Sustainability of Viscose Fibers

1. Introduction

The requirements placed on our products are no longer restricted to the classic product properties, but also to the social impact. The focus here is on sustainable and ecologically efficient actions. These include topics such as circular economy, resource-usage efficiency, climate-friendly energy management and the protection of the oceans against the entry of plastic and microplastics. There are existing no patent-solutions for this, but the use of viscose fibers offers very good solutions to the social problems as just described.

2. From tree to fibre – wood, a sustainable raw material

Viscose fibres consist of cellulose, the most abundant biopolymer in nature. Cellulose is the main component of many plants and is contained in wood with a proportion of about 50 %. More than 100 years ago, a process was developed to extract the cellulose stored in wood and form it into a fine fibre: the viscose process.
To this effect, the cellulose used in the form of pulp is dissolved to form a honey-like, highly viscous liquid, which also gives the viscose process its name. This liquid is spun into a bath by means of a jet, whereby the dissolved cellulose regenerates into a fibre. During this process, the shape, thickness and length of the fibre can be changed and an additive, e. g. a color pigment, can be embedded.

3. Process

Kelheim Fibres produces 100 % in Germany and is therefore obliged to comply with the strictest environmental regulations and emission limits. For achieving these ambitious goals, about 60 million euros have been invested in environmental protection since 2005. These investments not only minimize the impact on the environment, but also enhance the efficiency of the processes, meaning that production in Germany remains competitive despite strong competition from Asia.

Implementing a closed-loop philosophy means saving ressources, minimizing waste and emissions and operating plants in an energy-efficient way. This is guaranteed by operation of modern, technologically highly advanced recovery and recycling plants.

- Exhaust streams containing carbon disulphide in high concentrations are fed to an activated carbon adsorption plant or to direct condensation for recovery.
- Exhaust streams containing high concentrations of hydrogen and carbon sulphide are sent to the sulfuric acid plant for combustion to produce sulphuric acid and high pressure steam for power generation. This climate neutral process also contributes to reducing CO_2 emissions.
- Waste is professionally disposed of in our own incineration plant and used to generate steam and electrical power. In this way, natural gas can be saved which further reduces CO_2 emissions from fossil energy sources.
- Hot waste-water and exhaust air flows are passed through heat exchangers in order to recover the heat.

4. Evidence for sustainability

4.1 Initial remarks

The question is, how can sustainability be demonstrated in general?

There are some indicators:

- Properties of viscose fibers
  - Biodegradability both on terrestrial and marine area
- Responsible care
  - Circular economy
  - Recovery plants
  - Wood management
- Impact on environment - BREF
  - Abatement-technologies
  - Specific emissions for the key parameter sulphur
  - Specific emissions of key parameter COD
- Energy
  - High-efficiency in energy production
  - Efficiency of energy consumption
- Process improvement:
  - Waste development
  - Water consumption
- Robust Sustainability reporting
  - Implementation of EMAS
  - Sustainability report
  - Greenhouse gas-emission reduction

4.2 Properties of Viscose fibers

Viscose fibers produced by Kelheim Fibres are fully biodegradable in water soil and compost.

A large number of fibers, including Galaxy, are currently undergoing further tests for this purpose. Galaxy fibers are also tested here according to recognized OECD and ISO tests for biodegradability and compared to cotton, cellulose and acetate fibers.

In detail tests will be performed according to following methods:

- Ready Biodegradability (OECD TG 301 B)
- Biodegradable according to ISO 14851,
- Compostable according to DIN EN 13432

As soon as these extensive and so far unique tests have been carried out, we will inform you of these results.

4.3 Responsible Care

Sustainable action is our top priority. The circular economy plays an equally important role as the operation of recovery plants.

Implementing a closed-loop philosophy means saving resources, minimizing waste and emissions and operating plants in an energy-efficient way. This is guaranteed by operation of modern, technologically highly advanced recovery and recycling plants.

Examples of closed-loops in Kelheim:

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Exploitation of wood

The wood used for viscose production in Kelheim comes exclusively from certified, sustainably managed forests. Two types of wood are used: Plantation wood, in which the trees are reforested after harvesting, and waste wood from natural forests, which is no longer suitable for other uses, e. g. in the furniture industry. Through the exclusive use of wood with FSC® and PEFC™ certification, we ensure that the wood has not been obtained illegally or in violation of protection regulations for humans and nature. By joining the Canopy Initiative, Kelheim Fibres has committed itself to the protection of primeval forests and threatened forest areas. This commitment is also reflected in our specially published policy on pulp purchasing.

4.4 Impact on environment

Abatement technologies

We have abatement technologies for the waste gas and waste water system.

Waste gas

Use and handling of sulfur containing substances play a crucial role for production. Therefor the amount of sulfur emissions is an important criterion for assessing a sustainable viscose production. With it's closed-loop process by using recovery plants and purification technology, Kelheim Fibres is able to reach uniquely low specific sulfur emissions. This allows Kelheim Fibres to even comply with the low and and far more strict than state-of-the-art limits of the WHO for neighborhood relevant sulfur-immissions.

Kelheim Fibres has world-wide the best sulphur-emissions and sulfur-immissions.

Waste water

Kelheim Fibres was the first company in the world to invest in state-of-the-art BIOHOCH® reactors for wastewater treatment. At over 95 %, these reactors have a significantly higher degree of purification than previous processes. Their purification capacity corresponds to that of a sewage treatment plant for a city with 160,000 inhabitants. A close internal and external monitoring network guarantees constant compliance with legal limits.

4.5 Energy

Energy supply

Kelheim Fibres operates a modern gas-fired power plant that generates 50 % less CO_2 emissions than coal-fired power plants. Due to it's combined heat and power generation the power plant belongs to the class of high efficiency plants. With a total efficiency of over 80 %, the CO_2 emissions are 25 % lower compared to conventional power plants.

Energy consumption

Kelheim Fibres has implemented ISO 50001. Within this programme the factor for energy consumption is constantly decreased. There are regular meetings (at least one in every quarter) to observe, discuss and set new projects to reduce energy consumption. To obtain a low level of energy consumption a cooperation with other companies is made. This leads to a better balance in electricity and steam need, so the efficiency of our power plant is increased. Based on the forecast a goal for electricity and steam efficiency is set annually.

4.6 Robust sustainability reporting

Implementation of EMAS
We are going to implement the EU Eco-Management and Audit Scheme (EMAS) in 2020. EMAS is environment management system that includes all demands of ISO 14001, but requests the fulfillment of environmental aspects on a higher level. Part of EMAS is to publish a verified environmental report. This report must be updated every year with currently and verified data so that every interested person can observe the progress in environmental improvement.

Sustainability report
In addition to the EMAS environmental report, we are on the way to publish our first sustainability report in early 2021. This is a further step in our strategy to be one of the most sustainable viscose fibers producer.

4.7 Greenhouse Gas Emission Reduction

We produce all of our power in a combined heat and power plant. The greenhouse gas emissions from this plant is observed and verified by the European Emission Trading System. With this verified data we have an carbon footprint of 1.5 t $CO_{2,eq}$ per ton of our viscose fibres. This includes the production of chemicals like CS_2 and H_2SO_4 for usage in our production process. To further improve our carbon footprint we are are going to create a greenhouse gas balance for all of our scope 1, 2, 3 emissions until December 2020.

5. Data overview

Aspect	Unit	Polymer-BREF	Data KF
Consumptions per tonne of product			
Energy	[GJ]	20 – 30	✓
Process water	[m^3]	35 – 70	✓
Pulp	[t]	1.035 – 1.065	✓
Carbon Disulphide	[kg]	80 – 100	✓
Sodium Hydroxide	[t]	0.45 – 0.6	✓
Zinc	[kg]	2 – 5	✓
Spin Finish	[kg]	3 – 5	✓
Sulphuric Acid	[t]	0.6 – 1	✓
Emissions per tonne of product			
Sulphur to air	[kg]	12 – 20	✓
CO_2 to air	[t]	1.7 – 1.8	✓
Zinc to water	[kg]	0.15 – 0.17	✓
AOX to water	[g]	5	✓
COD to water	[kg]	5 – 6	✓