Institut für Textiltechnik und Lehrstuhl für Textilmaschinenbau
RWTH AACHEN UNIVERSITY

Project title:	Protective clothing material for emergency forces - Molotowcocktailschutz
Research Agencies :	Institut für Textiltechnik der RWTH Aachen University (ITA) Sächsische Textilforschungsinstitut e.V. (STFI)
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Mission Statement

Clothing textiles made of inherently and flame retardant yarn materials provide important protection to wearers in critical situations such as flame exposure. During Molotov cocktail attacks, temperatures of up to 2000 °C are generated, resulting in severe heat shrinkage of the protective clothing. The shrinkage of the protective clothing makes it fit closer to the body and reduces the insulating effect of the air layer between the body and the clothing. In combination with the good thermal conductivity of meta aramid compared to other fibre materials, this leads to faster heat transfer and consequently to burns. Furthermore, the increased admixture of adhesive bonding agents such as coffee grounds and glue in incendiary devices poses a new danger to the wearer.

In particular, police officers of the riot police of the states are exposed to an increased risk, especially when providing security at demonstrations or football matches. These officers wear body armour. Due to the increasing propensity to violence on the part of perpetrators and attacks with firebombs, emergency forces are increasingly exposed to flames. Therefore, the demands on the officers' body armour are also increasing. As a result, the protective clothing must not "only" protect against conventional hazards, but also against "contamination with fire accelerants" and "exposure to flames from below".

These problems are known to the manufacturers of flame-retardant and heat-protective textiles for personal protective equipment (PPE) as well as those involved in the entire value-added chains from other applications and represent a current development challenge.

The aim of the research project is to develop a fabric for PPE that is optimised both by an improved fibre blend and by an adapted yarn and fabric construction. Through these new developments, the heat shrinkage of the yarns and fabrics can be limited to a maximum of 1.5 %. The wearing comfort is also increased with sufficient protection by limiting the mass per unit area to a maximum of 230 g/cm^2. Finally, overalls made of the new fabrics are to be produced as demonstrators.

Approach

The solution approach is based on the partial change of the fibre composition as well as the optimisation of the construction and finishing of the new protective clothing fabric for the operational clothing. The fabric is adapted

via the multi-scalar design of the intermediate textile stages (fibre mixture, yarn, fabric) across all process steps.

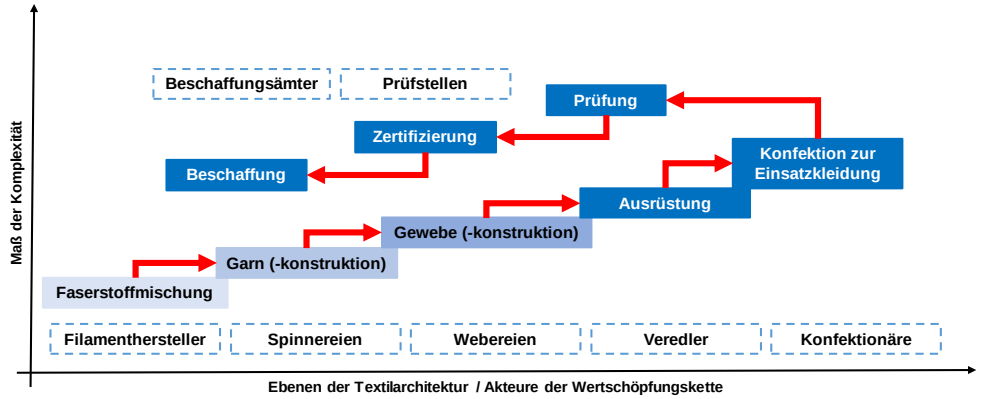

Figure: Multiscale designability of the textile intermediate stages across all process steps

At the yarn level, the fibre blend is adjusted. With the help of a test plan, the fibres are spun into yarns in different recipes.
Afterwards, the developed yarns are first processed into ribbon fabrics in various fabric constructions. For this purpose, structures with adapted weave, number of layers as well as thread density and orientation of the local reinforcement yarns are developed so that heat shrinkage can be further minimised and heat insulation.
Furthermore, a cleaning-resistant hydro-phobic, oil- and media-repellent finish is developed under consideration of the European chemicals policy (REACH regulation). For this purpose, products of C6-Chemie as well as new developments of textile auxiliary manufacturers are examined and modified. With the help of the optimised coating, an improved beading effect of the burning liquids is achieved. Finally, overalls made of the new fabrics will be produced as demonstrators.

Acknowledgement

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