LATEST TECHNOLOGIES FOR FUNCTIONAL COATING OF COTTON PRODUCTS

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ABSTRACT

For the functionalization of cotton a comprehensive toolbox is available to extent the properties of cotton and cotton products to exiting features.
Special and well experienced process technologies in addition with different chemical systems can be used to functionalize single yarns or/and textile areas made of cotton fibres or blends.

The possible functions which can be achieved differ in a wide range:
- Until now sizing agents are only used as a temporarily chemical agent, which is washed out after weaving. A new way is to construct sizing agents which are part of the final product and which are not removed.
- Permanent hydrophobic behaviour
- Permanent new flame retardant finishing are focussing on more sustainability
- Antistatic behaviour to reduce or even avoid electrostatic charge
- Metallisation for low electrical resistance and high electrical conductivity

INTRODUCTION

Functionalization of cotton opens a huge field to modify the same basic cotton textile for the use in completely different applications, in which special properties are absolutely necessary.
Besides clothes these special properties are indispensable for protection wear and technical applications in environmental protection, building, mobile applications and protective clothing in professional use.

CHEMICAL BASES

Cellulosic fibers like cotton or regenerate fibers (viscose, lyocell) are due to their reactive hydroxyl groups highly qualified for functionalization.
At our institutes we are focusing on:
- Harmless chemical substances
- Systems free of formaldeyde

To apply different physical properties the chemical systems can be:

- water based solutions,
- 100% systems and
- Hot melts.

Often after the application a hardening or fixation process should be applied to achieve high fastness levels.

REPLACING SIZING AGENTS BY FUNCTIONAL COATING

As an interesting alternative to conventional sizing process with the removal of the sizing agent after weaving, the use of appropriate processing technologies makes it possible to apply special chemicals as a sizing agent resistant to wash out processes. Thus, the wash out process and the combined waste water loading can be avoided and the properties of the sizing agent can beneficially be used in the later application of the fabric.
One way is to use a new biopolymer – Chitosan -, a natural polymer. It was made available to the textile industry as a sizing agent in fabric production by appropriate modification. Based on recipe developments on lab-scale the ecological and economical potential of mainly cotton yarns could be developed and demonstrated [Steg 2008]. In an actual research the coating with chitosan is further developed to a curing system [ITV 2016].

An alternative is the use of special adapted polyurethane as sizing agent. The recipes can be extended by flame retardant additives.

COATING WITH HOTMELTS

Hotmelts are 100% solid products (without solvents), which are applicable as melt on a substrate. By this process a high amount of energy can be saved in comparison to similar applications with water based recipes.
The development of the application of hot melts was shown on single yarns [ITV 2010] and on warp knitted fabrics. The hot melts based on polyolefin and polypropylen could be functionalized by antistatic, antimicrobial, flame-retarding and water/oil repellent additives. The homogeneous compounds were applied with knife, falt sheet extruding die and spraying systems in different amount on textiles. In different examples it could be demonstrated, that hot melts are not only suitable for adhesion and lamination, but also for functional coating with special properties [STEG 2014].

PERMANENT HYDROPHOBISING

Permanent hydrophobising is successful by anchoring of alkyl ketene dimers (AKD). They consist of long, hydrophobic alkyl chains and a reactive lactone ring, which couples by opening of the ring covalent to the cellulose. AKDs are available as emulsions, are used in paper industry and are comparable price worth. Even in low concentration they are effective. In textile sector AKD are used in new fields like the hydrophobic viscose fiber like Olea® [EP 2014] or Lenzing Biosoft®. In the first case AKD is added into the spin mass, in the second case AKD is used on the

surface during applying the finish. In the frame of an AiF-project [ITCF 2012] some application methods of AKD on cotton yarns are examined. The hyrophobising on yarn coil was possible with restriction. Due to the average particle size of about 1.500 nm in the coil filtration effects occurred which results in a gluing of the yarn. Successful was the finishing with fixation temperatures of 50-60°C. The cotton yarns showed high contact angles with 120°. The hydrophobic component was seen even after 30 household washings. The alkyl chains tend to adsorb hydrophilic washing surfactants, so a loss of hydrophobicity and a decrease of the contact angle were observed. In addition the yarns showed a higher hairiness in comparison to non functionalized yarns.

SOLGEL SYSTEMS

The sol gel process can be used to create nonmetallic inorganic or hybrid polymeric materials from colloid dispersions, the so called soles. The raw materials are called pre-cursors. In the application processes on textiles the coating film is generated in two steps:

- application as water based solution
- in drying the gel state is crosslinked
- by fixation with 100-160°C the inorganic-organic network is gained.

The raw solutions can be modified in a wide range on chemical and physical ways. On cellulosic material high permanence is achieved.
In special compositions antibacterial or photocatalytic effects could be developed [BOETTCHER 2010].

METALLIZATION

In close cooperation with a specialized institute we are focusing on a new way of fiber treatment based on ion implantation. This technology offers a huge field of material combination. Special advantage is the high adhesion force of the thin coating on the fiber surface.

An alternative chemical way on metallization of cotton yarns is described in [YAN 2015]. Based on a thin coating with different layers a high electrical conductivity is achieved. Like a primer the first layer is realized by a functional silane. After grafting of polymer brushes on the substrate surface, catalysis that couple with the grafted polymer brush were immobilized on the polymer brushes for the subsequent electroless metal deposition.

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