Bio-based Coated Yarns: Turning Waste into High-Value Sustainable Textile

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be@t bioeconomy at textiles

INTRO_

The textile industry is increasingly prioritizing sustainability through the adoption of environmentally responsible manufacturing processes and the integration of bio-based materials to replace fossil-derived resources. Although textile coating is recognized as a sustainable finishing technology, most commercial formulations remain predominantly fossil-derived.

ABSTRACT_

Development of an innovative bio-based coated yarn with water-based formulations incorporating industrial by-products and bio-based pigments as functional and coloring components.

CITEVE developed the process at laboratory scale, and CORK-A-TEX, the only company worldwide producing cotton yarns coated with industrial by-products or bio-based pigments, validated it industrially.

The process involves micronization of by-products, optimization of particle size, engineering and re-engineering of bio-based coating formulations, and continuous yarn coating.

The be@t project, is an initiative from the Portuguese government to improve the sustainability of the textile value chain.

PROCESS_

MILLING & SIEVING OF BY-PRODUCTS → BIO-BASED COATING FORMULATIONS WITH THE RAW MATERIALS → DIP-COATING → DRYING & THERMOFIXATION → JACQUARD FABRIC

RESULTS_

*Industrial by-products and bio-based pigments_*



Cork from residues generated in cork stopper production



Pine bark from agroforestry residues



Ashes from biomass boilers



100% wood-based carbon pigment



Pigment extracted from plant roots



Indigo pigment produced by microbial fermentation



Cork- and pine bark-based coatings were validated under industrial conditions, showing excellent performance and meeting the relevant industry requirements.



Lab-scale applications incorporating ash and bio-based pigments showed potential for industrial implementation. Both the carbon pigment and the ash achieved a washing fastness grade of 4–5 and a light fastness grade of 5. Rubbing fastness ranged from grade 4 to 4–5 for the carbon pigment and was grade 3–4 for the ash.

ACHIEVEMENTS_

- The cork-based coated yarn outperformed a conventional fossil-based paste-coated yarn in the LCA, with 16.4% lower GHG emissions (kg CO_2-eq/kg), 43.5% less fossil raw material and 88.2% higher water-use efficiency, while the pine bark-based yarn achieved 18.2% lower GHG emissions, 49.9% less fossil raw material, and 88% higher water-use efficiency.
- This work demonstrates a scalable bio-based coating technology that valorizes industrial residues and bio-based pigments, enabling high-performance coated yarns with a lower environmental impact and supporting the transition to circular, resource-efficient and sustainable textile manufacturing.

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