

Nonwoven pipe – Basic analyses of the correlations between flat needled nonwovens and round needled pipes made from them as well as their possible applications

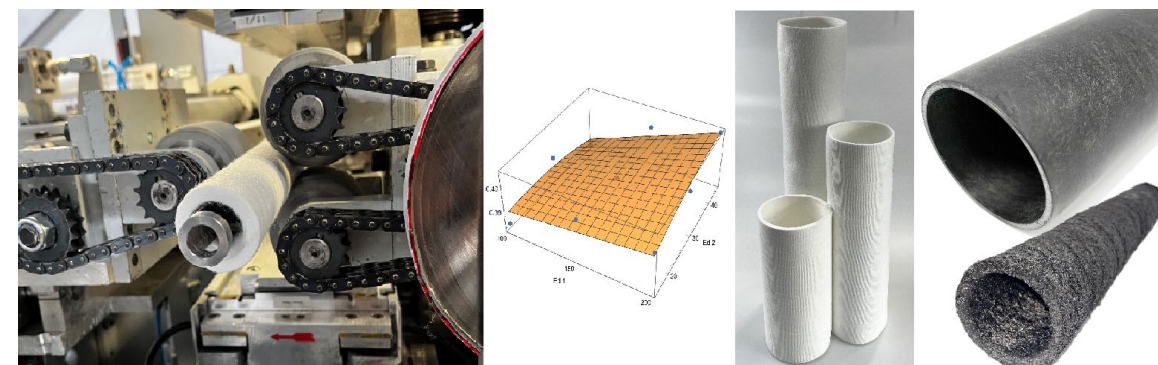
Objective

Tubular textile structures and fiber-reinforced composites are used in many technical fields, e.g. as filter sleeves, acoustic elements, and for pipe rehabilitation. Prefabricated roll goods, braids and circular woven and knitted fabrics served this market segment. However, these materials are limited in terms of dimensional and pressure stability, wall thickness, and manufacturing efficiency. Multi-layered structures require significant material and labor input, seams represent potential weak points, and strand-like yarn or roving structures complicate homogeneous matrix infiltration. This research project investigated the development of pipe and hose structures from circular needle-punched nonwovens as an innovative, seamless alternative.

Approach and results

Using statistical experimental design and multivariate analysis methods, the relationships between material and process parameters of the flat and circular needle-punching processes were determined. The influence of the nonwoven parameters and their processing on the properties of the circular needle-punched tubes could be specifically recorded and evaluated. It was possible to identify key correlations between the pipe product characteristics – such as wall thickness, textile mechanics, density, air permeability – and the key process parameters, thereby enabling rapid process design.

A key achievement of this project is the first successful manufacturing process for circular needle punching of carbon fiber nonwovens. This has demonstrated that this method enables the reliable processing of even demanding high-performance fibers. A successful resin transfer molding (RTM) is demonstrating clear potential for lightweight structural applications. These achievements open up new fields of application and lay the foundation for the development of innovative new high-performance products.



Circular needle punching of PES (left), graphical representation of the regression model (center), circular needle punched tubes made of polyester and carbon fibers (right)

Acknowledgement

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The final report on this project is available on request.

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