It is estimated that 675 million tonnes of primary raw materials were used to produce all the clothing (including footwear) and home textiles purchased by EU households in 2017. This is equivalent to 1,321 kg of primary raw materials per person. This includes fossil resources used as feedstock for synthetic fibres and for energy production, as well as biogenic resources, fertilisers and resource requirements for production facilities (European Environmental Agency 2019).

According to the Ellen McArthur Foundation (2017), the textile industry consumes around 98 million tonnes of fossil resources per year. This estimate includes the fossil fuel required for producing synthetic fibres, the fertilisers used in cotton production and for producing the chemicals used in textile production (Ellen McArthur Foundation 2017).

The Industrievereinigung Chemiefaser e.V. states that the global production of synthetic man-made fibres requires less than 1% of the crude oil produced. Based on freely available data from Statista that estimates the worldwide consumption of crude oil per day in 2020 to be 88.5 million barrels, and assuming a 1% requirement for synthetic fibre production, this would, according to the association's own calculations,[7] correspond to approximately 120,360 tonnes of crude oil in 2020 for producing synthetic man-made fibres. The Ellen McArthur Foundation (2017)(Ellen McArthur Foundation 2017) estimates that around 342 million barrels of crude oil are consumed worldwide each year for producing synthetic man-made fibres. According to the foundation's own calculations, this figure corresponds, when “rounded off”, to approximately 465,120 tonnes of petroleum.

Facts about the land required by cotton production

More than 31 million hectares of cotton are grown worldwide. This represents 2.4% of the world's arable land, with the largest producers being China and India. The use of productive land for fibre crops contributes to a shortage of land available for food production, which can lead to a reduction in local food supplies. In India, for example, it has been calculated that 9% of national malnutrition is due to cotton cultivation, which occupies 8% of the country's arable land (European Environmental Agency 2019).

Trends and facts regarding the use and disposal of textiles

The Ellen McArthur Foundation (2017) says in its study that more than half of the fast fashion produced is discarded in less than a year. Globally, clothing use - the average number of times a garment is worn before it is no longer used - has decreased by 36% compared with 15 years ago.

The "fast fashion" trend also has implications for water pollution from microfibres. Recent research results show that the emission of microplastics or fibre fragments is greatest during the first washing cycles. The more often a textile is washed, the lower the fibre abrasion. This means that textiles with high durability and a long service life can make a major contribution to reducing microplastic emissions (Bendt et al. 2021).

The extent of microplastic emissions from washing textiles is estimated by the Ellen McArthur Foundation (2017) to be half a million tonnes of plastic microfibres - the equivalent of more than 50 billion plastic bottles.

[7] The conversion from barrel to tonne [t] depends on the density of the crude oil. This can vary depending on the region and is usually between 0.130 and 0.149 t/barrel. For the conversion, a crude oil density of 0.136 t/barrel was assumed.

Even the disposal of textiles that are no longer worn is not done in a sustainable way. Instead of reusing clothes and recycling the materials they contain, an estimated 87% of all fibre input at the global level is landfilled or incinerated after first use (Ellen McArthur Foundation 2017). The resulting loss in value is estimated to exceed US$100 billion (Köhler et al. 2021).

In the business-as-usual scenario, the (Ellen McArthur Foundation 2017) concludes that more than 150 million tonnes of clothing will be landfilled or incinerated in 2050.

Developments in the textile sector

In view of the global environmental challenges facing our generation, alternatives in the textile sector are being promoted by various actors. In particular, these include the development of business models based on a circular economy with the development and refinement of various recycling approaches, the rediscovery and new development of alternative fibres as well as the development of energy- and/or resource-efficient processes.

1.2 Relevance of the Blue Angel eco-label for textiles

The consumer-oriented portal Siegelklarheit,[8] which emerged from a project initiated and financed by the Federal Ministry for Economic Cooperation and Development (BMZ), lists a total of 33 textile labels. Of these, 11 textile labels - including the Blue Angel for textiles - are rated as very good. Some of these labels only certify textile products made from natural fibres. They therefore cover only a limited range. Some labels only consider partial aspects along the life cycle of textile products.

The Sustainability Compass[9] is aimed at public procurers and lists 23 quality labels. The Blue Angel is one of the few quality labels that meets all the requirements of public procurement law pursuant to section 34(2) VgV[10] and section 24(2) UVgO.[11] This means that the Blue Angel for textiles can be referred to in the context of a public tender by means of a direct link to the award criteria[12] and can also be used as verification, which does not apply to most quality labels. For this reason, the interest of procurers in the Blue Angel for textiles is relatively high, as this option makes it easier to include ecological criteria in the award procedure.

There was also good stakeholder participation during the review, both in the many individual meetings and in the technical discussions and expert hearings. The industry is in favour of an eco-label that addresses both natural and chemical fibres, but also includes special textiles such as workwear, functional clothing and bedding.

[8] See https://www.siegelklarheit.de/, last accessed 10.12.2021

[9] https://www.kompass-nachhaltigkeit.de/, last accessed 16.08.2022.

[10] Awarding regulations

[11] Subthreshold Procurement Regulations

[12] www.blauer-engel.de/uz154

2 Revision of the Blue Angel Award Criteria for Textiles from July 2017, Version 8

2.1 Notes on the structure of the explanations regarding the revision

The following explanations regarding the revised Blue Angel award criteria for textiles from July 2017, version 8, are structured as follows:

- Section 2.2.1 explains which general or overarching revision requirements have been met.
- The order of the revision explanations in the following sections 2.2.2 to 2.2.20 is based on the structure of the revised award criteria for the Blue Angel for textiles (DE-UZ-154).13 Criteria that have not been changed are not discussed.
- Section 2.3 deals with so-called "new aspects", such as the problem of microplastic emissions. These are environmental aspects that were not previously covered by the award criteria. In this section, each sub-topic is presented in detail. It explains whether and how the issue can be addressed through a requirement (including compliance verification). This has been done for the requirements on energy and water consumption, energy carriers, waste and for the energy efficiency techniques used in washing, rinsing and drying.
- Section 3 provides an Outlook on issues that cannot be conclusively dealt with at present and should be addressed in the next revision.
- Section 4 contains the source references.

The status quo is briefly described for each topic. Reasons are given for revising the previous criterion. Finally, the outcome of the revision is detailed. This means that the new proposal for the criterion (including compliance verification) is listed at the end of each section. The revision is recognisable by the fact that the correspondingly changed text passages are shown in red. In some cases, only the (minor) change has been written in red as continuous text - without listing the criterion. Criteria that have not been changed are not listed.

2.2 Background and explanations on the revision

2.2.1 General

All references to standards, directives and legal requirements have been checked to ensure that they are up to date and adapted where necessary. Where relevant, other applicable standards have also been included.

In the "Definitions" section, various terms have been revised and supplemented. The inclusion of the definition of these terms was particularly necessary in view of the fact that a comprehensive revision of the fibre criteria has been carried out and various new aspects have been addressed with additional requirements. In this context, it is important to note that in the "Definitions" section, only those fibres that are included in the scope of the award criteria are mentioned under natural fibres, synthetic fibres and regenerated fibres. This means that no definition of the respective terms (natural fibres, synthetic fibres and regenerated fibres) has been made here. This is also not an exhaustive list of fibres covered by the term. Other fibres may be added after review by the Federal Environment Agency.

[13] www.blauer-engel.de/uz154

In addition, the following terms have been added and defined in consultation with the experts involved: workwear, functional clothing, identity preserved (supply chain management), mass balance (supply chain management), contract textiles, recycled content, segregation (supply chain management), secondary packaging, dust, textile fabrics, transportation packaging, outer packaging, sales packaging and shipping packaging.

Changes have been made to synthetic fibres (instead of chemical fibres), natural fibres, recycled fibres, and regenerated cellulose fibres. Technical or functional textiles have been deleted as a term because technical textiles were removed from the scope at the request of the participants. This is because most technical textiles would not meet the Blue Angel requirements. However, the team decided not to explicitly exclude them from the scope, so that technical textiles could still be certified if an application is submitted.

2.2.2 Scope

In the scope, a textile fibre content of 70% by weight has been introduced for handbags, bicycle bags and satchels, as accessories and fasteners (e.g. zips) often exceed the more than 10% by weight allowed in the 2017 criteria for these products. It was specified that uncoated carpets also fall within the scope and that if passive electronic components (RFID) are used, they must be removable/separable. Furthermore, it was specified that functional clothing consisting of more than 90% by weight of material produced by processing (welding or similar) textile fibres falls within the scope of application. In addition, "textile products with food contact" has been added.

In regard to exclusions, textile end products with electronic components were specified and a specification was made in this section in terms of materials from animal, plant and wood species.

The criteria have been adjusted as follows:

The "textile products" product group includes the following end products, whereby non-textile filling materials and membranes are not included in the weight calculation:

- Textile clothing and textile accessories made from at least 90% by weight of textile fibres,
- Textile products for use in the interior of buildings (household and home textiles including uncoated carpets) made of at least 90% by weight of textile fibres,
- Functional garments (for definition see section 1.5 "Definitions") that consist of more than 90% by weight of material produced by finishing processes (impregnation, welding or similar) of textile fibres or textile fabrics,
- Bedding made of at least 90 per cent textile fibres by weight,
- Cleaning textiles: woven or non-woven textiles made of at least 90% by weight of textile fibres, intended for wet or dry cleaning surfaces or for drying household articles,
- Handbags (bags), bicycle bags, backpacks and school satchels[14] made of at least 70 per cent textile fibres by weight,

[14] Other products can be included after consultation with the Federal Environment Agency.

- Fibres, yarn, woven, knitted and crocheted fabrics, nonwovens (including textile composites fabrics),[15]
- Textile products with food contact (e.g. oilcloths),
- Stainless steel fibres and mineral fibres are limited to a maximum of 10% by weight.

Excluded from the award are:

- End products intended to be discarded after single use,
- Upholstered furniture, mattresses, textile floor coverings, e.g. carpets, and textile fabrics made of recycled plastics for facade, advertising and decorative applications,[16]
- Textile shoes with a firm sole,[17]
- Materials, accessories and applications made of PVC,
- Materials, components, accessories and applications made of polytetrafluoroethylene (PTFE),
- Textiles containing asbestos, silver, cupro and cellulose acetate fibres,
- Textile end products with electronic components - if passive electronic components (RFID) are used, they must be removable/separable,
- Products that are subject to the Medical Devices Act (e.g. dressings),
- Textiles treated with biocidal products,
- Manufactured textiles from end-of-life textiles without breakdown of the fibres, i.e. textiles that are assembled from existing textiles to form new textiles,
- Material of threatened animal, plant or wood species that are either listed in CITES[18] in Appendix I, II or III[19] or originate from an area/region where they are on the IUCN Red List[20] and are classified as "Critically Endangered", "Endangered" or "Endangered".

The applicant shall inform RAL gGmbH in Annex 1 as to the materials and components used for the end product and shall enclose a colour photo of the corresponding models with the application documents.

2.2.3 Requirements for the origin of natural fibres

This requirement raised the question of whether other natural fibres should be included and what requirements should be placed on the origin of the natural fibres. The assessment was

[15] Textile composites are textile fabrics that consist of textile fibres, yarns or both, but are not woven or knitted. They are produced by sewing over layers of longitudinal and transverse threads or fibre fleeces, by consolidating fibre fleeces by chemical, mechanical or thermoplastic processes, etc. Felts are also counted among the textile composites. In addition to linings, decorative fabrics, plaster cloths, etc., many technical articles are also made from textile composites.

[16] Eco-labels already exist for this purpose: DE-UZ 117 for upholstered furniture, DE-UZ 119 for mattresses, DE-UZ 128 for textile floor coverings and DE-UZ 193 for textile fabrics made of recycled plastics.

[17] The DE-UZ 155 eco-label for shoes exists for this purpose.

[18] Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (CITES 2023).

[19] See https://cites.org/eng/app/appendices.php; last accessed 06.03.2022

[20] The IUCN Red List of Threatened Species, see https://www.iucnredlist.org, last accessed 06.03.2022.

based on a literature and internet search, the results of which will be published in detail in a separate report (Teufel et al. 2023).

Among the natural fibres, jute, nettle (Urtica dioica L. convar. fibra), ramie (Boehmeria nivea), bamboo, alpaca and cashmere have been newly included. Silk has been more precisely defined as “silk from silk farms". Natural fibres produced from residual materials derived from food and agricultural production are also explicitly permitted for the first time.

The fibres must come from controlled organic cultivation or controlled organic animal husbandry (kbT) or from fibres from the conversion phase[21] and meet the requirements of Regulation (EC) No. 2018/848 (EC Organic Regulation) or the American National Organic Programme (NOP). For finer yarns (fineness range > NM100) whose fibre length requirements cannot currently be met with organic cotton, the Federal Environment Agency can carry out an assessment to determine whether the cotton used in the product, which is certified according to other certification systems (e.g. CmiA and Fairtrade), can be approved.

In the case of alpaca, certification according to the Responsible Alpaca Standard 1.0 © 2021 Textile Exchange[22] can be submitted as an alternative to kbT certification. The reason for this is that kbT alpaca wool is hardly available. Most alpaca wool comes from South America (especially Peru). Here, the animals are mainly bred by small farmers and kept in the wild. However, there are also large farms, and there has been some negative criticism of the animal welfare practices of small farms, particularly in terms of the trapping and shearing methods (Blache and Maloney 2017; PETA 2021). Other issues include overgrazing and conserving the biodiversity. In view of this, it is proposed that alpaca wool should not be exempted from the organic farming requirement, but that certification in accordance with the Responsible Alpaca Standard 1.0 © 2021 Textile Exchange should be recognised as an alternative. This standard, which came into force on 20 April 2021, deals with ensuring animal welfare, but also takes into account environmental criteria (soil protection, biodiversity protection, use of synthetic fertilisers and pesticides) and social aspects.

Cashmere hair that has been obtained from kbT is, of course, only available in small quantities. For example, the Lanius GmbH23 company has cashmere products in kbT quality in its range. According to hessnatur, cashmere qualities certified according to kbT are also not available.24 According to hessnatur, precious hairs, which in addition to cashmere also include alpaca, camel and yak, only account for 0.5% of all animal hair produced worldwide. Cashmere goats are mainly kept in China and Mongolia. Basic animal welfare standards are lacking here. Overgrazing and soil erosion are also major problems. The Aid by Trade Foundation (AbTF) has now developed a standard that addresses these issues and certifies Kashmiri goat animal husbandry systems. In the case of cashmere, certification according to the Good Cashmere Standard® (GCS) by AbTF Version 1.125 can therefore be submitted as an alternative to kbT certification.

[21] "Conversion": transition from non-organic to organic farming within a certain period of time during which the rules for organic production have been applied. (EC Organic Basis Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092/91, OJ No L 189, 20.07.2007, p. 1) (Europäische Union 2007).

[22] The standard can be downloaded from the following link: https://textileexchange.org/documents/responsible-alpaca-standard/; last accessed on 07.06.2021. (TextileExchange 2021).

[23] See https://www.lanius.com/de/nachhaltigkeit/materialien/kaschmir; last checked 11.12.2021

[24] Compare https://www.hessnatur.com/magazin/textillexikon/kaschmir/; last checked 23.11.2021

[25] Aid by Trade Foundation (AbTF); the standard can be downloaded from the following link: https://thegoodcashmerestandard.org/wp-content/uploads/2021/04/The-Good-Cashmere-Standard-by-AbTF_v1.1_EN.pdf; last accessed on 14.07.2021

The certifications approved for animal fibre compliance are all based on the so-called "5 freedoms" concept in terms of animal welfare. The British Farm Animal Welfare Council (FAWC) developed this concept in the 1980s. The concept offers an approach to operationalising animal welfare in animal husbandry and forms the basis for various measurement and requirement systems for animal welfare. The five freedoms are:

- Freedom from hunger and thirst - the animals have access to fresh water and healthy, nutritious food;
- Freedom from housing-related discomfort - the animals are housed on suitable lying areas, for example;
- Freedom from pain, injury and disease;
- Freedom from anxiety and stress - through procedures and management, anxiety and stress are avoided, e.g. by not using propellants;
- Freedom to act out normal behavioural patterns - the animals can behave in a manner appropriate to their species, e.g. in the case of cattle by allowing them to graze or generally by providing sufficient space[26] .

As a result of the revision, the following requirements for the origin of natural fibres are now available.

Requirements for the origin of natural fibres

Textile natural fibres (cotton, hemp, flax or the textile material linen, kapok, nettles, ramie, jute, wool silk from silk farms, alpaca and cashmere) must be sourced from controlled organic cultivation or controlled biological animal husbandry or from fibres from the conversion phase[27] and comply with the requirements of Regulation (EC) No 2018/848 (EC Organic Regulation) or the American National Organic Programme (NOP).

In the case of alpaca, certification according to the Responsible Alpaca Standard © 2021 Textile Exchange[28] can be submitted as an alternative to certification of controlled biological animal husbandry.

In the case of cashmere, certification according to the Good Cashmere Standard® (GCS) by AbTF[29] can be submitted as an alternative to certification of controlled biological animal husbandry.

At all stages of the processing chain, it must be ensured that controlled biological fibres and products are not mixed with conventional fibres and products and that the controlled biological fibres are not contaminated due to contact with prohibited substances.

[26] Further information on the "5 freedoms" can be found at the following URL: https://www.thuenen.de/de/themenfelder/nutztierhaltung-und-aquakultur/wie-tiergerecht-ist-die-nutztierhaltung/wie-sich-tiergerechtheit-messen-laesst; last accessed on 24.03.2023

[27] "Conversion": Transition from non-organic to organic farming within a given period of time, during which the provisions concerning organic production have been applied; Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 on organic production and labelling of organic products and repealing Council Regulation (EC) No 834/2007; https://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:32018R0848&from=DE (Europäische Union 2007).

[28] The standard can be downloaded from the following link: https://textileexchange.org/documents/responsible-alpaca-standard/; last accessed on 21.12.2022.

[29] Aid by Trade Foundation (AbTF); The standard can be downloaded from the following link: https://thegoodcashmerestandard.org/wp-content/uploads/2021/04/The-Good-Cashmere-Standard-by-AbTF_v1.1_EN.pdf; last accessed on 21.12.2022.

The fibres used in the products must not be sourced from genetically modified organisms (GMO).

Mulesing is not permitted.

In the case of fine yarns (fineness range > NM100), where the required fibre lengths cannot currently be sourced from the controlled organic cultivation of cotton, the German Environment Agency can conduct an inspection to decide whether the cotton used in the product that has been certified by a different certification system (e.g. Cotton made in Africa (CmiA) and Fairtrade Cotton) can also be approved.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1. Fibres labelled with the German organic logo (Bio-Siegel) or the EU organic logo ("Euro leaf") or in accordance with the American National Organic Programme (NOP) will be accepted. In addition, corresponding certificates from an internationally recognised certification body accredited by the IFOAM or in accordance with DIN EN ISO/IEC 17065 that verify compliance with recognised international or national ecological farming standards can be submitted. In the case of alpaca, certification according to the Responsible Alpaca Standard 1.0 © 2021 Textile Exchange can be submitted as an alternative to certification of controlled biological animal husbandry.

The certification of products "in conversion" is only possible if the regulations on which the certification of the fibre production is based include the possibility of such certification for the fibres in question. However, they must be specially labelled in accordance with these regulations.

If requested to do so by RAL GmbH, the applicant shall submit, where relevant, a shipping or transaction certificate30 from an accredited certification body verifying compliance with the requirement at all stages of the processing chain, as well as information on the amount of biofibres produced and about the certification body and certification standard.

2.2.4 Requirements for the origin of cellulose and other plant-based raw materials

The cellulose used for regenerated cellulose fibres and the plant-based raw materials used for producing latex must come from wood grown according to the principles of sustainable forestry as defined by the FAO. The use of processing waste (e.g. production and processing waste generated in the various stages of the cotton textile value chain) and end-of-life textiles reduces the use of biogenic resources and contributes to the circular economy. Therefore, pulp from production, processing and consumer waste can be used as an alternative or in addition to certified pulp obtained from wood. The same applies to the use of residues from the agricultural and food industries as a raw material for cellulose extraction.

The question of whether to exclude FSC-certified eucalyptus as a raw material and instead allow FSC-certified bamboo as a raw material was discussed intensively at the expert meeting. The cultivation of eucalyptus in plantations is critical due to the considerable water required by eucalyptus plants in regions with water shortages. In addition, NGOs have raised concerns about the lack of respect for land rights and other adverse social consequences due to the change in land use in connection with this plantation economy (Giunta and Munnion 2020)[31]

[30] This is a certificate that confirms that the traded product (e.g. raw cotton or yarn) was produced in accordance with the relevant standard.

[31] See also e.g. https://www.deutscheklimafinanzierung.de/blog/2020/05/die-klimafinanzierung-fuer-die-holzkohleproduktion-in-brasilien-schuert-konflikte-in-der-bevoelkerung/; last accessed 11.12.2021

FSC certification covers the negative aspects listed above with corresponding requirements. In addition, FSC certification of plantations also requires that the original natural ecosystems surrounding the plantation area are preserved. There are also various regional requirements regarding the size of the areas in which the original natural ecosystems must be preserved.

Due to the growing demand for bamboo for various products (construction, bio-based plastics, etc.), bamboo is increasingly being grown in large-scale monocultures. This type of cultivation is associated with several negative social consequences and environmental impacts. Bamboo products can now be certified with the FSC seal. The certification criteria guarantee that the bamboo comes from responsible sources. However, inaccuracies and declaration errors in the bamboo supply chain, which were identified by FSC and ASI (Accreditation Services International) in an investigation, have led FSC to introducing a mandatory transaction audit[32] as of 2017.

In addition, there are now developments in the use of pulp obtained from production, processing and consumer waste (= recycled material), as well as pulp obtained from residues from the agricultural and food industries (Duhoux et al. 2021; Teufel et al. im Erscheinen. The future prospects for the development of other cellulose sources are promising. These developments will contribute to a reduction in the demand for pulp from primary sources. The requirement has been revised accordingly in view of this (Teufel et al. forthcoming).

Meanwhile, other biogenic resources (not residual materials) are also being used to replace fossil resources in the production of synthetic fibres. However, the use of biogenic resources as raw materials for the production of synthetic fibres (specifically polyester and polyamide) is not sustainable per se. The cultivation of biogenic resources is associated with a number of environmental impacts (use of pesticide and synthetically produced fertilisers, pollution of ground and surface waters, water consumption, land use, loss of biodiversity and ecosystem services, etc.). Furthermore, the issue of food security and potential competition with food production should be critically examined and evaluated against the backdrop of the internationally agreed Sustainable Development Goals (WBGU 2020).

The use of biogenic resources or biomass should only be based on defined sustainability criteria for the material use of biomass. For example, the sustainability criteria for bioenergy specified by DIN ISO 13065:2017-06 could be used. These cover environmental, social and economic aspects. The following certification systems, for example, could be used to demonstrate that the raw materials used meet these criteria.

- Roundtable for Sustainable Biomaterials (RSB)
- International Sustainability & Carbon Certification (ISCC) /the ISCC plus standard explicitly applies to bio-based products
- Rainforest Alliance
- RedCert (Europe only)

In view of this, a corresponding requirement for using renewable raw materials for producing bio-based polyester or polyamide fibres has been developed in the current proposal for revising the award criteria.

However, it is important to note that the "certification of bio-based products on the basis of the aforementioned systems cannot serve to resolve all potential sustainability conflicts. In

[32] See https://www.fsc-deutschland.de/transaktionsueberpruefung-fuer-bambus-lieferkette-wird-eingefuehrt/; last accessed 24.03.2023

particular, it cannot comprehensively guarantee "sustainability per se". A number of very important aspects, such as the conflict with food security and other indirect effects (see also the iLUC debate), can only be addressed very inadequately or hardly at all through certification (Fehrenbach et al. 2019).

An exception to the requirements for using biogenic resources from sustainable cultivation could be made for using residues from the agricultural and food industry (e.g. bagasse from sugar cane production, straw, etc.). In the context of a closed-loop economy, it makes sense to use residual materials in a sensible and sustainable way. It should be noted, however, that recycling these residual materials for producing biogenic synthetic fibres is difficult due to their mostly low starch content. Nevertheless, as part of the revision of the award criteria, a requirement has been formulated that explicitly allows the use of residual materials from the agricultural and food industry (e.g. bagasse from sugar cane production, pineapple leaves, the "perennials" from banana plants, the fibres from oilseed flax) as raw materials or components for producing textile fibres. These residues do not have to originate from organic production or from fibres from the conversion phase, and do not have to meet the conditions of Regulation (EC) No. 2018/848 (EC Organic Regulation) or the American National Organic Programme (NOP). However, a detailed declaration of the fibre components of the fibre(s) used must be submitted, indicating the proportion of fibre obtained from the waste materials used. In addition, the quantities of residual materials required for producing a defined quantity of fibre must be broken down on the basis of comprehensible calculations. In addition, the corresponding purchase or procurement documents for procuring resources based on residual materials for a defined period of time must be submitted, as well as the quantities of fibre produced based on residual materials.

As a result of the literature analysis and the expert discussion, the following requirements for the origin of cellulose and other plant-based raw materials are now available.

Requirements for the origin of cellulose and other plant-based raw materials

a) Cellulose for regenerated cellulose fibres and plant-based raw materials for the production of latex must be sourced from wood or bamboo that has been cultivated in accordance with the principles of sustainable forestry management as defined by the FAO. In the case of cellulose sourced from bamboo, a transaction certificate must also be submitted. The certificate must guarantee that a transaction verification process[33] has been carried out on the source of the cellulose and verify that the information provided by the label user is correct. As an alternative to cellulose sourced from wood, cellulose from production, processing and consumer waste (= recycled materials) can also be used. The same applies to cellulose sourced from residues from food and agricultural production.

Compliance verification

In the case of cellulose fibres used in the product, the applicant shall submit certificates verifying compliance with this criterion. For this purpose, the applicant shall obtain valid independently issued certificates about the product chain from the fibre producers verifying that the wood or bamboo used for the cellulose fibres was cultivated in accordance with the principles of sustainable

[33] The growing demand for bamboo for use in various products (building sector, plastic products made of biological resources, etc.) harbors the danger that bamboo will be increasingly cultivated in large-scale monocultures. Bamboo products can now be certified with the FSC Seal. The certification criteria guarantee that the bamboo comes from responsible sources. However, inaccuracies and declaration errors in the bamboo supply chain, which were identified in an investigation carried out by the FSC and ASI (Accreditation Services International), meant that the FSC introduced an obligatory transaction verification process from 2017. Against this background, it is recommended in the case of bamboo that not only certification from responsible sources but also an additional transaction certificate, which guarantees that the information provided by the label user is correct, is requested as verification. See https://www.fsc-deutschland.de/transaktionsueberpruefung-fuer-bambus-lieferkette-wird-eingefuehrt/; last accessed on 21.12.2022

forestry management. A transaction certificate must also be submitted for cellulose extracted from bamboo. The Forest Stewardship Council (FSC), the Programme for the Endorsement of Forest Certification Schemes (PEFC) or equivalent rules will be accepted as independent certification.

If production, processing and consumer waste is used in the production of textile fibres, the proportions of the different sources of cellulose shall be stated. The use of production, processing and consumer waste must be traceable back to the conditioning of the source material. This must be verified in the form of independent certification of the product chain (e.g. using the Recycled Claim Standard or an equivalent certification approach). Alternatively, purchasing and procurement receipts for these resources and a plausible list of their quantities can be submitted verifying that the amount of cellulose used in production that is not sourced from wood cultivated according to the guidelines for sustainable forestry based on the definition from the FAO is covered by the purchased quantities of production, processing and consumer waste.

b) If renewable raw materials are used to produce bio-based polyester or polyamide fibres, these must be sourced from sustainable cultivation on cultivation areas that can verify that they are managed in an ecological and socially responsible manner. The origin of the renewable raw materials for the production of the bio-based plastics must be verified in the form of a certificate from one of the following certification systems:

- International Sustainability and Carbon Certification (ISCC+),
- Roundtable on Sustainable Biomaterials (RSB),
- RedCert[34] (only in Europe)
- Rainforest Alliance (Sustainable Agriculture Network (SAN)),
- Roundtable on Responsible Soy (RTRS),
- Roundtable on Sustainable Biomaterials (RSB),
- Forest Stewardship Council (FSC),
- Programme for the Endorsement of Forest Certification Schemes (PEFC)
- or a comparable certification system whose scope and requirement standards is equivalent to one of the named certification systems. The equivalence of the certification system must be confirmed by an independent environmental verifier.
- Alternatively, individual verifications in accordance with the criteria and verification requirements of one of the named certification systems may be presented if an equivalent level of protection can be achieved. The equivalence of the individual verifications must be confirmed by an independent environmental verifier.
- Alternatively, residues from food and agricultural production may also be used.

The use of purchased certificates based on the Book & Claim system is excluded so that the traceability of the raw materials is possible. Certificates based on the identity preserved, segregation and mass balance systems are approved.

[34] REDcert GmbH operates one of the leading certification systems for sustainable biomass and biofuels in Germany and Europe (REDcert-DE and REDcert-EU).

The proofs of purchase for the raw materials or semi-finished products must be based on processes according to the identity preserved, segregation or mass balance systems (see Paragraph 1.5 "Definitions").

Compliance verification

The applicant shall declare in Annex 1 to the contract whether renewable raw materials are used to produce polyester and polyamide fibres. If this is the case, the applicant shall document the origins and proportions by mass of the renewable raw materials used for the plastics in Annex 2 and submit the required certificates or verifications.

As verification for the use of residues from agricultural and food production, the applicant shall supply justifiable calculations to demonstrate which quantities of the residues are required for the production of a defined amount of fibre. In addition, the applicant shall submit corresponding purchasing and procurement receipts for the residues and information on the amount of fibres produced using the residues for a period of one year (12 months) before submitting the application.

c) If using residues from the agricultural, timber and food industries (e.g. bagasse from sugar cane production, pineapple leaves, the "stems" of banana plants, the fibres from oilseed flax, residues from the processing of cork) as a raw material or component in the production of textile fibres or insulation and filling materials, the residues do not have to be sourced from controlled organic cultivation or from fibres from the conversion phase, neither do they have to comply with the requirements of Regulation (EC) No 834/2007 (EC Organic Regulation) or the American National Organic Programme (NOP). In the case of fibres or filling materials that are exclusively or partially produced using residues from the agricultural, timber and food industries, the applicant must enclose a precise declaration about the components of the fibre in the form of a data sheet.

Compliance verification

As verification for the use of residues from the agricultural, timber and food industries, the applicant shall declare compliance with the requirement in Annex 1 to the contract. The applicant shall submit a precise declaration about the components of the fibre, insulation or filling material verifying the proportion of the fibres, filling or insulation materials that was produced using these residues. In addition, the applicant shall provide justifiable calculations to demonstrate which quantities of the residues are required for the production of a defined amount of fibre, filling or insulation material. Furthermore, the applicant shall submit corresponding purchasing and procurement receipts for the residues for a period of one year (12 months). The applicant shall also provide information on the amount of fibres, filling or insulation materials produced using these residues.

2.2.5 Requirements for the manufacturing processes of fibres

The current Blue Angel award criteria set requirements for the manufacturing processes of flax fibres and other bast fibres, wool and other keratin fibres, regenerated cellulose fibres (viscose, lyocell and modal fibres), polyester, polyamide, polyacrylic, elastane, polypropylene fibres and elastolefin. The requirements for the manufacturing processes in the current Blue Angel award criteria were reviewed and discussed with experts. There is a fundamental need to revise the requirements in order to address whether the requirement also applies to recycled fibres. The level of knowledge required for this on the subject of recycling and recycled fibres is described in section 2.2.5.10. 2.2.5.10 described.

Another need for revision was to exclude the use of detergents containing alkylphenol ethoxylates (APEO) in wool laundering.

In addition, extensive requirements have been introduced for the manufacturing process of cellulose with regard to waste water emissions, emissions to air, bleaching processes and energy consumption. The currently revised award criteria for the Blue Angel for disposable nappies DE-UZ 208[35] have been used for this purpose.

As a result of the literature analysis and the expert discussion, the following requirements for the manufacturing processes of fibres are now available.

2.2.5.1 Production of flax and other bast fibres

Flax and other bast fibres may only be produced with the aid of water retting if the water used for the water retting has been treated so as to reduce the chemical oxygen demand (COD) or the total organic carbon by at least 75% for hemp fibres and by at least 95% for flax and other bast fibres.

This requirement does not apply to recycled fibres.

Compliance verification

If water retting is used, the applicant shall declare their compliance with the requirement according to 3.2.2.1 in Annex 1 and submit confirmation from the operator of the plant (Annex 3). The operator shall enclose a test report to verify compliance with the requirement. The test of the COD will be carried out in accordance with ISO 6060 or DIN 38409-41 or DIN 38409-44 or DIN-ISO 15705 on the basis of a qualified random sample or a 2-hour mixed sample.

If discharged to an urban waste water treatment plant (indirect discharge), the applicant shall also enclose a notice of approval verifying that the discharge process has been approved and that the urban waste water treatment plant meets the requirements of Directive 91/271/EEC.

2.2.5.2 Wool and other keratin fibres

2.2.5.2.1 Requirements for waste water from wool scouring before mixing (indirect discharge)

The chemical oxygen demand (COD) of the cleaning water discharged into the sewerage system must not exceed 45 g/kg of greasy wool before mixing with other waste water.

This requirement does not apply to recycled fibres.

2.2.5.2.2 Requirements for waste water from wool scouring at the discharge point (direct discharge)

The chemical oxygen demand (COD) of the cleaning water treated on-site and discharged to surface waters must not exceed 150 mg/l (qualified random sample) or 1.5 mg/l (2-hour mixed sample) of greasy wool. The pH value of the waste water discharged to surface waters must be between 6 and 9 (unless the pH value of the receiving waters is outside this range) and the temperature must be below 35 °C (unless the temperature of the receiving waters is already above this limit).

This requirement does not apply to recycled fibres.

Compliance verification

The applicant shall declare compliance with the requirement in accordance with either 3.2.2.2.1 or 3.2.2.2.2 in Annex 1 and submit confirmation from the operator of the wool scouring plant. The

[35] www.blauer-engel.de/uz208

operator of the wool scouring plant shall also provide information on how he/she treats the cleaning water (on-site treatment + direct discharge or on-site treatment + indirect discharge).

The applicant shall enclose a test report to verify compliance with the requirements. The test of the COD will be carried out in accordance with ISO 6060 or DIN 38409-41 or DIN 38409-44 or DIN-ISO 15705 on the basis of a qualified random sample or a 2-hour mixed sample.

If discharged to an urban waste water treatment plant, the applicant shall also enclose a notice of approval verifying that the discharge process has been approved and that the urban waste water treatment plant meets at least the requirements of Directive (EEC) 91/271.

2.2.5.2.3 Exclusion of washing agents containing alkylphenol ethoxylates (APEO)

Washing agents containing alkylphenol ethoxylates (APEO) are prohibited. The limits for direct and indirect discharge may not exceed 5µg/l APEO (NPEO, OPEO, NP and OP).

Compliance verification

The applicant shall declare compliance with the requirements in Annex 1 and submit a *compliance statement from the operator of the processing plant and test reports verifying compliance with the requirements in accordance with Annex 57 of the German Waste Water Ordinance or equivalent international test reports. The following test methods can be used here (on the basis of a qualified random sample or a 2-hour mixed sample):NPEO, OPEO, NP and OP: ISO 18857-1, ISO 18857-2, ISO 18254-1 or ASTM D7742-17.*

2.2.5.3 Regenerated fibres (viscose and lyocell fibres)

2.2.5.3.1 Emissions to waste water in the production of cellulose

Strict requirements apply to the emissions to waste water during the production of the cellulose used in the cellulose fibres. The applicant must determine the levels of the following chemical substances in the emissions to waste water at the cellulose plant (measurement specifications, see Annex C "Measurement of emissions to waste water in the production of cellulose"):

- Chemical oxygen demand (COD) in kg O_2 per air dry tonne[36]

Proportion of chemically oxidising organic compounds in the waste water (usually based on analyses using dichromate oxidation), given as O_2

- Total nitrogen content in kg N per air dry tonne

Total-N (Total nitrogen, Tot-N), given as N. This includes organic nitrogen, free ammonia and ammonium (NH_4^+-N), nitrites (NO_2^--N) and nitrates (NO_3^--N).

- Total phosphorous content in kg P per air dry tonne

Total-P (Tot-P), given as P. This includes both dissolved phosphorous and also undissolved phosphorous which enters the waste water in the form of precipitates or microorganisms.

The following reference values apply to the named substances:

- Chemical oxygen demand: $COD_{Reference}$ = 18.00 kg O_2/air dry tonne
- Total nitrogen content: $N_{Reference}$ = 0.25 kg N/air dry tonne

[36] air dry: air dried cellulose

- Total phosphorous content: $P_{Reference}$ = 0.03 kg P/air dry tonne

Based on the measurement values, the applicant must calculate so-called emission points (P) for each of the measured substances as a ratio between the measurement value and the reference value as follows:

- $P_{COD} = \frac{CSB_{Messwert}}{CSB_{Referenz}}$
- $P_N = \frac{N_{Messwert}}{N_{Referenz}}$
- $P_P = \frac{P_{Messwert}}{P_{Referenz}}$

The following requirements apply:

a) For each of the emission points P_{COD}, P_N and P_P, a value of 1.5 must not be exceeded in each case and

b) the sum of the emission points for emissions to waste water and air (P_{COD}, P_N, P_P, $P_{Sulphur}$ and P_{NOx}, see criteria 2.2.5.3.1 and 2.2.5.3.2) must not exceed a value of 5.0.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 to the contract and submit Annex 5 (emission values) completed by the producers of the cellulose, as well as test reports and the required supplementary documentation to the contract. The supplementary documentation comprises calculations of the emission points verifying compliance with this requirement. The test reports must comply with the requirements in the measurement specifications in Annex C "Measurement of emissions to waste water". The submitted test reports must be produced by a testing laboratory accredited according to DIN EN ISO/IEC 17025 (general requirements for the competence of testing and calibration laboratories) or with official accreditation as a GLP laboratory[37]. In-house laboratories are recognised as being of an equivalent standard when they have been accredited by an independent body as an SMT laboratory (supervised manufacturer testing laboratory).

2.2.5.3.2 Emissions to air in the production of cellulose

Strict requirements apply to the emissions to air during the production of the cellulose used in the cellulose fibres. The emissions to air include those from the recovery boiler, lime kiln, steam boiler and incinerator for strong smelling gases. Diffuse emissions must also be taken into account. The applicant must determine the levels of the following chemical substances in the emissions to air at the cellulose plant (measurement specifications, see Annex 57 "Measurement of emissions to air in the production of cellulose"):

- Gaseous sulphur compounds (sulphur) in kg S per air dry tonne

[37] https://www.oecd.org/chemicalsafety/testing/oecdseriesonprinciplesofgoodlaboratorypracticeglpandcompliancemonitoring.htm , last accessed on 21.12.2022 (OECD 2021).

Total reduced sulphur (TRS): Sum of the following reduced bad-smelling sulphur compounds released during the production of the cellulose: hydrogen sulphide, methyl mercaptan, dimethyl sulphide and dimethyl disulfide, given as S, plus sulphur dioxide (SO_2), given as S

- Nitrogen oxide (NO_x) in kg NO_x per air dry tonne

  Sum of nitrogen oxide (NO) and nitrogen dioxide (NO_2), given as NO_2

- Dust emissions (dust[38]) in kg dust per air dry tonne

  Sum of dust emissions at the waste liquor boiler and lime kiln, stated as dust

The following reference values apply to the named substances:

- Gaseous sulphur compounds: $Sulphur_{Reference}$ = 0.6 kg S/air dry tonne
- Nitrogen oxide: $NO_{xReference}$ = 2 kg NO/air dry tonne

Based on the measurement values, the applicant must calculate so-called emission points (P) for each of the measured substances as a ratio between the measurement value and the reference value as follows:

- $P_{Schwefel} = \frac{Schwefel_{Messwert}}{Schwefel_{Referenz}}$
- $P_{NOx} = \frac{NOx_{Messwert}}{NOx_{Referenz}}$

The following requirements apply:

a) For each of the emission points $P_{Sulphur}$ and P_{NOx}, a value of 1.5 must not be exceeded in each case and

b) the sum of the emission points for emissions to waste water and air (P_{COD}, P_N, P_P, $P_{Sulphur}$ and P_{NOx}, see criteria 3.2.2.3.1 and 3.2.2.3.2) must not exceed a value of 5.0.

In addition, it is recommended for the dust emissions that a reference value of 0.45 kg dust/air dry tonne is not exceeded. In future revisions of these Basic Award Criteria, it is anticipated that this value will be set as an obligatory requirement.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 to the contract and submit Annex 5 (emission values) completed by the producers of the cellulose, as well as test reports and the required supplementary documentation to the contract. The supplementary documentation comprises calculations of the emission points verifying compliance with this requirement. The test reports must comply with the requirements in the measurement specifications in Annex D "Measurement of emissions to air in the production of cellulose". The submitted test reports must be produced by a testing laboratory accredited according to DIN EN ISO/IEC 17025 (general requirements for the competence of testing and calibration laboratories) or with official

[38] See Paragraph 1.5 for the definition

accreditation as a GLP laboratory[39]. In-house laboratories are recognised as being of an equivalent standard when they have been accredited by an independent body as an SMT laboratory (supervised manufacturer testing laboratory).

2.2.5.3.3 Bleaching processes

In the production of the cellulose, the following requirements apply to the bleaching process:

- The cellulose must not be bleached using elementary chlorine and hypochlorite. Hypochlorite may still be used for a transitional period of 5 years. This means that the use of hypochlorite in the production of cellulose for the production of regenerated fibres is still permitted for a transitional period of 5 years from the date on which these Basic Award Criteria come into force. After this transitional period, the use of hypochlorite is prohibited, even for the bleaching of cellulose for the production of regenerated fibres.
- In the case of chlorine compounds used as bleaching agents, only a modern elementary chlorine free (ECF) bleaching process using chlorine dioxide is permitted[40]. In this case, the specific amount of chlorine dioxide (ClO_2) consumed, expressed as an annual average, must be stated in kg ClO_2 per air dry tonne. The adsorbable organically combined halogens (AOX) must be measured in the waste water. The annual average for the measured AOX emissions to waste water must not exceed a value of 0.14 kg AOX per air dry tonne.
- The specific amounts of poorly biodegradable complexing agents (thylenediaminetetraacetic acid (EDTA) and diethylenetriaminepentaacetic acid (DTPA)) must be stated in kg per air dry tonne, expressed as an annual average.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 to the contract and submit a declaration from the cellulose producer in Annex 5 verifying that no elemental chlorine or hypochlorite is used in the bleaching process or a declaration that hypochlorite will only be used for bleaching the cellulose until 31.12.2027 (stating the date). Based on test reports, the applicant shall state the specific amounts of EDTA and DTPA consumed, as well as the ClO_2, in Annex 5. If chlorine compounds (e.g. ClO_2) are added to the bleach for the cellulose, the applicant shall submit a test report for the AOX emissions to waste water in Annex x. One of the test methods ISO 9562, DIN EN 1485, DIN 38409 Part 14 or the equivalent EPA 1650C must be used for measuring the AOX emissions. The measurements shall be carried out over a production period of 12 months, with measurements taken on at least a monthly basis. The submitted test reports must be produced by a testing laboratory accredited according to DIN EN ISO/IEC 17025 (general requirements for the competence of testing and calibration laboratories) or with official accreditation as a GLP laboratory[41]. In-house laboratories are recognised as being of an equivalent standard when they have been accredited by an independent body as an SMT laboratory (supervised manufacturer testing laboratory).

[39] https://www.oecd.org/chemicalsafety/testing/oecdseriesonprinciplesofgoodlaboratorypracticeglpandcompliancemonitoring.htm ,last accessed on 21.12.2022

[40] The use of hypochlorite is prohibited or only permitted for a transitional period of 5 years from the date on which these Basic Award Criteria come into force.

[41] https://www.oecd.org/chemicalsafety/testing/oecdseriesonprinciplesofgoodlaboratorypracticeglpandcompliancemonitoring.htm ,last accessed on 21.12.2022

2.2.5.3.4 Energy consumption in the production of cellulose

The specific energy consumption in the production of cellulose must not exceed the following limit values:

- Electrical energy: ≤1,125 kWh/air dry tonne
- Heating energy: ≤7,500 kWh/air dry tonne

c) Electrical energy (electricity):

The electricity consumed in the production of cellulose must be measured over a period of 12 months and stated in relation to the cellulose produced (air dry tonnes) during this period. The electricity consumption is calculated as follows:

Electricity consumption = electricity generated at the plant

plus the electricity purchased from outside of the plant

less the electricity sold outside of the plant

less the electricity consumed for processes not related to the cellulose production at the plant

less the electricity consumed at the treatment plant

d) Heating energy (fuel):

The heating energy consumed in the production of cellulose must be measured over a period of 12 months and stated in relation to the cellulose produced (air dry tonnes) during this period. Heating energy can be in the form of gaseous, liquid or solid fuels (e.g. natural gas, heating oil, biomass) or in the form of heat transfer media (e.g. water, steam). For the energy content of the fuel, the lower heating value (LHV) for the relevant fuel is used. In the case of damp fuels (e.g. wood, biomass), the effective calorific value (after subtracting the evaporation energy of the enclosed water) is used, while the effective energy content is used for heat transfer media.

The heating energy consumption is calculated as follows:

Heating energy consumption = fuel produced at the plant

plus the purchased heating energy or fuel

less the heating energy or fuel sold

less 1.25 x the electricity generated at the plant

less heating energy consumed for processes not related to the cellulose production at the plant

Please note:

The heating energy includes all fuels used (their lower heat value) and the heating energy recovered from the incineration of pulping liquors and waste at the production site (e.g. waste wood, sawdust, pulping liquor, waste paper, rejected paper), as well as the heating energy

recovered from the plant's own electricity generation. The applicant must present the calculation for the energy consumption for the production of cellulose in the form of an energy statement together with the calculation parameters used. If the applicant does not have their own heat values for the fuels used, the heat values documented in the Nordic ecolabel for paper products[42] may be used.

Compliance verification

The applicant shall state the specific energy consumption and declare compliance with the requirement in Annex 1 to the contract. In addition, the applicant shall submit an energy statement in Annex 5, which documents the energy consumption over a period of 12 months, the heat values for the relevant fuels used, the annual production of cellulose and the calculation of the specific energy consumption values.

2.2.5.3.5 Halogen content

The halogen content of the fibres must not exceed 150 mg/kg.

This requirement also applies to recycled fibres.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 and submit confirmation from the operator of the plant (fibre producer), as well as a test report. The test shall be carried out in accordance with ISO 11480 (controlled combustion and microcoulometry).

2.2.5.3.6 Emissions to air

In the case of viscose fibres, the sulphur content of the emissions of sulphur compounds to air from fibre production processes, expressed as an annual average, must not exceed 30 g/kg of staple fibres produced, 40 g/kg of filament fibres for batch washing and 170 g/kg of filament fibres for integrated washing. If both types of fibres are produced at a particular site, the total emissions must not exceed the corresponding weighted average value.

This requirement also applies to recycled fibres.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 and submit confirmation from the operator of the plant (viscose producer), as well as a sulphur emissions report[43].

2.2.5.3.7 Emissions to water in the production of viscose fibres

The waste water from the production of viscose fibres must not exceed the following values (expressed as annual averages) when discharged to surface waters:

- Zinc: 1.5 mg/l,
- AOX: 1 mg/l,
- COD: 100 mg/l,
- Sulphide: 0.3 mg/l.

[42] Nordic Ecolabelling of Paper Products – Basic Module Version 3.0 • 05 October 2020 – 31 December 2025; see https://www.nordic-ecolabel.org/globalassets/ai001_3.0_basic_module_cd.pdf; last accessed on 21.12.2022 ((Nordic Ecolabelling 2020).

[43] Note: Using a sulphur emissions report on the carbon disulphide added and reused, it is possible to calculate what amount is actually emitted.

This requirement does not apply for approved discharge into an urban waste water treatment plant that meets at least the requirements of the Council Directive of 21 May 1991 concerning urban waste water treatment (91/271/EEC).

This requirement also applies to recycled fibres.

Compliance verification

The applicant shall declare compliance with the requirements in Annex 1 and submit a declaration of compliance from the operator of the plant (viscose producer), as well as a test report (the test report for the waste water measurement at the plant). The following methods may be used for completing these tests:

- Zinc: EN ISO 11885,
- AOX value: EN ISO 9562,
- COD: ISO 6060 or DIN ISO 15705 or DIN 38409-41 or DIN 38409-44,
- Sulphide: DIN 38405-27 or ISO 10530.

If discharged to an urban waste water treatment plant (indirect discharge), the applicant shall also enclose a notice of approval for the fibre producer verifying that the discharge process has been approved and that the urban waste water treatment plant meets at least the requirements of Directive 91/271/EEC.

2.2.5.4 Polyester fibres

Textile end products made out of polyester must comply with subcriterion a) as well as either of b) or c).

a) The amount of antimony present in the polyester fibres must not exceed 260 ppm or an elutable amount of 30 mg/kg.

This requirement also applies to recycled fibres.

Compliance verification

The applicant shall declare in Annex 1 that he/she uses antimony-free polyester fibres and submit a corresponding declaration for his/her supplier (Annex 6), or if fibres containing antimony have been used, the applicant shall submit a test report from the suppliers of the fibres to verify compliance with this requirement. The test shall be carried out using the following method: direct determination by atomic absorption spectrometry. The test shall be carried out on the raw fibre prior to any wet processing. Leaching according to DIN EN ISO 105-E04 / determined according to ISO 17294-2 (ICP/MS). The recycling process must be described if using recycled fibres.

a) Fibres must be produced using a minimum content of PET that has been recycled from production and/or consumer waste. The use of PET beverage packaging is not permitted. However, the use of PET beverage packaging in the production of recycled fibres is still permitted for a transitional period of two years from the date on which these Basic Award Criteria come into force. Mixtures of staple fibres must contain a minimum of 50% recycled fibres and filament fibres must contain at least 20% recycled fibres. This requirement does not apply to microfibres, which must comply with subcriterion c).

b) The emissions of volatile organic compounds (VOC) in the sense of the Industrial Emissions Directive (2010/75/EU) during polymerisation and the production of polyester fibres, measured at the process steps where they occur, expressed as an annual average, must not exceed 1.2 g/kg for PET chips, 10.3 g/kg for filament fibres or 0.2 g/kg for produced polyester resin. This requirement does not apply to recycled polyester fibres, unless the recycling process breaks down the materials to the monomer level. If this is the case, this requirement also applies to recycled polyester fibres.

Compliance verification

The applicant shall declare compliance with the requirement in Annex x and submit a compliance statement from the suppliers of the fibres (Annex 6), as well as a test report in accordance with DIN EN 12619 that verifies compliance with this requirement. The recycling process must be described if using recycled fibres.

2.2.5.5 Polyamide fibres

Textile end products made out of polyamide must comply with at least one of the product standards stated in subcriteria a) and b).

a) Fibres must be manufactured using a minimum content of 20% nylon that has been recycled from production and/or consumer waste.

b) The N_2O emissions to air during the monomer production, expressed as an annual average, must not exceed 9 g/kg of polyamide 6 fibre produced or 9 g/kg of polyamide 6.6 fibre produced. In addition, reduction technologies must be used in the production of caprolactam and adipic acid. It must be ensured that the degree of reduction in the N_2O emissions during adipic acid production is at least 95%. This requirement does not apply to recycled fibres, unless the recycling process breaks down the materials to the monomer level. If this is the case, this requirement also applies to recycled fibres.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 and submit a compliance statement from the monomer producer (Annex 7), as well as test reports for the raw and clean gas verifying that a reduction of at least 95% has been achieved. The recycling process must be described if using recycled fibres.

2.2.5.6 Polyacrylic fibres

2.2.5.6.1 Acrylonitrile

The residual acrylonitrile content in raw fibres leaving the fibre production plant must be less than 1.5 mg/kg. This requirement does not apply to recycled fibres, unless the recycling process breaks down the materials to the monomer level. If this is the case, this requirement also applies to recycled fibres.

Compliance verification

The applicant shall declare in Annex 1 that he/she complies with the requirement above and submit confirmation from the suppliers of the fibres (Annex 8), as well as a test report from the suppliers of the fibres verifying compliance with this requirement. The test shall be carried out in accordance with the following method: Extraction with boiling water and quantification by capillary gas-liquid chromatography. The recycling process must be described if using recycled fibres.

2.2.5.6.2 Acrylonitrile emissions

The emissions to air of acrylonitrile (during polymerisation and up to the solution ready for spinning), expressed as an annual average, must be less than 1 g/kg of fibre produced. This requirement does not apply to recycled fibres, unless the recycling process breaks down the materials to the monomer level. If this is the case, this requirement also applies to recycled fibres.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 and submit confirmation from the suppliers of the fibres (Annex 8) and a test report in accordance with VDI Guideline 3863, sheets 1 and 2 verifying compliance with this requirement. The recycling process must be described if using recycled fibres.

2.2.5.7 Elastane fibres

2.2.5.7.1 Organotin compounds

The use of organotin compounds is not permitted.

Compliance verification

The applicant shall declare in Annex 1 that such compounds are not used and submit confirmation from the suppliers of the fibres. The recycling process must be described if using recycled fibres and verification of the content of organotin compounds in accordance with DIN CEN ISO/TS 16179 or DIN EN ISO 22744-1 must be submitted.

2.2.5.7.2 Aromatic diisocyanate

The concentration of aromatic diisocyanates from the polymerisation and the spinning processes must not exceed a value of 0.05 mg/m^3 (corresponds to 0.005 ml/m^3) at the workplaces in which the relevant process steps occur, expressed as an 8 hour average (shift average). This requirement does not apply to recycled fibres, unless the recycling process breaks down the materials to the monomer level. If this is the case, this requirement also applies to recycled fibres.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 and submit confirmation from the suppliers of the fibres to verify compliance with this requirement. Suitable test methods using HPLC from recognised testing laboratories will be accepted. The recycling process must be described if using recycled fibres.

2.2.5.8 Polypropylene fibres

It is not permitted to use lead-based pigments.

Compliance verification

The applicant shall declare in Annex 1 that such compounds are not used and submit confirmation from the suppliers of the fibres. The recycling process must be described if using recycled fibres.

2.2.5.9 Elastolefin

The spinning oils used in the production of elastolefin may not contain the following substances:

- Octamethylcyclotetrasiloxane D4 CAS 556-67-2,

- Decamethylcyclopentasiloxane D5 CAS 541-02-6,
- Dodecamethylcyclohexasiloxane D6 CAS 540-97-6

Impurities of these substances in the spinning oil may not exceed a limit of 0.10%. This requirement does not apply to recycled fibres, unless the recycling process breaks down the materials to the monomer level. If this is the case, this requirement also applies to recycled fibres.

Compliance verification

The manufacturer shall declare in Annex 1 that no impurities above the acceptable limit of 0.10% are present in the spinning oil and shall submit confirmation from the suppliers of the fibres and the latest safety data sheets for the spinning oil. The recycling process must be described if using recycled fibres.

2.2.5.10 Recycled fibres

According to the International Resource Panel (IRP) of the United Nations Environment Programme (UN Environment), the world's population has doubled and resource extraction has tripled in the last five decades. The extraction and processing of natural resources has accelerated in the last two decades and is responsible for more than 90 per cent of biodiversity loss and water stress, as well as for about half of the impacts of climate change. In the last 50 years, there has not been a single decline in global demand for materials. (International Resource Panel IRP 2019) .

In view of the global challenges (climate change, water scarcity, loss of bio diversity, loss of ecosystem services, etc.),[44] there is therefore - in addition to the need to reduce the quantitative demand for resources - an urgent need to use existing resources in the sense of a circular economy (European Commission 2020).

For a few years now, various manufacturers have increasingly been offering textiles that contain more or less high proportions of recycled fibres. Recycled polyester, recycled polyamide, recycled cotton and wool are used.

In addition, natural fibres can now also be broken down into their original monomers through chemically recycling natural textile products. These are then used to produce "new" fibres. One example is the Refibra® technology from the Lenzing company in Austria. With this technology, both production waste from manufacturing cotton textiles as well as end-of-life and discarded cotton clothing are used for producing cellulose, which in turn is used for manufacturing regenerated fibres (Teufel et al. forthcoming).

In terms of volume, the use of recycled polyester is the most important on the market. TextileExchange (2020) states that recycled polyester[45] now accounts for 14% of global polyester production.

There are different processes for recycling polyester.[46] The most common process, and the one that is established on the market, is mechanical recycling, where different PET input streams (currently mainly PET beverage bottles or food packaging) are shredded, melted and processed into fibres (Hemkhaus et al. 2019). End-of-life textiles or textile waste from manufacturing that

[44] The global challenges we face are described in various state reports for the different environmental threats, such as for climate in the "Special Report 1.5 °C Global Warming" ((2018) and for the loss of biodiversity and ecosystem services in the report of the World Biodiversity Council ((2019)).

[45] The different proportions of recycled material from polyester staple fibres and polyester filaments were calculated accordingly.

[46] An overview of recycling processes used for recycling textiles is provided by (Duhoux et al. 2021).

is 100% polyester can also be mechanically recycled. The fabric is sorted by colour, washed, cut, shredded, melted and extruded into a new granulate (ChemSec 2020). However, the market share for polyester fibres recycled from end-of-life textiles is negligible. The main input streams for recycled polyester yarn are PET bottles and food packaging [47][48](Hemkhaus et al. 2019; ChemSec 2020)

Various life cycle assessment studies show that the use of recycled materials can, in some cases, have a major environmental impact (UNFCCC 2020; Suresh et al. 2021).

For example, mechanically recycled polyester has more than 70% lower global warming potential than fossil fuel-based polyester. Chemically recycled polyester performs about 35% better in terms of global warming potential than "virgin" polyester. Recycled cotton fibres have a 70% lower global warming potential than cotton yarn made from virgin cotton grown using conventional farming methods (UNFCCC 2020).

According to a report by the Ellen McArthur Foundation (2017), the chemical recycling of polyester is not yet competitive. The separation of dyes, coatings and other impurities is energy-intensive and costly. For example, a Patagonia project[49] charged a 20-30% premium for recycled polyester from used clothing compared to virgin polyester, while the Pulse of the fashion industry report found that chemically recycled polyester is 10% more expensive than virgin (Ellen McArthur Foundation 2017). According to TextileExchange (2020), several companies have started to commercially produce chemically recycled polyester. They process both end-of-life clothes and textile waste that arises when producing recycled polyester. Other companies are still in the research and development phase, so that the market share of chemically recycled polyester produced in closed cycles is expected to increase in the coming years.

However, the technological and infrastructural developments that can be observed (new recycling processes, new recycled fibres, collecting and recycling textile waste from production, collecting end-of-life textiles by brands or distributors, etc.) also entail risks, such as the accumulation of pollutants through recycling contaminated input flows [50](Schmidt et al. 2016). Particularly when mechanically recycling end-of-life textiles, there is a risk that the end product is contaminated with pollutants. By contrast, the risk is low with the help of chemical recycling processes based on depolymerisation (Schmidt et al. 2016).

Östlund et al. (2015, cited from (Schmidt et al. 2016) mentions the following product types that can contain problematic substances and can pose a problem during mechanical recycling:

- Sportswear and underwear, with or without claims of "odour prevention", may contain biocides,

[47] Yarn manufacturers such as Polygenta, Polyterra, Hilaturas Ferre (with its Recover brand) and Unifi (with its Repreve brand) produce recycled polyester yarn from PET bottles. This is then used in products by brands such as Adidas, C&A, H&M, Nike and many others. (Ellen McArthur Foundation 2017).

[48] In the meantime, a number of initiatives have also been founded worldwide that aim to curb plastic waste in the oceans. Some of the plastic waste collected through these initiatives is also processed into recycled polyester (see https://www.ispo.com/trends/recycling-polyesterfaser-vom-meeresgrund-zum-verbraucher; last accessed 24.03.2023).

[49] See https://eu.patagonia.com/de/de/stories/closing-the-loop-a-report-on-patagonias-common-threads-garment-recycling-program/story-19961.html; last accessed 27.06.2023 ((Patagonia-Projekt 2009).

[50] In a study, IKEA and H&M had 166 samples of cotton-based end-of-life textiles tested for various harmful substances. 8.7 per cent of the samples contained carcinogenic chromium compounds and other heavy metals. 19.3 per cent of the samples contained alkylphenol ethoxylates, which act as endocrine disruptors. Furthermore, some samples also contained formaldehyde (see https://www.treehugger.com/ikea-and-hm-analyze-content-recycled-fabrics-4854420?utm_term=0_32de41485d-9cd1c025b2-243762625&utm_campaign=9cd1c025b2-EMAIL_CAMPAIGN_11_16_2018_COPY_01&utm_medium=email&-utm_source=TreeHugger+Newsletters; last accessed on 12.12.2021). (Treehugger 2019).

- Workwear for use in hygienic applications, such as cleanrooms and health care areas, may contain biocides,
- Workwear, in general, may contain fluorinated substances and flame retardants,
- Outdoor clothing and equipment may contain fluorinated substances,
- Outdoor textiles (tents, tarpaulins, etc.) may contain heavy metals and perfluorinated substances,
- Curtains and other indoor textile products may contain flame retardants,
- Coated textile products may contain phthalates, SCCPs and fluorinated products,
- Printed textiles may contain phthalates, SCCPs and heavy metals,
- All dyed garments may contain dyes or pigments with hazardous properties (Schmidt et al. 2016).

In some cases, the use of recycled raw materials also poses challenges when complying with the quality requirements of the end product. Depending on the area of application of the textile end product, the associated quality requirements may not be met with the use of recycled raw materials. One reason for this is that mechanical recycling systems are still the predominant form of textile recycling. However, when mechanical recycling processes are used, the fibre qualities usually deteriorate compared with the non-recycled fibres (Peters et al. 2019).

Freely accessible data on the availability and origin of various recycled fibres are currently not available. However, with regard to the formulation of mandatory recycled content within the framework of environmental labelling, this means that feasible requirements for minimum recycled content can only be formulated on the basis of manufacturers' statements.

Overall, the use of recycled materials for producing textiles should be strived for against the background of resource protection and should also be supported by corresponding political measures. However, consumer protection as well as feasibility, also with regard to compliance with certain quality and usability requirements, should also be taken into account.

In relation to the product-related environmental labelling of textiles, this point is included in the currently valid requirements for the EU Ecolabel, for example, as follows: Polyester fibres must be produced with a minimum content of PET recycled from production and/or consumer waste. Staple fibres shall contain at least 50% recycled fibres and filament fibres shall contain at least 20% recycled fibres. This requirement does not apply to microfibres (Europäische Kommission 2014).

In the current EU criteria for the environmental public procurement of textile products and services published by the EU Commission, an optional requirement is formulated to promote the use of recyclable raw materials. impact tion. Points are awarded for polyester and/or nylon fibre products used in the execution of the contract for each 10 % increase over a minimum recycled content of 20 % from production and/or consumption waste (European Commission 2017). (European Commission 2017).

The Standard 100 by Oeko-Tex from April 2021 (OEKO-TEX 2021b) refers to the Global Recycled Standard (GRS) of Textile Exchange for textiles that are to be certified as "recycled". For textiles with a high synthetic fibre content of 70-80%, this standard explicitly requires a recycled content of 20% of the main material as the minimum content of recycled fibres.

The background document on the revision of the Nordic Swan criteria for textiles even proposes that only polyester fibres that are neither 100% recycled material nor biogenic raw materials are permitted (Nordic Ecolabelling 2023a). This proposal was also included in the current Nordic Swan for textiles.[51] With the exception of white polyester for workwear and for elastane, recycled material or material produced from biogenic resources must be used for the manufacture of poly ester.

Conclusion and proposal for revising the requirements for polyester and polyamide with regard to a minimum recycled content

As part of the current revision of the Blue Angel award criteria for textiles, there is no mandatory requirement for a minimum content of recycled material for polyester or polyamide fibres. This decision was taken after consultation with experts from industry, testing institutes, research institutions and NGOs in two expert meetings. The background against which this decision was made is presented below.

The use of recycled polyester fibres is associated with the risk of unwanted pollutants entering the end product if the waste used is not sorted and controlled (Schmidt et al. 2016).

The use of PET bottles and packaging with direct food contact can be assessed as uncritical from this point of view (Whitt et al. 2013), but draws input sources from other circular flows. Therefore, PET bottles and packaging should not be used for producing recycled polyester yarn. At present, their use for producing textile products is obviously still a relief to the environment, especially in view of the fact that the recycled raw material is mainly produced on the Asian market. However, due to the lack of necessary data, no reliable conclusions can be drawn as to the potential macro-rebound effects. In terms of a closed circular economy in the narrower sense, the use of the currently used input flows can only be a transitional solution. (Ellen McArthur Foundation 2017).

In addition, interviews with experts conducted as part of the criteria revision in spring 2021 revealed that recycled polyester fibres are currently difficult to obtain (probably also depending on the quality required). In particular, products that have been produced by chemical recycling processes (and not by mechanical recycling) and have other qualitative properties are difficult to obtain. According to the interviewees, this is partly due to the COVID-19 crisis, but also due to a boom in demand and the fact that these recycling processes are still in the establishment phase.

This means that no harmonisation with the EU Ecolabel is proposed with regard to this requirement. However, it is recommended that the limit value for antimony content required for polyester fibres should also apply to recycled polyester fibres. In addition, a general requirement for recycled fibres has been formulated. This states that the recycled content and the type of composition of the recycled fibres must be indicated. The origin and composition of the recyclable material streams used in the recycling process must be indicated. Furthermore, the recycling process shall be described.

As a result of the literature analysis and the expert discussion, the following requirement for recycled fibres and a requirement for recycled polyester specified in terms of material input (see section 2.2.5.4) are now available.

[51] The currently valid Nordic Swan award criteria for textiles can be downloaded from the following link: https://www.nordic-ecolabel.org/product-groups/group/?productGroupCode=039; last accessed 24.03.2023

Requirement for recycled fibres

If recycled fibres are used, the applicant must provide information on the recycled content and the type and composition of the recycled fibres. The origins and composition of the materials fed into the recycling process must also be stated. The applicant must submit a description of the recycling process.

In addition, the applicant must verify the origins and composition of the materials fed into the recycling process by submitting a certificate from one of the following certification systems:

- RCS (Recycled Claim Standard),
- GRS (Global Recycled Standard),
- International Sustainability and Carbon Certification (ISCC+),
- Roundtable on Sustainable Biomaterials (RSB),
- RedCert (only in Europe)
- or a comparable certification system whose scope and requirement standards is equivalent to one of the named certification systems. The equivalence of the certification system must be confirmed by an independent environmental verifier.

The use of purchased certificates based on the Book & Claim system is excluded so that the traceability of the raw materials is possible. Certificates based on the identity preserved, segregation and mass balance systems are approved.

The proofs of purchase for the materials fed into the recycling process must be based on processes according to the identity preserved, segregation or mass balance systems (see Paragraph “Definitions”).

Compliance verification

The manufacturer shall state the recycled content and the origins of the recycled materials in Annex 12 and submit the required certificates and verifications.

2.2.6 Requirements for the biodegradability of auxiliaries and finishing agents for fibres and yarns

The requirements for the degradability of auxiliaries and finishing agents for fibres and yarns in the currently valid award criteria were reviewed and discussed with experts. There is currently no need to revise the requirements.

The criterion is still as follows:

2.2.6.1 Sizing preparations

At least 95% (dry weight) of the components of any sizing preparation applied to yarns must be sufficiently biodegradable or recycled. The sum of the individual components must be taken into account.

2.2.6.2 Spinning solution additives

Spinning solution additives, spinning auxiliaries and mixtures for primary spinning (including carding oils, spin finishes and lubricants): At least 90% (dry weight) of the components in the mixture must be sufficiently biodegradable or eliminable in waste water treatment plants.

Compliance verification

Table 1: Scope of restriction, limit values and compliance verifications for various spinning solution additives

Substance group	Scope of restriction	Limit values	Compliance verification
i) Sizing preparations applied to fibres and yarns Applicability: Spinning processes	At least 95% (by dry weight) of the components must be readily biodegradable. In all cases, the sum of the individual components must be taken into account.	Readily biodegradable: 70% degradation of dissolved organic carbon within 28 days or 60% of theoretical maximum oxygen depletion or carbon dioxide generation within 28 days	Declaration from the chemical supplier supported by test results of OECD or ISO-test methods: OECD 301 A, ISO 7827 OECD 301 B, ISO 9439 OECD 301 C, OECD 301 D, OECD 301 E, OECD 301 F, ISO 9408 OECD 310, ISO 14593 ISO 10708
ii) Additives for Spinning solution, spinning additives and mixtures for primary spinning (including carding oils, spin finishes and lubricants) Applicability: Primary spinning processes	At least 90% (by dry weight) of the components must be readily biodegradable, inherently biodegra-dable or eliminable in waste water treatment plants. In all cases, the sum of the individual components must be taken into account.	**Readily biodegradable:** See definition under i) **Inherently biodegradable:** 80% degradation of dissolved organic carbon within 7 days (possibly 28 days). **Eliminability in laboratory clarification units:** 80% degradation of dissolved organic carbon (plateau phase)	Declaration from the chemical supplier supported by test results of OECD or ISO-methods: Test-methods: See compliance verifications under i) readily biodegradable tests. Inherently biodegradable tests that are accepted: OECD 302 B, ISO 9888 OECD 302 C Tests for eliminability in laboratory clarification units: OECD 303A/B, ISO 11733

2.2.7 Requirements for the production process for laminates

The requirements for the manufacturing process for laminates and membranes in the currently applicable award criteria were reviewed and discussed with experts. There is currently no need to revise the requirements.

The criterion is still as follows:

a) **Textiles used**

For the fibres of the textiles used, the requirements stated in the relevant sections are valid.

b) **Membranes used**

For membranes produced on the basis of polyester, polyurethane, and polyamide, they must comply with at least one of the two subcriteria i) and ii).

i) The membranes must be produced using at least 30% recycled materials from production and/or consumer waste.

ii) The membranes must not be produced using organic solvents.

The requirement for the amount of antimony in polyester fibres (3.2.2.4a) also needs to be taken into account in the case of polyester membranes. The N_2O (3.2.2.5b) requirement for polyamide fibres needs to be taken into account for polyamide membranes, while the limit values for polyurethane (3.5.2) need to be taken into account for polyurethane membranes. Components produced from polyurethane must also comply with the textile fibre requirement for organotin compounds (3.6.6.7) and the requirement for workplace exposure to aromatic diisocyanates (3.2.2.7.2).

c) **Adhesives used**

Solvent-based adhesives must not be used in the laminating process. Only thermoplastic or reactive (e.g. moisture curing) hotmelt adhesives may be used. If reactive polyurethane-based hotmelt adhesives are used, the concentration of aromatic diisocyanates must not exceed a value of 0.05 mg/m^3 (corresponds to 0.005 ml/m^3) measured at the workplaces, expressed as an 8 hour average (shift average).

d) **Functional products**

The exclusion criteria in Paragraph 3.6.2.4 apply to the functional products used on the textiles.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 and submit declarations of conformity from the membrane suppliers/adhesive suppliers or the laminate manufacturers.

2.2.8 Filling materials - down and feathers

Currently, the Blue Angel for textiles has requirements for down and feathers regarding feather extraction, waste water and hygiene.

2.2.8.1 Feather extraction

The EU Ecolabel and Fairtrade do not have a criterion for extracting feathers; GOTS, bluesign and Made in Green have also not formulated a clearly comparable criterion.

The verification certificates recognised by the Blue Angel with regard to feather extraction are DOWNPASS, Responsible Down Standard (RDS) and the Global Traceable Down Standard. All standards have been retrieved from their respective websites as of January 2023. The TDS is valid from August 2018; DOWNPASS from May 2018 and the RDS from August 2020. All three certificates cover the current Blue Angel criteria for textiles:

“The extraction of feathers from living animals, live plucking and plucking during moulting, as well as the extraction of feathers and down from animals that are held for the production of foie gras, is not permitted”. This means that these standards can still be recognised. According to current experience, companies using feathers and down as filling materials are usually already certified to one of these standards.

2.2.8.2 Waste water

In terms of waste water values, EU Ecolabel for Textile Products, Oeko-Tex Made in Green and GOTS have no values for down laundering; in the case of Fairtrade Textile, the requirements are very generally formulated, i.e. no specific limit values are defined. Only bluesign has formulated limit values that currently do not all correspond to the Blue Angel award criteria. The minimum limit values, as far as they exist, are identical, the "progressive" values are to some extent more ambitious. In order to enable harmonisation, the minimum limit values in the Blue Angel were chosen. Bluesign has additional limit values for various metals. In the expert discussion, however, it became clear that these criteria are not necessary for down laundry.

The waste water values for the Blue Angel criteria are based on Annex 38 of the Ordinance on Requirements for the Discharge of Waste Water into Waters (Abwasserver ordnung - AbwV), Textile Production, Textile Finishing. bluesign® has not formulated any limit values for copper, nickel and total chromium. Inquiries with the German Feather Industry Association (VDFI) revealed that these parameters do not play a role for down and feathers. At the third expert meeting, the relevance of verifying chromium VI was also questioned. Further research revealed that, in addition to chromium VI, tin and zinc are not relevant in the down and feather sector. In addition, a value for alkylphenol ethoxylates (APEOs) is included, as according to information from bluesign® these are repeatedly detected. Presumably, these chemicals are used by farmers or butchers during pre-washing to remove blood and other contaminants. A requirement for APEOs has been included in order to update and harmonise with bluesign®. The compliance verification has therefore been supplemented accordingly. Requirements for copper, nickel, total chromium, chromium VI, tin and zinc have been deleted.

The criterion has been adjusted as follows:

Requirements for waste water at the discharge point (direct discharge) in the processing of down and feathers

Waste water from the wet processing must not exceed the following values when discharged to surface water:

- COD: 160 mg/l (expressed as an average yearly value),
- BOD5: 30 mg/l,
- TSS: 30 mg/l,
- Ammonium nitrogen: 10 mg/l,
- Total nitrogen: 20 mg/l,
- Phosphorous: total 2 mg/l,
- Persistent foam at the discharge point
- Copper: 1 mg/l
- Nickel: 0,5 mg/l
- Chrome total: 0,5 mg/l
- Cr (VI): 0,1 mg/l
- Tin: 2 mg/l

- Zinc: 2 mg/l
- APEO (NPEO, OPEO, NP and OP): 5µg/l.
- The pH value of the waste water discharged to surface waters must be between 6 and 9 (unless the pH value of the receiving waters is outside this range) and the temperature must be below 35 °C (unless the temperature of the receiving waters is already above this limit).

This requirement shall not apply if it can be proven that the discharge into the urban waste water treatment plant has been approved and the urban waste water treatment plant meets at least the requirements of the Council Directive of 21 May 1991 concerning urban waste water treatment (91/271/EEC).

Compliance verification

The applicant shall declare compliance with the requirements in Annex 1 and submit a compliance statement from the operator of the processing plant and test reports verifying compliance with the requirements in accordance with Annex 38 of the German Waste Water Ordinance or equivalent international test reports. The following test methods can be used here (on the basis of a qualified random sample or a 2-hour mixed sample):

- COD: ISO 6060 or DIN 38409-41 or DIN 38409-44 or DIN ISO 15705,
- BOD: DIN EN 1899-1 or ISO 5815-1/-2,
- TSS: DIN EN 872 or ISO 11923,
- Copper and Nickel: ISO 8288
- Chrome: ISO 9174 or DIN EN 1233
- Ammonium nitrogen: DIN EN ISO 11732,
- Total nitrogen: DIN EN ISO 12260,
- Total phosphorous: DIN EN ISO 11885.
- Tin: DIN EN ISO 11885,
- Zinc: DIN EN ISO 11885.
- APEOs: ISO 18857-1, ISO 18857-2, ISO 18254-1 oder ASTM D7742-17.

The waste water treatment plant must be regularly monitored. In addition, the applicant shall submit a declaration from the operator of the processing plant about the frequency of the measurements of the discharge values (at least every six months).

If discharged to an urban waste water treatment plant, the applicant shall also enclose a notice of approval for the plant verifying that the discharge process has been approved and that the urban waste water treatment plant meets at least the requirements of Directive 91/271/EEC.

2.2.8.3 Exclusion of washing agents containing APEO

Washing agents containing alkylphenol ethoxylates (APEO) are prohibited. The limits for direct and indirect discharge may not exceed 5 µg/l APEO (NPEO, OPEO, NP and OP).

Compliance verification

The applicant shall declare compliance with the requirements in Annex 1 and submit a *compliance statement from the operator of the processing plant and test reports verifying compliance with the requirements. The following test methods can be used here (on the basis of a qualified random sample or a 2-hour mixed sample):*

NPEO, OPEO, NP and OP: ISO 18857-1, ISO 18857-2, ISO 18254-1 or ASTM D7742-17.

2.2.8.4 Hygiene requirements

The hygiene requirements for bluesign® correspond to those of the Blue Angel; the other eco-labels have no requirements. The current version of the Nordic Swan (version 5.2) has formulated criteria comparable to Blue Angel with regard to feather extraction and hygiene requirements. Specific requirements for waste water are missing here.

With regard to hygiene requirements, the EN 12935 standard is applicable. In addition, the two brands Downafresh® and Daunasan® were included as an award in the certificate and are valid if both the oxygen index and the microbial condition have been measured, as both brands then document that the feathers and down used as filling material meet the hygiene requirements of EN 12935.

The amended criterion is as follows:

Hygiene requirements

Table 2: Requirements for down and feathers

Description	Requirement EN 12935	Test methods
Oxygen index	max. 20 Target: less than 10	EN 1162
Microbiological state		EN 1884
Mesophil aerobic bacteria count	Less than 106 CFU/g	
Faecal streptococci count	Less than 102 CFU/g	
Sulphite reducing clostridium count	Less than 102 CFU/g	
Presence of salmonella	Not present in 20 g	
Oil and grease content	0.5 to 2%	EN 1163
Turbiditiy	min. 300 mm	EN 1164
pH value	6.6 to 8	ISO 3071

Compliance verification

Test reports according to the above-mentioned standards. Certificates from Downafresh® and Daunasan® will also be accepted, if both the oxygen index and the microbial state have been measured. Other certificates may be approved after examination by the German Environment Agency.

2.2.8.5 End product testing

In addition, it was investigated whether the testing of potential harmful substances in down and feathers should be extended to the end consumer. For both the Responsible Down Standard (RDS) and the Global Traceable Down Standard (TDS), the chain ends at B2B. Only DOWNPASS continues to B2C.

Down and feathers are susceptible to pest infestation and are stored in large quantities where they are treated with biocides. This treatment affects the raw material. Afterwards, the down is washed and heated to more than 100°C. According to interviews with experts, no biocides can be detected afterwards. However, possible pollutants can also come from detergents and optical brighteners. The EU environmental label states: "Criterion 10c) Detergents and other chemicals used for washing fillings (down, feathers, natural or synthetic fibres) must meet the RSL requirements for textiles with regard to auxiliary chemicals as well as detergents, softeners and complexing agents (see Appendix 1)".

Down and feathers, which are used as filling material for bedding, usually come from geese and ducks. They are produced as a by-product of meat production by the poultry industry. The bed feather industry acquires this raw material, which has to go through various handling processes (mainly washing and sorting) before it can be used as filling material in finished articles.

Germany cannot cover its demand for feathers and down with national resources or imports from European countries, so the vast majority is imported from Asia. In Asian countries, meat from water fowl is an important part of the diet all year round. Before these natural materials can be imported into Germany, they must be thoroughly cleaned to meet the specific requirements of the European Hygiene Import Ordinance. This means that the feathers and down must be hygienically processed in their countries of origin before they can be further processed by German bed feather factories.

Final inspections of ready-filled bedding, which was purchased through mystery shopping in the trade and subsequently checked for their hygienic condition, have so far not revealed any findings.

The DOWNPASS standard, which was first applied in 2017, is currently being revised. In the course of this revision, it is being examined whether requirements for the pollutant content of feathers and down should be included in a binding manner in the future.[52]

The RDS and TDS standards do not currently include pollutant testing.

As there are still few analytical results available about potential harmful substances, and as it has not yet been possible to develop a catalogue of criteria for the DOWNPASS standard as to whether and which harmful substances should be examined, the inclusion of an end product test for down and feathers will be waived in the revision of the Blue Angel award criteria. For subsequent revisions, a note will be included in the Outlook.

The DOWNPASS 2017 standard only considers new down and feathers, as the standard checks the traceability of the fillings in order to monitor the animal welfare criteria at source. For this

[52] Personal communication from the Association of the German Down and Feather Industry in 2021

reason, neither used nor recycled down and feathers have been considered in the standard so far. Recycled down and feathers have been available in Germany for a long time in the form of recycled feather and down filled bedding, which is collected, e.g. via Red Cross collections, commercial collections or private collectors, and is extracted from the opened bedding. The filling materials undergo the same hygienic processes as the new feathers and down. They are processed by specialised companies in Europe (e.g. Hungary, Czech Republic, Germany) or East Asia (China) and reused as filling materials. At present, there is no technical test procedure to check whether the down and feathers are recycled or new. In addition, it is also very difficult to trace their origin and therefore monitor animal welfare criteria.[53]

Due to the difficulties involved with testing and tracking recycled down and feathers described above, this material is very difficult to reconcile with the Blue Angel requirements. A requirement for the inclusion of recycled down has therefore not been included.

2.2.9 Requirements for filling materials - latex, polyurethane

Filling materials currently have to meet special requirements in addition to the general requirements. In the last revision of DE-UZ 154 (2017), the filling materials latex, polyurethane, down and feathers were selected as relevant for these award criteria in technical discussions with various experts and added. The requirements for down and feathers are discussed separately.

The following criteria were defined for latex in DE-UZ 154 (2017): the plant-based raw materials for producing latex must come from wood grown according to the principles of sustainable forestry as defined by the FAO.

The limit values for pollutants in latex foam, e.g. chlorophenols, heavy metals and butadiene and their verification, as well as the VOC emission limit values, correspond to the required limit values in the EU Ecolabel for furniture (2016) (Europäische Kommission 2016).

The GOTS 5.0 was taken into account when determining these criteria. The review of the current GOTS standard 6.0 showed that the values have not changed. According to GOTS, only latex foams may be used that must come from certified organic latex (or latex from cultivation under conversion), or from latex that is certified according to a programme for sustainable forest management. The limit values for butadiene, chlorophenols and carbon disulphides are identical to the Blue Angel values; nitrosamines, at 0.001mg/m^3, are above the value of 0.0005 mg/m^3 specified in the Blue Angel. The limit values for nitrosamines and butadiene in the current version of Nordic Swan (version 5.2) correspond to those of the Blue Angel. Latex is not mentioned in the EU Ecolabel for textile products (2014).

For polyurethane and PUR foam, the list of restricted substances and mixtures as well as the limit values for VOC emissions and their verification correspond as far as possible to the criteria in the EU Ecolabel for furniture (2016) (Europäische Kommission 2016).

No halogenated blowing agents may be used for producing PUR foam. The JRC technical report for furniture (2017) (JRC 2017) discusses in detail as to which substances may not be used in filling materials and PUR foam due to their properties as greenhouse gases or classification as "hazardous substances or substances of concern". Due to the general exclusion of substances with certain properties, these substances are taken into account and are prohibited. GOTS (6.0) does not allow polyurethane in mattresses, but only elastane up to 10%. In the EU Ecolabel for textile products (2014), the limit values for polyurethane also refer to elastane.

[53] Personal communication from the Association of the German Down and Feather Industry in 2021.

PUR foam was already included as a material in 2017 because it is used in bras and as shoulder padding (https://www.europur.org/applications/consumer-goods).

In the Consultation Draft for Nordic Swan, it was additionally proposed to introduce a criterion for isocyanates, as these are the second raw material used in polyurethane. However, this proposal was not included in the final adopted version.

One criterion for isocyanates concerns occupational safety; this is already regulated for elastane and has been added accordingly for polyurethane with regard to occupational safety.

CFCs can also play a role in the foaming of polyurethane. For this reason, a ban was also formulated here.

At the third expert meeting, it was determined that the criterion for plasticisers contained in the current award criteria does not play a role in PUR foam. This requirement has therefore been deleted here.

In summary, it can be stated that the limit values in filling materials have already been harmonised with other standards to the greatest possible extent and are still valid with a few exceptions. The limit values for nitrosamines have been changed from 0.0005 mg/m^3 to 0.001mg/m^3 for reasons of harmonisation. Isocyanates have been regulated for polyurethane with a criterion for compliance with the occupational health and safety limit value, as already exists for elastane. Phthalates, as they do not play a role in PUR foam, have been deleted. In addition, test methods were also adapted.

The following new criteria have been introduced:

Diisocyanates

The concentration of aromatic diisocyanates must not exceed a value of 0.05°mg/m^3 (corresponds to 0.005°ml/m^3) at the workplaces in which the relevant process steps occur, expressed as an 8 hour average (shift average).

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 and submit confirmation from the manufacturer and a test report verifying compliance with this requirement. Suitable test methods using HPLC from recognised testing laboratories will be accepted.

Chlorofluorohydrocarbons (CFCs)

Chlorofluorohydrocarbons may not be used as a foaming agent for polyurethane.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 and submit confirmation from the manufacturer verifying compliance with this requirement.

2.2.10 General exclusion of substances with certain properties

Until now, a large number of substances with certain properties have been excluded by the H-phrases regulated in EC Regulation 1272/2008. This list of currently 32 H-phrases has been supplemented by H373 (name all affected organs, if known) - in addition to H372 (name all affected organs) already listed on .

Furthermore, the currently applicable exemptions for enzymatic desizing were discussed. Enzymatic desizing and enzymatic post-treatment of sewn parts are important in the clothing industry. Enzymes are highly allergenic. However, since enzymes are washed out, there is no longer any risk in the end product. However, the problem is relevant in terms of occupational

health and safety; but only if the enzymes form dusts or aerosols. Therefore, a reference to the European guideline "Indus try Guidelines on the Safe Handling of Enzymes in the Textile Finishing/Garment Finishing Industry" was included. Furthermore, the use of enzymes in enzymatic surface modification has been added to the table of deviations.

2.2.11 Special material requirements in the finishing processes

Criteria that have not been changed are not described here. These include nanomaterials, chlorine bleaching agents, stain dyes containing chromium salts, flame retardants, PFCs, halogenated substances and VOCs.

2.2.11.1 Degradability of sizing agents, additives for spinning solutions and other textile auxiliaries

Sizing agents and additives for spinning solutions as well as other textile auxiliaries can be difficult to degrade and/or contribute to a high degree to the organic load in waste water.

The current criterion in the Blue Angel for Textiles (2017), which regulates the use of sizing and additives for spinning solutions, corresponds to the EU Ecolabel for textile products. GOTS links degradability to aquatic toxicity: "Ratio of biodegradability/eliminability to aquatic toxicity: only allowed if: < 70 % and > = 100 mg/l; > 70 % and > = 10 mg/l; > 95 % and > = 1 mg/l". This is a rather stricter regulation and can therefore be considered equivalent to the Blue Angel regulation for textiles. The bluesign® criteria are comparable in the blue category[54] - degradation 70% and aquatic toxicity >= 100 mg/l. The Nordic Swan criteria (version 5.2) are also comparable - slight aerobic biodegradability or inherent aerobic degradability or recovery of at least 80% from waste water. Oeko-Tex Made in Green (OEKO-TEX 2021a) does not provide any information on degradability.

Substances that are difficult to degrade are also regulated under the "Degradability of textile auxiliaries" item. In the 2017 criteria, this relates to softeners and complex formers. The BREF document (Roth et al. 2023) identifies further substances that are difficult to degrade: APEOs and mineral oil-based antifoams. APEOs are regulated under the criteria for end product testing. Mineral oil-based antifoams have been newly included. Due to their poor degradability, they will be excluded in future.

The new proposed criterion is as follows:

2.2.11.2 Mineral oil-based defoamers

The use of mineral oil-based defoamers is not permitted.

Compliance verification

The applicant shall declare compliance with the requirement under point # in Appendix 1, and provide a confirmation from the chemical supplier or textile finisher that this requirement is met.

2.2.11.3 Quaternary ammonium compounds

The criterion on quaternary ammonium compounds was specified. Previously, all of these compounds were not permitted. In the revision, only the essential compounds - DTDMAC, DSDMAC and DHTDMAC - will be excluded in future and the criterion will thus also be harmonised with bluesign®, EU Ecolabel, GOTS and Oeko-Tex. Furthermore, TEGEWA informed the third expert meeting that ester and silicone quats are not used as genuine heits improvers. This has therefore been removed from the requirements.

[54] Blue rated chemical products entirely fulfill the requirements of the bluesign® CRITERIA based on realistic worst-case exposure scenarios and may be used for all applications.

The criterion is as follows:

DTDMAC, DSDMAC and DHTDMAC are not permitted.

Compliance verification

The applicant shall declare compliance with the requirement under point 3.6.2 in Appendix 1, and provide a confirmation from the chemical supplier or textile finisher (Appendix 18) showing that this requirement is met.

2.2.11.4 Biocidal and biostatic products

The use of biocides in the sense of the Biocide Regulation (EU) No. 528/2012 and biostatic products is already excluded. Pot preservatives are excluded from this. In the third expert meeting, it was pointed out that it might be useful to test the end product for pot preservatives. Currently, there are already requirements for pot preservatives in various other Blue Angel criteria (e.g. DE-UZ 12a, DE-UZ 132 and DE-UZ 140),[55] including tables of approved agents (as of December 2020, November 2020 and October 2018). A declaration of the requirements of the manufacturer or supplier is required as verification.

At the expert meeting it was noted that no special biocides are used as pot preservatives in the textile sector either, but that the pot preservatives approved according to PT6 are permitted. Therefore, it was suggested to refer to the Biocide Directive and to allow all PT6 pot preservatives or to limit the use to these. As far as TEGEWA is aware, no more residues are expected on the textiles.[56] The Bremen Environment Institute reports findings of isothiazolinones up to 100 ppm, but in exception samples. Currently, members of a DIN working group are discussing a limit value of 130 ppm for isothiazolinones.[57]

For the Blue Angel award criteria for textiles, it was therefore proposed to choose a wording analogous to the other Blue Angel criteria. The criterion was therefore supplemented as follows: "Substances are permitted as pot preservatives that comply with the European Biocide Regulation and are listed in the list of active substances for pot preservatives (product type PT6)".

As in other award criteria, a declaration of compliance with the requirements run of the manufacturer or supplier is required as verification.

The criterion is as follows:

The use of biocidal products, as defined in the Biocidal Directive (EU) 528/2012[58], and biostatic products[59] is not permitted. In-can preservatives are exempted. Substances found in the European Biocidal Directive in the list of preservatives for products during storage (product-type PT6) may be used as in-can preservatives.

[55] Low-emission and low-emission paints (DE-UZ 12a) (RAL gGmbH 2019a); Low-emission thermal insulation materials and suspended ceilings for interior applications (DE-UZ 132) (RAL gGmbH 2020); External thermal insulation composite systems (new) (DE-UZ 140) (RAL gGmbH 2019d).

[56] Personal communication from TEGEWA from 2021

[57] Personal communication Bremer Umweltinstitut from 2021

[58] Regulation (EU) No 528/2012 concerning the making available on the market and use of biocidal products (Europäische Union 2012b).

[59] All substances with an inhibitory effect on growth and reproduction shall be considered as biostatic products.

Compliance verification

The applicant shall declare compliance with the requirements under point 3.6.2 in Appendix 1, and shall provide a confirmation from the chemical supplier or textile finisher that these requirements are met.

2.2.11.5 Further requirements in the finishing process

The criteria on cerium compounds and metal complex dyes were checked to ensure that they were up to date. The research revealed that these are no longer up to date.

2.2.12 Requirements for waste water from textile finishing

The current Blue Angel criteria for textiles were mainly taken from the EU Eco-label for Textile Products (2014) and Annex 38 Textile Production, Textile Finishing (2004) of the Waste Water Ordinance.

In addition to verifying the specific waste water values, it is also possible to confirm that the discharge into the municipal waste water treatment plant has been approved and that the municipal waste water treatment plant complies at least with the requirements of the Council Directive of 21 May 1991 concerning urban waste water treatment (91/271/EEC) (BMU 1991).

In the Outlook for the Blue Angel criteria for textiles from 2017, it was formulated that "the requirements for waste water should be compared with those in the ZDHC list and, if necessary, new values should be included".

The purpose of the ZDHC guidelines is to formulate uniform expectations for the textile industry regarding the quality of its waste water. These guidelines are intended to go beyond conformity with existing national legislation. This is to be achieved by measuring not only conventional waste water parameters, but also other parameters for chemicals in waste water that are hazardous to the environment and health. The ZDHC Waste Water Guidelines Version 1.1 (ZDHC 2019) refer, in addition to specific waste water parameters, to the ZDHC's Manufacturing Restricted Substance List (MRSL), i.e. to chemicals that are used in the value chain or enter waste water as contaminants, and not only to substances that may be contained in the final product.

The ZDHC waste water guidelines apply to industrial waste water and sludge from the treatment of waste water from wet processes in textile production such as dyeing, finishing, washing and printing. They apply to direct and indirect dischargers and to on-site Zero Liquid Discharge (ZLD) treatment plants.[60] They can also be used if the industrial waste water has been mixed with domestic waste water: this is then classified as industrial waste water.

Purely domestic waste water is not within the scope. The ZDHC Guidelines also do not apply to waste water management and treatment systems that are outside the operational boundaries of the respective equipment supplier. The ZDHC Guidelines are also not applicable to cotton growing, the polymer production of fibres, raw wool degreasing, and the manufacture or formulation of chemicals. However, the scope shall be extended for man-made cellulose fibres and for producing PU-coated textiles.

[60] Zero Liquid Discharge (ZLD): The concept that no water leaves a supplier in liquid form. At a supplier with an on-site ZLD treatment system, almost all the waste water is treated and recovered such that the only water discharged from the supplier exits by evaporation or as moisture in the sludge from treatment plant operations. A supplier is not considered to have a ZLD treatment system if there are liquid discharges ((ZDHC 2019).

The list of waste water parameters and chemicals to be tested in the Waste water Directives is very extensive. In addition, there are three different requirement levels for the waste water parameters: Foundational/Progressive/Aspirational.

It was found that most of the waste water parameters in the Foundational Level correspond to the required values and concentrations in the Blue Angel for textiles from 2017. For some waste water values (TSS, total phosphorus, AOX, copper, zinc and sulphite), the values in the Blue Angel for textiles are somewhat more demanding; for some others (COD, nickel, total chromium, Cr (VI), sulphide), the ZDHC standard is somewhat more ambitious. AOX remains less demanding in ZDHC than the Blue Angel value for textiles, even at the progressive level (Blue Angel: 0.5mg/l; ZDHC: 5 (foundational level)/1(progressive level)/0.1(aspirational level) mg/l).

The question remains open as to whether the Blue Angel for textiles should, in addition to waste water parameters, also include further mandatory tests for chemicals in waste water. By measuring these wastewater values, it could be determined whether undetected pollutants have been introduced. According to information from a textile finishing company, the examination of all waste water values listed in the ZDHC directive costs about 2000 euros. It could therefore be a major hurdle for companies wishing to apply for the Blue Angel for their products.

The chemical parameters in the ZDHC MRSL are regulated in the Blue Angel for textiles via the "General requirements and the general exclusion of substances with certain properties": Colourants and textile auxiliaries must comply with the limit values from section 1 of the ZDHC MRSL. The version of the ZDHC MRSL at the time of application applies.

Compliance with the ZDHC MRSL could also be confirmed by the chemical/auxiliary/dye suppliers. Companies that are not affiliated to the ZDHC programme could thus also comply with the requirement. Consequently, it could be assumed with a high degree of certainty that these substances are not present in the waste water. Companies that have joined the ZDHC programme are obliged to carry out these tests in their waste water (85 companies and 14 associations in 2020).

In the meantime, the revised "Best available techniques (BAT) reference document for the textiles industry" is also available (Roth et al. 2023). Not all parameters specified in the Blue Angel for textiles are regulated in this document. For example, colourfulness, toxicity to fish eggs, BOD, sulphite and ammonium nitrogen are missing. Other values, such as COD, total nitrogen and various heavy metals are somewhat more demanding.

Furthermore, the current requirements of the Blue Angel for textiles were compared with those in bluesign®, GOTS and Oeko-Tex Made in Green. The values are not comparable in every case. Depending on the location of the finishing plants and the national legislation, differences are to be expected.

The BREF values (Roth et al. 2023) are in most cases the most demanding compared with the requirements from other labels and those of the ZDHC guidelines. However, some values such as colourfulness, ammonium nitrogen, sulphite, fish egg test and tin are missing in the BREF (Roth et al. 2023). It was therefore proposed that these should be combined with the values in Annex 38, Textile Production, Textile Refinement (2004) of the Wastewater Ordinance.

Due to the high financial costs associated with testing the ZDHC waste water values for specific chemicals, it was decided not to formulate any further requirements for testing chemicals in waste water. The requirements for compliance with the ZDHC MRSL already provide a high degree of certainty.

This procedure was presented and accepted in the third expert meeting. By taking into account the waste water values in the BREF document (Roth et al. 2023), this resulted in more

demanding limit values for COD, total nitrogen and various heavy metals for the Blue Angel. A limit value for antimony was additionally introduced.

The revised criterion is as follows:

Requirements for waste water at the discharge point (direct discharge)

Waste water from wet-processing sites (except waste water from water retting of flax and other bast fibres) shall, when discharged to surface waters, not exceed the following limits:

- COD: 100 mg/l[61] (expressed as an average yearly value),
- BOD_5: 30 mg/l,
- Sulphite: 1 mg/l,
- Ammonium nitrogen: 10 mg/l,
- Total nitrogen: 15 mg/l,
- Total phosphorous: 2 mg/l,
- The dye must comply with the following values:
- Spectral absorption coefficient at:
- 436 nm (yellow spectral region) 7 m-1
- 525 nm (red spectral region) 5 m-1
- 620 nm (blue spectral region) 3 m-1
- Toxicity to fish eggs GEI: 2
- The pH value of the waste water discharged to surface waters must be between 6 and 9 (unless the pH value of the receiving waters is outside this range) and the temperature must be below 35 °C (unless the temperature of the receiving waters is already above this limit).

This requirement shall not apply if it can be proven that the discharge into the urban waste water treatment plant has been approved and the urban waste water treatment plant meets at least the requirements of the Council Directive of 21 May 1991 concerning urban waste water treatment (91/271/EEC).

Requirements for waste water before mixing (direct and indirect discharge)

The waste water shall not exceed the following values before it is mixed with the other waste water:

- AOX: 0.5 mg/l,
- Sulphide: < 1 mg/l,
- Copper: 0.4 mg/l,
- Nickel: 0.2 mg/l,

[61] The limit can be increased to 150mg/l in exceptional circumstances.
- if the specific volume of waste water is less than 25m^3/t of treated textile – as an average yearly value
- if the cleaning performance is at least 95% as an average yearly value.

- Total chromium: 0.3 mg/l,
- Tin: 2 mg/l,
- Zinc: 0.8 mg/l,
- Antimony: 1.2 mg/l

Compliance verification

The applicant shall declare compliance with the requirements in 3.6.4.1 and 3.6.4.2 in Annex 1 and submit a compliance statement from the operator of the textile finishing plant and test reports verifying compliance with the requirements in accordance with Annex 38 of the German Waste Water Ordinance or equivalent international test reports. The following test methods can be used here (on the basis of a qualified random sample or a 2-hour mixed sample, the requirement for AOX applies to the sample):

- COD: ISO 6060 or DIN 38409-41 or DIN 38409-44 or DIN ISO 15705,
- BOD: DIN EN 1899-2 or ISO 5815-1,
- Copper and nickel: ISO 8288,
- Total chromium: ISO 9174 or DIN EN 1233,
- Sulphide: DIN 38405-27 or ISO 10530,
- Sulphite: DIN EN ISO 10304-3,
- Toxicity to fish eggs: DIN EN ISO 15088,
- AOX (chloride content < 5g/l): DIN EN ISO 9562,
- Spectral absorption coefficient: DIN 38404-3,
- Ammonium nitrogen: DIN EN ISO 11732,
- Total nitrogen: DIN EN ISO 12260,
- Total phosphorous: DIN EN ISO 11885,
- Tin: DIN EN ISO 11885,
- Zinc: DIN EN ISO 11885,
- Antimony: DIN EN ISO 11885.

The waste water treatment plant must be regularly monitored. In addition, the applicant shall submit a declaration from the operator of the textile finishing plant about the frequency of the measurements of the discharge values (at least every six months).

As an alternative to measuring the copper, nickel and chromium contents, the applicant can submit a declaration from the operator of the textile finishing plant that metal complex dyes containing copper, chromium or nickel do not form part of the dye formula.

If discharged to an urban waste water treatment plant, the applicant shall also enclose a notice of approval for the textile finishing plant verifying that the discharge process has been approved and

that the urban waste water treatment plant meets at least the requirements of Directive 91/271/EEC.

The requirement for cerium compounds was deleted as research did not indicate that the substance is still used. The requirement for metal complex dyes was also deleted, as this is already regulated via the requirement in the wastewater and end product test.

2.2.13 Requirements for emissions to air in textile finishing

For better understanding, the explanation of the building block concept in the Annex to the award criteria has been revised.

The Annex reads as follows:

Appendix E: Calculation of emissions to air in textile finishing

The textile finisher should calculate the emissions before using a formulation in order to use a formulation with the lowest possible emissions. Both the emissions of total organic carbon and the emissions of critical individual substances are calculated, insofar as these are relevant in the textile auxiliary. This is done with the help of emission factors that the supplier of the textile auxiliary (THM) must provide. Sometimes the information can be found in the safety data sheet, but usually it has to be asked for specifically. As a rule, the emission factors are supplied separately for cotton (as a representative of the polar fibres) and polyester (as a representative of the non-polar fibres), since the finishing temperatures are also different. The finisher must use the most suitable emission factor in each case.

~~The substance emission factors are provided by the~~ textile ~~manufacturer as product information.~~

The substance emission factor is defined as the amount of substance in grams that can be emitted from one kg of textile auxiliary under defined process conditions (dwell time, temperature, substrate).

A distinction is made between

fc = emission of organic substances, given in total carbon/kg textile auxiliaries

fs = substance-specific emission factor, given in g specific substance/kg textile auxiliaries.

The substance-specific emission factor must be specified for carcinogenic, mutagenic or toxic to reproduction substances, other critical organic substances such as formaldehyde, and gaseous inorganic substances such as ammonia.

1 Calculation of goods-related emission factors from substance emission factors:

$WFC = \Sigma(FA \times FK \times fC)$ resp.

$WFs = \Sigma(FA \times FK \times fs)$

THM: Textile auxiliaries

WFC: Goods-related emission factor in g total carbon/kg textile or

WFs: Product-related emission factor in g substance/kg textile

FA: liquor uptake in kg liquor/kg textile

FK: liquor concentration in g THM/kg liquor

fC Total carbon substance ~~emission~~ factor in g total carbon/g THM or

fs: Substance emission factor in g substance/g THM

Calculation of the commodity-related emission factors of two formulations as an example (proposal for the revised award basis):

Fleet	Resources	FK [g/kg]	FA [kg/kg]	Substrate	T [°C]	fs [g/g]	fc [g/g]	FK*FA*fs	FK*FA*fc	WFs [g/kg]	WFc [g/kg]
Recipe 1	Fatty acid esters	20	0,65	CO	170	-	0,0152		0,2	-	-
	Polysiloxane	20	0,65	CO	170	-	0,0052	-	0,07	-	-
	Reactant networking with catalytic converter	100	0,65	CO	170	0.0041 FO	0,0009	0.27 FO	0,06	-	-
	Stearyl urea derivative with catalyst	20	0,65	CO	170	0.0165 FO	0,0162	0.21 FO	0,21	-	-
Sum 1		-	-	-	-	-	-	-	-	**0.48 FO**	**0,54**
Recipe 2	Plasticiser	50	1	CO	150	-	0,005		0,25	-	-
	Crease-resistant finish (formaldehyde free)	12	1	CO	150	-	0,010	-	0,12	-	
	Catalyst	12	1	CO	150	-	0,008	-	0,1	-	-
Sum 2										-	**0,47**

FK: liquor concentration in g auxiliaries/kg liquor
FA: liquor uptake in kg liquor/kg textiles substrate
Substrate: textile fabric to be finished
T: Temperature during finishing in °C
fs: Substance emission factor of an auxiliary in g substance/g auxiliary
fc: Total carbon emission factor of an auxiliary agent in g organic C/g Auxiliary
WFs: Commodity-related emission factor for a recipe in g substance/kg substrate = Σ(FK*FA*fs) (can be added up within the same substance class).
WFc: Total commodity-related carbon emission factor for a recipe in g C /kg substrate = Σ(FK*FA*fc)
FO: Formaldehyde

2 Calculation of the product-related emission factors from the measured concentrations:

First, the air-product ratio LWV in m^3/kg is calculated from the measured waste gas volume flow V (in m^3/h) of all emission points of a thermal treatment unit and the product throughput W (in kg/h):

$$LWV = V/W$$

If several thermal treatment plants are connected to one waste gas purification facility, the weighted LWV shall be determined by dividing the total waste gas volume flow by the total product throughput.

The goods-related emission factors are then calculated from the measured emission mass concentrations multiplied by the measured air-goods ratio.

$_{WFC}$ **= LWV x Σ cC** or WFs = LWV x Σ cs

$_{WFC}$: Goods-related emission factor in g total carbon/ kg textile

WFs: Product-related emission factor in g fabric/kg textile

LWV: Air-product ratio in m^3 exhaust gas/ kg textile

$_{cC}$: measured concentration in g total carbon/ m^3 exhaust gas

cs: Measured concentration in g substance/ m^3 exhaust gas

The criterion itself was supplemented as follows:

In the thermosetting, thermosoling, coating, impregnating or finishing of textiles, including the associated drying facilities, the sum of the organic substances as total carbon must not exceed 0.8°g C per kg of textiles.

In addition, a maximum of 0.4 g C per kg of textiles may be emitted from carry-overs from upstream processes and from residual preparations in each case.

In the case of critical substances such as formaldehyde and gaseous inorganic substances such as ammonia, the applicant must also state the substance emission factor. Maximum emission limits of 5 mg/m^3 for formaldehyde and 10 mg/m^3 for ammonia apply.[62]

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 and submit confirmation from the textile finishing plant verifying compliance with this requirement.

In addition, the operator of the textile finishing plant shall submit either a report in accordance with Annex E with the projected emissions based on the emission factors or a test report in accordance with DIN EN 12619 (total gaseous organic carbon), DIN CEN/TS 17638 (formaldehyde) and DIN EN ISO 21877 (ammonia). In the test, the product-related emission factor shall be determined from the measured concentration value and the actual air/product ratio.

[62] Exception: if ammonium sulphamate is used as a flame retardant, the maximum limit for ammonia is 20 mg/m^3. If the textile has an easy care (also non-crease or permanent press), flame resistant and/or water and dirt-repellent function, the maximum limit for formaldehyde is 10 mg/m^3.

2.2.14 Single substance requirements and tests on the end product

For the criteria for the tests on the end product, the requirements of bluesign®, EU Ecolabel for textile products, GOTS, Oeko-Tex 100 and Nordic Swan (version 5.2) were compared as well as which additional requirements are present in the Green Button 2.0. In addition, the "Best available techniques (BAT) reference document for the textiles industry" (Roth et al. 2023) was evaluated, REACh regulations were compared, information on including new skin-sensitising disperse dyes from the Federal Institute for Occupational Safety and Health (BAUA) and the Federal Institute for Risk Assessment (BfR) was reviewed, and the Federal Administration's Guide to Sustainable Textile Procurement was included.

The criteria that have not been changed or supplemented are not listed here.

At the expert hearing, a criterion for natural rubber was discussed and supplemented accordingly.

In the third expert meeting it was pointed out that it should be examined whether additional phthalates or other limit values for these substances should be included. The review showed that the phthalates mentioned in Entry 72 REACh [CA/44/2018] are already present in the Blue Angel for textiles. The limit values are set analogously to those in the Blue Angel with a maximum of 1,000 ppm for individual substances or as a total sum value. Furthermore, the requirements for phthalates are harmonised with other labels. Therefore, the criterion including verification is retained.

In the case of organotin compounds, further substances were included and the criterion was thus harmonised with other textile labels, i.e. bluesign®, GOTS, EU Ecolabel for textile products and Oeko-Tex 100.

In expert discussion 3, aniline continued to be discussed as a free component. The compound can be important in jeans products and will therefore be set for testing with a limit value of 30 ppm for these products in the future.

Furthermore, a criterion for alkylphenols and alkylphenol ethoxylates as well as a verification for perfluorinated and polyfluorinated chemicals (PFCs) were introduced, which were already banned but for which no analytical verification obligation existed so far.

All other substances in Entry 72 REACh were also reviewed and it was found that, with the exception of chinoline (quinoline), all substances have already been included in the Blue Angel criteria with corresponding or stricter limit values. Chinoline is included in the new award criteria with a limit value of 50 ppm.

The adapted criteria are described and listed in sections 2.2.14.1 to 2.2.14.7.

2.2.14.1 Requirements for natural rubber

The content of soluble proteins from natural rubber must not exceed 200 mg/kg. The products must also be labelled if the soluble proteins exceed 20 mg/kg.

Compliance verification

The applicant shall submit a test report based on the following methods: Quantitative determination of soluble proteins in extracts from consumer goods according to DIN EN 455-3 (medical gloves) or according to the 59th Notification from the BfR (formerly BgVV), BGBI. 42 (gloves, balloons, suction cups). The applicant must confirm that the product has been labelled in accordance with the requirement.

2.2.14.2 Organotin compounds

The content of organotin compounds must not exceed the limit values stated in the following table.

Table 3: Limit values for organotin compounds in final fabrics

Organotin compounds		Limit values in mg/kg
Dibutylzinn / Dibutyltin	DBT	1
Dimethylzinn / Dimethyltin	DMT	1
Dioctylzinn / Dioctyltin	DOT	1
Diphenylzinn / Diphenyltin	DPhT	2
Dipropylzinn / Dipropyltin	DPT	1
Monomethylzinn / Monobutyltin	MMT	2
Monobutylzinn / Monobutyltin	MBT	1
Monooctylzinn / Monooctyltin	MOT	2
Monophenylzinn / Monohenyltin	MPhT	1
Tetrabutylzinn / Tetrabutyltin	TeBT	1
Tetraethylzinn / Tetraethyltin	TeET	1
Tributylzinn / Tributyltin	TBT	0.5
Tricylcohexylzinn / Tricylcohexyltin	TCyHT	1
Trimethylzinn / Trimethyltin	TMT	1
Trioctylzinn / Trioctyltin	TOT	1
Triphenylzinn / Triphenyltin	TPhT	0.5
Tetraoctylzinn / Tetraoctyltin	TeOT	1
Tripropylzinn / Tripropyltin	TPT	1

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1. The applicant shall also submit test results in accordance with the test method DIN EN ISO 22744, CEN ISO/TS 16179, CEN ISO/TS 16179 or BVL B 82.02-33 or another suitable test method[63].

2.2.14.3 Free aniline in jeans products

The content of free aniline in jeans products must not exceed 30 ppm.

Compliance verification

The applicant shall submit a test report for extraction with MeOH / LC-MS or DIN EN ISO 14362-1 without reductive cleavage.

[63] Test methods used by testing laboratories accredited according to DIN EN ISO 17025 are accepted.

2.2.14.4 Alkylphenols and alkylphenol ethoxylates

The criterion was supplemented because entry 46a on nonylphenol ethoxylate (NPE) in Annex XVII of the REACh Regulation suspends the set limit value for textiles made exclusively from recycled material:

"46a. Nonylphenol ethoxylate (NPE) (C2H4O)nC15H24O

1. May not be placed on the market after 3 February 2021 in textile articles which can reasonably be expected to be washed in water during their normal life cycle in concentrations ≥ 0.01% by weight of that textile article or parts thereof.
2. Paragraph 1 shall not apply to the placing on the market of end-of-life textile products or of new textile products made exclusively from recycled textiles without the use of NPE.
3. For the purposes of paragraphs 1 and 2, "textile product" shall be defined as any unfinished, semi-finished or finished product containing at least 80% by weight of textile fibres and any other product containing in any of its parts at least 80% by weight of textile fibres, including products such as garments, accessories, home textiles, fibres, yarns and fabrics and knitted or crocheted garments."

Nevertheless, a corresponding analytical report should be submitted for such end products: Such a reporting obligation could possibly be used in the next revision to determine a limit value for textiles made exclusively from recycled material.

The criterion now is:

4-tert-butylphenol, pentylphenol, heptylphenol, octylphenol and nonylphenol as well as octylphenolethoxylate and nonylphenolethoxylate may not exceed the following limits in the end product: A total limit value of 10 mg/kg for alkylphenols and 100 mg/kg for alkylphenols and alkylphenol ethoxylates combined.

These limit values do not apply to end products that are exclusively produced using recycled cotton/wool and polyester without the use of alkylphenols and alkylphenol ethoxylates; however, verification including an analysis report must still be submitted.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1z and submit confirmation that these substances have not been used. The applicant shall also submit an analysis report: Solvent extraction followed by LCMS (alkylphenol) and EN ISO 21084, EN ISO 18254-1 or EN ISO 18254-2 (alkylphenol ethoxylate).

2.2.14.5 Perfluorinated and polyfluorinated chemicals (PFCs) in hydrophobized textiles

Perfluorinated and polyfluorinated chemicals (PFCs) may not be added (see 3.6.2.4.4). In hydrophobized textiles, the concentrations of the PFCs listed in Annex H4 may not be exceeded.

Name	Cas-No.	Acronym	Limits
Perfluorooctane sulfonic acid and sulfonates / Perfluorooctane sulfonic acid and sulfonates	1763-23-1, et. al.	PFOS	1 µg/m²
Perfluorooctane sulphonamide / Perfluorooctane sulphonamide	754-91-6	PFOSA	1 µg/m²
Perfluorooctane sulfonfluoride / Perfluorooctane sulfonfluoride	307-35-7	PFOSF / POSF	1 µg/m²

Name	Cas-No.	Acronym	Limits
N-Methyl perfluorooctane sulfonamide / N-Methyl perfluorooctane sulfonamide	31506-32-8	N-Me-FOSA	1 µg/m²
N-Ethyl perfluorooctane sulfonamide / N-Ethyl perfluorooctane sulfonamide	4151-50-2	N-Et-FOSA	1 µg/m²
N-Methyl perfluorooctane sulfonamide ethanol / N-Methyl perfluorooctane sulfonamide ethanol	24448-09-7	N-Me-FOSE	1 µg/m²
N-Ethyl perfluorooctane sulfonamide ethanol / N-Ethyl perfluorooctane sulfonamide ethanol	1691-99-2	N-Et-FOSE	1 µg/m²
Perfluoroheptanoic acid and salts / Perluoroheptanoic acid and salts	375-85-9, et. al.	PFHpA	0.025 mg/kg
Perfluoroctansäure und Salze / Perfluorooctanoic acid and salts	335-67-1, et. al.	PFOA	0.025 mg/kg
Perfluornonansäure und Salze / Perfluorononanoic acid and salts	375-95-1, et.al.	PFNA	0.025 mg/kg
Perfluorodecanoic acid and salts / Perfluorodecanoic acid and salts	335-76-2, et. al.	PFDA	0.025 mg/kg
Henicosafluorundecanoic acid und Salts / Henicosafluoroundecanoic acid and salts	2058-94-8, et. al.	PFUdA	0.025 mg/kg
Tricosafluorododeanoic acid and salts / Tricosalfluorododedanoic acid and salts	307-55-1, et. al.	PFDoA	0.025 mg/kg
Pentacosafluorotridecanoic acid and salts / Pentacosafluorotridecanoic acid and salts	72629-94-8, et. al.	PFTrDA	0.025 mg/kg
Heptacosafluortetradecanoic acid und Salze / Heptacosafluorotetradecanoic acid and salts	376-06-7, et. al.	PFTeDA	0.025 mg/kg

Weitere perfluorierte Carboxylsäuren / Further Perfluorinated carboxylic acids

Name	Cas-No.	Acronym	Limits
Perfluorbutanoic acid and salts / Perfluorobutanoic acid and salts	375-22-4, et. al.	PFBA	0.025 mg/kg
Perfluoropentanoic acid and salts / Perfluoropentanoic acid and salts	2706-90-3, et. al.	PFPeA	0.025 mg/kg
Perfluorhexanoic acid and salts / Perfluorohexanoic acid and salts	307-24-4, et. al.	PFHxA	0.025 mg/kg
Perfluor(3,7-dimethyloctanoic acid) und Salze / Perfluor(3,7-dimethyloctanoic acid) and salts	172155-07-6, et. al.	PF-3.7-DMOA	0.025 mg/kg

Perfluorierte Sulfonsäuren / Perfluorinated sulfonic acids

Name	Cas-No.	Acronym	Limits
Perfluorbutane sulfonic acid and salts / Perfluorobutane sulfonic acid and salts	375-73-5, 59933-66-3, et. al.	PFBS	0.025 mg/kg
Perfluorhexane sulfonic acid and salts / Perfluorohexane sulfonic acid and salts	355-46-4, et. al.	PFHxS	0.025 mg/kg
Perfluorheptansulfonic acid und Salze / Perfluoroheptane sulfonic acid and salts	375-92-8, et. al.	PFHpS	0.025 mg/kg
Henicosafluorodecane sulfonic acid and salts / Henicosafluorodecane sulfonic acid and salts	335-77-3, et. al.	PFDS	0.025 mg/kg

Partially fluorinated carboxylic / sulfonic acids / Partially fluorinated carboxylic / sulfonic acids

Name	Cas-No.	Acronym	Limits
7H-Perfluorheptanoic acid and salts / 7H-Perfluoro heptanoic acid and salts	1546-95-8, et. al.	7HPFHpA	0.025 mg/kg
2H,2H,3H,3H-Perfluoroundecanoic acid and salts / 2H,2H,3H,3H-Perfluoroundecanoic acid and salts	34598-33-9, et. al	4HPFUnA	0.025 mg/kg
1H,1H,2H,2H-Perfluorooctane sulfonic acid and salt / 1H,1H,2h,2H-Perfluorooctane sulfonic acid and salts	27619-97-2, et. al.	1H,1H,2H,2H-PFOS	0.025 mg/kg

PFOA-related Substances / PFOA related Substances

Name	Cas-No.	Acronym	Limits
1H,1H,2H,2H-Perfluorodecyl acrylate / 1H,1H,2H,2H-Perfluorodecyl acrylate	27905-45-9	8:2 FTA	0.025 mg/kg
1H,1H,2H,2H-Perfluoro-1-decanol / 1H,1H,2H,2H-Perfluoro-1-decanol	678-39-7	8:2 FTOH	0.025 mg/kg
Perfluoroctanethylsulphonic Acid / Perfluorooctylethylsulphonic Acid	39108-34-4, et. al.	8:2 FTS	0.025 mg/kg

Compliance verification

The applicant shall declare in Annex 1 that the substances have not been used and submit an analysis report based on CEN/TS 15968 or DIN EN 17681-1.

2.2.14.6 Chinoline/ quinoline

The content of chinoline/quinoline must not exceed 50 mg/kg.

Compliance verification

The applicant shall declare in Annex 1 that the substance has not been used and submit an analysis report based on the following method: Extraction with methanol or THF, analysis using HPLC-MS/MS, HPLC-DAD or DIN EN 54231.

2.2.14.7 Pesticides

The testing of pesticides was supplemented with regard to recycling end-of-life textiles made of cotton and wool, as well as with regard to using yarns made from residues from, among others, the agricultural, timber and food industries in the individual material requirements. In the 3rd expert meeting, it was noted that fibres from recycled cotton are unlikely to be contaminated with pesticides used in cotton cultivation. However, pesticide residues cannot be ruled out, especially when recycling end-of-life textiles produced with cotton from conventional cultivation or wool from conventional animal husbandry. It was therefore proposed to test the end product for pesticides if textiles contain >5% recycled cotton/wool.

A comparison of the pesticide lists of AFIRM[64], GOTS, bluesign® and Oeko-Tex showed that different individual substances are listed for the individual substance testing of the end product. The generation of a "new" list of pesticides as the largest common denominator from the aforementioned lists has only led to confusion in a comparable context in the discussion with experts. The actual intention to recognise different approaches and certificates could not be communicated via a "new RSL for pesticides".

For wool, GOTS[65] differs from other textile labels in that, among other things, other specific insecticides such as permethrin are listed for wool. Since permethrin is an approved biocide in the EU, it is not listed by Oeko-Tex or its use is not prohibited under Oeko-Tex. In addition, expert discussions with testing laboratories have shown that the limit value formulated by GOTS for recycled wool can probably not be met.

For the test on the end product, a test according to the pesticide list of the Oeko-Tex® Standard 100 was therefore proposed in order to pick up established lists and their limit values. The present requirement is also fulfilled by testing according to bluesign®.

However, it should be noted that glyphosate is not included in the pesticide list and cannot be verified by the test methods specified in the compliance verification (BVL L 00.00-34:2010-09 is a "modular multi-method"). For testing for glyphosate, a single method would have to be used. However, there is currently no standardised method for this.

The newly formulated criterion is as follows:

Pesticides in textiles containing recycled cotton/wool

In textiles containing > 5% recycled cotton/wool or yarn by mass, which is produced from, amongst other things, residues from the agricultural, timber and food industries, the sum of the pesticides named in Anhang H5 may not exceed 0.5 mg/kg. In addition, the value for glyphosate and salts[66] may not exceed 5 mg/kg.

[64] Founded in 2004, the Apparel and Footwear International RSL-Management (AFIRM) Group is a brand-driven membership organisation of apparel and footwear companies working together to promote chemical management in the global supply chain. AFIRM is supported by Phylmar Group, a California-based environmental, health and safety and sustainability consulting firm. Since its inception, AFIRM has focused on the continued promotion of chemical management, including the phase-out or restriction of restricted substances to specified limits in apparel, footwear and accessories (see https://www.afirm-group.com/about/; last accessed 12.12.2021).

[65] MANUAL FOR THE IMPLEMENTATION OF THE GLOBAL ORGANIC TEXTILE STANDARD; BASED ON THE GLOBAL ORGANIC TEXTILE STANDARD (GOTS) VERSION 6.0; March 2020; https://global-standard.org/images/resource-library/documents/standard-and-manual/GOTS_Implementation_Manual_6.0-DE.pdf (GOTS 2020b)

[66] Glyphosate is the biologically active main component in a total herbicide, which the chemical company Monsanto sells under the name RoundUp. The different RoundUp products differ based on their salt formulations, medium (solution or granulate) and glyphosate concentration. Example formulations include Glyphosate Ammonium Salt (CAS no. 40465-66-5) and Glyphosate Isopropylamine Salt (CAS no. 38641-94-0).
Source: https://www.chemie.de/lexikon/Glyphosat.html, last accessed on 21.12.2022 (chemie.de 2023).

Compliance verification

The applicant shall submit test results according to the test method BVL L 00.00-34:2010-09 or BVL L 00.00-114:2007-12.

Annex H No. 5 Pesticides

According to number 3.6.6.14, in textiles containing > 5 % by weight of recycled cotton/wool or yarns made from, among other things, residues from the agricultural, wood and food industries, the value for glyphosate and salts shall not exceed 5 mg/kg and the sum of the following pesticides shall not exceed 0.5 mg/kg:

- 2,4,5-T (93-76-5)
- 2,4-D (94-75-7)
- Acetamiprid (135410-20-7, 160430-64-8)
- Aldicarb (116-06-3)
- Aldrin (309-00-2)
- Azinophosethyl(2642-71-9)
- Azinophosmethyl (86-50-0)
- Bromophos-ethyl (4824-78-6)
- Captafol (2425-06-1)
- Carbaryl (63-25-2)
- Chlorobenzilate (510-15-6)
- Chlordane (57-74-9)
- Chlordimeform (6164-98-3)
- Chlorfenvinphos (470-90-6)
- Clothianidin (210880-92-5)
- Coumaphos (56-72-4)
- Cyfluthrin (68359-37-5)
- Cyhalothrin (91465-08-6)
- Cypermethrin (52315-07-8)
- DEF (78-48-8)
- Deltamethrin (52918-63-5
- DDD (53-19-0, 72-54-8)
- DDE (3424-82-6, 72-55-9)
- DDT (50-29-3, 789-02-6)

- Diazinon (333-41-5)
- Dichlorprop (120-36-5)
- Dicrotophos (141-66-2)
- Dieldrin (60-57-1)
- Dimethoate (60-51-5)
- Dinoseb, salts and acetate (88-85-7 et al.)
- Dinotefuran (165252-70-0)
- Endosulfan, α- (959-98-8)
- Endosulfan, β- (33213-65-9)
- Endrin (72-20-8)
- Esfenvalerate (66230-04-4)
- Fenvalerate (51630-58-1)
- Heptachlor (76-44-8)
- Heptachlor epoxide (1024-57-3)
- Hexachlorobenzene (118-74-1)
- Hexachlorocyclohexane, α- (319-84-6)
- Hexachlorocyclohexane, β- (319-85-7)
- Hexachlorocyclohexane, δ- (319-86-8)
- Imidacloprid (105827-78-9, 138261-41-3)
- Isodrine (465-73-6)
- Kelevan (4234-79-1)
- Kepon (143-50-0)
- Lindane (58-89-9)
- Malathion (121-75-5)
- MCPA (94-74-6)
- MCPB (94-81-5)
- Mecoprop (93-65-2)
- Metamidophos (10265-92-6)
- Methoxychlor (72-43-5)
- Mirex (2385-85-5)

- Monocrotophos (6923-22-4)
- Nitenpyram (150824-47-8)
- Parathion (56-38-2)
- Parathion-methyl (298-00-0)
- Perthane (72-56-0)
- Phosdrin/Mevinphos (7786-34-7)
- Phosphamidon (13171-21-6)
- Propethamphos (31218-83-4)
- Profenophos (41198-08-7)
- Stroban (8001-50-1)
- Quinalphos (13593-03-8)
- Telodrine (297-78-9)
- Thiacloprid (111988-49-9)
- Thiamethoxam (153719-23-4)
- Toxaphene (camphechlor) (8001-35-2)
- Trifluralin (1582-09-8)

2.2.15 Textile products with food contact

Textiles with food contact are to be approved in future. A new criterion has been formulated for this purpose. It reads as follows:

In the case of products designed for food contact, a declaration that the product and its coating are suitable for this purpose must be enclosed with the application.

Compliance verification:

The applicant shall declare compliance with the requirement in Annex 1 and submit a declaration according to EU Regulation No 1935.

2.2.16 Serviceability

The serviceability criteria present in the 2017 award criteria were reviewed. At the third technical meeting, the values for changes in dimensions during washing and drying, especially for socks and hosiery (+/- 8%), were considered high. As a supplement, a current report by the Sustainable Apparel Coalition[67] from July 2021 was evaluated. The values listed there were compared with the Blue Angel requirements and the changes in dimensions for socks and hosiery were then reduced from +/-8% to +/-3% (woven) and +/-5% (knitted).

[67] Sustainable Apparel Coalition, Draft Product Environmental Footprint Category Rules: Apparel and Footwear, July 2021

For reasons of sustainability (durability, longevity), further criteria were proposed: the performance of zips (DIN EN 16732) and hook-and-loop fasteners (DIN 3415-1) as well as testing of abrasion resistance (EN ISO 12947-2).

Furthermore, the criteria were re-sorted into 1. dimensional stability, 2. colour fastness, 3. durability and 4. functional stability.

In the context of functional durability, the requirement to have an impregnation service for renewing water-repellent finishes was discussed, but was ultimately not included for the following reason: quality assurance for the after-treatment of textiles is outside the area of competence of the Blue Angel as a product labelling scheme. This would at least require the development of further criteria for impregnating agents to be used and informative consumer information on the correct application of these respective agents.

The criterion is as follows:

Change in dimensions during washing and drying

After washing and drying in accordance with the care instructions, the change in the dimensions of the final textile must not exceed the following (see Table 4):

Table 4: Tolerances for the change in dimensions of the textile end product or type of material after washing and drying

Textile end product or type of material	Change in dimensions after washing and drying
Knitted fabrics	+/- 5%
Chunky knit	+/- 6%
House and home textiles	+/- 8%
Woven fabrics: Cotton and cotton mix Linen, flax and silk Cotton and cotton mix for bedding Wool mix	 +/- 3% +/- 3% +/- 5% +/- 2%
Chemical fibres	+/- 2%
Bathroom linen, including terry towelling and fine rib fabrics	+/- 8%
Socks and hosiery woven knitted	~~+/- 8%~~ +/- 3% +/- 5%

These requirements do not apply to:

- Fibres or yarn;
- End products clearly labelled with “dry clean only” or equivalent (insofar as such end products are generally labelled accordingly in practice);
- Furniture fabrics that are not removable and washable.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 and submit a test report for verification. The test shall be carried out in accordance with the test methods DIN EN ISO 6330 and DIN EN ISO 5077 taking into account the following modification: three washes at temperatures indicated on the end product with tumble drying after each washing cycle, insofar as no other drying processes are indicated on the end product.

Colour fastness to washing

The colour fastness to washing in accordance with the care instructions must be at least levels 3-4 according to DIN EN ISO 105-A03 (grey scale for assessing staining) or DIN EN ISO 105-A04 (instrumental assessment of the degree of staining) and according to DIN EN 2015-A02 (grey scale for assessing change in colour) or DIN EN ISO 105-A05 (instrumental assessment of change in colour).

This requirement does not apply to end products that are clearly labelled with “dry clean only” or equivalent labelling (insofar as these products are generally labelled accordingly in practice). In addition, it does not apply to indigo dyed denim and end products that are neither dyed nor printed, or to non-washable furniture fabrics.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 and submit a test report for verification. The test is carried out in accordance with test method DIN EN ISO 105-C06 (single wash, at temperature marked on the product, with perborate powder).

Colour fastness to perspiration (acid, alkaline)

The colour fastness to perspiration (acid and alkaline) must be at least levels 3-4 according to DIN EN ISO 105-A03 (grey scale for assessing staining) or DIN EN ISO 105-A04 (instrumental assessment of the degree of staining) and according to DIN EN 2015-A02 (grey scale for assessing change in colour) or DIN EN ISO 105-A05 (instrumental assessment of change in colour). ~~A resistance of 3 is acceptable if the fabrics are dark coloured (standard depth > 1/1) on the one hand and consist of regenerated wool or more than 20% silk on the other.~~ This requirement does not apply to end products that are neither dyed nor printed and also does not apply to curtains or similar textiles intended for interior decoration, except for cushions.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 and submit a test report for verification. The test is carried out in accordance with the test method DIN EN ISO 105-E04 (acid and alkaline, comparison with multi-fibre fabric).

Colour fastness to rubbing

The colour fastness to wet rubbing must be at least levels 2-3, and for dark colours at least level 2, according to DIN EN ISO 105-A03 (grey scale for assessing staining) or DIN EN ISO 105-A04 (instrumental assessment of the degree of staining) and according to DIN EN 2015-A02 (grey scale for assessing change in colour) or DIN EN ISO 105-A05 (instrumental assessment of change in colour). This requirement does not apply to end products that are neither dyed nor printed.

The colour fastness to dry rubbing must be at least levels 3-4 for dark colours and at least level 3 for denim according to DIN EN ISO 105-A03 (grey scale for assessing staining). This requirement does not apply to end products that are neither dyed nor printed and also does not apply to curtains or similar textiles intended for interior decoration.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 and submit a test report for verification. The test is carried out in accordance with test method DIN EN ISO 105-X12.

Colour fastness to light

The colour fastness of furniture, curtains or drapes to light must be at least level 5 according to DIN EN ISO 105-A03 (grey scale for assessing staining) or DIN EN ISO 105-A04 (instrumental assessment of the degree of staining) and according to DIN EN 2015-A02 (grey scale for assessing change in colour) or DIN EN ISO 105-A05 (instrumental assessment of change in colour). For all other products, the colour fastness to light must be at least level 4. Level 4 is accepted if furniture, curtains or drapes are both light coloured (standard depth < 1/12) and made of more than 20% wool or other keratin fibres, or more than 20% silk or more than 20% linen or other bast fibres.

This requirement does not apply to mattress ticking, mattress protection or underwear.

Compliance verification

The applicant shall declare compliance with the requirement in Annex x and submit a test report for verification. The test is carried out in accordance with test method DIN EN ISO 105-B02.

Colour fastness towards saliva

The textile materials must be colour fast to the effects of saliva. This corresponds to level 5 of the currently valid standard DIN 53160 Part 1. This requirement applies to babies and children up to 36 months old. This requirement does not apply to end products that are neither dyed nor printed.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 and submit a test report for verification. The test shall be carried out in accordance with §64 of the LFGB (German Food and Feed Code), B 82. 92-3 and ~~BVL B 82.10-1~~ BVL B 82.92-13 in combination with DIN 53160-1.

No changes were necessary in the criteria for pill resistance and abrasion resistance of fabrics as well as functional resistance.

Abrasion resistance

Socks (tested on the heel), carpets without coating for private households and work clothing must demonstrate an abrasion resistance of at least 15,000 abrasion cycles. Contract textiles[68] must have an abrasion resistance of at least 20,000 abrasion cycles.

[68] Contract textiles: Textile products designed for use in the commercial sector. This includes, in particular, hospitals, care facilities, hotels and the gastronomy sector.

Compliance verification

The applicant shall submit a report on the tests in accordance with the DIN EN ISO 12947-2 standard. The test shall be carried out in a dry state using the load stated in the standard for the type of textile.

Strength of zip and hook-and-loop fasteners

The applicant must test the strength of zip and hook-and-loop fasteners to ensure that they comply with the stipulated values in the test standard (see compliance verification).

Compliance verification

The applicant shall submit a report on the tests in accordance with the DIN EN 16732 (zips) or DIN 3415-1 (hook-and-loop fasteners) standards.

2.2.17 Packaging

The original task of packaging is to protect the goods so that they arrive at the customer in perfect and undamaged condition. In addition, they serve the purpose of easy handling and also the presentation of the goods. For textiles, packaging must protect against mould or pest infestation as well as against soiling or damage during storage and transport. Today, a wide range of packaging materials is used for textiles. Some textiles are wrapped in a band of paper, cardboard or carton, others in plastic packaging. Generally, a distinction is made between sales and shipping packaging, outer packaging and transportation packaging. All packaging must meet product-specific requirements as a matter of priority. They are always adapted to these specifics and the variants are therefore manifold.

- **Sales packaging** is packaging that is offered to the end consumer with the goods as a sales unit (RAL gGmbH 2021)). *"Sales packaging also includes packaging that is only filled at the final distributor. This also includes service packaging such as carrier bags and shipping packaging"* (RAL gGmbH 2019c) , p.7). Textiles are solid materials and do not usually require sales packaging. The special case is **shipping packaging**. They are intended to *"enable or [...] support the shipment of goods to the final consumer"* (cf. (BMJ 2021)VerpackG §3 (1) No. 1b)).
- **Repackaging** is not mandatory for supplying textiles to the final consumer, whereas for other product groups it is necessary for reasons of hygiene, shelf life or to protect the product from damage or soiling. In the case of textiles, outer packaging is therefore used as additional packaging (RAL gGmbH 2017). They are *"packagings that contain a certain number of sales units (consisting of goods and sales packaging) and are typically offered to the end consumer as "bulk packaging""* (RAL gGmbH 2021) *"or serve to stock sales shelves*" (BMJ 2021)(VerpackG §3 (1) No. 2).
- The purpose of **transportation packaging** is to facilitate the handling and transport of goods in such a way that their direct contact and transport damage are prevented. It is typically not intended to be passed on to the final consumer. However, it should be noted that *"containers for road, rail, ship or air transport are not transportation packagings*" (BMJ 2021) VerpackG §3 (1) No. 3; (RAL gGmbH 2021).

Requirements for textile packaging that can be formulated in the Blue Angel relate to outer, transport, sales and shipping packaging, insofar as this is used directly by the applicant. Other packaging used along the supply chain or by other traders in B2C online trade is excluded, as

only weak verification, such as manufacturer's declarations, could be required in this respect. They are thus outside the scope of the Blue Angel as a product labelling scheme.

Until now, the Blue Angel for textiles only regulated two aspects for packaging. Firstly, the plastics used were not allowed to contain halogenated polymers. Secondly, the paper or cardboard material used had to be at least 80% recycled. Recycled packaging materials are defined as product waste (post-consumer waste) if they have undergone a mechanical recycling process.

In the course of revising the Blue Angel for textiles, these requirements were specified and supplemented to ensure that plastic packaging and packaging used for paper, paperboard and cardboard is designed in an environmentally friendly way, since in terms of resource efficiency, sustainable packaging solutions for textile products should be standard. In particular, two approaches were pursued:

- In principle, packaging avoidance should be aimed at reducing the packaging material used to the minimum necessary quantity. One specific approach in this context is the use of returnable transportation packaging. *"Returnable packaging is packaging that is designed and intended to be reused several times for the same purpose after use and whose actual return and reuse is made possible by adequate logistics and promoted by suitable incentive systems, usually by a deposit"* (BMJ 2021) VerpackG §3 (3)). The Blue Angel for Returnable Transportation Packagings (DE-UZ 27, August 2019 version 5) deals comprehensively with the returnable packaging concept. However, since the expansion of logistics systems in this area is often still a challenge, the use of returnable packaging is not explicitly required in the current award criteria. Future revisions should re-examine this issue and, if necessary, develop appropriate requirements.

- Another key starting point for sustainably designing packaging solutions, which has been included in the revision of the award criteria, is the change in material selection and composition. When choosing specific packaging materials, from an environmental point of view it is preferable to use plastic-free packaging options made from renewable, sustainably grown raw materials wherever practicable and appropriate, i.e. paper, paperboard and cardboard. Mono-materials without additional coatings are particularly recommended, as these make it easier to recycle the packaging. Overall, the use of at least some recycled content in the main raw material is preferable to using virgin fibre materials. Attention was paid to the availability of raw materials or recyclates as well as capacities, technical status and expansion plans for the existing recycling infrastructure.
  The inclusion of bio-based plastic alternatives from sustainable cultivation was also considered, but was once again rejected, as comparative life cycle assessments show that the environmental impact of bio-based plastics is not significantly better than that of fossil-based plastics. The impact tends to shift from the emission of greenhouse gases, especially CO_2, to a higher potential for acidification and eutrophication. In addition, the agricultural cultivation of raw materials can lead to land competition with food production or compensation and forest areas. The recyclability of bio-based raw materials, whose chemical structure differs from that of fossil-based plastics, is also not guaranteed with the current sorting and recycling infrastructures (UBA 2020).
  In addition to the criteria for packaging made of paper, paperboard and cardboard and plastic packaging, the extent to which requirements for textile packaging and storage packaging can or should be formulated was discussed during the expert hearing.
  As an extension of the packaging considered so far, which is designed to ensure that a textile arrives at the customer in an undamaged condition, storage packaging is intended for the

(repeated) storage of the product by the consumer during the usage phase. One such example includes the use of cotton bags for (seasonally) storing bed linen. This type of packaging is therefore packaging that is offered to consumers as an additional product for long-term multiple use. Appropriate consumer information on the use of storage packaging is therefore recommended. At the same time, the (re-)use of (textile) packaging by consumers cannot be verified by product certification such as the Blue Angel. Since (textile) storage packaging should be understood as a complete product, it needs to be certified separately. If desired, the requirements of the Blue Angel for textiles can be used for textile storage packaging. Particularly given the limited availability and correspondingly high prices for cotton from organic farming, this raises the question, however, as to whether it is currently expedient to place such high requirements on packaging. If textile packaging is used, it should therefore be designed in such a way that it has an additional benefit, such as the long-term preservation of the product. In future revisions of the criteria, it should be examined whether special criteria for textile packaging or storage packaging can be included. The topic was therefore addressed in the Outlook.

The following criteria result from these considerations:

General packaging requirements

The applicant must provide a description of the packaging for the textile to be certified. Unnecessary packaging material must be avoided. Composite packaging is not permitted and the packaging may not contain any dimethyl fumarate. The requirements apply to repackaging and transport, sales and delivery packaging that is directly used by the applicant[69]. Clothes hangers[70] are exempt from this requirement.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 and provide RAL gGmbH with a description of the intended packaging solution, incl. the designation of the packaging and its composition, the raw materials used (designation/trade name) and their origin (supplier) as well as a sample of the product packaging (photo) where relevant.

Special requirements for packaging made of paper, paperboard and cardboard

Packaging made of paper, paperboard and cardboard must contain at least 80% recycled materials. Packaging materials are considered recycled if product waste (post-consumer waste) has been subjected to a material recycling process. Full-surface coating and partial coating (e.g. in the form of lettering) of paper, paperboard and cardboard packaging with plastics or metals is not permitted. It must be possible to verify the origin of the wood for the virgin fibres added to the product. The wood must be sourced from forests that are able to verify that they have been managed according to the guidelines for sustainable forestry. The relevant forestry business must work in accordance with a high ecological and social standard and be certified accordingly. The certification systems FSC and PEFC and certification according to the Naturland standard will be accepted.

[69] Other packaging along the supply chain and delivery packaging used by other online retailers are exempt from these requirements.

[70] According to Annex 1 § 3 (1) of the German Packaging Law (VerpackG), clothes hangers sold with a piece of clothing are considered to be packaging.

Compliance verification

The applicant shall provide information on the recycled content (PCR) of the packaging solution. If primary fibres are used, the applicant shall submit a certificate for sustainable forestry management (FSC, PEFC or Naturland standard).

Special requirements for packaging made of plastic

It is only permitted to use unmixed plastic without any coating. The plastics used for the packaging of the product are not permitted to contain any halogenated polymers. PE bags must contain at least 80% recycled plastic (PCR materials according to ISO-14021, 7.8.1.1 a, 2). The packaging must be recyclable in accordance with the current "minimum standard for determining the recyclability of packaging". (Stiftung Zentrale Stelle Verpackungsregister 2020)

Compliance verification

The applicant shall submit confirmation from the packaging supplier on the recycled content and the recyclability of the packaging in accordance with the "minimum standard for determining the recyclability of packaging" (Central Agency Packaging Register/Zentrale Stelle Verpackungsregister 2020). The Blue Angel ecolabel DE-UZ 30a "Products made from recycled plastic" can also be submitted as verification of the recycled content.

2.2.18 Consumer information

The existing requirements for consumer information, in particular concerning the declaration of the fibres used and instructions for caring for and cleaning textiles, were adopted and supplemented with requirements for using radio-frequency identification (RFID) components. A further addition is that the manufacturer or distributor of the product must include a note explaining how the product can be repaired.

RFID technology (see section 2.3.3) makes it possible to electronically identify products such as clothing and textiles with RFID tags, so-called RFID-based smart labels. In contrast to barcodes, individual products can be identified by means of a digital signature (Electronic Product Code (EPC)) stored on transponders. The system also enables the EPC to be read automatically and contactlessly from the product without direct visual contact over a certain distance (depending on the technology). This enables efficient supply chain management within the textile value chain as well as efficient logistics in wholesale and retail. Other potential applications for textile-integrated RFID technology include logistics for leasing services and business solutions, such as hospital linen, catering textiles, large laundries and workwear (Müller et al. 2020).

However, smart labels represent an additional component in textiles. Their legal classification and the resulting consequences for disposal are explained in the following section.

RFID tags fall under DIRECTIVE 2012/19/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 4 July 2012 on waste electrical and electronic equipment and thus under the German Electrical and Electronic Equipment Act (ElektroG)[71][72] . This means that according to the law, RFID tags must be disposed of like electrical waste.

[71] See https://ec.europa.eu/environment/pdf/waste/weee/faq.pdf point 3.7 on page 9: 3.7. Do Radio Frequency Identification (RFID) tags fall within the scope of the Directive? Response: Yes. RFID tags (active and passive) meet the definition of EEE as set out in Article 3(1)(a) and thus fall within the scope of the Directive, unless they benefit from an exclusion on the basis of Article 2. (European Commission 2014).

[72] The ElektroG transposes the European WEEE Directive 2012/19/EU (see https://eur-lex.europa.eu/legal-content/DE/TXT/?uri=CELEX:32012L0019) into German law. It regulates the placing on the market, the taking back and the

Passive electronic components (RFID) should therefore be removable or detachable and an indication of their presence should be included.

It was also discussed whether additional consumer information should be included to encourage consumers to use the textile as sustainably as possible. Looking at the life cycle of a textile, it becomes clear that consumers can (strongly) influence the environmental impact of the textile through their consumption decisions and their usage behaviour. In particular, three proposals were discussed:

- An addition to the care instructions with the suggestion to reduce the washing frequency of washable garments (except underwear, socks and stockings) where possible to minimise the associated environmental impact.
- An encouragement to use the textiles as long as possible, e.g. with the addition "Wear me as long as possible!" or similar wording. In addition, the provision of consumer information on repair options (including repair services and guarantees, availability of spare parts or components for repair as well as information on repair instructions and repair cafés) was evaluated. This repair information could either be provided with the textile or be available on the Internet site of the applicant.
- The additional advice to dry fleece products once before the first wash, if possible, in order to minimise the emission of microplastics.

In the discussion with textile experts, however, it was argued that information of this kind was not (yet) useful, so that none of the three suggestions was included as a criterion in the award criteria, but rather these were addressed in the introduction. As an indication for formulating consumer information, reference was made in the introduction to the UN guidelines for the provision of information on the sustainability of products .[73]

The new criterion on consumer information therefore includes the following wording:

Consumer information

Insofar as the textile end products are sold in Germany, the consumer information must also be fully provided in German.

The fibres used in the end product must be declared in accordance with Regulation (EC) No 1007/2011 of the European Parliament and of the Council[74]. In addition, care and cleaning information must be provided in the form of textile care symbols in accordance with the guidelines of GINETEX[75] or DIN EN ISO 3758. The standards ISO 15797 and ISO 10023 apply to industrial washable textiles. If passive electronic components (RFID) are used, these must be removable/separable and corresponding information must be provided. In addition, information on which parts of the textile – depending on the type and severity of the damage or wear – are repairable or replaceable, e.g. buttons, zips, hook-and-loop fasteners and seams, should also be

environmentally sound disposal of electrical and elec(Europäische Union 2012b)tronic equipment. The law first came into force in 2005 and was amended in 2015 (ElektroG2) and 2022 (ElektroG3) (Europäische Union 2012a).

[73] United Nations Environment Programme (2017) Guidelines for providing information on product sustainability. Global guidelines for making effective environmental, social and economic product claims to build decision-making power and empower consumers; last accessed 08.12.2021 at https://www.oneplanetnetwork.org/sites/default/files/guidelines_full_german.pdf. (Umweltprogramm der Vereinten Nationen 2017).

[74] Regulation (EC) No 1007/2011 of the European Parliament and of the Council of 27 September 2011 on textile fibre names and related labelling and marking of the fibre composition of textile products and repealing Council Directive 73/44/EEC and Directives 96/73/EC and 2008/121/EC of the European Parliament and of the Council. (Europäische Union 2011)

[75] http://www.ginetex.de/

provided. All information must be made available on the product itself, the packaging, via a brochure or via the website operated by the manufacturer.

Compliance verification

The applicant shall declare compliance with the requirement in Annex 1 and submit a sample of the consumer information where relevant.

2.2.19 Working conditions

The requirements for working conditions have been revised to align the criteria with the revised product criteria for the Green Button (Green Button 2.0) in the social sustainability area. This is to ensure that the eco-label can continue to be recognised as a credible certification label in terms of the social sustainability product criteria of the Green Button.

The basis for the revision was the draft product requirements GK 2.0[76] published by the Green Button for the social sustainability, occupational safety and health areas (date of analysis: June 2022).

The revised criterion is as follows:

The textile product to be certified must comply with the social and human rights requirements for the recognition of certification labels in the respective recognition areas for the Green Button 2.0 from 1 August 2024[77]:

For a transitional period up until 31 July 2024, it is still possible to comply with the product requirements with respect to social and human rights for the Green Button 1.0[78].

The current social and human rights requirements for the recognition of certification labels by the Green Button 2.0 in the recognition areas manufacturing, wet processes and fibre and material use are presented below[79].

3.15.1 Social and human rights requirements for the recognition of certification labels for manufacturing (B.1) according to the Green Button 2.0

- Labour Rights Management,
- Freedom of Association and Protection of the Right to Organise (ILO C087),
- Worker Representatives' Rights (ILO R143),
- Right to Organise and Collective Bargaining (ILO C098),
- Workers' Representation Where Restricted by Law[80],

[76] Can be downloaded at https://www.gruener-knopf.de/konsultation; last accessed 12.12.2021

[77] Green Button Standard 2.0: Process and Requirements for the Recognition of Certification Labels, Part B: Requirements for the recognition of certification labels; https://www.gruener-knopf.de/standard-20,last accessed on 21.12.2022 (Grüner Knopf 2020b).

[78] Green Button Standard 1.0, section 2. Product requirements, subsection 2.1 Social Criteria; https://www.gruener-knopf.de/standard-10, last accessed on 21.12.2022 (Grüner Knopf 2020a).

[79] They are available online under: Green Button Standard 2.0: Process and Requirements for the Recognition of Certification Labels at: https://www.gruener-knopf.de/sites/default/files/file/2022-06/Gr%C3%BCner%20Knopf%20Standard%202.0_Metaansatz.pdf, (Version: June 2022) (Grüner Knopf 2022).

[80] Prohibition, "alternative forms of independent and free workers' organisations and collective bargaining as defined in ILO Conventions 87 and 98 in countries in which the national, regional, or local law prohibits or restricts these rights. This shall

- Prohibition of Forced Labour (ILO C029 and ILO C105),
- Bonded Labour and Financial Deposits (ILO C029, ILO C095, ILO C181)
- Withholding of Papers and Wages (ILO C029, ILO C095),
- Freedom of Movement (ILO C155, ILO C170),
- Minimum Age (ILO C138),
- Age Verification (ILO C138),
- Prohibition of Worst Forms of Child Labour (ILO C138, ILO C182 and ILO R190),
- Special Protection of Young Workers (ILO C090, ILO 138, ILOC182, C090, ILO R146 and ILO R190),
- Child Labour Remediation,
- Non-Discrimination (ILO C100, ILO C111, ILO C135 and ILO C158),
- Harassment and Abuse,
- Anonymous Worker Grievance Mechanism,
- Conditions of Employment Relationship (ILO R085 and ILO C189),
- Legal Minimum Wage,
- Payment of Statutory Social Benefits,
- Provision of Legal Maternity Leave and Protection (ILO C158 and ILO C183),
- Working Hours (ILO C001, ILO C014 and ILO R116),
- Working Time Records,
- Paid Overtime (ILO C001 and ILO R116),
- Provision of Break Times,
- Targets for Piece-Rate Workers,
- Rights of Sub-Contracted Workers,
- Occupational Safety and Health (OSH) Management System (ILO C155, ILO C148, ILO R164, ILO C174, ILO C062, ILO C170 and ILO R156),
- Workplace Safety (ILO C155 and ILO R164),
- Medical Treatment of Work Related Accidents (ILO C155 and ILO C062),
- Workplace Conditions (ILO R097),

include not hindering the establishment of and membership in alternative forms of workers' organisations or representations, free elections of representatives, access to the workplace, entering into social dialogue and taking on voluntary negotiations with the employer, as well as enjoying adequate protection against discrimination and interference" (BMZ 2022; GREEN BUTTON Standard 2.0, Process and Requirements for the Recognition of Certification Labels).

- Potable Water (ILO R097),
- Building Safety (ILO C155 and ILO R164),
- Fire Preparedness (ILO C155),
- Emergency and Evacuation Safety (ILO C155),
- Dormitories,
- Legal Compliance, and
- Business Legality.

3.15.2 Social and human rights requirements for the recognition of certification labels for wet processes (B.2) according to the Green Button 2.0

- Chemical Management (ILO C155),
- Chemical Storage and Labelling,
- Use of Chemicals,
- Hazard Communication (ILO C155),
- Personal Protective Equipment (ILO C155, ILO R164 and ILO R079), and
- Training on Chemical Handling and Exposure (ILO C155 and ILO R177).

3.15.3 Social and human rights requirements for the recognition of certification labels for fibre and material use (B.3) according to the Green Button 2.0

B.3.1 Requirements for raw materials for man-made fibres from natural polymers (regenerated) – forestry

- Verification of Employee Rights and Working Conditions,
- Ensure Respect for the Rights of Indigenous Peoples, and
- Local Community Relations .

B.3.2 Social and human rights requirements for raw materials from other sustainable, agricultural production (plant-based fibres) [81] according to the Green Button 2.0

- Freedom of Association (ILO C087),
- Collective Bargaining (ILO 098),
- Forced Labour (ILO C029 and C105),
- Minimum Age (ILO C138),
- Worst Forms of Child Labour (ILO C182),
- Ensuring Occupational Health and Safety,

[81] Acceptance of a mass balance chain of custody, as long as the volumes of input (certified fibres) and output (products containing fibres that are labelled as certified) are reconciled within the standard/certification system.

- Sub-Contractors,
- Labour Contracts,
- Equal Remuneration (ILO C100), and
- Non-Discrimination (ILO C111).

Compliance verification

The applicant shall declare in Annex x to the contract that the manufacturer of the products to be certified complies with all of the relevant social and human rights requirements for the recognition of certification labels in the respective recognition areas for the Green Button 2.0. Alternatively, the applicant can declare until 31 July 2024 in Annex 1 that the manufacturer of the products to be certified complies with all of the relevant product requirements with respect to social and human rights for the Green Button 1.0. In addition, the applicant shall submit the names and addresses of all suppliers and factories (for the recognition area/value added chain stages covered by the Green Button at the time of application) that process the product to be certified or process the raw materials used to produce the product to be certified in Annex x.

The applicant shall submit a corresponding certificate in Annex 1to the contract to verify that the product to be certified has been certified by one of the standards recognised by the Green Button for the applicable recognition area or that the manufacturer of the product to be certified is a member of a standard recognised by the Green Button for the applicable recognition area. In the case of the Green Button 1.0, this includes those standards recognised for the social criteria. This obligation to provide verification only applies if at least one of the recognition areas/value added chain stages covered by the Green Button for the product to be certified is located in a country at risk at the time of the application. A country is considered to be at risk if the country was classified in the categories "Highest Risk" or "High Risk" in the country risk assessment process for the SA8000 standard82, which is based on the World Governance Indicators (WGI). This requirement does not apply if none of the recognition areas/value added chain stages covered by the Green Button for the product to be certified are located in a country at risk at the time of the application.

Instead of submitting a standard recognised by the Green Button, as described above, the applicant can submit verification in the form of a test report from an independent, accredited auditing body for the product to be certified in Annex 1. The audit report must confirm:

- compliance with the social and human rights requirements for the recognition of certification labels in the respective recognition areas for the Green Button 2.0 or
- compliance with the product requirements with respect to social and human rights for the Green Button 1.0.

The audit on which the report is based must not be more than one year old when the application is submitted.

The independent auditing bodies must be recognised and monitored by a third party or accredited. They must also use test methods and indicators that are at least equivalent to one of the standards recognised by the Green Button. Alternatively, the auditing bodies must meet the requirements for independence (section VIII(A) of the Fair Labor Association (FLA) Charta), expertise and accountability (ISO 19011) of the independent, third party auditing bodies. Reports from the following auditing bodies will be recognised in all cases:

[82] A complete list is available at: https://sa-intl.org/resources/country-risk-assessment-process-for-sa8000/, Version 2020, last accessed on 21.12.2022 (SAI 2023).

- Reports from an RBA-approved auditor,
- Auditing bodies accredited according to SA8000.

If the product to be certified or the raw materials used to produce the product to be certified are processed in countries classified in the categories "Highest Risk" or "High Risk" in the country risk assessment process for the SA8000 standard, which is based on the World Governance Indicators (WGI), the audits and corresponding audit reports must be completed every year. If deficiencies are identified during the audits or due to concerns raised by external organisations, such as independent trade unions or non-governmental organisations, the corrective action plan (CAP) according to section 3.1 "Cease, prevent or mitigate harm in the enterprise's own operations" of the "OECD Due Diligence Guidance for Responsible Supply Chains in the Garment and Footwear Sector" must be implemented. This includes an obligation for the applicant and manufacturer of the product to be certified to provide information to RAL gGmbH and a six month transitional period to correct the deficiency and supplement the verifications, which must also be confirmed by an independent, accredited auditing body.

2.2.20 Restriction of the processing of denim

Due to the possible known workplace hazards of potassium permanganate, its use in open systems was prohibited. At the third expert meeting, it was discussed as to what is actually meant by an open system and what a description of this could look like. It is proposed that confirmation that no exposure of the workers takes place should be additionally added to the compliance verification.

The criterion is as follows:

The use of manual and mechanical sandblasting to achieve distressed denim finishes and the use of potassium permanganate is not permitted.

Compliance verification

The applicant shall provide detailed information on all production sites at which denim end products holding the environmental label are produced, as well as documentation and photos to verify the alternative processes with which the distressed denim effect is achieved. The applicant must confirm that no mechanical sandblasting or potassium permanganate is used.

2.2.21 Aims of the eco-label and explanatory field

At the end of each revision, the objectives of the eco-label are reviewed again and adapted to the new award criteria. The existing goals have essentially been retained. The goal of proven usability was expanded to include the term durability, as this is a term that is more familiar to consumers in particular. In addition, a fifth target was added, which addresses residual materials and recyclates. All goals were also formulated in a more active way:

- Observe high environmental standards in the manufacturing process,
- Improve occupational safety and social conditions in manufacturing,
- Avoid chemicals in the end product that are harmful to health,
- Ensure proven serviceability and durability; and
- Use residual materials and recyclates.

The explanatory field was also adapted. In particular, linguistic adjustments were made, so that instead of "manufactured in an environmentally friendly way", "manufactured in an environmentally sound way" is now used and instead of "tested for harmful substances", "low in harmful substances" is used. "Durable" was now selected as the third point, as this is highly relevant in the current discussion. For this reason, the social criteria have been deleted. As a result, the following three lines can be found in the new declaration field:

- Manufactured in an environmentally sound way
- Low-emission
- Durable

2.3 Review and consideration of various new aspects

2.3.1 Circular textile design including the (preferred) use of end-of-use textiles

A - schematically - linear textile life cycle (so-called textile chain) begins with the design of the garment and ends with its disposal. By contrast, circular textile design, also known as "Design for Circularity", which also includes the (preferred) use of fibres from end-of-life textiles, aims at closed material cycles. This means that at the end of their life cycle, textiles are reprocessed into new textiles of identical type. On the one hand, the choice of raw fibres and ingredients has a direct impact on the product-related water and land footprint and biodiversity. On the other hand, the decisions on colour and material composition directly affect downstream processes relating to yarn and raw material production and textile finishing:

"In yarn and raw material production, emission-relevant chemicals are used, some of which are only emitted into the exhaust air or waste water in textile finishing processes. In textile finishing, the biggest environmental problem is the amount of waste water and its chemical load. Other important environmental aspects of textile finishing are energy consumption, dust and exhaust emissions and solid waste." (Die Bundesregierung 2023)

In addition, the textile design stage influences the performance characteristics and the textile's chances of durability and reparability beyond the design and manufacturing phase. Through decisions on pattern constructions, for or against a certain timelessness or independence from fashion trends, the selection of high-quality, stable or robust fabrics and other aspects, the design determines the suitability for use and maximisation of service life. "*Longer use leads to lower resource consumption in terms of raw materials and water use, as well as lower emissions"* (ibid.).

Textile design must therefore take into account the textile's entire life cycle - from extracting the resources and producing the textile to the usage phase and processes at the end of the product's life, the so-called end-of-life management - and, if necessary, also balance divergent requirements regarding the usability, environmental compatibility and recyclability.

Circular textile design thus combines the macro-perspective of process and organisational design to achieve a circular textile economy in accordance with the "circular design" concept (as described by (Senthil Kumar and Saravanan 2019) with the micro-level of the production- and concept-led design of textiles (WRAP 2017). In the following section we will focus on this micro-understanding of textile design and conceptually define it as "circular apparel design", as product labelling schemes can only have an influence at this level.

Circular apparel design quintessentially refers to a harmonisation of textile design and recyclability, and comprises the following three basic elements:

1. Fibre and material selection/composition
2. Extended useful life: serviceability and reparability
3. Recycling-friendly design and end-of-life management for closed-loop recycling

As part of the criteria revision, it was analysed as to what extent environmental requirements could be included for these topics (see section 2.3.1.1 to 2.3.1.3).

2.3.1.1 Fibre and material selection/composition

The selection and composition of fibres and materials implies consideration of the basic properties and environmental impacts of a raw material, as well as the resulting textile surface, and takes into account potential handling during and after the usage phase. Of course, the Blue Angel cannot prescribe specific fibre compositions for individual textiles. Rather, the respective requirements for the approved fibres provide certain guidelines to ensure that the fibres used and their production processes meet specified minimum sustainability criteria. In the context of circular apparel design, the use of recycled materials and the recyclability of the textile after the usage phase also come into focus. In order to promote the use of recycled materials, a minimum content of recycled fibres from production and/or consumer waste was already required for polyester and polyamide fibres in the previous version of the award criteria - although this was not mandatory. The corresponding formulations were adopted in the revision of the criteria (see section 2.2.5). In the future, it is also conceivable that a minimum content of recyclates from end-of-life textiles and textile waste will be required. Worldwide, only 1% of end-of-life textiles are currently recycled in the form of high-quality "fibre-to-fibre recycling" (Ellen MacArthur Foundation 2017). With the annual collection volume of end-of-life textiles in Germany alone totalling approximately 1.27 million tonnes (2018), there is therefore a great deal of previously untapped potential for recycling (bvse 2020). Although various technical and infrastructural developments for recycling end-of-life textiles are currently under consideration, they also pose challenges and risks, such as the collection and sorting of end-of-life textiles, a possible accumulation of pollutants through recycling contaminated input streams, and possibly lower-quality recyclates that can no longer meet the requirements for the textile end product. There is a need for further research and development in this area. Therefore, no award criteria for using recyclates from end-of-life textiles and the recyclability of textiles can be demanded at present.

2.3.1.2 Extended useful life: serviceability and reparability

Extending the useful life of a textile can significantly reduce its CO_2, water and waste footprint (WRAP 2017). Simple, timeless designs that users can and want to wear over a long period of time are a key aspect of circular apparel design (WRAP 2017). However, this is beyond the scope of the Blue Angel as a product labelling scheme and it is therefore only included as a reference in the introduction. Furthermore, extending the useful life of a textile depends on both its fitness for use and its reparability.

- The usability of a textile describes the satisfactory fulfilment of the intended use of the textile over the entire period of use and is therefore an essential criterion for high-quality textiles, even beyond circular apparel design. It is determined by aspects relating to the material composition, construction and fit, quality and finishes. The suitability for use is also supported by the correct care of the textiles during use. The durability of the materials used is elementary to ensuring that the basic properties of the textiles allow for a long period of use (longevity). For example, heavily used areas (e.g. pockets in overalls, where employees always put their keys or pens, etc.) can be reinforced from the outset by using more robust

and/or multi-layered fabrics, double seams, etc. The use of these materials is also recommended. The Blue Angel award criteria for textiles already address the issue of fitness for use by specifying requirements for dimensional stability, colour fastness, pill resistance, abrasion resistance and functional durability. Based on the review of existing standards concerning suitability for use, and the discussions held while revising the Blue Angel, the previous criteria still proved to be adequate, but were updated and supplemented with criteria for the performance of zip and hook-and-loop fasteners and for testing abrasion resistance (see section 2.2.162.2.15).

- In terms of repairability, circular apparel design both consciously uses and places (easily replaceable) tucks, pockets, loops, buttons and zips, and also consciously does without them. Repairability can be addressed by means of repair services and guarantees, availability of spare parts or components for repair, as well as references to repair instructions and repair cafés. All these possibilities were evaluated when reviewing the criteria in discussion with textile experts, and were ultimately included in the revised version of the Blue Angel for textiles not as a criterion, but as a note in the introduction (see also sections 2.2.16, 2.2.18. and 2.3.1).

The longevity of the textile is also influenced by the washing and wearing behaviour of the users. Extensive information on the ideal care should therefore be made available (WRAP 2017). The Blue Angel for textiles stipulates that textiles must be labelled with the textile care symbols (according to GINETEX or DIN EN ISO 3758). This requirement was also carried over from the previous version of the award criteria (see section 2.2.18).

2.3.1.3 Recycling-friendly design and end-of-life management for closed-loop recycling

In the context of environmental sustainability, the full traceability (closed-loop recycling) of end-of-life textiles through end-of-life management is desirable. Reuse and recycling as well as the active further development and promotion of take-back logistics are important, future-oriented strategies in this context. Optimised waste management could support the increase of fibre-to-fibre recycling. The amount of textile waste generated per inhabitant and year in Germany increased by 2.2% between 2015 and 2018 (bvse 2020). This corresponds to around three items of clothing/household textiles or 1.5 pairs of shoes being discarded. The collection volume of end-of-life textiles[83] in Germany totalled around 1.27 million tonnes in 2018, which is partly due to improved collection infrastructures. However, the main cause is the inherently short lifespan of most textiles currently produced: the consumption of textile products has increased significantly, while their quality has declined at the same time (bvse 2020).[84]

Currently, the end-of-life textile sector is based on the free collection of end-of-life textiles by citizens. After manual sorting, the corresponding portions are sold within and outside Europe and reused or recycled there. The recycling routes for end-of-life textiles collected in Germany are currently as follows: 62% reuse (second-hand use), 12% fibre recycling,[85] 14% recycling

[83] In this paper, the term "end-of-life textiles" covers clothing and household textiles (also shoes and bags/leather goods) from post-production and post-consumer waste.

[84] Quality deterioration is a multi-dimensional problem. It includes, for example, the increase in the market share of e-commerce, fast fashion and low-cost retailers. In addition, quality goods are siphoned off from each other through sharing and passing-on practices among end consumers. These are so-called consumer-to-consumer models such as clothes swapping, resale via Internet platforms such as vinted.de or the rental of outerwear by subscription, and many more. In addition, there is textile production in low-wage countries with no or very low environmental and social standards, which enable cheap mass production that is designed for consumption rather than durability (bvse 2020).

[85] Use as non-woven, i.e. painter's fleece, insulation material, etc.

(downcycling)[86] and 12% incineration[87] (bvse 2020).[88] From the future perspective of a circular textile economy, the collection and sorting of textiles can serve as a recyclate supply sector. By supplying end-of-life textiles to textile recyclers, they channel a material flow that is still largely unused as input for recycling processes, the outputs of which (granulate, pellets, flakes, etc.) represent the raw material for circular textiles. Worldwide, only one per cent of end-of-life textiles are currently recycled in the form of high-quality fibre-to-fibre recycling, resulting in a new textile of equal value (Ellen McArthur Foundation 2017). At the same time, production waste offers untapped potential for textile recycling (Seisl and Hengstmann 2021)

With regard to end-of-life management and recycling, it can basically be said that blended fabrics must either be recyclable together or easy to separate (separability/disassembling) for recycling. Monomaterial design simplifies recycling (Haeggblom and Budde 2021). However, the implementation of recycling on an industrial scale - and thus the integration of recycling requirements into the Blue Angel for textiles - still require further research: firstly, coatings and textile finishes must not hinder the recycling process; secondly, it remains to be seen how requirements and limit values for the recycling process itself and the recyclates must and can be integrated into eco-label requirements. The main issue here is the absence of harmful chemicals in the process and in the actual recycling outputs, because impurities from the recyclates cannot be prevented or excluded. And thirdly, it remains to be seen how it can be ensured, even for large volumes, that the blended fabrics and various ingredients used can either be recycled together or easily separated. There is a lack of systematic approaches here, as well as proposals for verification so that compliance can be checked and certified by external third parties. In terms of integrating (fibre-specific) requirements into the Blue Angel, there is also currently a lack of reliable information regarding the feasible mandatory minimum contents of recycled fibres and permissible sources (PET bottles, ocean plastic, end-of-life textiles, regenerated cellulose fibres, etc.) for the recycled fibres used (cf. section 2.2.5.10).

The EU Waste Framework Directive RL 2018/851/EU[89] creates the legal framework for the separate collection of end-of-life textiles from 2025 onwards and is intended to facilitate improved textile recycling. The German Recycling Management Act (BMJV 2020) implements the EU Waste Framework Directive, which is why collecting and recycling end-of-life textiles will also change radically in Germany. For future revisions of the Blue Angel as a product labelling scheme, the minimum content of recycled fibres in the end product (see section 2.3.1.1) and designing automated sorting and high-quality recycling (see below) are particularly important aspects for promoting the reuse of end-of-life textiles.

So far, no environmental or social label addresses the aspect of **digital tracking** and tracing. In Industry 4.0 and a circular textile economy, manual sorting as a preliminary stage to recycling end-of-life textiles is not an option. Only mechanical sorting can effectively handle the volumes required. This means that electronic and biological markers and other methods such as QR codes are essential for identifying the fibres (and process materials) used. These allow textiles with the same fibre composition (and the same quality, if this information is also stored on the tracking IDs) to be read out in batches, identified and sent for joint recycling. Digital tracking IDs are also suitable for storing information on the appropriate recycling process.[90] This would enable the management of recycling processes to be improved (Niebler 2020). Since various developments

[86] Used for cleaning rags etc.

[87] The share of non-recyclable end-of-life textiles in German sorting has doubled since 2015 (ibid.: 23).

[88] In such breakdowns, it is important to note that there are no standardised collection parameters for the respective collection volume, the real and absolute numbers can vary greatly, and the figures therefore vary in some cases.

[89] Directive 2008/98/EC (Europäische Kommission 2008), as amended by Directive 2018/851/EU (Europäische Kommission 2018).

[90] One simple way would be to use the circularity ID from the Berlin startup circular.fashion (2020); https://circular.fashion/de/ .

are currently being observed in the digital tracking field and various possibilities are being tested, it is recommended in the Outlook that the next revision should consider whether and how digital tracking can be addressed in a requirement.

Overall, it can be said that every product labelling scheme, and thus also the Blue Angel eco-label, can only formulate selected requirements, in particular regarding the choice of fibres and materials and the functionality and usability. It is beyond the scope of a product labelling scheme to fully cover the complex requirements for a design for circularity with specifications for constructing and producing recyclable, durable, repairable, functional textiles equipped with tracking IDs. However, a recommendation for simple or uncomplex pattern constructions, fewer material mixtures and also less complex prints and applications makes sense and is therefore discussed in the Blue Angel's Introduction and Outlook in order to nevertheless clarify the relevance of the topic and to suggest a possible consideration in a future revision of the Blue Angel.

2.3.2 Energy, water, greenhouse gas emissions and waste

In light of various developments and international efforts to make the textile sector more sustainable and, in particular, more climate- and recycling-friendly, an initial screening should be carried out to determine to what extent requirements for sustainably using water and energy, for recording and carrying out measures to reduce greenhouse gas emissions and for sustainably handling waste can be included in the Blue Angel award criteria for textiles. The aim is to address these issues in the award criteria to a much greater extent than before. However, it should be noted that some of these issues are already included in the current award criteria. One example that should be mentioned are the requirements for producing synthetic regenerated fibres based on cellulose. These requirements can only be met if the fibres are produced in a strictly closed-loop process.

This first examination was based on a label comparison and the evaluation of further documentation:

- **Label**: Bluesign (bluesign® CRITERIA for production sites Version 3.0 2020) (bluesign 2020), C2C (C2C CRADLE TO CRADLE CERTIFIED® VERSION 4.0) (Cradle to Cradle Products Innovation Institute 2021), EU Ecolabel for textile products (2014/350/EU) (Europäische Kommission 2014), Fairtrade Textile Standard (Fairtrade Textile Production™, 2016) (Fairtrade 2016) , GOTS 6.0 (2020) (GOTS 2020a), Oeko-Tex® Made in Green, Green Button 2.0 (2021) (OEKO-TEX 2021a), currently published Blue Angel award criteria on other product groups, as well as the "Background Document" on Nordic Swan version 5.2 (Nordic Ecolabelling 2023a)
- The draft BREF document, or after publication of the final version, section 5.4 of the BREF document has been included. (Roth et al. 2023).

The following shows how the aspects listed above are addressed in various product-related environmental standards and in the BREF document (Roth et al. 2023).

EU Ecolabel for textile products (2014/350/EU) (Europäische Kommission 2014)

In the EU Ecolabel for textile products, criterion 15 describes energy efficiency in dyeing, printing, washing, drying and finishing.

The applicant must verify that the **energy** used in the printing, dyeing and finishing steps for washing, drying and finishing eco-labelled products is measured and evaluated in an energy or carbon dioxide emissions management system. In addition, the applicant must verify that the

production sites apply a specified minimum number of **BAT energy efficiency techniques specified** per plant.

For **waste,** the applicant should provide a report and waste shipment evidence concerning the type and proportion of waste recovered and the methods used.

Global Organic Textile Standard - GOTS 6.0 2020 (GOTS 2020a)

In section 2.4.10 "Environmental management", the GOTS Standard 6.0 formulates criteria for energy, water, waste and greenhouse gas emissions. Companies[91] must have a written environmental policy and have established procedures to ensure that the relevant environmental performance is monitored and improved on their premises. Data should be collected about the **water and energy sources and consumption per kg of textile produced**, measures should be taken to monitor and reduce waste and environmental inputs, and staff trained in water and energy conservation.

Furthermore, an inventory list of chemicals approved under GOTS and complete records on the use of chemicals and treatment of waste water, including the disposal of sewage sludge, should be maintained. In-house waste incineration or uncontrolled land filling with **waste** may not be undertaken. Certified companies must also record information on **sources of greenhouse gas emissions** in their own operations and identify measures to reduce each source.

Oeko-Tex STeP 02.2020 (OEKO-TEX 2021c)

Oeko-Tex Made in Green combines criteria from Oeko-Tex STeP (OEKO-TEX 2021c) and Oeko-Tex 100 (OEKO-TEX 2021b). The management objectives can be found at SteP and define the **efficiency of machines and processes using BAT** (Best Available Techniques). The extent to which energy and water savings and the associated cost savings are possible should be measured and determined.

A system for calculating the **CO_2 footprint of the production site** should be documented and targets defined. In addition, a project to reduce CO_2 emissions should be planned and documented. Furthermore, an annual reduction of CO_2 emissions should be defined as a goal of the responsible management. A **ban on the use of various CFCs** is formulated due to their greenhouse and ozone depletion potential. Criteria are also in place for refrigeration systems (4.2.6).

The energy deployed must be used optimally. To meet this requirement, the **energy consumption** must be monitored for the **entire production site.** It is desirable to introduce this for each individual process and to monitor the energy consumption for each individual process. The use of alternative energy sources with a lower environmental impact/better CO_2 balance should be considered.

The type, category and quantity of all production waste should be recorded and documented. Disposal practices should be documented. Preference should be given to waste recycling, recovery and reuse (4.2.8). The **disposal of hazardous substances should be documented**. A recycling programme to minimise or eliminate all waste should be implemented and documented.

Knowledge and **documentation of the annual water consumption** for the entire production site is required.

The company must have an **environmental management system.**

[91] The scope of this standard covers the processing, making-up, packaging, labelling, trade and distribution of textiles made from at least 70% organically produced natural fibres.

bluesign® CRITERIA for production sites Version 3.0 2020 (bluesign 2020)

The bluesign® standard lists several criteria for the new aspects to be addressed in the Blue Angel for textiles. However, these are mostly not mandatory. For example, environmentally friendly energy sources should be used and their share increased. In addition to this, internal targets should be defined and monitored. **Energy consumption** should be measured on a monthly basis, at least for the **entire production site**. The main energy users should be monitored separately. Internal and external benchmarking of the **absolute and specific energy consumption** and **CO_2** emissions should be carried out at least annually for the entire production site. Heat exchangers should be used. Another requirement is that heated machines and pipes are insulated.

The fresh water consumption should be **measured** continuously, at least at the **company level**. Here, too, internal and external benchmarking of the **absolute and specific consumption** should be carried out at least annually for the entire production site. Where possible, cooling water should be reused; closed cycles should be implemented. The water consumption should be established as a criterion when purchasing new machines. The economic, technical and legal feasibility of a water recycling system should be assessed for water-intensive processes.

Comprehensive criteria are also formulated for waste, based on its avoidance, reduction, reuse and recycling. Standard operating procedures for waste management should be established. **Waste generation,** including the different **types of waste, quantity and disposal methods,** should be documented and archived on an annual basis. Packaging material should be reduced. The responsible handling of hazardous waste is addressed in various criteria. Unavoidable waste should be collected separately to ensure its reuse, recycling or orderly disposal. The uncontrolled disposal of hazardous waste is not permitted, nor is the treatment of waste gases from incinerating waste, heavy oil or coal.

System partners for bluesign® shall define and monitor their own targets for reducing greenhouse gases. The goal is to reduce greenhouse gas emissions by 30% by 2030 and to achieve zero emissions by around 2050.

Fairtrade Textile Standard 2016_v1.2 (Fairtrade 2016)

The Fairtrade Textile Standard (Fairtrade 2016) formulates core requirements and development indicators. Core requirements must be met; development indicators refer to ongoing developments, which are provided with review periods in the criteria. Fairtrade formulates various **criteria for energy and water consumption as well as waste management**. The criteria are verified by reporting methods at different intervals for companies that employ wage-dependent workers within the supply chain and physically for brand companies that purchase the finished textile products.

As core requirements, companies must collect and separate waste in accordance with local regulations and comply with specific requirements for cleaning, storing and disposing of hazardous waste. Furthermore, companies must have a **waste management plan** that includes strategies for waste prevention, recycling, reuse and disposal alternatives. This plan must define time periods within which their company identifies the main wastes, methods for their reduction and reuse, where possible, and how these wastes can best be disposed of under local conditions (annual review). The company should develop waste prevention measures and document the reduction of waste generation.

As a development indicator, companies must **measure energy consumption** and develop a plan to reduce and recover energy. Progress must be documented using indicators defined by

appropriate cross-functional teams. The company must have a system in place to measure success in this area (review every 6 years).

Another development indicator relates to wet processing: If the company uses wet processing, measures must be developed to reduce water consumption and/or to reuse water. For this purpose, the achieved effects must be documented (review every 6 years). In the case of fibre processing, water consumption should either be limited or monitored. More specific requirements are not defined.

The CO_2 footprint reduction criterion applies to all traders, except traders participating in the Fairtrade cotton post ginning programme. Measures are to be taken on a voluntary basis to reduce their CO_2 footprint within their Fairtrade value chain(s). More specific requirements are not formulated here.

C2C CRADLE TO CRADLE CERTIFIED® VERSION 4.0 (Cradle to Cradle Products Innovation Institute 2021)

C2C requires several criteria related to energy, water and greenhouse gases. As with all other C2C criteria, the level of ambition increases from bronze to platinum.

The bronze level requires quantification of the electricity used (in kWh) and the associated greenhouse gas emissions (in CO_{2e}) in the last manufacturing step. The Silver, Gold and Platinum levels must follow different ISO standards: "*For the Silver, Gold, and Platinum levels, the methods employed to quantify embodied emissions must follow ISO 14040 and ISO 14044 (Environmental management - Life cycle assessment -Principles and framework and - Requirements and guidelines) or other standards or guidance based on ISO 14040 and ISO 14044 (e.g., the Greenhouse Gas Protocol Product Life Cycle and Accounting Standard). If available, product category rules must be followed"* (section 6.2). The use **of renewable energies in different percentages**, **starting at 5%, is required.** Furthermore, climate-relevant initiatives shall be financially supported and emission offset certificates are acquired. Continuous improvement is required, as well as on-site emission reduction projects. Data on greenhouse gas emissions should be available to stakeholders.

In the case of **water**, in addition to compliance with local and product-relevant conditions, the **annual consumption** must also be reported (Bronze level). For higher levels, **environmental protection technologies** (conservation technologies) must be introduced.

Green Button 2.0, 2022 (Grüner Knopf 2020a)

The Green Button meta label formulates requirements in the production phase for energy and water consumption, waste management and waste volumes, and air emissions. It requires continuous **overall monitoring of operations with regard to energy and water consumption**, as well as **continuous monitoring of waste streams** and other discharges, as well as their disposal. **Uncontrolled dumping must be prohibited.** Binding measures must be formulated to reduce total waste quantities. Total waste quantities refer to waste for disposal or recycling. The monitoring of air emissions includes at least the **greenhouse gases emitted** by the business operation - specifically CO_2 , SO_2 , NOx, VOC, dust and ozone-depleting substances.

Nordic Swan version 5.2, 1 March 2022 - 1 May 2026 (Nordic Ecolabelling 2023a; 2023b)

Nordic Swan version 5.2 formulates criteria for energy and water consumption. They include the introduction of energy efficiency techniques such as measurement, monitoring and control measures at the company level to reduce energy and water consumption. These requirements are comparable to the aforementioned requirements in the EU Ecolabel.

The authors of the award criteria emphasise that textile finishing has a significant impact on climate change, followed by the transport from the trader to the consumer. However, no specific requirements are formulated. In addition, a criterion for greenhouse gases - especially fluorinated hydrocarbons - is formulated: these should not be used.

For consumer information, it is proposed to insert a text - for washable garments (except underwear, socks and stockings) *"Reduce number of washes - and help save energy and reduce climate impact".*

In addition, a criterion for waste minimisation is formulated. There are currently various proposals to make the packaging material recyclable.

Furthermore, the authors of the Consultation Draft examined whether it is possible to use a PEF (Product Environmental Footprint) or an EPD (Environmental Product Declaration). The PEF includes the environmental impact categories "climate change" and "water consumption". However, the authors describe it as difficult to introduce these for all textiles because they are very diverse. It would, however, make sense to formulate such requirements for different fibres or textile types. An overarching requirement would not be possible.

BREF document (Roth et al. 2023)

A general BAT 6 for monitoring energy and water and minimising waste was formulated, as well as various techniques for reducing energy consumption (BAT 11 to 13).

BAT 10 describes various techniques for reducing water and waste water:

"In order to reduce water consumption and wastewater generation, BAT is to use all techniques (a), (b) and (b1), and an appropriate combination of the techniques (c) to (i) given below."

The BREF document also provides "Indicative values for specific water consumption", which suggest the water consumption in different finishing sectors (see table 5.1 there) (Roth et al. 2023).

BAT 11 to BAT 13 describe techniques for increasing energy efficiency.

"BAT 11: In order to use energy efficiently, BAT is to use techniques (a), (b) (c) and (d), and an appropriate combination of the techniques (e) to (k) given below.
BAT 12: In order to increase energy efficiency when using compressed air, BAT is to use a combination of the techniques given below.
BAT 13: In order to increase the energy efficiency of thermal treatment, BAT is to use all of the techniques given below ".

Some of the techniques mentioned are very specific. In a more general form, they are comparable to those from Nordic Swan version 5.2 and the EU Ecolabel for textile products.

Evaluation of the requirements from other Blue Angel award criteria

In addition to the Blue Angel for textiles, there are 100 other Blue Angel product groups. The underlying criteria were also evaluated. In numerous places, formulations on energy, water, waste and greenhouse gases were found. In many cases these are only general in nature - as in the objectives, background or environmental aspects relating to energy and water consumption, waste avoidance and climate protection. Monitoring and documentation of the energy and water consumption are rarely required. This mainly concerns products where consumption is easy to track, such as car sharing, T-computers (energy consumption) or leather, nappies, hand and head showers (water consumption). In individual award criteria, there are requirements regarding the origin of the electricity (e.g. low-emission materials), parameters on greenhouse

warming potential (e.g. thermal insulation composite systems) and on returnable packaging (e.g. returnable bottles and glasses).

Overall, the introduction of criteria for the sustainable use of energy, water, waste and the avoidance of greenhouse gases is discussed in the revision of the Blue Angel criteria for all product groups - as far as is relevant.

Conclusion on the evaluation of requirements in other labels and documents

Eight different labels were analysed in terms of energy, water, greenhouse gas emissions and waste. In addition, the current BREF document (Roth et al. 2023) and other Blue Angel award criteria were also examined. The investigation shows that so far only a few binding requirements can be found in the standards. Instead there is more of a focus on formulating targets and the measures to be developed. Occasionally, there are also tiered systems with increasing requirement levels. In the case of the Blue Angel, the requirements are formulated in such a way that they must be met at the time of application. If a criterion is not met at the time of application, the respective product cannot be certified. Targets and measures are not part of the Blue Angel product standard. New challenges are analysed in the course of revisions and, if necessary, specified as new requirements.

Proposals for expanding the current criteria are formulated below. The basis is provided by the mandatory requirements of the previously analysed standards and the BREF document (Roth et al. 2023).

2.3.2.1 Proposals for extending the Blue Angel award criteria for textiles

Energy and water consumption

The development of a definition for energy and water consumption in the textile sector, such as for the Blue Angel for Leather (DE-UZ 148) (RAL gGmbH 2015) is not possible for textiles, as the processes are too diverse and not enough data is currently available for the individual processes.

Based on other award criteria, a requirement for energy and water consumption is being introduced. In the BREF document (Roth et al. 2023), the specific water consumption for individual processes are presented as indicative values. In view of this, it would also make sense to collect data on the individual processes in order to be able to set limit values in future. Since, to the authors' knowledge, there are companies that do not (yet) record individual processes, the requirements are made for production at the entire production site, and requirements for individual processes that go further are formulated in the Outlook.

Specific requirements regarding the use of more environmentally friendly energy sources cannot be demanded at present. Interviews with experts have revealed that non-European producers are not yet able to reliably meet such requirements.

Since, based on the documents analysed, textile finishers are a major consumer of energy and water, a corresponding requirement has been introduced for this area. In the medium term, data can thus be collected and the requirements specified in future.

The following criteria are proposed for energy and water consumption:

Requirements for energy and water consumption

Textile finishing companies must submit information on their average energy (kWh/kg textile) and water (l/kg textile) consumption per year, which is consumed or measured during pre-treatment, dyeing and finishing of textiles (including the associated washing and drying processes), preferably specific to the textile product certified with the environmental label.

Compliance verification

The applicant shall prepare reports on the average energy and water consumption per kg of textile (over a period of one year) for all finishing companies.

Requirements for energy sources

Textile finishing companies must list the energy sources used during the pre-treatment, dyeing and finishing of the textiles (including the associated washing and drying processes).

Compliance verification

The applicant shall submit a report on the energy sources used.

Greenhouse gas emissions

The main contributors to the anthropogenic greenhouse effect are the greenhouse gases carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), which are usually produced as by-products of various technical and natural processes. Hydrofluorocarbons and chlorofluorocarbons (CFCs) as well as the sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3) gases also contribute to the greenhouse effect. These are produced specifically and used for various purposes. CFCs are generally produced and used as propellants, refrigerants or fire extinguishing agents. In the textile sector, they can play a role in producing shoulder pads or shoe soles and through their use in air conditioning systems. Sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3) are not relevant in the textile sector. Volatile organic compounds (VOCs) also have a so-called indirect impact on the greenhouse effect. Like carbon monoxide (CO) and nitrogen oxides (NO_x), VOCs contribute to the formation of the greenhouse gas ozone (O_3) in the troposphere in the presence of sunlight and are therefore often referred to as "ozone precursors".

The emissions to air that occur during the production of fibres and the pretreatment, dyeing and finishing of textiles, such as the GHG-relevant gases N_2O and total C via VOCs, are already regulated in the Blue Angel for textiles (see sections 2.2.5.4, 2.2.5.5, 2.2.7 and 2.2.8). In addition to the existing criteria, the exclusion of CFCs in the production of shoulder pads (see polyurethane) is included. The greenhouse gas carbon dioxide (CO_2) is addressed by the new requirements on energy consumption. Methane (CH_4) plays a role in the textile sector in connection with sheep breeding for producing wool or, in the future, with the use of biogenic raw materials for producing biogenic synthetic fibres. Specific requirements have been formulated for using biogenic resources in the current award criteria (see section 2.2.3). A reduction in methane emissions from sheep farming could only be achieved by abandoning wool as a raw material, which in turn would create other environmental impacts by switching to alternatives. In the case of cattle, a change in husbandry and feeding conditions would help to reduce methane emissions (e.g. (UBA 2022).

Waste

In future, applicants must record in a waste register the type, category and quantity of production waste, as well as its storage, reuse, recycling or disposal. The type of waste (e.g. via the waste key number), the quantity and the disposer as well as the approved period of time must be specified in the waste register. Appropriate permits must be available from the waste disposal company for disposing of the waste. In-house or uncontrolled land filling with waste must not be carried out.

The following requirement has been formulated for handling waste:

Requirements for waste

Textile finishing companies must not burn waste internally at the company or dispose of waste in uncontrolled landfills. Controlled burning of waste at the company for the purpose of generating energy is exempt from this ban. Waste should preferably be recycled or taken back and reused. A waste register must be kept in which at least the type, category, quantity and disposal method or recycling method for all production waste is recorded and documented. The disposal practices, including for the disposal of hazardous waste, must also be documented.

Compliance verification

The applicant shall submit documentation that records all production waste, including hazardous materials, and the relevant disposal methods or recycling methods (waste register). The corresponding approvals from the applicable authorities for the disposal of hazardous waste must also be submitted. Official approval for the controlled burning of waste at the company must be submitted where relevant. If requested to do so by RAL gGmbH, the applicant shall submit further information.

Efficiency techniques

Based on the EU Ecolabel for textile products, Nordic Swan version 5.2 and BREF (Roth et al. 2023) as well as the contents of blue sign®, a selection of energy and water efficiency techniques is formulated as a further measure. 15 techniques are described in total, of which at least four techniques from different areas (i.e. general techniques, washing and rinsing as well as drying and finishing) must be implemented and proven, depending on the product volume in the company.

The following criteria are proposed:

Applied energy efficiency techniques in washing, rinsing and drying

The applicant must verify that the finishing companies have implemented the minimum number of BAT energy saving techniques. These techniques are also listed below.

Table 5: Minimum number of BAT energy saving techniques to be used during washing, rinsing and drying

BAT area	Production volume	
	< 10 tonnes	> 10 tonnes
General energy management	Two techniques	Three techniques
Washing and rinsing	One technique	Two techniques
Drying and finishing on stretching frames	One technique	Two techniques

Table 6: Energy efficiency techniques during washing, rinsing and drying

- General energy efficiency techniques
- Measuring what energy is consumed where
- Process monitoring and automatic control systems for flow controls, filling volumes, temperatures and time management
- Insulating pipelines, valves and flanges
- Frequency controlled electric motors and pumps
- Enclosed design of machines to reduce steam losses
- Reuse/recycling of water and liqueur in batch operation
- Combining multiple wet treatments in one process
- Recovering heat, e.g. from washing, steam condensate, waste process air, combustion gases
- Solar panels, photovoltaic systems or heat recovery systems that within the energy generating process supply at least 30% of the energy required by the process

Washing and rinsing

- Using cooling water as process water
- Using overflow processes with emptying/filling processes
- Using intelligent rinsing technologies with water flow and counterflow control systems
- Installing heat exchangers

Drying and finishing on stretching frames

- Optimising air circulation
- Insulating the housing
- Installing effective combustion systems
- Installing heat recovery systems

Compliance verification

The applicant shall verify the implementation of the BATs by submitting technical descriptions of the processes and an evaluation of the energy savings from the finishing companies, as well as a visualisation of the technique (e.g. a drawing or photo). Energy management systems according to DIN EN ISO 50001 or comparable systems will also be accepted as verification.

2.3.3 RFID, radio-frequency identification

The application of RFID technology requires a system that essentially consists of two components: on the one hand, an active reader[92] that is connected to a computer-assisted database; on the other hand, a large number of passive transponders or tags (also referred to as RFID tags or smart labels) that are attached to or in textile products. Textile-integrated smart labels are usually thin, flexible labels that are sewn on in combination with other labels. They are usually designed in such a way that consumers can cut them off before using the clothes and dispose of them separately (as household waste) (Finkenzeller 2006; digitalcourage 2013; GERRY WEBER international AG undatiert).

An RFID tag or smart label, on the other hand, has just a very simple microchip and a small antenna made of copper, silver or aluminium. Smart labels do not contain batteries and the tags are only electronically active in the radio field of the reader at the moment they are activated (Finkenzeller 2006).

RFID technology makes it possible to electronically identify products, such as clothing, with smart labels. In contrast to barcodes, individual products can be identified by means of a digital signature (Electronic Product Code (EPC)) stored on transponders. The system also enables the EPC to be read automatically without touching the product and without direct visual contact over a certain distance (depending on the technology). This enables efficient supply chain management within the textile value chain as well as efficient logistics in the wholesale and retail trade (Kern 2007; Schoblick and Schoblick 2005).

Other potential applications for textile-integrated RFID technology include logistics for rental services and business solutions, e.g. hospital linen, catering textiles, industrial laundries and workwear. For example, clothing and linen can be tracked within companies through individual identification with RFID tags during the usage phase in order to determine their current whereabouts, cleaning status, number in circulation and frequency of use. This enables more efficient inventory management, while item-related traceability also benefits the service quality and hygiene (e.g. monitoring the use and cleaning intervals) and makes it easier to plan the service life of products (Müller et al. 2021).

Theoretically, RFID tags could be used to store digital tracking IDs that can be linked to environmental or social labels on the database side. Such technology can also be used to store care instructions and information about repair and treatment or recycling instructions. However, the data is not located on the RFID tags, but must be made available in cloud-based services (Niebler 2020).

Transponders vary considerably in terms of the RFID technology used. They differ in terms of the design and size of the antennas, the type of carrier material and the type of chip. The design of the transponders also depends on the frequency range of the radio coupling with the reader. RFID transponders do not store any data other than the so-called EPC. As a result, the microchips in transponders are very small and cost-efficient, but they do not enable applications for automatically sorting end-of-life textiles for recycling purposes.

In the past, there have been various considerations for using RFID technology to sort end-of-life textiles. In order to store information about the material composition etc. of a textile, which could be used for automatic sorting in textile recycling, larger microchips would have to be used. However, these would incur considerably higher costs. In addition, textile sorters would have to invest in RFID readers and database solutions. However, as the economic incentive in textile recycling for these investments is low, the authors doubt that this technology will ever be used

[92] The type of reader is related to the desired range/geometry of the readout area and the required number of readings per time unit.

for this purpose. Since some consumers separate the smart labels (as well as other "normal" labels containing information about the material composition, washing instructions, etc. in printed form) from the garments for reasons of comfort, a reliable identification of end-of-life garments on this basis is in any case impaired.

Below we will first discuss whether the presence of RFID-based smart labels in garments could have negative and/or positive effects on the Blue Angel's objectives in terms of consumer risks, minimising environmental impacts in the usage phase, proper disposal or promoting the circular economy for textiles.

1. **Environmental risks**
   An RFID-based smart label represents an additional component in a textile product, which differs significantly in its material composition from the surrounding textile material. As described above, an RFID tag essentially contains an antenna, which either consists of a metallic layer printed onto plastic film or is embroidered onto a textile carrier from metal threads. A diverse range of differently designed smart labels are available on the market. However, labels based on plastic film are primarily relevant for the cost-sensitive textile market. For these, nylon or PET film coated with aluminium is most likely to be considered for mass application, but tin-plated copper coatings are also possible depending on the application. Such smart labels are not very robust and can either not be washed at all or only a few times. RFID tags for use during the textile usage phase or even for use in textile recycling consist of materials that are chemically and mechanically more resilient, such as silver threads or silver-plated copper threads (Erdmann et al. 2009). Aluminium and copper are relatively uncritical from a health and environmental perspective. However, Erdmann et al. (2009) point to possible effects on waste water treatment that could result from the mass use of RFID tags containing silver in textiles. If silver threads are used, the dissolution of silver ions from the antenna material during the washing process could disrupt the biological waste water treatment, as silver ions have a biocidal effect. If RFID tags are to be used on a large scale in the clothing sector, their production is likely to require significant resources. In particular, the use of silver as an antenna material for textile RFID tags could exacerbate the scarcity of this raw material as a resource.

2. **Minimising environmental impacts in the usage phase**
   Integrating smart labels in textiles could help to optimise the use of energy, water and detergents during the phase in which clothing textiles are used if future household machines (washing machines, tumble dryers, irons) are equipped with smart RFID technology. In a smart home scenario, for example, the washing machine and tumble dryer could recognise which garments are in the drum and, after consulting a database in the cloud, use the EPC to select the care programmes to be applied.
   However, corresponding technology concepts are not yet commercially available on the market, and current innovation trends do not seem to be developing in this direction, as the cost-benefit ratio still appears to be insufficient. There are also concerns about data protection. Since cheap unencrypted RFID tags can also be read contactlessly at a distance, without users being aware of this, the technology presents an undesirable surveillance scenario.
   The benefits of introducing such an RFID-based application concept to private textile users do not appear to be conducive to achieving the Blue Angel objectives.

3. **Promoting the circular economy for textiles, in particular extending the service life extension and reparability**
   The use of RFID-based smart labels could offer a technical option for digitally tracking

clothing textiles (Niebler 2020). RFID tags could be used to store digital tracking IDs that can be linked to environmental or social labels on the database side. Such technology can also be used to store care instructions and information about repair and treatment procedures. However, the data is not stored on the RFID tags, but has to be made available in cloud-based services. Given the relatively low complexity of textile products, it is questionable whether the mass introduction of such a complex RFID-based labelling system would significantly contribute to achieving the Blue Angel objectives. In view of the necessary technical requirements (mass integration of smart labels in clothing and readers in household appliances), the cost-benefit ratio is considered unfavourable.

4. **Promoting the circular economy for textiles, in particular recycling-friendly design and end-of-life management for closed-loop recycling.**
   In principle, RFID-based smart labels should generally be viewed critically with regard to recyclable textile design, as they represent an additional foreign body in the textile. However, due to their low mass proportion in the garment, their disruptive effect on textile recycling is also considered to be low. It can be assumed that the metals contained in smart labels would not be recyclable during textile recycling due to their "dilution" in other textile materials. The smart labels separated from the textiles by end users are also unlikely to be recyclable due to their small size and would be disposed of in household waste.
   A dedicated use of textile-integrated RFID tags for end-of-life management aimed at the closed-loop recycling of clothing would be technically feasible (Niebler 2020). This would require a significant proportion of all clothing products put on the market to be tagged with smart labels. These would need to be robust enough to survive the usage phase, including washing and drying processes. However, RFID tags of this type have so far been too expensive for mass application, and consumer acceptance for leaving the tags in the product is also low. Overall, the potential benefits of integrating RFID tags into clothing for the purpose of textile recycling are considered to be rather low, as simpler and more cost-effective technical solutions exist (e.g. QR codes).

Conclusion: The presence of RFID-based smart labels in clothing and laundry products does not pose a direct threat to the environment and consumer health in terms of the material composition. However, widespread use of such tags would increase the consumption of resources for scarce materials and could have a biocidal effect on silver-based tags. RFID tags are not a significant disruptive factor in the recycling process for textiles. However, the hypothetical use of RFID technology for more efficiently recycling post-consumer used clothing has not yet proven successful.

2.3.4 Microplastics

After the pollution of the oceans by microplastics first caught the attention of the public and policymakers, concerns about the use of plastics in society have been further heightened by recent reports that microplastics are found everywhere in the air, soil, sediments, fresh water, oceans, plants, animals and in some cases even in human food (European Commission 2019).

Microplastics (MPs) from textiles derive mainly from the chemical fibres, caused through abrasion when worn and washed (Umweltbundesamt 2019). The EU Mermaids Project (2016) (European Commission 2016) reports 1 million fibres per wash for a polyester fleece jacket, 300,000 fibres in an acrylic scarf and 136,000 fibres in nylon socks.

The contribution of MPs from textiles in the oceans is estimated to be 5-10% (Hann 2018, after (Burkhardt et al. 2020) and even up to 35 % (Boucher and Friot 2017). According to (Boucher and Friot 2017), textiles are the main source of MPs entering the sea. In contrast, the Fraunhofer

Institute (2018) (Bertling et al. 2018) ranks the contribution of textiles to MPs in Germany in 10th place, after tyre abrasion (1), waste disposal (2), road abrasion (3), pellet losses (4), sports fields and playgrounds, especially artificial turf fields (5), construction sites (6), shoe soles (7), plastic packaging (8) and road markings (9). As reliable analytical methods are not yet available, these percentages should be viewed as preliminary estimates.

It remains undisputed that textiles are a relevant product group with regard to the occurrence of MPs in the environment.

Furthermore, the total production of man-made fibres worldwide increased from about 7.44 million tonnes in 1975 to about 80.9 million tonnes in 2021 (IVC 2023). In 2021, 553,000 tonnes of textile man-made fibres, 17,000 tonnes of cotton and 14,000 tonnes of wool were processed in Germany (IVC 2021b). In 2021, the share of chemical fibres in Germany for clothing was 13%, for home textiles 25% and for technical use 62% (IVC 2021a).

The relevance of man-made fibres as a source of microparticles is further illustrated by the following estimate: assuming that each of the 500 million people in Europe owns at least one fleece jumper, that this fleece jumper weighs 500 grams on average, and that it loses about 1 to 5% of its weight during its five-year usage phase due to losing microparticles during washing cycles, then the total amount of this source is between 500 and 2,500 tonnes of microparticles from plastics per year. Based on the German population of 80 million people, this calculation would mean that approximately 80 to 400 tonnes of microparticles are released annually (Essel et al. 2015).

It can currently be assumed that in waste water treatment plants of size classes 4 and 5, which meet the legal requirements, remove more than 90 per cent of the input content of solids (including micro- and macroplastics). The Federal Environment Agency's own initial investigations at waste water treatment plants indicate that the proportion of plastics in relation to the solids in the effluent is well below one per cent. However, plastics also enter the environment through sewage sludge. They are used in agriculture, landscaping and recultivation, and in Germany are part of the secondary raw material fertilisers (UBA 2019).

Due to their small size, microplastics can be easily digested by living organisms and accumulate along the food chain. Concentrations that are safe for humans and the environment cannot currently be estimated, as there are not enough conclusive studies available. However, there are indications that adverse health effects may occur (LAWA 2019). Plastics degrade slowly in the environment, usually into ever smaller particles that are increasingly difficult to remove from the environment (UBA 2019).

Validated statements that quantitatively describe the potential environmental impact of plastics are not currently sufficiently possible due to the lack of harmonised or standardised testing procedures. It has also been shown that microplastic particles can be easily contaminated by the laboratory materials used (e.g. Jekel et al. (2020)).

In 2017, the European Commission mandated the ECHA (2019) to propose restrictions on products in which MPs are intentionally added, such as cosmetics or artificial turf. However, this proposed regulation to prevent microplastics in the environment does not apply to textiles, as these are secondary MPs that are only formed through the abrasion, degradation or ageing of larger plastic parts. The reduction of secondary microplastics in the aquatic environment is described by the Commission as part of the European Strategy for Plastics in the Circular Economy.

In view of this, it was important to examine the extent to which microplastics can be regulated in the Blue Angel criteria for textiles (DE-UZ 154).

No regulations for microplastics are currently integrated in the applicable labels for textiles - GOTS has only added a definition.

Filters that retain microplastics are proposed for textile laundries. This would be more of a recommendation for inclusion in the DE-UZ 104 award criteria (performance of wet cleaning services). A report by senior scientific advisors (Europäische Kommission 2019) also concludes that setting performance standards for household washing machines, industrial laundries and the like, which can be achieved through incremental technical improvements, could significantly reduce textile fibre emissions, and recommends stringent performance standards for washing machines to address the release of microplastics from textiles as an issue.

Nordic Swan version 5.2 advises consumers to wash clothes no more than necessary and at the lowest possible temperature. Burkhardt et al. (2020)also point out that consumers can reduce the release of microplastics by avoiding high water volume wash cycles (gentle wash cycles) and ensuring that full loads are used. The Nordic Swan background document (Nordic Ecolabelling 2023a) also mentions wash bags that are currently offered to reduce MPs, but states that their retention capacity varies greatly. It depends on the mesh size and also on the correct use, as users often rinse the bags under running water because they are difficult to clean (Burkhardt et al. 2020).

In a presentation by the German Sporting Goods Industry Association at the Textile Mission Closing Conference (BSI 2021) it was pointed out that a large number of particles can be removed or collected during the first drying process. However, it remains unclear as to what extent this is effective. It needs to be discussed whether it would not be much better for such measures to be taken directly by the industry in order to reduce microfibre emissions.

Other possibilities are seen in the development of materials and production methods (Nordic Ecolabelling 2023a). The Nordic Swan background document ultimately concludes that criteria for microplastics will (not) be discussed again until the next revision (Nordic Ecolabelling 2023a).

What does this mean for the Blue Angel criteria?

At the third expert meeting, a criterion for inclusion in the consumer information was discussed, according to which fleece products should first be dried in the tumble dryer before being washed for the first time. The criterion was rejected as not (yet) useful.

Mainly due to the lack of standardised analytical methods and the current lack of possibilities to effectively reduce MP emissions from textiles, criteria for MPs cannot be defined at present in Blue Angel DE-UZ 154, but only in future revisions. Indications for future developments are described in the "Outlook" section of the award criteria.

2.3.5 Accessories

In the scope, a textile fibre content of 70% by weight was introduced for handbags, bicycle bags and satchels, as accessories and fasteners (e.g. zips) often take up more than the 10% by weight allowed in the 2017 criteria.

For this reason, the criteria for accessories were examined and further criteria formulated.

In the 2017 criteria, accessories were indirectly covered by the scope and some by the end product criteria. In the scope, several materials were already excluded, e.g. materials, accessories and applications made of PVC, polytetrafluoroethylene and electronic components. Nickel and phthalates, for example, were already taken into account in the end product testing.

These criteria were retained and supplemented with tests for lead, cadmium and chromium (where parts are chromium-plated).

In addition, certificates from GOTS, Oeko-Tex and bluesign®, where accessories are already tested, are recognised. Other certificates can be accepted after examination.

The new Blue Angel award criteria for textiles therefore include a new criterion that incorporates the previous criterion on "nickel and its compounds".

Testing of accessories

If metal and plastic parts such as zips, buttons and other closures are used, the following tests must be carried out and the stated limits apply. In the case of accessories made of metal, the applicant must carry out tests for lead, cadmium and chromium (if the parts are chromed). The following limits must be complied with: Lead: 90 mg/kg, Cadmium: 50 mg/kg, Chromium: 60 mg/kg. If nickel is used for metal objects that come into contact with the skin for long periods of time, the migration value for metal alloys is 0.5 ug/cm²/week.

No phthalates may be used in accessories made of plastic parts.

Compliance verification

The applicant shall declare in Annex 1 that he/she either does not use any nickel-containing metal alloys or other metal accessories or shall declare compliance with the requirement and submit a certificate from the supplier verifying that the metal components used comply with this requirement. Alternatively, the applicant can also submit a test report from a testing institution approved for this test verifying the harmlessness of the dermal exposure for nickel. DIN EN 1811 in combination where relevant with DIN EN 12472 can be used as the test method.

The test of the composition of the other metal components shall be carried out according to GC-ICP-MS or DIN ISO 11466, while the test for phthalates shall be carried out according to 3.6.6.6.

3 Outlook

The rapid developments that can currently be observed in the textile sector at various levels (process technology, new fibres, policy frameworks, etc.) open up opportunities to make textile production even more sustainable in future. A major driver is the recently published EU Textile Strategy (Europäische Kommission 2022). Among other things, this envisages binding requirements for the design of textiles, for example with regard to the material composition and recyclability.

However, some developments can also pose risks. For example, recycling end-of-life textiles can lead to the accumulation of pollutants. Not all of these new developments could be conclusively assessed as part of this revision process. For example, there is still a lack of standardised analytical verification methods to measure microplastic emissions. This has prevented the development of targeted requirements for minimising the risk of microplastic emissions, including the necessary verifications. Relevant aspects that could not be conclusively assessed as part of this revision are listed below so that they can be reviewed again in the next revision process.

- An important starting point for establishing circular economy systems in the textile sector lies in the design of textiles. A good "**Design for Circularity**[93]" with specifications for designing and producing recyclable, durable, repairable, functional textiles equipped with tracking IDs[94] holds important potential for a functioning, sensible circular system that contributes to minimising the environmental impacts of the textile sector. Overall, however, it is beyond the competence of a product labelling scheme to directly influence the complex requirements for a design for circularity. However, a recommendation to keep pattern constructions simple or uncomplex, to use fewer material mixtures and to use less complex prints and applications makes sense and is therefore addressed in the introduction to these award criteria. In the next revision process, it should be checked again whether the conditions have changed in such a way that meaningful requirements can be developed on the topic, such as specifications for material compositions.
- For future revisions of the Blue Angel as a product labelling scheme, aspects concerning the **minimum content of recycled fibres** in the end product and designing for automated sorting and high-quality recycling are also particularly relevant for promoting the reuse of end-of-life textiles. The EU Waste Framework Directive RL 2018/851/EU creates the legal framework for the separate collection of end-of-life textiles from 2025 onwards and is intended to facilitate improved textile recycling. The German Closed Substance Cycle Waste Management Act (BMJV 2020) implements the EU Waste Framework Directive, which is why collecting and recycling end-of-life textiles will also change in Germany. In line with the EU Textile Strategy, it is planned to anchor extended producer responsibility in the Waste Framework Directive, which will go significantly beyond the requirements for separate collection. In addition, further developments in mechanical and chemical recycling will promote better recycling and thus facilitate the use of recycled fibres. Therefore, aspects concerning the recycling content of specific fibres and the minimum content of recycled fibres in the end product should be re-examined in the next revision. In this context, there should also be a thorough review of whether there are new findings on the contaminant risks from recycling end-of-life textiles that would require a revision of the end product testing. It

[93] The term "Design for Circularity" is used here for a product design or conception that enables the reuse and/or recyclability of the textile product.

[94] The term "tracking ID" is used here generally for information carriers that contain information important for recycling the textile.

should also be examined whether the traceability of recycled fibres in the textile chain can be further addressed.

- The market development of **Cupro** should be specifically noted again in the next revision with a view to including this fibre in the next revision if necessary.
- The next revision process should examine whether the requirements from new standards for fibres from sustainable animal production (such as RWS - Responsible Wool Standard) are equivalent to the requirements for controlled biological animal husbandry.
- For **feathers and down,** an end product test is not included in this revision of the award criteria, as no findings on potential harmful substances are available here. This point should be reintroduced for the next revision. The next revision should also consider whether a requirement for recycled down should be developed. In future, only inputs that are verifiably free of harmful substances should be permitted, including with a view to **residues from the agricultural, timber and food industries.** The revision should therefore also consider whether it is feasible and sensible for these input streams to require exclusively raw materials from organic and certified organic farming.
- For input flows such as wood, palm oil, etc., which carry a high risk of deforestation and are associated with severe **losses of biodiversity and ecosystem services,** the next revision should examine whether a plausibility check of the input flows used can and should be required.
- The issue of **microplastic emissions** has been thoroughly examined in the context of this revision. The lack of standardised analytical methods is currently being discussed, as is the current lack of possibilities for effectively reducing microplastic emissions from textiles. The EU Textile Strategy also addresses the reduction of microplastic emissions, including the development of standardised measurement methods. One possible measure is to require the pre-washing of textiles by textile manufacturers. The next revision should therefore consider how the issue of microplastics can be taken up in the Blue Angel.
- In Industry 4.0 and in a circular textile economy, manual sorting as a preliminary stage before end-of-life textile recycling is not an option. Only mechanical sorting can effectively handle the volumes required. **Electronic and biological markers and other methods** such as QR codes for labelling or recognising the fibres (and process materials) used are therefore essential. This means that textiles with the same fibre composition (and the same quality, if this information is also stored on the tracking IDs) can be read out in batches, recognised and sent for joint recycling. Digital tracking IDs can also be used to store information about the appropriate recycling process. This will enable recycling management to be improved (Niebler 2020). Various developments are currently taking place in the digital tracking field. As part of the EU Textile Strategy, the EU Commission is planning to introduce a digital product ID card that will contain information on both sustainability aspects and recyclability. This aspect should therefore also be examined in the next revision.
- The existing criteria collect data on water and energy consumption. In order to further conserve resources and reduce greenhouse gas emissions, a future revision should consider the feasibility of deriving and implementing demanding product group-specific benchmarks for water and energy consumption. In this context, the Product Environmental Footprint Category Rules mentioned in the context of the EU Textile Strategy should be taken into account.

- Where possible, **returnable** packaging should be used to conserve resources when handling packaging materials for textiles. As the development of logistics systems in this area is often still a challenge, the use of returnable packaging is not currently required. A future revision should re-examine this issue and could, for example, also refer to the Blue Angel for Returnable Transportation Packagings (DE-UZ 27) (RAL gGmbH 2019b)
- In addition to the criteria for packaging made of paper, paperboard and cardboard and plastic packaging, future revisions should examine the extent to which **requirements** can be formulated for **textile packaging and storage packaging.** As an extension of the packaging considered so far, which serves to ensure that a textile arrives at the customer in undamaged condition, storage packaging serves the (repeated) storage of the product by the consumer during the usage phase. One such example are cotton bags for (seasonally) storing bed linen. This type of packaging is therefore packaging that is offered to consumers as an additional product for long-term multiple use. Appropriate consumer information on the use of storage packaging is recommended. At the same time, the (re-)use of (textile) packaging by consumers cannot be verified by product certification such as the Blue Angel. Since (textile) storage packaging is to be understood as a complete article, it is currently left to the applicant to decide whether it should be certified separately. If desired, the requirements of the Blue Angel for textiles can be used for textile storage packaging. However, particularly given the limited availability and the correspondingly high prices for organically grown cotton, the question arises as to whether it is currently expedient to impose such high requirements for packaging. If textile packaging is used, it should therefore be designed to provide an additional benefit, such as the long-term storage of the product.
- With regard to addressing **working conditions,** the next revision should examine whether further process stages in the textile chain can be included in the requirements. The requirements set for working conditions are also relevant in other stages of the textile value chain, such as in fibre production.

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