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Single-filament coating as a platform technology for the development of multifunctional yarns

Research project 49MF250034 and 49MF250128

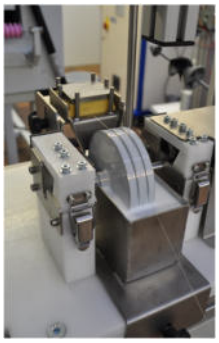


Figure 1: single-filament coating on pilot plant

Introduction

The targeted functionalization of textile yarns offers new possibilities for tailoring properties in a resource-efficient and an application-oriented manner. In contrast to established finishing processes for fabrics or the incorporation of functional additives into the spinning dope, coating individual filaments allows the application of active agents directly on the surface, as well as precise control over the functional components within textile structures. This leads to new degrees of freedom regarding to material development and offers the potential to reduce the consumption of both materials and chemicals.
The development aims for a reliable, robust process for coating individual filaments to create multifunctional yarn materials. Suitable coating systems are evaluated in terms of wetting behavior, film formation, adhesion, and durability on various types of filament materials; these are then qualified for subsequent textile manufacturing processes through the application of tailored protective layers. The developed technology is validated using two distinct functional applications.

Solution

<u>first application:</u> development of antimicrobial yarns based on AGXX technology via yarn coating

- Investigation of various coating formulations with adjustment of process parameters
- Application on yarn materials made of polyester and cotton
- Investigation of the influence of yarn structure, such as the number of filaments
- Investigation of moisture-affine binder systems
- Investigation of the antimicrobial effect of textile fabrics, comparing partial versus complete integration of the developed antimicrobial yarns into a woven textile structure
- First results, received from standardized tests in accordance to ISO 20645 an ISO 20743 performed by INNOVENT e.V., illustrated in figure 2 and 3

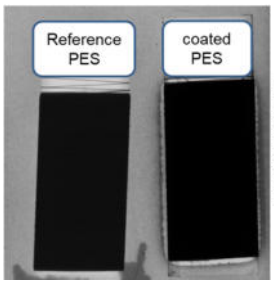


Figure 2: Antibacterial activity of coated PES fibres in agar diffusion test against *E.coli* embedded in agar plates after 24 h incubation at 37°C. Antibacterial activity indicated by inhibition zones (clear agar). Uncoated PES were used as a reference. PES = polyester yarn 110 dtexf36 [black/white image]

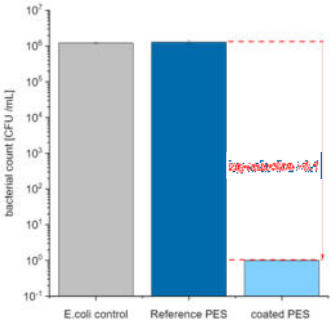


Figure 3: Antibacterial activity of the coated PES, expressed as log10 reduction, determined by counting colony-forming units (CFUs) per milliliter of *E.coli* on agar plates after 24h incubation at 37°C. Uncoated PES were used as a reference. Log10 reduction > 3 indicates strong antimicrobial activity. PES = polyester yarn 110 dtexf36

<u>second application:</u> development of light-reactive, multifunctional yarns within a single thread system

- combinable photochromic, phosphorescent, reflective, and fluorescent effects in one yarn, while also offering resistance to washing and UV exposure.
- Development of suitable coating systems with functional additives/particles
- Selection and adaptation of suitable yarn coating technologies
- Realization of protective layers
- Development of yarn structures like plied yarns to improve processing characteristics and enhance the multifunctionality of a single yarn construct



Figure 4: Multifunctional light-reactive yarn for innovative safety and design applications in clothing and accessories

Result, applications, outlook

The results demonstrate the potential of single-filament coating as a scalable platform technology for the production of multifunctional yarns. By specifically functionalizing individual filaments, various operating principles can be realized within a common process framework and integrated into textile structures tailored to specific applications. This approach thus contributes to the development of sustainable, resource-efficient, and highly functional textiles for areas including medical, safety-related, and technical applications.

Acknowlegements
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