The challenging conversion of natural elementary fibrils into Man-Made Cellulosic Fibres

Abstract

Basic building block of plant cellulose is the elementary fibril with a highly oriented, highly crystalline fringed fibrillar structure, exhibiting excellent mechanical properties. It's produced by a fascinating biosynthetic process and apparatus developed by natural evolution over millions of years. The targeted structure of a Man-Made Cellulosic Fibre (MMCF) is basically similar.

This is true with all the novel spinning processes currently aiming at industrial breakthrough; the carbamate process; the ionic liquid -based process; the process based on direct dissolution of cellulose in cold lye – and even when a suspension – rather that a solution – of microfibrillated cellulose is used as the spinning dope. It's also true with the current industrial manufacturing processes; the prevailing, old viscose process and the NMMO-Lyocell process with a rapidly growing market share.

If the fundaments of strong MMCF products are already available in the natural starting material, why is it so challenging to efficiently convert cellulose pulp into high-quality MMCFs? And why so many different novel routes are explored to bring about a seemingly minor rearrangement?

What happens to cellulose – the pulp, the fibril and the polymer – in certain key steps of various MMCF processes is an exciting story, all molecular level details of which are still not completely understood. Nevertheless, the behavior of cellulose in all MMCF manufacturing processes is much more dictated by structural and morphological characteristics of pulp fibres and the micro- or nanoscale fibrils of a plant cell than, e.g., by the reactivity of isolated cellulose polymer molecules.

The presentation aims at providing a brief insight to certain key mechanisms and factors, which need to be controlled in order to develop and operate a MMCF manufacturing process.

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