

## BioFibreLoop develops first functional Digital Twin for laser-based functionalisation

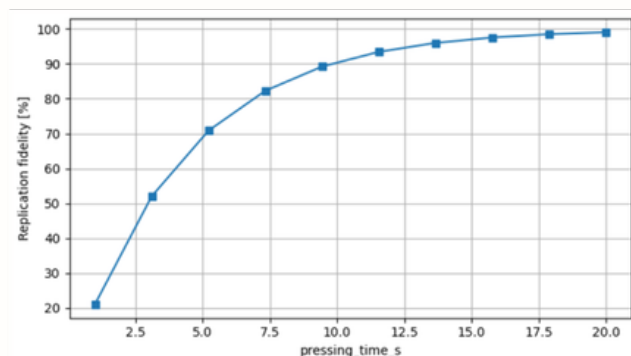
*The new virtual modelling framework supports the development and optimisation of bio-based, non-toxic functional textiles*

The BioFibreLoop project has completed the first functional version of its Digital Twin, marking an important milestone in the development of safer and more sustainable textile technologies.

The Digital Twin is a virtual modelling tool that focuses in its first version on the embossing process. Within this process, a metallic roller laser-engraved with the selected biomimetic structures stamps the structures via heat and pressure into the coating of the textile. Currently, the tool can simulate different embossing conditions (material properties, process properties such as temperature and pressure) and estimate how these conditions affect the final textile surface. For example, it can assess how well a desired surface pattern is replicated, how much contact time between roller and textile is needed, how much thermal and mechanical energy is required, and how the resulting surface may influence wetting behaviour.



a)



b)

a) Screenshot of Digital Twin interface for setting input parameters  
b) Results of simulations: Replication fidelity in dependence of contact time between textile and roller.  
Source: IDENER.AI / BioFibreLoop project

This allows project partners to better understand the relationship between material properties, process settings and the final performance of functionalised textiles. Since physical testing can be time-, material- and resource-intensive, the Digital Twin provides a way to explore different scenarios virtually and identify promising process conditions before further experimental validation. This can help reduce development time, limit the need for extensive trial-and-error testing, thereby making the development more sustainable.



*“With this first version of the Digital Twin, we have created a flexible digital framework that connects process conditions with surface performance. This gives the project a solid basis to move from experimental data towards optimisation, validation and future replication.”*

Francisco Daniel García Romero (IDENER.AI)

This is particularly relevant for BioFibreLoop's overall ambition: developing bio-based, recyclable and non-toxic functional textiles. The textile industry needs new approaches that reduce the use of harmful chemicals while maintaining high-performance properties. Digital tools such as the BioFibreLoop Digital Twin will support this transition by making process development more efficient, transparent and data-driven.

The development was led by IDENER.AI, with important technical input from DITF (Deutsche Institute für Textil - und Faserforschung Denkendorf), including experimental data from embossing trials and coating viscosity measurements. A-Nov (ALPhANOV) and NTT (Next Technology Tecnotessile) were also involved through technical discussions within the project.



*"The Digital Twin is able to simulate the embossing process under different operational conditions, then, it allows us to virtually test diverse scenarios and pinpoint the best production parameters without wasting time and resources on endless physical experiments. This is key to make the BFL process efficient and sustainable."*  
Victoria Caballero (IDENER.AI)

The final industrial Virtual Replication Tool will be based on the strong foundation of this first version. In the coming phase, the framework will be used for process optimisation with machine learning and AI-supported methods. It will also be validated with additional experimental and sensor-based data to improve its accuracy and compare model predictions with real process behaviour.

In the longer term, the Digital Twin will contribute to the development of a more user-friendly Virtual Replication Tool for future users and stakeholders in the textile industry.

With this first functional version, BioFibreLoop takes an important step towards the digitalisation of sustainable textile production. The Digital Twin can help to reduce development time and save costs and materials, support better decision-making and contribute to the future scale-up of innovative, safer and more circular textile technologies.

### Project facts

The BioFibreLoop project (GA number: 101130603) has a duration of 42 months (start: 01 June 2024), a participation of 13 partners and a total budget of 7 million euros (funded by the EU with 6.5 million euros). For further information, please visit the website (<https://biofibreloop.eu/>) and/or contact the project coordinator Thomas Fischer (e-mail: [thomas.fischer@ditf.de](mailto:thomas.fischer@ditf.de)), DITF.

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