PRESS RELEASE

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DEUTSCHE INSTITUTE FÜR TEXTIL+FASERFORSCHUNG

Foam-filled spacer fabric for body protection

Shock absorption based on the model of pomelo fruit

Helmets and protectors provide protection in accidents occurring at work or during leisure activities, sports, everyday life or traffic. Improved body protection systems can significantly reduce the serious consequences of injuries. This safeguards the health and lives of accident victims and could lead to considerable cost savings in the health and insurance sectors. The financial benefit of the new generation of body protection system amounts to several billion euros. The German Institutes for Textile and Fiber Research Denkendorf (DITF) are investigating on more effective protective systems using textile hybrid structures.

The researchers at Denkendorf took nature as a model when developing new body protection systems. The pomelo fruit has a very effective cushioning principle. The cushioning mechanism of the pomelo shell is technically reproduced by integrating a pressure-stable spacer fabric in a foam medium. Three load cases were investigated: fast impact using the example of a ski helmet, medium impact with a back protector and quasi-static pressure load with protective padding.

To ensure that the protective equipment cushions correctly in every application, the pressure stability of the spacer fabric is optimally adjusted to the hardness and elasticity of the foam. The pressure stability of the spacer fabric is significantly influenced by the fabric spacing, the packing density of the spacer threads as well as their bending stiffness and spatial alignment in the spacer area. A very good damping effect is seen in the impact test in the form of a flat progression of the force transmission in the protective element over time, and a low residual force, which is indicated as a measure of the remaining impact load on the body.

Deutsche Institute für Textil- und Faserforschung Denkendorf
Koerschtalstrasse 26 | 73770 Denkendorf | Germany | www.ditf.de
Board: Prof. Dr. rer. nat. habil. Michael R. Buchmeiser,
Prof. Dr.-Ing. Götz T. Gresser, Peter Steiger

public relations
Sabine Keller | sabine.keller@ditf.de
P +49 (0)711 93 40-505
F +49 (0)711 93 40-297

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In head protection gear, the damping behavior of the standard helmet was improved by up to 30 percent by reinforcing the EPS rigid foam with spacer fabric. In order to be able to fill the spacer fabric with EPS particles directly during the foaming process, the upper layer of the spacer fabric was already provided with additional openings during weaving.

In case of the back protector, the temperature window within which the protector shows good damping properties could be significantly enlarged by integrating spacer fabric into the foam. This means that the spacer fabric integrated protector meets stricter test standards and also offers good protection against penetration.

In case of the fabric-foam composites for protective padding, an adaptive deformation behavior was achieved by using a very soft viscoelastic PU foam and a spacer fabric with lower pressure stability. To ensure that the fabric-foam composite padding can easily be deformed and that it can adapt to the shape of the body, the spacer fabric was divided into many smaller fabric cells with compressed spacer threads by spacer thread-free channels running in the warp and weft direction.

On the basis of these research results, demonstrators were produced for the three areas - head protection, back protector and protective padding. These demonstrators offer better protection in the event of a crash, impact or pressure load than previous series products made of foam alone.

These innovative body protection elements based on foam-filled spacer fabrics were developed at the DITF within the framework of the IGF research project in 19398, which was funded by the Federal Ministry of Economics and Energy.

The research results can be directly implemented by the German textile, safety and sports goods industry in economic production processes and

innovative body protection products and strengthen the competitiveness in the global market.

Photo 1: Spacer fabric inserted into the helmet shell with filling openings. Photo: DITF

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Photo 2: Manufactured textile-reinforced demonstrators for the back protector. Photo: DITF

Further information on the topic: Dr. Hans-Jürgen Bauder
Manager weaving technologies, filament yarn finishing
T +49(0)711 9340-254
E hans-juergen.bauder@ditf.de