bluesign® CRITERIA for production sites ANNEX: Fiber manufacturing

Version 1.0 | 2020-03

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1 Scope

Fiber input analysis improves efforts to establish an adequate chain of custody and optimize environmental and OH&S performance upstream of textile finishing.

The following criteria for fiber manufacturing apply to man-made fibers derived from natural and chemical sources.

Purely natural fibers (including cotton, linen, wool and silk) currently do not fall under the bluesign® CRITERIA, and the responsibility for input stream management of these raw materials lies with the textile manufacturer.

However, bluesign® SYSTEM PARTNERS are encouraged to make efforts to improve their environmental performance in the processing of natural fibers.

2 Definitions

For a comprehensive list of terms and abbreviations, please refer to the document *bluesign® glossary*.

2.1 Textile fiber

A fiber can be defined as a very thin and flexible threadlike chain of polymer molecules, which lie alongside each other and are bonded together. The polymer source can be vegetable, animal or synthetic. A textile fiber represents the raw material to be spun into yarns and then processed into fabrics by various methods, including weaving, knitting, braiding, and then dyed and finished. Fibers can also be used directly for manufacturing non-woven fabrics.

Depending on the origin of the polymers, textile fibers (in the following called 'fibers') can be categorized in one of four main groups:

- Natural fibers of plant origin (e.g. cotton, flax)
- Natural fibers of animal origin (e.g. wool, silk)
- Man-made fibers of natural polymers (e.g. viscose, acetate); if the natural polymer is cellulose, then the fiber is a man-made cellulose fiber (MMCF)
- Man-made fibers of synthetic polymers (e.g. polyester, polyamide, elastane, acrylic)

2.2 Fiber manufacturer

A company that performs primary spinning, which may include upstream processes like polymer manufacturing and pulp production or even monomer manufacturing and downstream fiber processing to produce filament or staple fiber yarns or other mechanical process, e.g. texturizing.

3 Best Available Techniques

The fiber manufacturing system partner shall be aware of Best Available Techniques (BAT) that are relevant for the industry (see for example http://eippcb.jrc.ec.europa.eu/).

4 Industry specific requirements

4.1 General

A bluesign® APPROVED fiber shall be manufactured by a bluesign® SYSTEM PARTNER, and the fiber manufacturer shall comply with the requirements of the *bluesign® CRITERIA for production sites*. Where applicable, the specifications in this annex document prevail over the requirements of the *bluesign® CRITERIA for production sites*.

A raw yarn can achieve the bluesign® approved status only, when the yarn is made of bluesign® approved fibers. For blends all fibers have to be bluesign® approved.

bluesign® APPROVED (raw) fibers shall comply with *BSSL (consumer safety limits)*. In qualified cases justified by extensive and appropriate data and at the discretion of BLUESIGN, BSSL consumer safety limits may be applied for the fiber/textile as delivered to the end-consumer only.

When polymer or pulp production or monomer manufacturing does not take place on the production site of the system partner, the system partner shall ensure that the polymer or pulp supplier and the monomer supplier comply with the respective criteria and shall collect proof of compliance.

When dry spinning or wet spinning is in use a solvent recovery rate of 99 % or more shall be the goal.

System partners are encouraged in developing fibers that fulfill the requirements of the circular economy and to increase the manufacture and use of recyclable and recycled fibers, which are suitable and safe for circular textile production.

4.1.1 Use of preparation and sizing agents

Preparation agents (e.g. sinning oils, texturizing preparations) and sizing agents are typical fiber byproducts that can be washed out or emitted in thermal processes during textile finishing and can therefore exert a strong environmental impact during pre-treatment. For this reason, all preparation and sizing agents used at the fiber manufacturing site shall pass bluesign® CHEMICAL ASSESSMENT – most critically, these agents must be APEO free. System partners are additionally encouraged to focus on low emission preparation agents, which cause less emissions of Volatile Organic Compounds (VOC) during thermal processes in finishing (e.g. heatsetting). Furthermore, preparation agents and sizing agents that are readily biodegradable are recommended. Minimizing the use of preparation agents can best be achieved by reducing possible add-ons.

4.1.2 Additives

Additives, such as master batches, pigments and UV stabilizers, must pass bluesign® CHEMICALS ASSESSMENT. For biocidal products and antimicrobial active substances, flame retardants and nanoscale materials/structures, the respective criteria apply.

4.2 Acrylic

Air emissions of acrylonitrile (evolving during polymerization and up to the solution ready for spinning) shall not exceed the annual average emission factor of 1.0 g/kg of fiber produced. Acrylonitrile (CAS 107-13-1) emissions shall be captured and off-gas cleaning shall be installed. The goal for acrylonitrile emission shall be a maximum concentration of 5 mg/m³ in off-gas.

Workplace emissions to air of N,N-dimethylacetamide (CAS 127-19-5) and monomers during polymerization and spinning shall not exceed the limit values defined in the bluesign® *Guidance sheet - Occupational Exposure Limits*.

4.3 Elastane

System partner shall declare that tin-organics are not used and that raw materials are checked for tin-organic impurities.

Further, workplace emissions to air of the following substances during polymerization and spinning shall not exceed the limit values defined in the bluesign® *Guidance sheet - Occupational Exposure Limits*, with specific attention to:

- Diphenylmethane-4,4′-diisocyanate (CAS 101-68-8)
- Toluene-2,4-diisocyanate (CAS 584-84-9)
- N,N-dimethylacetamide (CAS 127-19-5)

4.4 Polyamide (6 and 6.6)

Off-gas from polyamide production processes shall be treated by wet scrubbing or equivalent system. System partners shall provide evidence that N_2O (CAS 10024-97-2) emissions from monomer production comply with the following emission factors:

Emissions to air of N_2O from polyamide monomer production, expressed as an annual average, shall not exceed the annual average limit of

- 9.0 g N_2O/kg caprolactam (CAS 105-60-2; for PA 6) or
- 9.0 g N_2O/kg adipic acid (CAS 124-04-9; for PA 6.6)

Additionally (if caprolactam is produced at the site), caprolactam emissions shall not exceed 0.1 g/m³ in off-gas.

4.5 Polyester

Antimony (CAS 7440-36-0) content in polyester raw fibers prior to any wet processing shall not exceed 260 ppm.

The goal shall be that the average annual emissions of VOCs – from point sources as well as fugitive emissions – do not exceed the following emission factors

- 1.2 g/kg PET chips
- 10.3 g/kg filament fiber

A long-term goal shall be the phase-out of antimony compounds as catalysts with replacement by non-regrettable substitutions (i.e. substances with a generally preferable hazard and environmental profile).

4.6 Man-made cellulose fibers (including viscose, lyocell and acetate)

For man-made cellulosic fibers, the upstream processes of wood cultivation and subsequent pulp processing are of significant environmental relevance.

4.6.1 Wood policy

A wood policy shall be established which prescribes that pulp fibers/pulp shall generally originate from legal and sustainable forestry. In particular, the wood policy shall

- prescribe that at least 25% of sourced pulp fibers/pulp comes from wood that is certified by independent third-party certification with the label of the Forest Stewardship Council (FSC®);
- include a statement on the commitment to not using pulp originating from
  - ☐ illegally harvest wood;
  - ☐ forests of high conservation value, including ancient and endangered forests and endangered species habitats;
  - ☐ plantations established after 1994 through significant conversion of natural forests or conversion to non-forest use;
  - ☐ forests or plantations in which genetically modified trees are cultivated;
  - ☐ sources that are in violation of traditional, community and/or civil rights or in violation of any of the ILO Conventions mentioned in the *bluesign® SYSTEM* document;
- be supported by a system partner's adequate supply chain management to comply with the above-mentioned requirements.

This wood policy is best realized by

- aiming for an increasing amount of recycled materials for pulp processing and/or an increasing amount of wood that is certified by independent third-party certification with a label such as the Forest Stewardship Council (FSC®) or equivalent schemes;
- knowing that large-scale science-based conservation plans take place in the area and supporting them respectively;
- supporting conservation solutions that protect ancient and endangered forests, which are best supported by:

  - ☐ regularly carrying out independent third-party risk assessments, audits and on-site visits with positive results (preferably a CanopyStyle Audit with at least bronze status) or independent third-party certification of sustainable forest management programs (e.g. Rainforest Alliance);

  and

  - ☐ long-term partnerships with wood and pulp suppliers as well as personal and direct business with forest owners and pulp mills.

4.6.2 Pulping process

Dissolving pulp, also called dissolving cellulose, is specifically made for viscose and Lyocell fiber production and is characterized by a high cellulose content (>90%), a high level of brightness and uniform molecular-weight distribution. Pulp for fiber production shall

- be bleached without the use of elemental chlorine (ECF bleaching)

The goal shall be that at least 50% of the pulp is manufactured in a pulp mill that recovers value from their spent process liquors

- either by generating electricity and steam on site
- or by manufacturing chemical co-products

Wastewater shall not contain more than 0.170 kg AOX/ADt[1] pulp.

The system partner shall perform adequate supply chain management to comply with the above-mentioned requirements.

4.6.3 Viscose staple fibers

Viscose fiber manufacturing shall aim for closed-loop processes for key chemicals. The following methods shall be considered:

- Operate spinning frames in housings
- Condense exhaust air from spinning lines to recover carbon disulfide (CS_2; CAS 75-15-0) and recycle it back into the process
- Recover carbon disulfide from exhaust air streams through adsorption and activated carbon
- Apply exhaust air desulphurization processes based on catalytic oxidation with sulfuric acid (H_2SO_4; CAS 7664-93-9) production
- Recover sulphate from spinning baths
- Reduce zinc concentration in wastewater by alkaline precipitation followed by sulphide precipitation
- Use anaerobic sulphate reduction techniques for sensitive water bodies
- Use fluidized bed incinerators to burn non-hazardous wastes and recover the heat for steam and power generation

Appropriate OH&S measures, explosion protection and disaster control, and minimizing any fugitive emissions of carbon disulfide shall be considered and continually improved; the current status and goals shall be documented. A program defining responsibilities, budget and timelines shall ensure that the goals can be realized in due time.

[1] ADt= air dry ton (metric) (pulp with a moisture content of 10%)

For the key environmental issues related to the manufacturing of viscose staple fiber the following goals shall be set:

Parameter	Method	Unit	Emission factor/ concentration
Emissions to water			
COD	DIN 38409-41, ISO 6060 USEPA 410.4, APHA 5220D, GB/T 11914 validated cuvette methods (e.g. according to ISO 15705) can be used alternatively"	kg/t	5
Zinc (Zn)	ISO 11885, USEPA 200.7, USEPA 200.8 USEPA 6010c, USEPA 6020a"	kg/t	0.05
Sulfide	DIN 38405-26, ISO 10530 APHA 4500-S2-D, GB/T 16489"	mg/L	1
CS_2	ISO 15680, ISO 11423-2, USEPA 8260B, HJ 810, GB/T 15504	mg/L	0.2
Sulfate	DIN EN ISO 10304-1, USEPA 375.2	kg/t	300
AOX	ISO 9562, USEPA 1650, HJ/T 83-2001"	mg/L	5
APEO (measured in raw wastewater)	ISO 18857-1, ISO 18857-2, ISO 18254-1 ASTM D7742-11"	µg/L	1
Emissions to air			
Sulfur	Mass balance	kg/t	20
Carbon disulfide (CS_2)	VDI 3487	mg/m³	150
Hydrogen sulfide (H_2S)	VDI 3486	mg/m³	50

Table 4.1: Goals for emission factors and concentration in viscose staple fiber production
Measuring point for wastewater: before discharge to receiving water body
Measuring point for air emissions: all captured emissions

Emission factors shall be determined by a reliable mass balance on a yearly basis. The average of at least four wastewater tests and the average of the continuous wastewater volume measurements shall be used for calculation.

Additionally, the following goals (expressed in emission factors) for the consumption of main inputs shall be pursued:

- Process water: < 45 L/kg produced fiber
- Energy: < 25 GJ/t (6.9 kWh/kg) produced fiber
- CS_2 < 100 kg/t produced fiber
- NaOH < 0.6 t/t produced fiber
- H_2SO_4 < 1.0 t/t produced fiber
- Zn < 10 kg/t produced fiber

An appropriate environmental program defining responsibilities, budget and timelines shall ensure that the above-mentioned goals can be realized in due time.

4.6.4 Lyocell fibers

For lyocell fiber production the goal shall be a solvent recycling rate of at least 99%. An appropriate environmental program defining responsibilities, budget and timelines shall ensure that this goal can be realized in due time.

4.6.5 Acetate fibers

Acid management shall be in place with the aim of continually improving environmental performance. Solvent management shall aim for a 99% recovery rate (e.g. dichloromethane, methanol, acetone, etc.). An appropriate environmental program defining responsibilities, budget and timelines shall ensure that this goal can be realized in due time.

4.7 bluesign® APPROVED recycled fibers

Labeling bluesign® APPROVED recycled fibers as "recycled" is only valid when recycled content is

- traceable back to the reprocessing of the feedstock;
- certified by recycling standards (e.g. GRS (Global Recycled Standard) or SC Global Services (Recycled Content Certification).

PVC content in recycled fibers shall be below 500 ppm.

4.8 bluesign® APPROVED fibers derived from biopolymers

The claim of fibers with polymers generated from bio-based sources shall be proven by the system partner.

4.9 Fibers not mentioned in this annex

For fibers not mentioned in this document, an approval is only possible after a single case decision of BLUESIGN.

5 Verification of compliance

BLUESIGN verifies compliance with the bluesign® CRITERIA by means of a bluesign® COMPANY ASSESSMENT including an on-site inspection.

Re-assessments shall be carried out no later than every three years.

5.1 Company with multiple production sites

The goal is to physically assess all production sites of the system partner. It is at the discretion of BLUESIGN to define a specific assessment approach and site selection considering relevance of the impact on people and the environment.

The department(s) responsible for Product Stewardship for the fibers intended for certification will be assessed physically in any case. A system partner shall assure by means of an appropriate corporate policy that all site(s) follow the three guiding principles for production sites (see *bluesign® CRITERIA for production sites*), and that the delivered products comply with the relevant bluesign® CRITERIA, by maintaining a suitable Product Stewardship program and company policies.

6 Validity

This document comes into effect from 2020-03.
For all companies that signed an agreement for an assessment or for a bluesign® SYSTEM PARTNERSHIP before 2020-03, the requirements are binding after a transition period of one year from the date of release.
This document is subject to revisions. Details on the revision procedure for regular and unscheduled revisions are compiled in the *bluesign® SYSTEM* document.

7 Other applicable documents

The following documents complement the document at hand:

- *bluesign® SYSTEM*
- *bluesign® glossary*
- *bluesign® CRITERIA for production sites*
- *bluesign® CRITERIA for production sites – ANNEX: Exclusion criteria*
- *bluesign® CRITERIA for production sites – Annex: Rating of production sites*
- *bluesign® SYSTEM BLACK LIMITS (BSBL) – Threshold limits for chemical substances in chemical products*
- *bluesign® SYSTEM SUBSTANCES LIST (BSSL) – Consumer safety limits*

Current versions are available for download at www.bluesign.com/criteria.