

Project title: Biological transformation of textile recycling:
Enzymatic, selective degradation of used textiles
(EnzyDegTex)

Partner: RWTH Aachen University:
Institute of Applied Microbiology (iAMB)
Institute of Biotechnology (BIOTEC)
Institut für Textiltechnik (ITA)

Duration: 01/2022 –12/2024

Funding Agency: Federal Ministry of Education and Research
(BMBF), Competence Center Bio4MatPro

Univ.-Prof.
Prof. h.c. (Moscow State Univ.)
Dr.-Ing. Dipl.-Wirt. Ing.
Thomas Gries
Director

Ricarda Wissel
Researcher
Multifilament Technologies

Stefan Schonauer
Researcher
Chemical Technologies for Textile
and Fibre Innovations

Henning Löcken
Researcher
Fabric Production

Mission Statement

The development and extension of circular economies will play a central role in the future for the security of supply in the Rhenish Mining Area, Germany and Europe. Textile waste has a very high, so far almost completely untapped potential, as its disposal currently takes place in a linear and non-circular manner. In Germany alone, more than 1.5 million tonnes of post-consumer textile waste from private households are generated annually. With current recycling approaches, it is not possible to recycle widely used textiles, e.g. in the form of polyester-cotton blends, in a sustainable way. These textiles are usually processed via so-called "downcycling" into low-quality products, e.g. painting fleeces or insulation materials. Further recycling of these products does not take place due to the lack of recycling possibilities.

The aim of project "EnzyDegTex" is to develop enzymatic degradation and recycling processes for textiles and to provide raw materials from textile waste for the chemical, plastics and textile industries. Target raw materials are e.g. mono- and oligomers for the synthesis of melt- or solution-spinnable polymers, which are subsequently processed into yarns and textile products.

Ref.: RW
25.07.2022

	State of the art (e.g. apparel)	Project goal „EnzyDegTex“
Processing chain of non-reusable textiles	<p>~ 1.5 mio. t (Germany) ~ 4,7 mio. t (NW-Europe)</p> <p>Non-wearable fractions ~ 750 kt (Germany)</p> <p>Cleaning rags, insulation and filling material</p> <p>RDF power plants, waste incineration plants</p> <p>Linear!</p>	<p>~ 1.5 mio. t (Germany) ~ 4,7 mio. t (NW-Europe)</p> <p>Monomers and oligomers</p> <p>Target products for spinning processes (e.g. spin finishes, granulates)</p> <p>Yarns, fabrics and apparel</p> <p>Circular!</p>
Potential for the Rhenish Mining Area	<p>Process steps currently mainly located in Eastern Europe / Asia</p> <p>No additional jobs</p>	<p>Establishing of basic industries in the Rhenish Mining Area possible</p> <p><u>Stage 1:</u> Concept for the creation of approx. 1,000 jobs <u>Stage 2:</u> Exploitation chain (TRL 6-7) <u>Stage 3:</u> Industrial implementation</p>
Ecological potential		<p><u>No landfill</u></p> <ul style="list-style-type: none"> → No leachate → No CH₄ emissions → No macro- / microplastics <p><u>No incineration</u></p> <ul style="list-style-type: none"> → Less CO₂ emissions → No risk slags <p><u>Short transport routes</u></p> <ul style="list-style-type: none"> → Less CO₂ emissions → Raw materials in the region

Fig. 1: Mission statement of project „EnzyDegTex“

Approach

The use of enzymes makes selective degradation possible and thus the design of custom-fit recycling processes. In these recycling processes, textile constructions can also be separated and their original materials returned, which cannot be separated according to the current state of the art.

For the development of enzymatic degradation and recycling processes for textile waste, process chains with the following steps are being investigated:

- Selection and preparation of textile waste
- Development and implementation of the enzymatic degradation
- Enrichment of suitable degradation products
- Synthesis of chemical base materials and products
- Development and validation of suitable spinning processes
- Development of textile products

Acknowledgement

We would like to thank the German Federal Ministry of Education and Research for funding the research project as part of the Bio4MatPro competence centre.



Contact

Ricarda Wissel, M. Sc.

Tel.: +49/(0)241/80 49149

ricarda.wissel@ita.rwth-aachen.de

Stefan Schonauer, M. Sc.

Tel.: +49/(0)241/80 23400

stefan.schonauer@ita.rwth-aachen.de

Henning Löcken, M. Sc.

Tel.: +49/(0)241/80 24707

henning.loecken@ita.rwth-aachen.de

Institut für Textiltechnik

der RWTH Aachen University

Otto-Blumenthal-Str. 1

52074 Aachen

Tel.: +49/(0)241/80 23400

Fax: +49/(0)241 80 22422