Preparing Biocelsol textile fibres and yarn in pilot scale

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Abstract

The overall objective of the tExtended project is to develop a knowledge-based Blueprint, i.e. a master plan for a sustainable textile ecosystem. The Blueprint was implemented as a real-scale demonstrator to verify its replicability and assess its potential to reduce textile waste by 80%.
As one of the demonstrators, cotton textiles were chemically recycled at VTT using VTT's Biocelsol technology. The cotton was enzymatically treated to activate the cellulose for dissolution and to adjust the intrinsic viscosity of the cotton fibres to an optimal level for dissolution. The activated cotton was dissolved in cold alkali. Some traces of undissolved polyester fibres, probably from sewing yarn, were separated from dissolved cotton by filtration. The dissolved part was further filtrated in a multistep process to obtain a fine cellulose solution (Biocelsol dope) suitable for fibre spinning.
The Biocelsol dope was wet spun at pilot scale into an acidic regeneration bath. Dope was pushed through 27 spinnerets each having 2000 holes of 50 μm. Targeted linear density was 1.3 dtex and cut length 38 mm. Fibres were washed and finished in line with a commercial cationic fabric softener (MiniRisk). The resulting Biocelsol fibres had a tenacity of 1.2 cN/dtex and an elongation of 17%. The regenerated Biocelsol fibres were successfully spun into a Ne 24/1 yarn containing 67% Biocelsol fibre and 33% virgin cotton. The produced yarn exhibited a tenacity of 7.8 cN/tex, demonstrating the feasibility of incorporating regenerated fibres into conventional spinning processes. Moreover, the mechanical properties of the yarn were assessed regarding mass irregularities and surface characteristics. The yarn presented 52 $\pm$ 28.4 thin places, 877 $\pm$ 11.6 thick places, and 179 $\pm$ 11.6 neps per 1000 m, together with a hairiness index of 6.8 $\pm$ 1.6. These results indicate that, while the yarn can be successfully produced, further optimisation of fibre production and spinning parameters are required to improve yarn evenness and overall quality.

Keywords: cotton textiles, recyclable textiles, regenerated cellulose fibres, Biocelsol

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