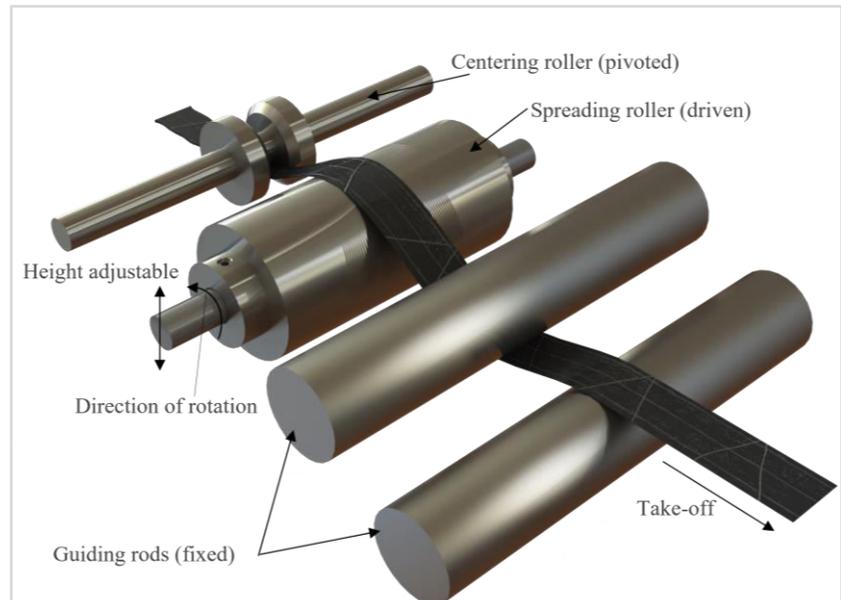


CHASE**Chemical Systems Engineering**

Programm: COMET – Competence Centers for Excellent Technologies

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Projekttyp: Exploitation of Data and Domain Knowledge, 10/23 – 09/27, strategic project



FORCED CONVEYING TO SPREADING FIBER ROVINGS USING A GROOVED ROLLER

A NOVEL METHOD FOR HOMOGENEOUS FIBER SPREADING

A crucial step in the production of unidirectional (UD) fiber-reinforced plastic tapes is fiber spreading. Fiber bundles (rovings), which consist of thousands of continuous individual filaments, usually twisted together in multiple layers, are spread and distributed into a homogeneous fiber carpet of defined width before being impregnated with a polymer melt in a downstream processing step. The quality of this process has a decisive impact on the properties of the final product.

Conventional spreading methods such as mechanical deflection, electrostatic, or pneumatic techniques, however, quickly reach their limits. Even minor fluctuations in the initial roving width, which may occur during production or winding, often lead to uneven spreading and thus reduced tape quality. In particular, the widely used deflection-based

spreading method is highly dependent on numerous process parameters and requires high fiber tensions. This not only increases the risk of fiber damage but also makes it difficult to maintain consistent spreading quality under industrial conditions, especially for wide rovings with a high filament count (>24K).

To overcome these limitations, an innovative method for the spreading of rovings by forced conveying using a grooved roller has been developed. The concept is based on a novel spreading roller featuring specially designed spiral grooves with intermediate relaxation zones. By guiding the filaments along precisely defined geometric paths, the fiber bundles are spread gently and effectively, using just a single roller. Key features of this method include:

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- (i) Use of a grooved roller with segmented spreading and relaxation zones.
- (ii) Adjustable wrap angle and circumferential speed for flexible process control.
- (iii) Significant reduction of fiber tension compared to mechanical methods based on deflection.

Experimental tests with carbon fibers on a laboratory test rig confirmed the robustness of the new spreading principle based on forced conveying compared to conventional spreading methods (Figure 1). Even with significant fluctuations in the initial roving width, homogeneous final widths were achieved. The relative standard deviation (RSD) decreased from 8.86 % at the inlet to 2.38 % at the outlet, demonstrating the improved process stability and uniformity. In addition, the forces acting on the fibers were reduced by more than one order of magnitude, minimizing filament breakage and improving material integrity. A quadratic regression model accurately described the spreading behavior, identifying the wrap angle as the most significant influencing factor.

The new spreading method offers a robust, cost-effective, and industrially applicable alternative to conventional spreading systems. It enables

homogeneous fiber spreading, largely independent of the input quality, simplifies process control, and reduces fiber loads.

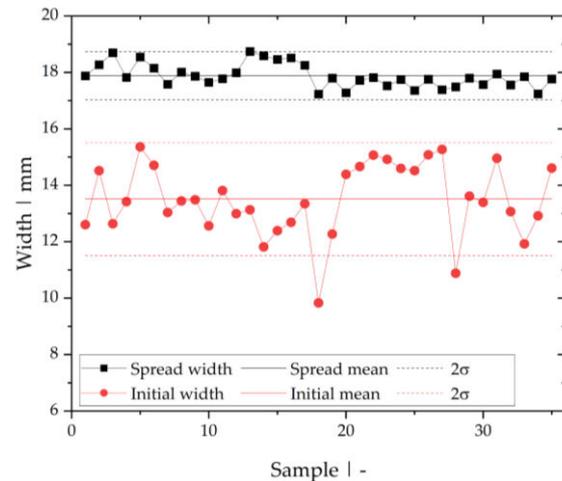


Figure 1: Comparison of initial and final widths during spreading by forced feeding using a grooved roller.

A national and international patent application has been filed for the new spreading method, and the results have been published in the Journal of Engineered Fibers and Fabrics. Work is currently underway on industrial implementation and adaptation to different fiber types.

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