Nonwoven, perfectly needled

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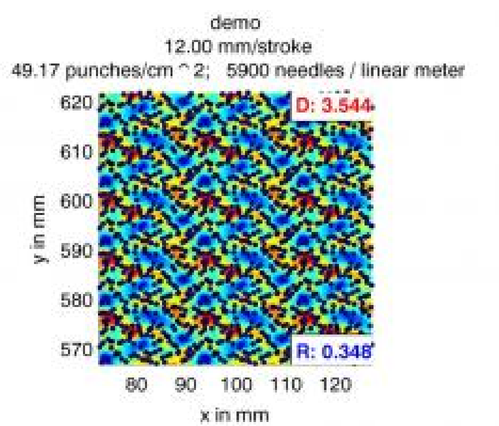

The density of the needle penetrations can be simulated using special software tools. (© Fraunhofer ITWM)

Hardly any other textile is as versatile as nonwoven: it keeps babies' bottoms dry and protects plants from the sun. In the Gulf of Mexico, special nonwovens soaked up the oil washed up on beaches like blotting paper. A new piece of simulation software now makes it possible to produce high-quality, stripe-free nonwoven fabrics.

What do diapers, wiping cloths, wall paneling, sticking plasters and Ultrasuede covers for upholstered furniture have in common? All these products are made of nonwovens. There is hardly any other fabric that is as versatile. Last summer the operators of the Zugspitze railroad even used sheets of nonwovens to prevent the snow melting away on Germany's highest mountain. The quality of this textile, however, varies considerably. It is generally true to say that the firmer, the smoother and the freer of marks the nonwoven is, the higher the quality. In the search for the perfect nonwoven, the Austrian needling machine manufacturer Oerlikon Neumag Austria asked the Fraunhofer Institute for Industrial Mathematics ITWM in Kaiserslautern for help.

Needling machines are essential in the production of nonwoven fabrics: “Nonwovens are bonded mechanically by needling. The needles punch vertically in and out of the material. The machine then transports the material and the needles come down again. This process locks the fibers together,” explains Dr. Simone Gramsch, a scientist at the ITWM. “The needle penetrations have to be completely even, otherwise unwanted marks such as longitudinal, diagonal or transverse stripes occur, and the material is less tear-resistant,” says Gramsch. Oerlikon Neumag Austria used to conduct the needling process without computer simulations. The needles were arranged manually based on past experience, and the needle boards constructed and tested by trial and error an approach that took several months and cost a lot of money. The research scientist and her team have managed to cut the time needed for this process significantly. There will no longer be a need for practical tests: Using software tools they themselves developed, the scientists have been able to simulate the needle penetration geometry, allowing them to optimize the needle patterns.

The strength and stretch characteristics of the nonwoven fabric are affected not only by the arrangement of the needles but also by their penetration density. The draft and the feed per stroke have to be coordinated as well. “Our software takes all these factors into account. We simulate and assess the penetration pattern according to the parameters entered. This enables the design engineer to determine where the needles are best placed on the needle board,” says the scientist.

Thanks to the new program, objective quality criteria now replace subjective assessment by the human eye. What's more, the experts have also programmed a design engineering tool. The user enters the feeds per stroke and the drafts for which he wants to construct a needle board. He specifies how wide he wants the board to be and what type of needles to use. The software then automatically comes up with a suitable needle board design.

But the development of the software posed some problems for the researchers. For example, a needle board has to be able to handle various feeds, because textile manufacturers do not produce the same nonwovens with the same feeds every day. Each needle rearrangement leads to several hours of lost production, and no manufacturer can afford that. For this reason the ITWM program has to be able to design a needle board that delivers equally well needled nonwovens for several feeds per stroke. "We managed that too," beams Gramsch. Oerlikon Neumag Austria has now used the results of the software to build numerous new needle boards.

Provided by Fraunhofer-Gesellschaft

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