ZDHC

ZDHC MMCF Responsible Fibre Production Guidelines

Version 1.0

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- It is not the intent of the ZDHC Foundation to act as an agency reporting wastewater and sludge discharge data to governments or authorities having jurisdiction. It is expected that manufacturing facilities are accountable for reporting on their wastewater and sludge discharges, in accordance with applicable laws.

Revision history

Version Number	Changes	Time of publication
Version 1.0	Initial publication of the ZDHC Man-Made Cellulosic Fibres Production Wastewater Guidelines	2020

Related Work

This document is one part of a series of solutions provided by ZDHC. Manufacturing facilities are expected to comply with the solutions applicable to them, considering the type of processes conducted in their facility. For that the following documents must be taken into account:

ZDHC MMCF Guidelines – The three guidelines are related among each other.

ZDHC MMCF Responsible Fibre Production Guidelines

ZDHC Wastewater Guidelines

ZDHC Air Emissions Guidelines - under development

ZDHC CMS - Framework

Chemical Inventory List (CIL)

Definitions

To help understanding the implementation of our documents the following definitions will be used to indicate requirements, recommendations, permissions and/or possibilities:

- Shall: Used to indicate a requirement.
- Should: Used to indicate a recommendation.
- May: Used to indicate permission.
- Can: Used to indicate possibility or capability.

For more definitions please click here.

Abbreviations

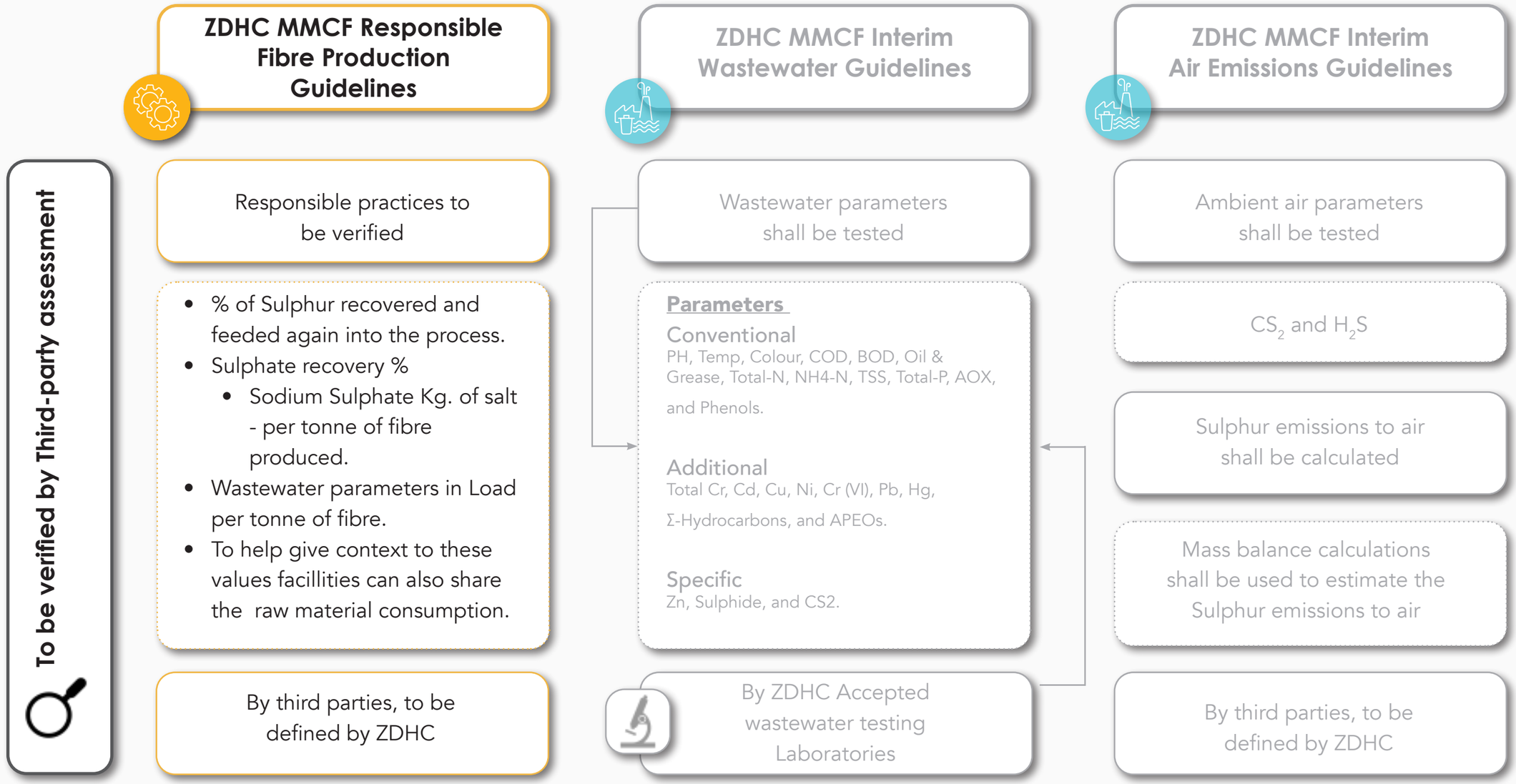
CETP	Centralised EffluentTreatment Plant
CIL	Chemical Inventory List
CMS	Chemical Management System
Cupro	Cuprammonium rayon
EN	European Norm
ETP	Effluent Treatment Plant
EU BAT BREF POL	EU-BAT BREF Reference Document on Best Available Techniques in the Production of Polymers (August 2007)
GB	Guojia Biaozhun (Chinese required national standard)
GB/T	Guojia Biaozhun/Tuījiàn, (Chinese recommended national stadard)
HJ/T	Chinese recommended environmental protection standard (Chinese industry standard)
IPE	Institute of Public & Environmental Affairs - Chinese Non-Governmental Organization
ISO	International Organization for Standardization
LC	Liquid Chromatography
MMCF	Man-Made Cellulosic Fibres
MRSL	Manufacturing Restricted Substances List
N/A	Not Available or Not Applicable
PTE	Potential to Emit
RL	Reporting Limit
USEPA	United States Environmental Protection Agency
WHO	World Health Organization
WWTP	Wastewater Treatment Plant

Contents

Summary

In the last years MMCF has become an increasingly important fibre category, stimulated by the growing number of brands that have committed to use of preferred fibres[a]. With its production volume doubled in past decades it is expected to continue its market growth due to MMCF's sustainable potential. The ZDHC Roadmap to Zero Programme (ZDHC) recognises the value of addressing hazardous substances that may be discharged into the environment, generated across the value chain of the textile and footwear industry, and decided to address MMCF production process by collaboratively creating an aligned approach for manufacturing facilities by working towards a circular approach for the substances present in the process and to generate cleaner outputs from production.

As a multi-stakeholder initiative working towards a common goal, ZDHC understands that achieving it requires collaborative efforts in the industry. The ZDHC MMCF Guidelines is a set of guidelines that addresses integrated expectations for discharge wastewater quality, emissions to air, and chemical recovery for manufacturing facilities producing Man-Made Cellulosic Fibres.



[a] Textile Exchange – Preferred Fibre & Materials.

Introduction

The ZDHC Roadmap to Zero Programme (ZDHC) is a collaboration of brands, value chain affiliates and associates committed to eliminating hazardous substances from the textile, apparel and footwear value chain. ZDHC recognises that achieving this goal requires collaborative efforts in the industry, especially in regard to capacity building, time, technology, and innovation.

The ZDHC Programme recognises the value of addressing hazardous substances that may be discharged into the environment during the manufacture of materials used in the textile and footwear industry. That is hazardous substances, which could be used deep within the value chain and not just those substances that could be present in finished goods. Discharge of wastewater or air emissions containing hazardous substances could have a significant impact on the environment.

Background

In January 2018 ZDHC commissioned an expert report on the production of Man-Made Cellulosic Fibres (MMCF). The report concluded that due to technical limitations, the inclusion to the ZDHC MRSL of the chemical substance Carbon disulphide (CS_2) (used as a solvent for the production of Viscose and Modal) was not feasible - because a restriction of this chemical would halt the Viscose and Modal production processes. The conclusion was that the ZDHC Roadmap to Zero Programme could have substantial impact by collaboratively setting guidance around good chemical management. Alongside setting guidance limits for wastewater, sludge, air emissions and chemical recovery during fibre production while calling for continued further research into processes for the production of MMCF, using alternative and less hazardous substances.

Objective

ZDHC MMCF Guidelines

During the last years MMCF has become an increasingly important fibre category, incentivised by the growing number of brands committed to the use of preferred fibres[a]. With its production volume doubled in past decades it is expected to continue its market growth due to MMCF's sustainable potential. For this reason, ZDHC decided to address its production process by collaboratively creating an aligned approach for manufacturing facilities to generate cleaner outputs from production while including a circular approach to its process.

The ZDHC MMCF Guidelines is a set of guidelines that addresses integrated expectations for discharge wastewater quality, emissions to air, and chemical recovery for manufacturing facilities producing Man-Made Cellulosic Fibres.
The complete set includes:

- **ZDHC MMCF Responsible Fibre Production Guidelines**
- ZDHC MMCF Interim Wastewater Guidelines
- ZDHC MMCF Interim Air Emissions Guidelines

The ZDHC MMCF Guidelines should be implemented as one, as the outputs from the production process of fibres cannot be seen as separate. These three documents provide guidance for an aligned industry approach. With this set of documents, ZDHC appeals to its members and the entire industry to improve the quality of discharged industrial wastewater and production-related emissions to air. With this, ZDHC expects also to support the transition of the production of MMCF towards a circular approach, by proposing recovery rates for substances such as Sulphur compounds.

ZDHC aims to catalyse a roadmap to define milestones for fibre manufacturing facilities to advance towards the production described in EU BAT BREF Reference Document on Best Available Techniques for the Production of Polymers (EU BAT BREF POL). Aiming to achieve integrated prevention and control of pollution arising from the production, leading to a high level of environmental protection[i] (EUROPEAN COMMISSION - IPPC Bureau 2007).

[a] Textile exchange – Preferred Fibre & Materials.

The scope expansion plan of this document includes the outputs proceeding from the dissolving pulp[a] for MMCF fibres, and other fibres including but not limited to:

- Viscose Filament Yarn[a]
- Modal Filament Yarn[a]
- Lyocell[a]
- Cupro
- Acetate
- Triacetate
- Fibres based on next generation feedstock

In this document a three-level approach is proposed:

- As manufacturing facilities are not identical in terms of capabilities, knowledge, strategic priorities or resources, this document provides a three-level (foundational, progressive, aspirational) approach for the limit values and/or recovery rates of the proposed parameters.
- Manufacturing facilities shall proactively develop and manage a data-driven, continuous improvement plan to reach the next level. To create this continuous improvement plan, ZDHC MMCF Implementation Guidelines should be observed.

Levels defined:

- **Foundational**: First level to be achieved by manufacturing facilities at minimum.
- **Progressive**[b]: AAn intermediate level to be achieved by manufacturing facilities through the application of technologies such as, but not limited to, those mentioned in the Reference Document: EU-BAT BREF Reference Document on Best Available Techniques in the Production of Polymers, (EU BAT BREF POL) corresponding to the viscose production processes.
- **Aspirational**: To become best in class, manufacturing facilities shall achieve the third level, through the application of technologies such as, but not limited to, those mentioned in the Reference Document: EU-BAT BREF Reference Document on Best Available Techniques in the Production of Polymers (EU BAT BREF POL) applicable to viscose and beyond. This achievement sits alongside the supplier further enhancing their chemical management.

To learn more about the continuous improvement roadmap, see ZDHC MMCF Guidelines Implementation Plan.

[a] The work in order to add these fibres/process to the scope of this document will start in June 2020, and the publication date is yet to be defined,

[b] Approximately 43% of the global production market have active commitments of reaching this level by 2023-2025.

ZDHC MMCF Responsible Fibre Production Guidelines

The objective of this guideline is to address the expectations for process chemical recovery rates, as well as provide additional recommendations for best practices in production of Man-Made Cellulosic Fibres.

1. Scope

The feedstock in-scope for the production of the below mentioned fibres includes but is not limited to, wood and bamboo.

The fibres within the scope of this document are:

- Viscose Staple Fibres
- Modal Staple Fibres

2. Best practices for fibre feedstock

The selection of the feedstock for the production of MMCF can have great impact on the environment. The increasing growth of the market share of these fibres, shows a need to establish clear policies related to raw material input. The following sub-sections are some recommended best practices that should be implemented by your organisation.

2.1. Raw material sourcing

a. Your organisation should have a responsible raw material policy defining the sourcing of wood, pulp, and/or pulp fibre; eliminating the sourcing from ancient and endangered forests, endangered species habitats and controversial sources. To support this policy, your organisation should:
   i. Take part in the CanopyStyle verification audits in order to assess the sourcing of raw materials.
   ii. Complete verification audits in order to assess the sourcing of raw materials.
   iii. Can include a requirement for the raw materials to be certified by sustainable forestry standard. Certification bodies that examine each individual forest are preferred.

b. In order to ensure transparency throughout the value chain, your organisation should have a proper chain of custody system, which includes but is not limited to blockchain-based traceability or use of Unique Trace.

2.2. Circularity and recycled feedstock

In order to reduce the environmental impact of the MMCF production it is imperative to incentivise new developments that lead to the creation of a product fitted for purpose within a circular economy.

For this reason, Brands and Manufacturing facilities should work to reduce the input of virgin raw materials by increasing the amount of alternative fibre feedstock, included but not limited to pre and post-consumer fibre waste and agricultural waste.

a. Your organisation should have a sourcing strategy that includes commitments to increase the percentage of raw material originated from next generation[a] feedstock, with clearly defined feedstock, targets and timelines for adopting materials originated, from next generation feedstock.

[a] ZDHC refers to Next Generation feedstock as the one originated from alternative and recycled feedstock.

3. Responsible production of viscose and modal staple fibres

Another aspect to consider when planning to move to a circular economy approach, is the recovery of chemicals used or produced as a by-product during the fibre production process.

Manufacturing facilities should strive for continuous improvement in the management of hazardous substances within their value chain. For this reason, the policies around the production of these fibres should include alternative non-virgin feedstock sources and also address the recovery of chemicals and by-products related to the MMCF production process.

3.1. Chemical Recovery

During the production process of Viscose and Modal (staple fibres), Sulphur compounds from the spin bath and Sodium Sulphate as by product should be recovered and either returned to on-site production processes or sold as by-product. In order for these substances (Sulphur and Sodium Sulphate) to reach the recovery percentage in this document, control technologies and recovery treatments should be applied.

3.1.1. Sulphur recovery

Treatments methods and control technologies

The Sulphur recovery treatment methods mainly include:

- CS_2 recovery from Spinning off-gases by Condensation Route.
- CS_2 recovery by activated carbon adsorption from exhaust gases of spinning & spin bath, coupled with either of following upstream process to remove H_2S:
  a) Recovery as Sulphur by Catalytic Redox Process.
  b) Recovery as $NaHS+Na_2S$ produced by caustic scrubbing.
- Conversion of both CS_2 & H_2S to Sulphuric Acid by a catalytic process.

There are various Sulfur recovery technologies available within the viscose and modal production. The control technology applied at the point of fibre production depends on many conditions, including:

- Year of establishment of the plant and the technology used
- National regulations
- Best Available Technologies

Recovery rates

Correlation of Sulphur release to Air and the corresponding Sulphur recovery rates in percentage of CS_2 charged in feed.

Table 1 - Sulphur recovery rates

ZDHC levels	Sulphur to Air[a] (Kg/Tonne Fibre)	Corresponding Sulphur recovery in % of CS_2 added in the process
Foundational	35	85%
Progressive	20	92%
Aspirational	12	95%[b]

3.1.2. Sulphate recovery

This document recognises there are several technologies available for the recovery of Sulphate during the MMCF production process. It is important to clarify that while this document focuses on the recovery of Sodium Sulphate salt, there are other recovery technologies available. It is the intention of ZDHC to review technologies available in the market and add to the revisions of this document.

[a] Limits from ZDHC MMCF Air Emissions Guidelines

[b] Conversion is based on the ZDHC MMCF Air emissions guidelines Sulphur to air parameter combined with the industrial average of carbon disulfide consumption addition of 280 kg/tonne of fibre.

For those manufacturing facilities recovering Sulphate using any other recovery technologies, the following recovery rates should apply:

ZDHC levels	Unit	Sulphate recovery
Foundational	%	50
Progressive		60
Aspirational		70

3.1.2.1. Sodium Sulphate recovery rates[a]

Table 2 - Sodium Sulphate recovery rates

	Sodium Sulphate recovery - Kg of salt per Tonne of Fibre produced
Foundational	500
Progressive	600
Aspirational	700

Calculation of Sodium Sulphate Recovery

Table 3 - Calculation of Sodium Sulphate recovery in Kg of salt per tonne of fibre

$$\text{Sodium Sulphate kg of salt recovery} = \frac{\text{Quantity of sodium sulphate produced as by-product (Tonne)}}{\text{Fibre Production (Tonne)}}$$

[a] A higher rate of recovery might be theoretically achievable for this substance. The decision of setting the aspirational limit on 700 kg of salt per tonne of fibre as recovery rate (equivalent to 70% recovery) resides in the fact that a higher recovery process will require increased input of energy and steam, and this will lead to increased GHG emissions creating additional environmental pollution.

3.1.3 Recovery technologies within Viscose and Modal production

The below is a non-extensive list of available technologies, containing those specified in the Best Available Techniques for Polymer production applicable to viscose. (EUROPEAN COMMISSION - IPPC Bureau 2007). The following should be taken into consideration to increase recovery rates:

1. Operate spinning frames in houses.
2. Condense the exhaust air from spinning streets to recover CS_2 and recycle it back into the process.
3. Recover CS_2 from exhaust air streams through adsorption on activated carbon.
4. Applying exhaust air desulphurisation processes based on catalytic oxidation with Sulphuric Acid (H_2SO_4) production.
5. Reduce Zn from the wastewater by alkaline precipitation followed by Sulphide precipitation.
6. Recover sulphate from spinning baths

In addition to the above listed, there are several other technologies that have been applied in Viscose processes in recent years to improve its natural resource efficiency.

3.2. Best practices for resources consumption

3.2.1 Normalised consumption

The below listed parameters are defined as the amount of the raw material or natural resource input required to produce one tonne of fibre, being the raw material average input for Viscose and Modal fibre production process. To understand more about the production process, it is important to have a complete overview of the raw material average input consumption. To share this information, manufacturing facilities should calculate the consumptions on an annual base average of fibre production per site. The minimum average accepted is not less than one month.

Table 4 - Recommended consumption for Viscose and Modal (Staple fibre) per tonne of fibre[a]

Parameter	Unit	Recommended consumption for Viscose and Modal[23] - Staple Fibre
CS_2	Kg/ per tonne of fibre	80 - 100
Caustic		0.45 - 0.6
H_2SO_4	t/ per tonne of fibre	0.65 - 1.03
Zn	Kg/ per tonne of fibre	2 - 10
Pulp	t/ per tonne of fibre	1.010 - 1.065
Spin finish	Kg/ per tonne of fibre	3 - 5.3
NaOCl		0 - 70

3.3. Wastewater environmental impact

3.3.1 Wastewater parameters – Load per tonne of fibre

To understand the environmental impact of the discharged wastewater coming from a fibre manufacturing facility that produces viscose or modal staple fibres, it is necessary to provide context to the concentration testing required in the ZDHC MMCF Wastewater Guidelines. This requires measuring the amount of water involved in the fibre production process and determining the load per tonne of fibre, by linking the pollutant concentration with the water volume used in the fibre manufacturing. The calculation of the parameters listed in Table 5 shall be done using the monthly average of water flow from the fibre production process. The concentration used for this calculation shall be taken from the ZDHC MMCF Wastewater Guidelines reporting. The month that shall be selected to create the average water flow, shall be the same as the sampling of the reporting parameter.

[a] The applicability of this table for Modal staple fibre production shall be only for sites with mixed production of Viscose and Modal fibres. This table does not apply to facilities with production of Modal without Viscose production. And while ZDHC recognises the importance of Energy and Water consumption during the production process, the inclusion of these parameters in this document, will require further data collection and analysis.

Table 5 - Example of a full reporting year of a manufacturing facility

Reporting cycle	Parameter	Sampling month for reporting ZDHC MMCF Guidelines	Test report	Water Flow volume – month average	Load per tonne of fibre
1 - 2020	COD - Sea	January 2020	150 mg/L	January= 60m^3	9000
2 - 2020	COD - Sea	June 2020	150 mg/L	June= 60m^3	9000

Table 6 - Wastewater Parameters to be reported in Load per tonne of fibre

Wastewater Parameters –				
	Unit	Limit values		
		Foundational	Progressive	Aspirational
COD – to sea	Load[a]/tonne of fibre	9000	6000	3600
COD - to other bodies of water		7200	6000	3600
BOD - 5 day		1800	900	300
Zn		150	60	18

Table 7 - Calculation of Parameters to be reported in Load per tonne of fibre

Parameter load (**A**)	=	Concentration (**B**)	x	Water flow (**C**)
A= any of the parameters from Table 5		**B**= Concentration from wastewater testing. The test result used shall be the one from the testing of the parameters listed ZDHC MMCF Wastewater Guidelines.		**C**= Monthly average water flow. Calculated from the month when the sampling for the wastewater test-ing of the concentration parameter was collected.

[a] Load calculated on a 60m^3 water flow average.

To support the reporting of this document, facilities should provide the following information:

- Fiber production of the time period to calculate.
- Wastewater third party lab test results of the required parameters for the corresponding testing cycle.
- Wastewater flow of the month of the sampling conducted for the testing of the above-mentioned parameters.
- By-products produced, including but not limited to sodium sulphate, H_2SO_4, Barium sulphate, etc.

Relevant Organisations and Contributions

- Canopy click here
- Bluesign System click here
- The European IPPC Bureau (EU-BAT BREF Reference Document on Best Available Techniques in the Production of Polymers August 2007) click here
- The Collaboration for Sustainable Development of Viscose (CV) click here
- EU Eco Label click here
- World Health Organization – Making Water a Part of Economic Development click here
- ZDHC Roadmap to Zero Programme click here

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End Notes

i EUROPEAN COMMISSION - Reference Document on Best Available Techniques in the Production of Polymers August 2007