Technical note
non-chemically modified cellulose fibres

1. Context

The proposed Directive on the Reduction of the impact of certain plastic products on the environment proposes the following definition of plastic: "'plastic' means a material consisting of a polymer within the meaning of Article 3(5) of Regulation (EC) No 1907/2006, to which additives or other substances may have been added, and which can function as a main structural component of final products, with the exception of natural polymers that have not been chemically modified."

Article 3(40) of Regulation (EC) No 1907/2006 of the European Parliament and of the council of 18 December 2006 states: "Not chemically modified substance: means a substance whose chemical structure remains unchanged, even if it has undergone a chemical process or treatment, or a physical mineralogical transformation, for instance to remove impurities".

2. Regenerated cellulose fibres have the same molecular structure as cellulose and are not chemically modified

All plants contain cellulose as a major structural polymer. Especially in wood, cellulose is the main constituent together with lignin. Cellulose fibres can also be produced by an industrial process, by extraction of the cellulose from plant material, dissolution and regeneration. The most important raw material used is wood, therefore these fibre types are also summarized as wood-based fibres. They are termed viscose, modal, and lyocell according the generic fibre names by BISFA[1] (BISFA, 2018). The cellulose in natural fibres (cotton and bast fibres) and regenerated cellulose fibres (viscose, lyocell…) is the same natural polymer and completely identical.

The production process starts from the renewable raw material wood. In the first step, pulp is produced in a process very similar to paper pulp making. Following, this pulp is dissolved either by a non-isolated intermediate (viscose) or by direct physical dissolution (lyocell). Viscose and lyocell fibres are pure cellulose without any chemical modification. Viscose and lyocell have the same molecular structure as the natural cellulose. It is known that cellulose in both natural and regenerated cellulose fibres is biodegradable by the same enzyme systems of microorganisms[2].

3. *Not chemically modified* should be interpreted in an appropriate manner

In a draft guideline on scope and definitions[3] of the single-use plastics directive, three interpretation options are proposed for the notion of *not chemically modified natural polymers*. EDANA provides scientific evidence why only the third interpretation option is valid.

Part B, 3.3.2. of the draft guideline: With regard to "natural polymers", it is important to consider the fact that the extraction processes used often result in modifications of the polymers compared to their original state in nature. However, this indirectly also implies that there are not perfect references, which could potentially be employed when chemical similarities are considered.

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[1] BISFA (2018) generic fibre names, www.bisfa.org

[2] T. Bechtold and C. Schimper (2010) Hydrolysis of regenerated cellulose fibres for textile and other applications. Advances in textile biotechnology, 312 pp.

[3] Identifying and describing the products covered by the SUP Directive parts A, B, D; March 31st 2020

In conclusion, the term "not been chemically modified" (SUP Directive, Article 3(1)), can with regard to natural polymers, be interpreted in different ways, including, at least, the following:

Options for interpretation of *"not chemically modified"* Cases: viscose and lyocell	**Accepted by industry and scientists**	**Why?**
1) A strict interpretation where no modification is allowed even during the extraction process.	No	**The final product viscose and lyocell cellulosic fibers as well as plant cell wall cellulose follow the same structural formula, namely $[C_6H_{10}O_5]_n$.** If EU Commission were to follow this option, any natural polymer would fall under the definition of plastic within the SUP Directive. Any single use paper material (such as newsprint, paper board, or toilet paper) would be considered a single use plastic product. Starch isolated from grain and baked to bread with grain proteins would also be classified as a plastic, just like any "processed" (i.e. cooked) meat. Furthermore, cotton fibers and processed cotton, used in any single use product (e.g. mercerized or bleached cotton) would fall under the directive. Many more examples can be given.
2) An interpretation that refers to a process in which no intentional change occurs in any stage of the manufacturing process. The changes which occur due to the extraction process are not considered as intentional changes and therefore not to affect the status of the extracted substance as a 'natural polymer'.	No	The key question is what is *intentional change* in the manufacturing process? The interpretation of term "intentional change" can lead to ambiguity. The production process of pulp, paper, as well as regenerated cellulose fibres viscose and lyocell starts from the renewable raw material wood. The intention of these processes are to purify and convert raw cellulose in a more usable form. In the first step, wood-pulp is produced from wood in a process very similar to paper pulp making. The biopolymer cellulose in general is insoluble in almost all organic and inorganic solvents and does not melt. In order to produce a textile fibre from wood-pulp, it needs to be dissolved before it can be spun it into fibres. In viscose process, viscose fibers are produced through chemical process via a non-isolated intermediate step "xanthogenation". The resulting viscose fiber is consisting of >99.9% pure cellulose with the same structural formula as cellulose in the nature, namely $[C_6H_{10}O_5]_n$ .There is no intentional change of the cellulose structure in manufacturing process of viscose. Lyocell process does not use a chemical process at all. The process of dissolution is a physical process and does not cause any chemical change in the cellulose polymer during the manufacturing process. Lyocell fibers are pure cellulose without any chemical modification. Lyocell cellulose fibers have with the same structural formula as cellulose in nature, namely $[C_6H_{10}O_5]_n$. There is no intentional change of the cellulose chemical structure in manufacturing process of viscose and lyocell. This is also the case with for example manufacturing paper and mercerized cotton.
3) An interpretation that refers to the end stage of the manufacturing process. The changes occurring during the manufacturing process are not considered relevant, the end product of the manufacturing should be considered	Yes	If temporary changes do occur during the manufacturing process of products made of natural polymers (e.g. intermediate as non-isolated derivatization of cellulose in viscose process), the chemical structure in the final product the natural polymer should be reverted to the original state. Since the endpoint of the product is an essential criteria for the environment, both lyocell and viscose meet the definition of natural polymer that have "not been chemically modified", since they have the same molecular structure as natural cellulose in wood and cotton and are biodegradable in compost, soil, fresh water and marine water within

when determining the status of the polymer.		a short period of time (approx.10 weeks) according to the accepted OECD or ISO-standards groups 1-4 in ECHA proposal ANNEX XV Restriction for intentionally added microplastics.