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Mein Zeichen: MS
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Projekttitle: Product-driven process development for substrate-flexible, tailor-made PHA polymer-based textiles (PHAtex)

Partner: Technische Universität Berlin, Fachgebiet Bioverfahrens-technik
Institut für Textiltechnik der RWTH Aachen University
WarmX GmbH
PHP Fibers GmbH (assoziierter Partner)

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Mission Statement:

79 % of the world's plastic production ends up either in landfills or in the sea, where it causes enormous damage to the environment.[1] As a possible alternative, about 2.2 million tonnes of bioplastics are produced annually, but only about 0.9 million tonnes of these are actually biodegradable[2] (In 2017).

Biobased and biodegradable polyhydroxyalkanoates (PHAs) polymers are an environmentally friendly raw material for the plastics and textile industries. PHAs can be completely biodegraded to CO^2 and water, and possibly also methane, so that in the long term they will not leave behind any micro plastics after complete degradation.[3] Today, despite a large potential, the production volume is only about 74,000 t[3]. High costs for the suitable carbon source as well as for PHA processing slow down an expansion of PHA production. The potential of PHAs can therefore be realised either by using a low-cost carbon source or by establishing a lower-cost production process.

PHAtex focuses on the development of a complete green process chain for the production of novel, flexible and biodegradable textile filaments from PHA. The aim of the PHAtex project is to develop a PHA production process that could realise a market introduction of less than 2 €/kg.

Approach:

The TUB will influence the molar composition of the produced PHA based on the regionally available raw materials via the composition of the carbon source by developing flexible feeding strategies in parallel bioreactor systems. For even greater feedstock independence, the substrate spectrum of a PHA production strain will be extended by molecular strain engineering. Taking into account the feedback from the partners on melt-spin ability of PHA and PHA filament properties, tailor-made PHA compositions will be developed.

[1] https://news.nationalgeographic.com/2017/07/plastic-produced-recycling-waste-ocean-trash-debris-environment/, Zugriff 06.01.2021
[2] https://www.ifbb-hannover.de/files/IfBB/downloads/faltblaetter_broschueren/Biopolymers-Facts-Statistics_2017.pdf, Zugriff 29.07.2019
[3] (Abou-Zeid et al. 2001, Altaee et al. 2016, Avella et al. 2005, Jendrossek and Hendrick 2002, Guierrez-Wang et al. 2010, Mueller 2006, Wang et al. 2013, 2014

State of the art:

- Necessity of biobased and biodegradable polymer development because of the tremendous pollution of the environment.
- PHAs are one of the most sustainable biopolymers since they can be synthesized from renewable carbon sources and are fully biodegradable.
- Plant oils are a cost-efficient feedstock for the PHA production.
- The annual production of PHA is currently very low with 50 t (2017).

Initial situation:

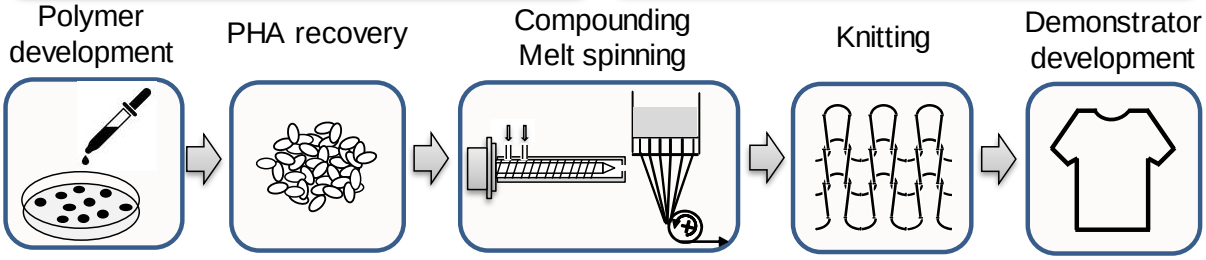
- technology for PHA production has so far been very substrate-dependent and inflexible.
- No previous research on filament extrusion

Deficits

- High production costs due to expensive and complex PHA recovery
- Low flexibility due to dependency on substrates
- No melt spinning process for PHA fibers from plant oil available

Approach

- Polymer development with regard to independence from substrates
- Optimization of the PHA recovery
- Polymer blending and fibre extrusion
- Processability testing in industrial knitting process
- Demonstrator development



Relevance:

- The EU-28 is the world's largest market for textile and clothing products with a household consumption of more than € 500 billion (2017). The annual turnover amounts to € 181 billion and the sector employs a total workforce of 1.7 million (2017). [4]
- The manmade fibre production is recorded to 64.8 million metric tons in 2016 with an increase of 6.75 % in comparison to 2015. [5]

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At ITA (with support from PHP Fibers), a melt spinning process for tailor-made PHAs will be developed. The properties of the filaments are optimised by process optimisation and modifications in the PHA polymer morphology (e.g. by blending with other biopolymers). The aim is to improve the filament properties to such an extent that the production of textile demonstrators in the knitting process at WAX becomes possible.

[4] http://euratex.eu/library/statistics/key-data/key-data-details/?tx_ttnews%5Btt_news%5D=5964&cHash=6dee9b9ed7e8c87de9e87c3afc6a6713 zuletzt zugegriffen am 20.07.2018

[5] https://www.statista.com/statistics/271651/global-production-of-the-chemical-fiber-industry/, zuletzt zugegriffen am 20.07.2018

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GEFÖRDERT VOM

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